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Title:

ENVIRONMENTAL RESPONSIBILITY IN NURSING IN HOSPITALS: A MODIFIED DELPHI STUDY OF NURSES' VIEWS

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Conflicts of Interest

The authors have no conflicts of interests to declare.

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TITLE

Environmental responsibility in nursing in hospitals: A modified Delphi study of nurses' views

IMPACT STATEMENT

What does this paper contribute to the wider global clinical community?

- This paper reports nurses' views of the opportunities they have to decrease hospitals' environmental burdens during clinical practice.
- The findings can be used to inform hospital administrators who develop corporate environmental responsibility.

ABSTRACT

Objectives. This study identified nurses' views on environmentally responsible clinical practices. It also examined consensus regarding the stakeholders, roles and tools needed to promote, and enable, environmental responsibility in clinical practice.

Background. Using materials and energy in hospitals has a negative impact on the environment and people's environmental health. Research on decreasing this burden in clinical practice is sparse.

Design. A modified Delphi method with two rounds.

Methods. Data were collected from 35 nursing staff in five Finnish university hospitals in 2019. The first-round data were collected with semi-structured interviews in small groups and subjected to content analysis. The second-round data were collected with an Internet-based questionnaire from 27 of those participants and statistically analyzed. The CREDES checklist was used.

Results. According to nurses, environmentally responsible clinical practices focus on effective material and energy use. Material use focused on sustainable and cooperative purchasing, considerate use of products and minimizing waste and idle electricity and reducing water and transport use. The tools needed to promote, and enable, environmental responsibility in clinical practice were staff inducements and training and certain resources and guidance. All the hospital health and support service staff needed to commit to collaboration.

Conclusions. It is important to address stakeholders' roles in environmental responsibility in hospitals. Environmental aims should be firm and visible and nurses should have the relevant competencies. They also need sufficient time to develop environmental initiatives and proper facilities to carry out their work with a minimal environmental burden. Providing staff feedback and rewards for their environmental efforts is beneficial for engagement.

Relevance to clinical practice. This study will help nurses to identify their needs and opportunities to realize and develop environmental responsibility in their practice. It can also inform hospital leaders to develop corporate environmental responsibility, including in-service training.

KEYWORDS

Delphi method, energy, environment, hospitals, materials, nurses, responsibility

1 INTRODUCTION

In the last decade, there has been increased interest in hospitals' environmental burdens. Hospitals are resource intensive institutions, as examining and treating patients requires immense resources (U.S. Energy Information Administration, 2016; International Council of Nurses [ICN], 2018) that lead to notable greenhouse gas emissions (Eckelman & Sherman, 2018) and diverse waste (Brusco & Ogg, 2010). Clinical activity accounts for a significant part of a hospital's environmental burden (McGain & Naylor, 2014). There are 20 million nurses worldwide and they form the largest group of healthcare professionals (World Health Organization, 2016). Nurses use a wide range of materials in their daily work, including care products (Brusco & Ogg, 2010), pharmaceuticals (Becker, Méndez-Quigley, & Phillips, 2010) and nutrients (Dias-Ferreira, Santos, & Oliveira, 2015). Manufacturing, transporting and disposing of these items (Campion et al. 2015), as well as producing electricity and purifying and warming water for nursing procedures (Kleber, 2018; Leffers & Butterfield, 2018), require natural resources and cause pollution. There is potential for nurses to prevent their work from causing an unnecessary environmental burden on their hospitals (ICN, 2018; Leffers & Butterfield, 2018; Muñoz, 2012), but little is known of environmental responsibility in nursing clinical practice and how it is promoted.

2 BACKGROUND

Environmental responsibility in nursing aims to provide good care with minimum environmental harm (Kallio, Pietilä, Johnson, & Kangasniemi, 2018; Kangasniemi, Kallio, & Pietilä 2014). It prevents pollution and advocates clean and productive ecosystems and promote the sustainable use of natural resources (Association of Perioperative Nurses [AORN], 2020; Topf, 2005.) Environmental responsibility is value-based and linked to nurses' professional ethics (Kangasniemi et al. 2014; AORN, 2020; Harris, Pisa, Talioaga, & Vezeau, 2009) and their social responsibility to protect the environment (ICN, 2018; Peres et al. 2014) that humankind is dependent on (American Association of Colleges of Nursing, 2014; Intergovernmental Panel on Climate Change, 2019). In nurses' clinical practice, environmental responsibility focuses on optimal, effective material and energy use processes (Kallio et al. 2018; Kangasniemi et al. 2014).

Based on previous studies, nurses need to have specific competencies to carry out environmentally responsible practices. These include the knowledge and skills needed to plan and optimize the use of products and energy (Álvarez-Nieto et al. 2018; Schenk, Butterfield, Postma, Barbosa-Leiker, & Corbett, 2015). In addition, studies have reported that pro-environmental attitudes have been crucial when developing responsible practices (Griggs, Fernandez, & Callanan, 2017; Peres et al. 2014; Topf, 2005). However, nurses' awareness of environmental responsibility in nursing and healthcare has been reported to be relatively low (Álvarez-Nieto et al. 2018; Richardson, Grose, Doman, & Kelsey, 2014). Studies have also reported that nurses have used materials and energy without considering the environment (Kallio et al. 2018*;* Moreschi et al. 2014; Richardson et al. 2014) and they have not been aware of, or followed, waste sorting instructions (e.g. Vogt & Nunes, 2014).

