

Environment-Friendly Practices in Operating Rooms in Turkey

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ABSTRACT

Background: Environment-friendly practices refer to decreasing energy consumption, using resources carefully and sustainably, and reducing environmental pollution. An environment-friendly hospital is defined as a hospital where energy is saved, carbon emissions are decreased, and productivity and quality are increased. Operating rooms (ORs) account for most wastes generated daily by hospitals. Thus, adopting environment-friendly healthcare practices in ORs will have a positive impact on the environment.

Purpose: The aim of this study was to identify and recommend environment-friendly practices that are feasible for implementation in ORs in Turkey.

Methods: Data on the environment-friendly practices that are currently being practiced in the ORs of hospitals in Izmir Province were collected using face-to-face interviews with nurses who were in charge of ORs in Izmir Province. The interviews were conducted using an OR identification form and Greening the OR Checklist. The study population included all of the hospitals in Izmir Province, and the study sample included 18 ORs in the 11 hospitals that consented to take part in the research. Permission to conduct this research was obtained from the ethics committee of the nursing school as well as from the participating hospitals where the study was conducted.

Results: The hospitals included in the study had, on average, 7.44 ± 7.32 ORs, each of which employed an average of 16.83 ± 17.16 nurses. Four fifths (83.3%) of the ORs always monitored their wastes, and 88.9% gave their batteries to recyclers. In addition, 72.2% renewed their surgical sets to reduce excessive use of materials, and 72.2% preferred using reusable materials instead of single-use materials in their surgical sets. However, 66.7% of the ORs had no environmental team, 93% did not use an environmentally safe surface cleaner, 83.3% did not use sensor controls on lights, and 66.7% did not use LED lights.

Conclusions: Although most hospitals did not have a special team to recommend and enforce environment-friendly procedures, the OR nurses did their best to protect the environment.

KEY WORDS:

nursing, operating room, environment-friendly, greening, environmental health.

important issues faced by hospitals (Karayurt, Andıç, & Ceylan, 2014; Potera, 2012). For example, health institutions in the United States generate four million tons of waste annually, of which 15% is infectious (Kagoma, Stall, Rubinstein, & Naudie, 2012; Kwakye, Brat, & Makary, 2011). Despite their physically small footprint, operating rooms (ORs) generate about 20%–33% of the total waste of a hospital. A single surgical operation may generate more waste than an average family of four generates in a week. Waste reduction strategies hold the potential to reduce the environmental impact of hospitals without compromising the health of patients (Kagoma et al., 2012; Lee & Mears, 2012).

The inadequate management of waste causes environmental pollution and the multiplication of disease vectors such as insects, rodents, and worms and may lead to the transmission of diseases such as typhoid, cholera, hepatitis, and AIDS through injuries from contaminated syringes and needles (Karayurt et al., 2014; Terekli, Özkan, & Bayın, 2013). In addition to the health risks associated with poor management of medical waste, the environmental impact must also be considered, especially the risks of water, air, and soil pollution (Karayurt et al., 2014). Although the negative impacts of medical waste are continuing, implementing simple, environment-friendly practices holds the potential to reduce the adverse effects of this waste and reduce costs without compromising patient care (Karayurt et al., 2014; Kwakye et al., 2011; Potera, 2012).

Certain environment-friendly practices do not require any technical application, such as the segregation of OR wastes. OR wastes are solid, biologically hazardous wastes that require regular segregation. The cost of biologically hazardous waste disposal is eight times higher than that of normal solid waste disposal. Waste that is not properly segregated must be treated as biologically hazardous waste by default, which significantly increases overall disposal costs (Kagoma et al., 2012; Potera, 2012; Terekli et al., 2013). Most of the

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Introduction

Surgical and delivery rooms generate most of the daily waste volume of hospitals. Waste management is one of the most

waste that is generated in ORs is solid waste such as paper, cardboard, metal, and plastic. Waste in this category that is not contaminated by bodily fluids is typically easy to recycle (Karayurt et al., 2014; Potera, 2012).

Twelve liters of liquid waste may be generated during a single surgical operation, and an average OR generates around two tons of liquid waste every month (Kagoma et al., 2012). In ORs, liquids are collected in aspiration containers and must be treated as biologically hazardous waste. As wastewater has a tendency to splash and spray during manual disposal, health workers are exposed to infectious liquids, which constitute a professional threat (Huncke et al., 2012; Kagoma et al., 2012).

