

**DESCRIPTION OF THE CONTENTS OF ENVIRONMENTAL DOCUMENTS IN
EUROPEAN HOSPITALS**

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March 2019

TABLE OF CONTENTS

ABSTRACT

| | | |
|----------|---|-----------|
| 1 | INTRODUCTION | 1 |
| 2 | ENVIRONMENTALLY SUSTAINABLE HOSPITAL AND ITS GUIDANCE | 3 |
| 2.1 | Literature Search | 3 |
| 2.2 | Environmental Sustainability in a Hospital | 3 |
| 2.2.1 | Sustainable Hospital System and Stakeholders | 4 |
| 2.2.2 | Environmental Targets | 5 |
| 2.2.3 | The Role of Health Care Professionals | 13 |
| 2.3 | Guidance of Environmental Sustainability in Hospitals | 16 |
| 2.3.1 | Guidance on Global and National Level | 16 |
| 2.3.2 | Guiding Programs and Documents on Environmental Sustainability in Organisations | 18 |
| 2.4 | Summary of the Literature | 18 |
| 3 | AIM OF THE STUDY AND RESEARCH QUESTIONS | 20 |
| 4 | DATA AND METHODS | 21 |
| 4.1 | Document Analysis | 21 |
| 4.2 | Data Collection and Selection | 21 |
| 4.3 | Selected Data | 23 |
| 4.4 | Data Analysis | 24 |
| 5 | RESULTS | 26 |
| 5.1 | The Environmental Sustainability Targets | 26 |
| 5.1.1 | Sustainable Material Choices and Procurement | 26 |
| 5.1.2 | Sustainable Waste Management | 27 |
| 5.1.3 | Optimising Energy Use | 28 |
| 5.1.4 | Optimising Water Use | 29 |
| 5.1.5 | Minimising the Use of Toxic Chemicals | 30 |
| 5.1.6 | Smart Use of Pharmaceuticals | 30 |
| 5.1.7 | Sustainable Hospital Food and Food Services | 31 |
| 5.1.8 | Sustainable Travel and Transportation | 31 |
| 5.2 | The Stakeholders and Their Roles | 32 |
| 5.2.1 | Health Care Professionals | 33 |
| 5.2.2 | Governing Body | 33 |
| 5.2.3 | Other Stakeholders Inside a Hospital | 34 |
| 5.2.4 | Stakeholders Outside a Hospital | 35 |
| 5.3 | The Means of Establishing an Environmentally Sustainable Hospital System | 36 |
| 5.3.1 | Planning and Integration | 36 |
| 5.3.2 | Human Capital | 37 |
| 5.3.3 | Evaluation, Reportage and Follow-Up | 39 |
| 5.3.4 | Innovation and Research | 40 |
| 5.4 | Summary of the Results | 40 |
| 6 | DISCUSSION | 41 |
| 6.1 | Review of the Results | 41 |
| 6.2 | Future Prospects | 45 |
| 6.3 | Study Ethics and Trustworthiness | 47 |
| 7 | CONCLUSIONS | 49 |

APPENDICES

APPENDIX 1. Search words and limitations.

APPENDIX 2. Numbers of search results, article selection and reasons for exclusion.

APPENDIX 3. Articles chosen for literature review.

APPENDIX 4. The themes of the final observation matrix.

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Description of the Contents of Environmental Documents in European Hospitals

Master's Thesis, 64 pages, 4 appendices (6 pages)

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March 2019

Hospitals use massive amounts of resources for their operations. By planning their operations environmentally sustainably, hospitals can make a positive impact on climate change as well as reduce pharmaceuticals and toxic chemicals in the environment. Environmental sustainability in hospitals is mostly guided by governments, corporations and non-governmental organisations.

The aim of this study was to provide international perspective on the contents of European hospitals' environmental documents. Produced knowledge can be used when making and evaluating an environmental program of a hospital. Document analysis was used as a research method to analyse the selected environmental documents from eight organisations. The data was collected from Google search engine in spring 2018. An observation matrix was developed based on previous research to be used in selecting and organising the data of the environmental documents. The data analysis phase combined elements of thematic analysis and content analysis.

According to the results of this study, the contents of environmental sustainability in hospital environmental documents can be divided into three main categories; the environmental sustainability targets, the stakeholders and their roles, and the means of establishing an environmentally sustainable hospital system. The environmental sustainability targets contain; material choices and procurement, waste management, the use of energy, water, chemicals and pharmaceuticals, hospital food, and travel and transportation. The stakeholders include health care professionals, governing body, and other stakeholders inside and outside the hospital. The means of establishing an environmentally sustainable hospital system includes planning and integration, human capital, evaluation, reportage and follow-up, and innovation and research.