Previous studies have highlighted that environmental responsibility in clinical nursing practice requires multi-professional collaboration at all levels in a hospital (Kallio et al. 2018; Lipkin, 2012; Ryan-Fogarty, O'Regan, & Moles, 2016). Success in environmental responsibility has been found to require strategic development and follow up (Kallio et al. 2018; Kangasniemi et al. 2014), but nurses also need opportunities to contribute to environmental improvements in hospitals. For example, it has been recognized that nominated environmental support contacts have been beneficial with regard to developing arrangements and peer support in their units (Kallio et al. 2018). Nurses are close to everyday clinical practice and previous studies have highlighted the benefits this offers when they get involved in environmental policy development at an organizational level (Anåker & Elf, 2014; Dunbar-Reid & Buisktra, 2017). One example is advocating sustainable procurement in hospitals (Huffling & Schenk, 2014).

Using organization-wide tools in hospitals has been found to be crucial, in order to promote, and enable, environmental responsibility in clinical practice. These tools are administrative and managerial efforts to improve their staff's working environments and their competencies and engagement (Ryan-Fogarty et al. 2016; Vogt & Nunes, 2014). However, previous studies have shown that little is known about nurses' views of these tools. Three research questions were posed by this study from nurses' perspectives. What environmentally responsible clinical practices could be used in hospitals? Who are the stakeholders and what are their roles? What tools are needed to promote, and enable, environmental responsibility in clinical nursing practice in hospitals?

3 METHODS

3.1 Study design and environment

We adopted a pragmatic approach (Brady, 2015) and used a modified Delphi method, which means that the first round data were collected by interviews (Boulkedid, Abdoul, Loustau, Sibony, & Alberti, 2011) and analyzed qualitatively (Figure 1). The purpose of the first phase was to inform the quantitative round (Hasson, Keeney & McKenna, 2000). The first phase identified nurses' views regarding environmentally responsible clinical practices, what stakeholders should be involved and what their roles should be and the tools that could be used to promote, and enable, environmental responsibility in clinical nursing practice. The purpose of the second phase was to gain consensus from the nurses (Boulkedid et al. 2011) on the issues relating to stakeholders and tools.

The study environment was five publicly funded university hospitals who provided specialized medical treatment. After the hospitals agreed to take part, a researcher (HK) contacted the nurse managers in four hospitals and the environmental manager in the fifth and informed them about the study. They were all asked to recruit participants from their hospital who were prepared to take part in the study. We involved participants who had knowledge of the research topic and this meant prioritizing nurses who were the environmental support contacts for their unit or who had a particular interest (Boulkedid et al. 2011) in environmental issues related to nursing. The main contact at each hospital provided the potential participants with information and they contacted the researcher by telephone or email if they wanted to volunteer to take part. The Guidance on Conducting and Reporting Delphi Studies (Supplementary file 1) was adapted for use in the study (Jünger, Payne, Brine, Radbruch, & Brearley, 2017).

[Figure 1. The Delphi procedure.]

3.2 First round of the Delphi

There were 35 voluntary participants (31 female) in the first Delphi round and they ranged from 30–62 years of age, with an average age of 47 years. They were all nursing staff and

nurse managers (Table 1). The majority (n=25) were environmental support contacts in their units and had worked in this role for six months to 15 years, with an average of six years. Almost half of the participants (n=15) had received environmental training from their organizations.

[Table 1. Work characteristics of the 35 Delphi panellists (Delphi round 1).]

The purpose of the first round was to build up a diverse picture of the participants' views of the study topic (Rayens & Hahn, 2000). It also enabled us to develop a set of close-ended statements for the second round (Hasson et al. 2000), covering the stakeholders and their roles and the tools needed to promote, and enable, environmental responsibility in clinical nursing practice. Data were collected using a semi-structured interview technique to allow nurses to speak freely within certain themes. The interview guide was developed in five phases (Figure 1). (Kallio, Pietilä, Johnson, & Kangasniemi, 2016.) The first phase was to identify if the semi-structured interview method was suitable. This method was selected as the aim was to get a broad view of the nurses' perceptions of the study topic. The second phase was to use previous research knowledge (e.g. Kallio et al. 2018; Kangasniemi et al. 2014) to identify the central concepts and the content of the interview guide. A preliminary interview guide was formulated during the third phase and the fourth phase was pilot-testing with four nurses who had experience of environmental issues in nursing using the field-testing technique. They were all nursing science students who had research knowledge of the topic. The fifth phase was to change the wording of the final guide (Table 2), based on the pilot-testing, to make it more logical and understandable.