Healthcare professionals may take action to minimize waste by reducing waste production, conserving energy, using green or environment-friendly products, recycling, and reusing resources and materials in the OR (Kagoma et al., 2012; Kwakye et al., 2011).

Healthcare institutions should consider the impact of reusable and disposable products when purchasing supplies, equipment, and/or surgical instruments. Waste generation is directly related to the purchase and supply practices of each unit (Conrardy, Hillanbrand, Myers, & Nussbaum, 2010; Gadani & Vyas, 2011). To explore the opportunities to minimize waste, a critical analysis of purchasing practices, storage requirements, and the wastes that are generated during the process of purchasing supplies and equipment is required (Kagoma et al., 2012).

In selecting materials for ORs, it is important to consider waste management and the use of disposable materials. Disposable materials are preferred for infection prevention. The costs of labor and cleaning, including special materials and quality control systems, are eliminated when disposable products are used. Furthermore, the disinfectant solutions used to clean reusable materials may be toxic, and disposable instruments may be of poor quality and tend to accumulate, leading to garbage heaps that emit toxins into the atmosphere. For surgical interventions, materials that meet both low-cost and low-environmental-impact criteria should be identified (Huncke et al., 2012; Kagoma et al., 2012; Laustsen, 2010). Only 5%–20% of the anesthetic gasses given to patients are physically metabolized, with the remaining gasses, especially carbon dioxide, having 2,000 times greater potential of leading to global warming when released into the atmosphere. Preventing the emission of these gasses into the atmosphere may reduce environmental harm (Gadani & Vyas, 2011).

Implementing environment-friendly healthcare practices in ORs will positively impact the environment. Furthermore, these initiatives are easily implemented, generate results in the short term, and reduce expenses significantly (Hoeksema, 2010; Laustsen, 2010).

Purpose

This descriptive study was conducted to determine the environment-friendly practices of ORs located in Izmir Province, Turkey.

Research Questions

The following research questions were used for this study:

- What are the environment-friendly practices of OR nurses in Turkey?
- What are the environment-friendly practices of hospitals in Turkey?

Importance to Nursing

Leadership in Energy and Environmental Design for Healthcare, Green Guide for Health Care, American Society for Healthcare Engineering, Practice Greenhealth, and Health Care Without Harm are organizations that have established certification programs for green hospitals. The purpose of these and other similar programs is to generate alternatives to current resource-use practices; encourage the efficient use of energy, water, and materials; reduce all categories of waste; and create environment-friendly hospital buildings.

In terms of the current state of environment-friendly practices in Turkey, the “Regulations on Environmental Law Obtaining Permits and Licenses,” published in the Official Gazette numbered 27214 on April 29, 2009, requires that health facilities of 20 beds or more must employ at least one environment official, establish an environmental management unit, or receive regular environmental counseling services from an authorized firm.

The Association of periOperative Registered Nurses (AORN) recommends that the OR support team implements and takes an active role in environment-friendly practices to maintain a safe and healthy environment (AORN, 2010). In addition, healthcare professionals should actively promote and participate in natural resource conservation strategies such as recycling and reprocessing supplies; improving energy efficiency; managing pharmacological waste (Kwakye et al., 2011; Laustsen, 2010); turning off lights and electronic devices (pumps and computers) when not in use; using occupancy sensors in public areas; using energy-efficient electrical equipment, lights, and appliances; and using waterless scrubs and solar film on windows where appropriate (Candan Dönmez, 2016; Kagoma et al., 2012; Kwakye et al., 2011).

Healthcare workers in ORs perform an important role in providing care that has a low environmental impact. Everyone has the responsibility to protect the environment by thinking globally and acting locally in their daily practice.

Literature Review

No studies related to environment-friendly practices in ORs have been published in Turkey. Thus, this article is important in highlighting this issue.

In April 2010, Practice Greenhealth launched the “Greening the OR” initiative, providing data, tools, and resources to support best practices for developing green ORs. Since April 2012, more than 200 healthcare facilities in the United States have

endorsed the “Greening the OR” initiative (Kwakye et al., 2011; Practice Greenhealth, 2011).