We conducted semi-structured interviews with groups of 3–5 participants, as we felt that social interaction would produce fruitful ideas and views. One of the groups only had two participants, as two nurses cancelled at the last moment. One of the researchers, a PhD student (HK), conducted two interviews in meeting rooms in each of the hospitals between January to February 2019 and audio recorded them for the analysis. The researcher also made field notes during the interviews, to ensure that they progressed well and that follow-up questions were asked at the appropriate moments. The 10 interviews lasted a total of 12 hours and 59 minutes and the average was 78 minutes.

[Table 2. The semi-structured interview guide (Delphi round 1).]

The interview data were analyzed using the deductive-inductive content analysis method (Elo & Kyngäs, 2008) and the pre-defined main categories were created based on the studies used in the development of the interview guide. The categories were *environmentally responsible clinical practices, stakeholders' roles, a detailed description of the environmental support contact role* and *the tools needed to promote, and enable, environmental responsibility in clinical nursing practice*. The researcher (HK) started the preparation phase by transcribing the recordings verbatim and that yielded 202.5 pages of text with normal Word margins and 1.5 line spacing in 12 point Times New Roman. Expressions were extracted from the data according to the pre-defined categories. They were grouped based on their similarities and then sub-categories and generic categories were created. The data were also analyzed inductively to see if new content would arise and a new generic category of *resources needed* was identified. (Elo & Kyngäs, 2008.) The statements were developed from the results that covered the stakeholders and their roles and the tools needed (Table 3), for the purpose of the second Delphi round.

[Table 3. An example of how we developed the close-ended statements based on the content analysis results (Delphi round 1).]

3.3 Second round of the Delphi

The purpose of the second round was to gain a consensus among the nurses on the stakeholders and their roles and the tools needed to promote, and enable, environmental responsibility in clinical nursing practice. Data were collected using an Internet-based questionnaire developed using the first-round results and earlier studies (Clayton, 1997). It consisted of 40 close-ended statements (Tables 4 and 5) developed from the first-round data analysis (Table 3). Participants were asked to rate if they agreed with the statements using a 4-point Likert-scale: *agree*, *partly agree*, *partly disagree* and *disagree* (Rayens & Hahn, 2000) and *can't say* (Clayton, 1997). Participants could also use the free text section to clarify their answers or comments, if they felt any content was missing from the themes. However, no additional comments on content were made. The questionnaire was pretested with an evaluation panel of four clinical nurses and three nursing researchers. They were asked to assess whether the content was logical and easy to understand and to make any other relevant comments. The structure, content and wording of the questionnaire were revised

based on the panelists' feedback. The research data were collected in May 2019 and 27 (77%) of the first-round participants agreed to take part in this stage of the study. The data were analyzed with descriptive statistical methods (Hasson et al. 2000). A pre-defined consensus level of 75% was set for when the nurses partly or totally agreed with a statement (Clayton, 1997). The itemized results are reported in Tables 4 and 5.

4 RESULTS

4.1 Nurses' views on environmentally responsible clinical practices (Delphi round 1)

The nurses' views on environmentally responsible clinical practices were based on the qualitative analysis in the first Delphi round. The practices that emerged from this included: considerate and optimized material use, sustainable and cooperative purchasing, finding other uses for items that would otherwise be thrown away, optimizing energy use, including minimizing the idle use of electricity and water, and reducing transport.

Sustainable and cooperative purchasing. When optimizing material use was discussed, the nurses highlighted the importance of sustainable and cooperative purchasing. Sustainability in purchasing referred to buying durable products, using renewable energy and responsible support services in hospitals. Nurses broadly criticized cheap products, such as gloves, syringes and blankets, as they were often low quality and created extra garbage and energy waste compared to good-quality, durable products. Repairing products instead of buying new ones was also desirable.

'Low-quality gloves are often already damaged before use'.
'A surgery patient may have as many as seven low-quality blankets on their bed and they all go
to the laundry.'

Co-operative purchasing referred to the importance of hospital units working together when buying products and making sure that devices and accessories were compatible across departments so that the best use could be made of any equipment. This was also important if products were rarely used by the units.

'In hospital units there are different brands of devices to measure the same attributes…We had
to change a central canula for a patient who came from another unit, as it was incompatible with
the medical device in our unit.'

Considerate material use. Nurses said that considerate material use should be a priority when it came to environmental responsibility in daily clinical practice. It included ensuring that units only ordered the products, drugs and food they actually needed. Anyone who was in charge of ordering needed to be aware of what the unit actually needed.

'A great shelf had been ordered full of the kind of intravenous tubes that we only use one a month or so.'
'A nurse should monitor a patient's appetite daily and order the right sized portion that they can
eat.'

Considerate material use also referred to avoiding waste by only using products when they were truly needed. This included gloves and other personal protection equipment, incontinence pads, bed covers, kidney basins and disposable cups and only opening kits when they were definitely needed. The use of personal protection equipment could be reduced during doctors' rounds by making sure that only essential personnel entered isolation rooms. They also said that doctors could reduce the use of materials by making sure that all the orders they gave the nurses were absolutely necessary.