After reviewing 43 studies on the environment-friendly practices in hospitals, the authors of “Green Surgical Practices for Health Care” convened a panel of experts who developed five practical strategies:

- Waste reduction and separation in ORs
- Reprocessing of single-use medical devices
- Purchasing environmentally friendly products
- Management of energy consumption
- Management of pharmaceutical waste (Kwakye et al., 2011).

Operational Definitions

Environment-friendly

Implementing environment-friendly processes reduces energy consumption, uses resources in sustainable and mindful ways, and decreases environmental pollution. An environment-friendly hospital is a productive and quality operation that uses energy efficiently and reduces carbon emissions. “P” and “3R,” which focus on reinvention, reduction, reuse, and recycling, are strategies that are frequently adopted to achieve environment-friendly goals. The literature addresses environment-friendly implementations in six facets: reducing and separating waste, reusing disposable medical equipment, recycling waste, purchasing environment-friendly materials, managing energy consumption, and managing medical wastes (Karayurt et al., 2014; Terekli et al., 2013).

Green hospital

The “Green Hospital” concept has emerged from the efforts of hospitals to reduce and destroy toxic substances, provide a healthier environment, and adopt “green approaches” to healthcare (Practice Greenhealth, 2011). The primary topics that must be dealt with under this concept include architectural design and functionality, interior ventilation quality, energy management, water management, waste management, and connection with nature (Karayurt et al., 2014; Practice Greenhealth, 2011), among others.

Methods

Fifty-two hospitals were located in the target area (Izmir Province), including four university hospitals, 24 state hospitals, and 24 private hospitals. The research sample included 18 ORs from the 11 hospitals that agreed to participate in the study, including four state hospitals, three university hospitals, and four private hospitals.

Procedures for Protection of Participants' Rights

Written permission (no. 27344949-878) to conduct this study was obtained from the ethics committee of the nursing faculty as well as from Izmir Province, South and North

Union General Secretariat of Public Hospitals, and the participating university and private hospitals. The purpose and methodology were explained to nurses and consented to by all participants.

Study Procedures and Methods

Data collection took place between February 24 and May 30, 2014. Eleven hospitals participated in the study. One university hospital had one OR in each department for a total of seven ORs, and the remaining participating hospitals had one OR each. Therefore, 18 ORs were included in the study. The 18 nurses who were in charge of these hospital ORs participated in face-to-face interviews, which gathered information on OR characteristics and environmental nursing practices in the OR.

Instruments, Including Reliability Measurement and Validity Evidence

Data were collected using the nine characteristics that define ORs, which were developed by the researchers based on a literature review, and using the Greening the OR Checklist designed by Practice Greenhealth (2011). The nine OR characteristics included name of the hospital, hospital type, bed capacity, type of OR, placement of the OR, total number of hallways, total number of nurses, number of nurses per shift, and number of surgeries per day. The Greening the OR Checklist contains 46 items that are categorized under four topics, including organizational development (three items), waste reduction and prevention in the OR (nine items), environmentally preferable purchasing in the OR (19 items), and built environment (15 items). This instrument was translated into Turkish and used after validation. Greening the OR Checklist was translated into Turkish by three specialists who are native speakers of the Turkish language and competent in the English language. Each item was first translated into Turkish, and then the Turkish text was back-translated into English by a specialist in English linguistics. A pilot study with OR nurses was conducted to test the linguistic accuracy and comprehensibility of the checklist. After verifying that the checklist could be fully understood and completed by the OR nurses, the translators evaluated the pilot study data to create the final version of the instrument. The Turkish-language version of this checklist was considered ready for use in Turkey after it had been adapted to the Turkish population and confirmed as equivalent to the original English-language version. Each item of the Greening the OR Checklist was assessed and quantified (number and percentage) based on the following four potential responses: “fully established,” “implementation in progress,” “not implemented,” and “unaware of the program/process.”

Results

Eleven hospitals participated in the research, of which 36.4% ($n = 4$) were state hospitals, 36.4% ($n = 4$) were private

hospitals, and 27.3% ($n = 3$) were university hospitals. Eight (72.7%) of these hospitals had a central OR. The average number of rooms in the ORs was 7.44 ± 7.32 , the average number of nurses employed was 16.83 ± 17.16 , and the average number of surgeries conducted per day was 29.72 ± 35.55 .

This study determined that 55.6% ($n = 10$) of the participating hospitals supported environment-friendly OR practices. However, 66.7% ($n = 12$) did not have a dedicated team, and 61.1% ($n = 11$) did not provide training related to environment-friendly ORs (see Table 1).

Moreover, this study found that 83.3% ($n = 15$) of these hospitals conducted waste audits, 88.9% ($n = 16$) segregated noninfectious wastes, 94.4% ($n = 17$) segregated domestic wastes, and 77.8% ($n = 14$) segregated liquid wastes. Sixteen ORs (88.9%) recycled batteries, and only 50.0% reused the containers used to collect spent sharps (Table 1).

In addition, 72.2% ($n = 13$) of the ORs rearranged OR kits to reduce excessive material use and preferred using reusable elements rather than disposables. Fifteen (83.3%) of the ORs preferred reusable metal materials for surgical instruments and reused pulse oximeter probes, whereas 66.7% ($n = 12$) did not reuse electrosurgical pads. Reusable surgical gowns were used by OR staff in 88.9% ($n = 16$) of the ORs (Table 1).

Furthermore, 83.3% ($n = 15$) of the ORs did not use lighting sensors, and 66.7% ($n = 12$) did not use a heating, ventilating, and air conditioning system to reduce air circulation in unoccupied rooms or use LED surgical lighting to save energy.

Finally, half of the ORs (50.0%) used an anesthetic gas capture system to remove waste anesthetic gasses and prevent venting, and 83.3% did not use an evacuation system for surgical smoke (Table 1).

Discussion

The following sections present the main findings of this study.

Organizational Development

This study revealed that ORs are deficient in creating and training environment-friendly teams. OR staffs are not educated on greening and safety benefits or opportunities for waste and cost reduction. It is important to educate health professionals on environment-friendly practices and on how to apply this knowledge in their clinical practice. Hospital administrators play a key role in increasing environmental training and awareness among staffs. Thus, hospital administrators should also receive environmental education (Weiss et al., 2016).

Waste Reduction and Prevention

The ORs in this study were fully capable of implementing waste reduction initiatives, with rates of accomplishment ranging from 77.8% to 94.4%. However, poor implementation of container systems for reusable sharps was found.

Only the waste is destroyed when a reusable container is used, and the used container may be reutilized after being washed appropriately. Therefore, reusable containers produce greater environmental savings than recyclable or disposable containers. According to Stericycle report, one reusable container prevents 600 disposable sharps containers from being disposed in landfills. Reusing containers eliminates the need to manufacture new containers and helps conserve natural resources (Hubbard, Hayanga, Quinlan, Soltez, & Hayanga, 2017; Weiss et al., 2016).

Regarding waste segregation, noninfectious and biological wastes should be collected in discrete containers; radioactive and sharp wastes should be collected separately in disposable, clearly marked containers (Kwakye et al., 2011; Lee & Mears, 2012). By raising awareness among OR staff regarding the disposal of biologically hazardous waste and by providing access to waste containers, health institutions may better support the segregation of waste in ORs. One study found that 92% of the wastes deposited in biologically hazardous waste containers were not biologically hazardous and could be treated as nonhazardous waste (Huncke et al., 2012).

Closed liquid-collection systems reduce the risk of exposure during disposal. These systems collect liquids during their formation in the OR for discharge directly into sewage networks. Despite their high cost, these systems significantly reduce the amount of infectious waste, which would otherwise require a high-energy disposal process (Huncke et al., 2012; Kagoma et al., 2012).

In addition, the various batteries that are used in anesthesia and other medical equipment are recyclable. Programs to collect, transport, and remove environmentally hazardous, rechargeable batteries should be implemented and followed. Furthermore, all nickel-cadmium and lead-acid batteries should display the universal recycling symbol label and a warning that batteries should be recycled. Furthermore, all batteries should be easily dismountable for appropriate disposal, and the lead-acid batteries used in anesthesia machines and elsewhere should be recycled according to established protocols (Huncke et al., 2012). Purchasing reusable sharps and containers rather than disposables reduces waste and provides financial benefits (Kwakye et al., 2011).

Giving Preference to Environment-Friendly Purchasing in the Operating Room

This study showed that over 70% of the participating hospitals had programs to purchase environment-friendly materials. Managing hospital waste and implementing environment-friendly waste practices are important. Moreover, having an independent metals recycling unit in the hospital may increase the recycling of metal parts (Huncke et al., 2012).