'There is no need to change a diaper every sift if it is clean.'
'Four doctors wear the whole set of personal protection equipment and go into an isolation room…why can't only one or two go in there to prevent waste?'

It was important to avoid products expiring and this could be achieved by making sure that the oldest products were used first and donating seldom used products to other units. The nurses also discussed how staff could prevent product contamination and thus waste. This included only taking what was necessary into patients' rooms and properly storing products,

such as personal protective equipment and medicines. Considerate material use also included carefully using and maintaining devices.

'Everything goes into the garbage after we discharge a patient from an isolation room. They must go because of hygiene.'

Reusing potential waste. Nurses also described optimal material use in relation to reusing potential waste, so that they prevented the need to use new products and materials. Sorting and recycling waste was central to this. The nurses also pointed out that some unused products could be used for other purposes, instead of throwing them away, including operation theatre kits. As well as measures that were focused on clinical practice, the nurses said that hospital restaurants could sell surplus food at a discount. They also suggested that events could be organized to see if units could make use of unwanted furniture from other parts of the hospital or sell them to staff.

'I can use an unused bag from an operation kit to take samples to the laboratory instead of throwing it away.'

Minimizing idle use of electricity and water. The nurses said that minimizing idle electricity and water use was an important way of optimizing energy use. Electricity use could be optimized by using daylight instead of electric lights and only keeping lights, screens and other devices on when they were being used. However, this could pose challenges for devices that needed to be used quickly.

'In our unit, the computers that are close to the patients' beds can't be switched off because patients suddenly arrive in the unit and you can't wait for all the programs to wake up.'

Optimizing electricity use also related to water, as purifying and warming water and using washing machines required electricity. Water use optimization included avoiding water running unnecessarily, making sure washing machines were full before they were switched on and using the correct programs. The nurses also suggested that bedding should only be changed when it was actually required and not as a matter of routine. Decreasing laundry use also meant guiding patients' and relatives' behavior on the wards. Nurses also talked about how property maintenance could optimize energy use. This included calling maintenance

staff promptly to mend leaking bathroom fixtures and other faulty devices and adjusting unsuitable room temperatures. They also recommended installing light and water tap motion detectors to save electricity and water.

Reducing transport. Nurses said that reducing transport was an important part of optimizing energy use in nursing practice and they highlighted both material and passenger transport. For example, they said that waste bags should be full, waste should be as compact as possible and that working with other hospital departments reduced single journeys. Passenger traffic referred to both patients and employees. Transporting more than one patient to the hospital, good public transport in the area around the hospital and the use of telemedicine to avoid journeys were all highlighted. The nurses also said that encouraging staff to use bicycles could reduce fuel use.

'If you throw a milk carton in the garbage without folding it, it takes more space.'

The nurses emphasized the need to ensure hygiene and asepsis in relation to material and energy use optimization. For example, dirty textiles and dressings needed to be changed to prevent infections and hot water needed to be run to clean taps in cancer wards where patients' immune systems were weak. It was also important that environmental affairs were handled humanely so that they didn't threaten the wellbeing of patients.

'You can't turn off a tap and let the patient get cold while you wash their back in a shower.'

4.2 Nurses' consensus on stakeholders, their roles and the tools needed to promote, and enable, environmental responsibility in clinical nursing practice (Delphi round 2)

The nurses' consensus on the stakeholders and their roles and the tools needed to promote, and enable, environmental responsibility in clinical nursing practice are presented based on the statistical analysis conducted in the second Delphi round. The nurses reached a consensus on all the statements on stakeholders and tools presented in Tables 4 and 5.

Stakeholders and their roles. Various stakeholders played a role in environmental responsibility in clinical nursing practice (Table 4). All the participants agreed that each hospital needed an environmental manager to coordinate and develop environmental

responsibility at an organization-wide level. The majority (96%) agreed that it was the nurse manager's role to ensure that the staff were competent and engaged. Some of the nurses were uncertain about the roles of various stakeholders and responded 'can't say'. These related to support services (n=4), purchasing professionals (n=3), students (n=3), administrators (n=2), infection control nurses (n=2), ward pharmacists (n=2), and patients (n=2).

Nurses carried out a detailed assessment of the tasks needed by the *environmental support contacts* (Table 4). All of the participants agreed that the role was to highlight environmental issues in team meetings, guide other staff to adopt responsible practices and assess and develop environmental responsibility in the patient care units. The other tasks that achieved very high agreement (96%) were to develop their own environmental skills, ensure that units provided functional working environments and make sure that new employees and student were clear about their environmental responsibilities. In addition, there was high agreement on developing unit-specific environmental instructions (89%).

[Table 4. Stakeholders and their roles in environmental responsibility in clinical nursing practice in hospitals (Delphi round 2: response rate 77%).]