Gaziantep University Hospital conducted a cost-benefit analysis of using disposable and reusable surgical gowns and drapes. The results revealed that using these disposable items was more useful despite their higher unit costs (Baykasoğlu, Dereli, & Yilankirkan, 2009).

TABLE 1.
Distribution of Environment-Friendly Practices in the OR (N = 18)

Item	Fully Established (> 1 Year)		Implementation in Progress		Not Implemented		Unaware of the Program/Process	
	n	%	n	%	n	%	n	%
Organizational development								
1. Endorse and participate in Practice Greenhealth's Greening the OR Initiative	10	55.6	2	11.1	3	16.7	3	16.7
2. Build a Green Team for surgical services/OR	1	5.6	2	11.1	12	66.7	3	16.7
3. Educate OR staffs on the benefits of greening, the opportunities for cost and waste reduction, and related safety benefits	3	16.7	1	5.6	11	61.1	3	16.7
Waste reduction and prevention in the OR								
1. Conduct a waste audit in surgical services/OR	15	83.3	2	11.1	1	5.6	–	–
2. Implement a process to divert preincision, nonpharmaceutical waste from regulated medical waste streams into a clear bag for noninfectious waste disposal	16	88.9	1	5.6	1	5.6	–	–
3. Implement a process to segregate noninfectious solid waste from the regulated medical waste stream during and after procedures	17	94.4	1	5.6	–	–	–	–
4. Utilize a fluid management system for capturing liquid waste from surgery in reusable containers that empty liquid directly into a sanitary sewer	14	77.8	1	5.6	2	11.1	1	5.6
5. Recycle batteries generated in the OR	16	88.9	–	–	1	5.6	1	5.6
6. Utilize a reusable sharps container system	8	44.4	–	–	9	50.0	1	5.6
Environmentally preferable purchasing in the OR								
1. Reformulate OR kits to reduce excess supplies and overage	13	72.2	3	16.7	2	11.1	–	–
2. Replace disposable items with reusable items in OR kits where demonstrated safe and economically viable	13	72.2	1	5.6	4	22.2	–	–
3. Utilize reusable hard cases for surgical instruments	15	83.3	3	16.7	–	–	–	–
4. Purchase reusable gowns for surgical staff and covers for mayo stands and back tables	16	88.9	–	–	2	11.1	–	–
5. Utilize mercury-free blood pressure devices	13	72.2	–	–	1	5.6	4	22.2
6. Use reusable pulse oximeter sensors/probes	15	83.3	–	–	2	11.1	1	5.6
7. Utilize reusable grounding pads	6	33.3	–	–	12	66.7	–	–
8. Utilize environmentally benign cleaners or disinfectants for hard surfaces in the OR	5	27.8	5	27.8	8	44.4	–	–
Built environment								
1. Utilize occupancy sensors for lighting to reduce energy use in unoccupied ORs	–	–	1	5.6	15	83.3	2	11.1
2. Program the HVAC system to reduce air changes when ORs are unoccupied to reduce energy use	1	5.6	–	–	12	66.7	5	27.8
3. Utilize LED surgical lighting to reduce energy use and increase thermal comfort	3	16.7	2	11.1	12	66.7	1	5.6
4. Use an anesthetic gas capture system to capture waste anesthetic gasses and prevent venting to the outside	9	50.0	2	11.1	7	38.9	–	–
5. Install a power boom with a laser smoke capture system	2	11.1	–	–	15	83.3	1	5.6

Note. OR = operating room; HVAC = heating, ventilating, and air conditioning; LED = light emitting diode.

However, another study that calculated the unit costs of reusable surgical drape sets and disposable surgical drape sets (Hekim, Durukan Köse, Bener, Gül, & Polat, 2015) determined that using disposable surgical drape sets was 33.74% cheaper than using reusable woven fabric surgical drapes.

The rate of using reusable electrosurgical pads and cleaning them with environmentally benign disinfectant products was still low in the participating ORs. A study conducted by Bektaş et al. (2013) tested the efficiency and safety of reusable and disposable electrosurgical pads on patients. Researchers found that reusable and disposable electrosurgical pads were more efficient and safe when devices were periodically checked and calibrated, users were trained, and patient plaques were used correctly.

The Built Environment

This study revealed that built environment implementations were performed at a lower rate in ORs than in other organizations. Most of the participating hospitals were in older facilities that were not up to current environment-friendly standards.

Color-forming diode bulbs (LED) are a new alternative for lighting ORs that decrease energy use by 49%. These light bulbs do not heat the environment and consequently reduce the amount of energy required for cooling. Using natural light is recommended. However, in conditions where natural lighting is insufficient, the use of motion sensors can save energy. Saving energy results in financial savings (Chapman & Chapman, 2011; Karayurt et al., 2014; Kwakye et al., 2011).

In ORs, smart heating and cooling systems should be used to gradually adjust the temperature in unoccupied rooms. Smart room heating and cooling systems provide energy savings of up to 25% of total energy consumption (Siemens, 2011).

Only 5%–20% of the anesthetic gasses given to patients are metabolized; the global warming potential of a halogenated anesthetic is up to 2,000 times greater than CO₂ when released into the atmosphere. Nitrous oxide and potent inhalable anesthetics are considered greenhouse gasses (Gadani & Vyas, 2011). The use of inhaled anesthetics has increased in the last 30 years, and desflurane, in particular, has a significantly greater impact on the environment than older alternative agents. A technical solution to the problem of disposal consists of separating anesthetic gasses such as isoflurane in the ORs (Gadani & Vyas, 2011; Huncke et al., 2012). According to research conducted by the University of Chicago, the health sector is responsible for 8% of total greenhouse gas emissions in the United States. Another study found that hospitals are a major contributor to carbon emissions. Preventing the emission of waste agents into the atmosphere may also reduce the environmental impact of hospitals, and systems for collecting and reusing anesthetic gasses are under development. According to a system currently in use in Canada, a canister with a filter is placed in the anesthesia scavenging system machine to absorb the anesthetic gasses. These canisters are collected, and the anesthetic is retrieved and purified

at another facility (Candan Dönmez, 2016; Chung & Meltzer, 2009; Huncke et al., 2012).

Identifying the potential dangers of surgical smoke generated in the ORs and developing effective safety practices are important and necessary. The smoke generated during electrosurgical interventions and its particulates (toxic gasses, dead and living cell wastes, viruses, hair, etc.) cannot be removed from the OR using ordinary methods. They constitute respiratory, ophthalmic, dermatological, and mutagenic health risks for medical staffs and patients. ORs should use wall-mounted ultralow-penetration air filters, which are efficient in purifying air to 99.99%. In addition, proper safety protocols should be implemented to ensure that surgical smoke is evacuated properly (AORN, 2010; Conrardy et al., 2010).

Limitations

Although all of the hospitals in Izmir Province were part of the research scope, only a minority agreed to participate in this study and provided data.

Recommendations for Clinical Practice

The clinical recommendations supported by the findings of this study are discussed below.

Current efforts to build environment-friendly teams in the ORs are inadequate. An “environment-friendly team” should be created in each OR or surgical service. In addition, all hospital staffs should receive training on the benefits of environment-friendly hospitals.

Waste separation practices were found to be satisfactory in the participating hospitals. Waste supervision should be performed in the surgical units, and ORs should ensure that waste is collected and separated.

Battery recycling practices were also found to be satisfactory. The batteries used in the ORs should be recycled, OR sets should be reorganized to prevent wasting materials and to decrease surplus materials, and reusable materials should be given preference over disposable materials.

New hospitals should be built in compliance with environment-friendly objectives and practices. The OR unit should be located on the ground or middle floors, and heating requirements should be considered.

Recommendations for Future Research

Future studies should target larger numbers of hospitals and use larger sample sizes. Studies of environment-friendly practices may target all of the units of a hospital and not only ORs.

Conclusions

The purpose of this study was to identify the environment-friendly practices that are currently being practiced in ORs in Turkey. This study showed that OR nurses are committed to reducing waste to protect the environment. However, hospitals typically do not have special teams to implement environment-friendly procedures. The literature recommends

that wastes be reduced and segregated, that disposable medical instruments be reused, and that wastes be recycled. The active participation of surgical nurses in environment-friendly practices will significantly and positively contribute to the protection and improvement of the environment.

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