Staff inducements. The nurses were unanimous about the need to use several inducements to promote environmental responsibility in clinical nursing practice (Table 5). They all agreed that these should include visible environmental communication in hospitals, internal reports on units' consumption and waste volumes and providing functional facilities so that staff could use bikes to get to work. Inducements that reached very high agreement (96%) were arranging environmental theme days and weeks, setting targets for material and energy consumption and rewarding staff for their progress. Nurses also considered it beneficial to financially support the use of public transport for commuting (85% agreement) and to arrange staff competitions that focus on environmental responsibility (81% agreement).

Content of environmental in-service training. Nurses reached a consensus on the importance of training hospital staff on environmental issues (Table 5). There was unanimous agreement that the training should cover the responsible use of materials and energy, the environmental effects of chemicals and drugs, the hospital's environmental program and collaboration between different professional groups in realizing environmental responsibility. There was 89% agreement on the topic of technical waste management processes. The

suggestion that climate change should be included in the in-service training barely reached consensus (78%), as one nurse disagreed and another four partly disagreed.

Resources needed. The consensus reached by the nurses implied that realizing environmentally responsible practices required certain resources. All of the nurses agreed that it required functional facilities for waste sorting and high-quality, durable products, such as furniture. There was also 93% agreement that environmental responsibility required sufficient staff (Table 5).

Guidance needed. According to the nurses' consensus, guidance was needed to promote environmental responsibility in hospitals and in clinical nursing practice. When it came to guidance, all of the nurses agreed that it was necessary to have hospital environmental programs and national laws. There was also very high agreement (96%) that there needed to be both unit-specific environmental aims and a national environmental program that focused on specialized healthcare (Table 5).

[Table 5. The tools needed to promote, and enable, environmental responsibility in clinical nursing practice (Delphi round 2).]

5 DISCUSSION

5.1 Scrutiny of the results

This study has confirmed the previous knowledge on environmental responsibility in nursing practice and adds new insights into this topical subject. It did this by examining the clinical practices, the roles of stakeholders and the tools needed to promote, and enable, nurses to help hospitals reduce their environmental burden. We showed that nurses expected hospital administrators to demonstrate corporate environmental responsibility. It was critical to make sure that environmental endeavors were measurable, firm and compelling and that hospital policies addressed designated duties for different professionals and provided staff with concrete resources so that they could act in a responsible manner and develop their competencies.

Our study showed that in order to involve staff, it was important to make corporate environmental responsibility visible in hospitals. The nurses said that presenting concrete data on consumption and waste made people aware of the issues and encouraged them to behave responsibly. Providing staff with feedback seemed to be an important factor in maintaining their interest in environmentally responsible behavior and development (also Staddon, Cycil, Goulden, Leygue, & Spence, 2016). That is why administrators needed to set aims and measure and verify environmental achievements. Target-based follow ups provided staff with valid information on how their hospital optimized materials and energy and created the foundation for focused interventions to promote initiatives. However, providing hospital units with feedback was not enough. Hospitals also needed to publicly reward staff for their efforts and this provided motivation and a positive stimulus for passive hospital units to improve their practices. Nurses suggested both official recognitions of excellence and concrete rewards, such as providing coffee services in the units.

The nurses' interviews filled in the gaps in previous knowledge (Kallio et al. 2018*;* Huffling & Schenk, 2014; Lipkin, 2012) and identified the variety of stakeholders needed if hospitals are to enable environmentally responsible clinical practice. Our study shows that officially defining the tasks of hospital administrators, unit leaders, nursing staff and the various support services, creates the foundation for multi-professional collaboration and information sharing. It also prevents people passing their duties on to each other. In particular, our study provided detailed knowledge about the role of environmental support contacts in hospital units. Another previously, and largely unknown, stakeholder was the nurse manager, who was central to engaging staff. In line with a previous study (Anåker, Nilsson, Holmner, & Elf, 2015), our participants said that environmental initiatives were rarely covered in general discussions among nurses. Our study showed that environmental support contacts and nurse managers played a key role in contributing to positive environmental cultures among nursing communities.

This study showed the central role that administrators played in creating organizational structures to promote, and enable, environmental responsibility in clinical practice. This included ensuring that nurses were provided with concrete resources, as a number of barriers were identified that stopped them from doing this. For example, crowded and impractical premises (also Joshi et al. 2015; Nichols & Manzi, 2014) and low-quality products often led to unnecessarily wasting materials and energy during patient care. Lipkin (2012) noted that

when environmental responsibility was successfully integrated into nursing' practices, they didn't have to spend extra time behaving responsibly. For example, then nurses didn't need to visit a different room to sort waste. Our nurses discussed the question of having sufficient staff and agreed with Swedish colleagues (Anåker et al. 2015) who said that being too busy meant staff did not have time for environmental initiatives. This indicates that developing and realizing environmentally responsible clinical practice requires organizational resources and also requires government funding for healthcare staffing. For example, does the national staffing budget mean that nurses have time to develop and enact environmental responsibility during their working hours or do they only have time for the most compulsory, immediate nursing duties? However, it needs to be noted that our nurses said that environmental responsibility was also a matter of attitude, not just a resource issue. The nurses in our study said that this concerned nurse managers as well. If nurse managers felt that environmental responsibility was important, they would give environmental support contacts allocated time to develop, and discharge, their role during working hours.

This study confirms the findings of previous studies (e.g. Anåker et al. 2015; Álvarez-Nieto et al. 2018; McDermott-Levy, Jackman-Murphy, Leffers, & Jordan, 2018), as it highlights the need for nurses to receive environmental training. It also suggests the specific areas that this training needs to cover. The nurses who took part in our study agreed that it was important to include the effects of pharmaceuticals and chemicals when in-service training was provided. There was less support for including climate change topic in this training, even though the role that it plays in primary health promotion has underlined the importance of nurses being aware of the issues (McDermott-Levy et al. 2018). However, the interviews with the nurses indicated that they thought it was important to contribute to the wider prevention of greenhouse gases caused by healthcare organizations and to integrate environmental topics into nursing degree education. The findings of this study indicate that it would be justifiable to provide more thorough coverage on the causes of environmental hazards, and the implications for health, in degree courses. In addition, in-service training should focus on specific organizational and clinical practice issues. The continuity between nursing degree courses and ongoing professional training highlights the need for collaborative planning between learning institutions and hospitals, as well as steps to ensure the environmental competencies of the professionals who provide this education.

5.2 Ethics of the study

We adhered to the principles of responsible research conduct during all phases of the study (Finnish Advisory Board on Research Integrity [TENK], 2012). Permission for the research to be carried out was obtained from each of the participating hospitals before we contacted the nurse managers in the hospital units. According to national Finnish law (Ministry of Social Affairs and Health, 1999), we did not require ethical pre-assessment, as this was a study that focused on the working life of the nurses who took part. We ensured that the participants were able to provide informed consent (TENK, 2012), by providing them with both written and oral information on the study. The information provided for the participants included the voluntary and confidential nature of study and the fact that they could withdraw at any time without any consequences. The anonymity of the participants was guaranteed by removing any names and places and any specific information that could have identified them, like unusual expressions.

5.3 Limitations

There were some possible limitations to our study. The central question concerned the consensus level, as the methodological literature did not provide determination of a certain consensus level (Boulkedid et al. 2011, Hasson et al. 2000). The nurses were asked to respond to our statements using a four-point scale. We decided to define a minimum agreement level of 75% and only included responses that totally and partly agreed with the statements at, or above, this level. Providing more possible responses, such as a seven-step scale, and/or excluding partly agreed answers from the minimum agreement level, may have produced different study results. It should also be pointed out that the 'can’t say' -responses were included in the non-agreement category and this had an impact on the agreement levels. The other question concerns how the statements were phrased and whether this encouraged positive responses (Hasson et al. 2000). We have reported all the statements and second-round results in a transparent way (Tables 4 and 5), to allow readers to assess how the statements were formulated and the levels of agreement.

6 CONCLUSIONS

Hospital nurses play multiple roles in optimizing material and energy use during clinical practice. Our study showed that hospital administrators played an important role in ensuring

that it was possible for nurses to achieve environmental responsibility in nursing practice. A number of factors made a beneficial contribution to this aim. First, identifying and addressing different stakeholders' duties created a basis for various professionals to cooperate. Second, making environmental responsibility visible, firm and measurable in organizations can further its pro-environmental culture. Third, it is essential to ensure that nurses have environmental competencies so that they know how to optimize material and energy use. They also need to perceive environmental responsibility as part of high-quality patient care. Fourth, administrators and nurse managers should allocate nurses sufficient work time and proper facilities so that they can provide patient care in a high-quality manner. Rewards and feedback are a highly recommended way of motivating and inspiring staff, so that they are engaged in environmental responsibility. Future studies are needed that examine environmentally responsible practices in relation to measurable reductions in waste and pollution and cost savings.

7 RELEVANCE FOR CLINICAL PRACTICE

The results of this study can help nurses and nursing leaders to identify opportunities to optimize material and energy use in their everyday clinical practice. They will also be of interest to the wider health sector and to the hospital administrators who develop corporate environmental responsibility. Our findings indicate the importance of multi-professional collaboration and involving nurses in organizational development and decision-making. They also address the subjects that are worthy of being included in nurses' in-service training. The knowledge that is gained from this study can ultimately be used to widen the opportunities that nurses have for promoting public health issues associated with the environment.

CONFLICTS OF INTEREST

The authors have no conflicts of interests to declare.

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Table 1. Work characteristics of the 35 Delphi panellists (Delphi round 1).

Professional position	**n**	**%**
• Nursing staff	32	91
• Nurse manager	3	9
Total	**35**	**100**
Work unit		
• Operative units	10	28
• Conservative units	9	26
• Emergency and intensive care units	9	26
• Infection control units	2	6
• X-ray units	1	3
• Other (nurses who currently worked in other duties)	4	11
Total	**35**	**100**

Table 2. The semi-structured interview guide (Delphi round 1).

Main theme	**Follow-up questions**
Warm-up questions	• How did you get involved in environmental work? • What kind of training or orientation have you received with regard to environmental work? • What kind of environmental tasks does your role include?
(1) What kind of practices can be used to promote environmental responsibility in patient care?	• How can material, electricity and water use make a difference? • What is your environmental responsibility with regard to using support services (e.g. kitchen, transport, pharmacy, laboratory, property maintenance, laundry)?
(2) How can environmental responsibility in patient care be promoted at an organisational level?	• What kind of role distribution supports environmental responsibility (administrators, leaders, environmental support contacts, staff, others)? • What kind of extra-organisational collaboration with various parties are needed? • What kind of guidelines and programmes are needed (e.g. what kind of environmental programmes in an organisation benefit people working in patient care practice)?
(3) How can the roles and competencies of staff be promote with regard to environmental responsibility?	• What kind of competencies do the staff need? • What kind of training is needed? • In future, how can staff be encouraged and inspired to act environmentally responsibly in immediate patient care and as an employee?
Closing discussion	• What else would you like to say about environmental responsibility in patient care?

Table 3. An example of how we developed the close-ended statements based on the content analysis results (Delphi round 1).

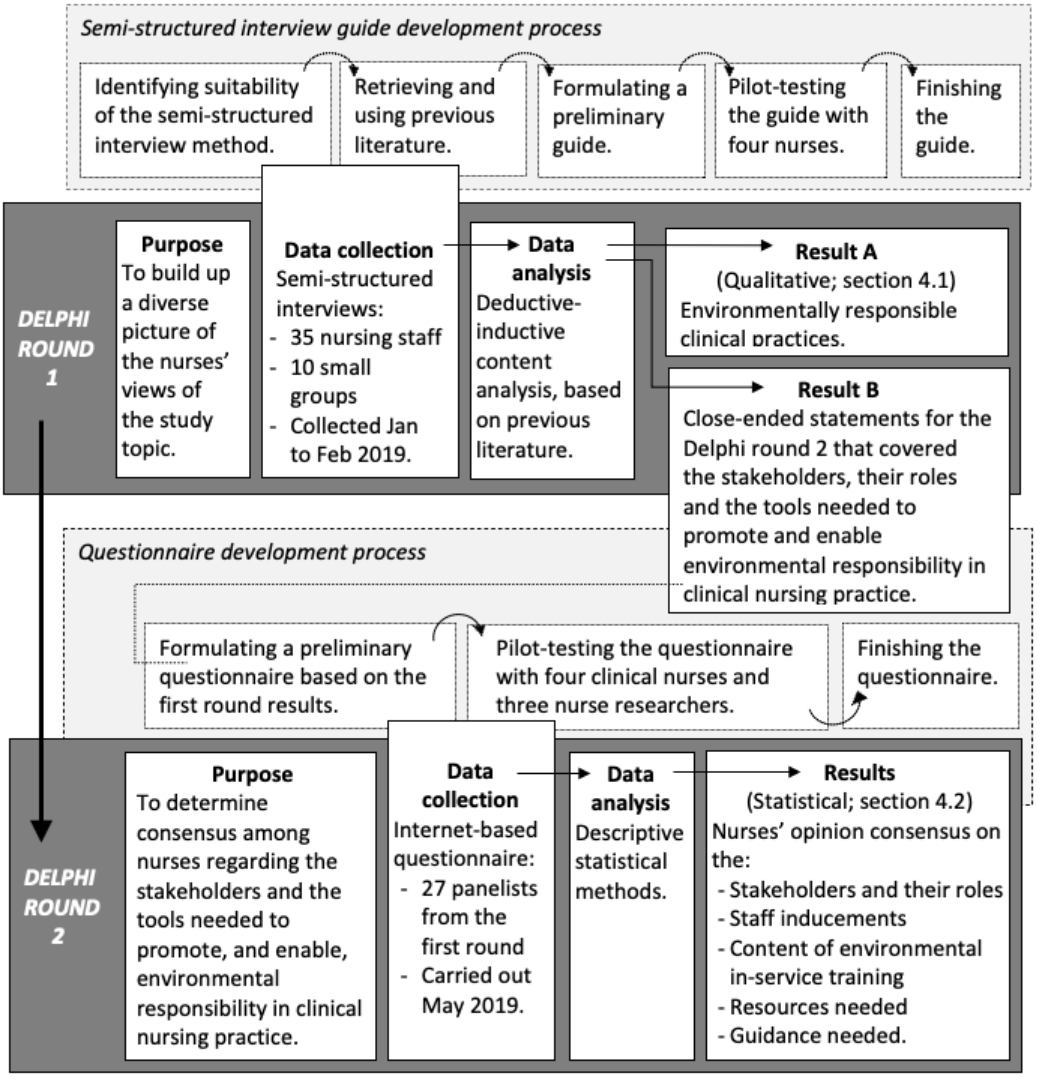
Examples of the extracted expressions from the interview data	**Sub-category created in the content analysis**	**The statements that were developed**
Stakeholders and their roles		
– *'One of the nurses showed how a practice could be carried out in a more effective way.'*	Role of the nursing staff is to look for opportunities to develop environmentally responsible patient care practices.	Realization of environmental responsibility in a hospital requires collaboration in which nursing staff look for opportunities to develop environmentally responsible patient care practices.
– *'The staff in my unit suggest how practices can be developed so that they are more environmentally responsible.'*		
– *'Nurses in my unit have said that it doesn't make sense to order certain products that we don't use anymore.'*		
Tools needed to promote, and enable, environmental responsibility in clinical nursing practice		
– *'There is no space in the units for the waste bins.'*	Functional facilities for waste sorting is a resource needed for environmental responsibility in nursing.	Environmental responsibility in hospital nursing requires functional facilities for waste sorting.
– *'The waste bins are the wrong size and in the wrong places.'*		
– *'All the waste bins look the same.'*		

Table 4. Stakeholders and their roles in environmental responsibility in hospitals (Delphi round 2; response rate 77%).

	Agreement	*Agree*	*Partly agree*	*Partly disagree*	*Disagree*	*Can't say*
	%	n	n	n	n	n
Realizing environmental responsibility in hospitals requires collaboration, in which						
• The hospital's environmental manager coordinates and develops environmental responsibility at an organization-wide level	**100**	23	4	0	0	0
• Nursing staff avoid the unnecessary use of material, water and electricity	**96**	22	4	0	1	0
• Nurse managers encourage staff to act in an environmentally responsible way	**96**	22	4	0	1	0
• Nurse managers ensure that staff have sufficient environmental competencies	**96**	16	10	0	1	0
• Ward pharmacists ensure that as little drug waste in generated in units as possible	**93**	20	5	0	0	2
• Students act according to units' environmental guidelines	**89**	23	1	0	0	3
• Administrators integrate environmental responsibility into all the decision-making in the hospital	**89**	22	2	1	0	2
• Nursing staff look for opportunities to develop environmentally responsible patient care practices	**89**	21	3	2	1	0
• Hygiene nurses consider the environment when preventing infection	**89**	16	8	0	1	2
• Housekeepers act as waste experts	**89**	12	12	3	0	0
• Support services (kitchen, transport, etc.) develop their own services with regard to environmental responsibility	**85**	22	1	0	0	4
• Purchasing professionals order sustainable products	**85**	22	1	1	0	3
• Patients sort their own waste and do not unnecessarily run water	**78**	14	7	4	0	2
Environmental support contact's duty in a hospital unit is to						
• Highlight environmental issues in team meetings	**100**	27	0	0	0	0
• Guide other staff to adopt responsible practices	**100**	25	2	0	0	0
• Assess and develop environmental responsibility	**100**	22	5	0	0	0
• Make sure that new employees and student are clear about environmental responsibility	**96**	21	5	1	0	0
• Develop their own environmental skills	**96**	17	9	1	0	0
• Ensure that units provide functional working environments	**96**	15	11	1	0	0
• Compose unit-specific environmental instructions	**89**	16	8	2	1	0

Table 5. The tools needed to promote, and enable, environmental responsibility in clinical nursing practice (Delphi round 2).

	Agreement **%**	*Agree* n	*Partly agree* n	*Partly disagree* n	*Disagree* n	*Can't say* n
Staff inducements: ***Staff needs to be engaged in environmental responsibility with***						
• Visible environmental communication in hospitals	**100**	22	5	0	0	0
• Internal reports on units' consumption and waste volumes	**100**	21	6	0	0	0
• Providing facilities so that staff could use bikes to get to work	**100**	26	1	0	0	0
• Arranging environmental theme days and weeks	**96**	21	5	1	0	0
• Setting targets for material and energy consumption	**96**	17	9	1	0	0
• Rewarding staff for their progress	**96**	22	4	1	0	0
• Financially supporting the use of public transport for commuting	**85**	20	3	4	0	0
• Arranging competitions that focus on environmental responsibility	**81**	11	11	4	1	0
Content of environmental in-service training: ***Staff's training should cover information of***						
• The responsible use of materials and energy	**100**	25	2	0	0	0
• The environmental effects of chemicals and drugs	**100**	24	3	0	0	0
• The hospital's environmental program	**100**	21	6	0	0	0
• Collaboration between different professionals in realizing environmental responsibility	**100**	21	6	0	0	0
• Technical waste management processes	**89**	14	10	3	0	0
• Climate change	**75**	13	8	5	1	0
Resources needed: ***Environmental responsibility in hospital nursing requires***						
• Facilities for waste sorting	**100**	27	0	0	0	0
• Highquality, durable products, such as furniture	**100**	27	0	0	0	0
• Sufficient staff	**93**	19	6	2	0	0
Guidance needed: ***Environmental responsibility in hospitals should be guided and regulated with***						
• Hospital environmental program	**100**	24	3	0	0	0
• Law	**100**	19	8	0	0	0
• Unit-specific environmental aims	**96**	23	3	1	0	0
• National environmental program focusing on specialized healthcare	**96**	20	6	0	0	1



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