The study results emphasise the difference in existing environmental documents and suggest a need for more detailed addressing of environmental issues in hospitals. Institutions guiding environmental care are encouraged to take more detailed approach to environmental sustainability in hospitals, and in order to achieve this, more comprehensive research data on environmental sustainability in hospitals is required.

Keywords: Environmental sustainability, hospital, resource efficiency, organizational change and document analysis.

1 INTRODUCTION

Progressive climate change is a current phenomenon linked to, for example, increasing global temperatures, loss of sea ice, extreme weather events and moreover, effects to the human health (Nasa 2019). Health care and hospitals contribute to climate change as they use extensive amounts of world's natural resources such as oil, water and minerals and furthermore, contribute essentially to total carbon dioxide (CO₂) emissions (McGain & Naylor 2014). There are around 15,000 hospitals only in the European Union which means that hospitals' consumption on the world-wide level is even more significant (Health Care Without Harm 2016). In addition, hospitals use chemicals (Santos et al. 2019) and pharmaceuticals (Wang & Wang 2016) which are both problematic in waste treatment and cause challenges to the environment.

Governments, corporations and non-governmental organisations like United Nations guide most sustainability actions on a global level (Benn & Dunphy 2007, 10, United Nations 2017). In Europe, the European Union guides its members in sustainability with environmental standards (EU 2018a). National regulations guide practices on a national and local level (Kangasniemi et al. 2014, Ryan-Fogarty et al. 2016). Hospital sustainability is closely connected to ethics. Environmental justice and the responsibility over future generations needs to be considered when planning and estimating hospital procedures. (Kangasniemi et al. 2014.)

The health care system can make a considerable positive effect on climate change by modifying its way of acting to more sustainable (Health Care Without Harm 2016) and furthermore, sustainable practices will show in economical benefits for the institution (Furukawa et al. 2016a). Clinical practices are a significant part of hospitals' environmental footprint (McGain & Naylor 2014), which highlights the importance of environmental education (Huffling & Schenk 2014, Kangasniemi et al. 2014). Already simple actions and changes can make a considerable difference for example in energy consumption and waste reduction (Kangasniemi et al. 2014). Moreover, unpolluted environment supports patient safety (Ryan-Fogarty et al. 2016) and the safety of professionals (Lipkin 2012).

Environmental programs guide the hospital and give information to the public and decision makers. Programs should be based on evidence in order to be reliable. (Pullin et al. 2009.) However, there is currently no scientific evidence demonstrating what kind of en-

vironmental programs exist now and are already being operated, and how an environmental program should be formed. The aim of this study is to provide international perspective on the contents of European hospitals' environmental documents. Produced knowledge can be used when making and evaluating an environmental program of a hospital. As there isn't previous research on the subject, a qualitative document analysis was chosen as a research method.

As nurses are the largest professional group in a hospital (Furukawa et al. 2016a), it is essential for nursing practice and nursing science to take environmental sustainability into account in education, management and research. This study is focusing on an organisational level change in a hospital in which nurses and nursing management can provide their expertise on the environmental sustainability from the point of view of nursing.

2 ENVIRONMENTALLY SUSTAINABLE HOSPITAL AND ITS GUIDANCE

2.1 Literature Search

A systematic literature search was conducted on March 2018 using three electronic databases; CINAHL, PubMed and Web of Science. The aim of the search was pursuing articles on environmentally sustainable hospitals; the role of health care staff in a hospital setting and information on hospitals' environmental actions. The search was done in English language and articles needed to be published within last ten years. In CINAHL, the searches were also limited to peer-reviewed articles. Exclusion criteria was set to exclude articles that focus on the hospital building and its environmental aspects as well as effects of the environment to human health. Moreover, articles that didn't answer to research questions and non-scientific articles were excluded.

The search words were created from different combinations of the following words: hospital, patient, staff, nurse, environmental responsibility, environmentally friendly, eco-friendly, environmental effect, environmental impact, environmental practice, environmental sustainability, greening, and footprint. Detailed search words and limitations can be found from Appendix 1. The results in PubMed were limited to title/abstract and results in Web of Science to title to achieve reasonable number of results. Because the search word patient* gave hundreds of results in PubMed and Web of Science the search word was altered to "patient care".

Total of 618 articles were found from three databases. Numbers of detailed search results, article selection and reasons for exclusion at each step can be found from Appendix 2. After selection, 18 articles were chosen to be used in the literature review. Studies were conducted using varied study designs including life cycle assessment, before and after study, critical interpretive synthesis, energy-use survey, comparison study, systematic review, review, case study, and implementation evaluation. Furthermore, one article was a feature article and one measured environmental impact with their own model. In addition, articles found with random sampling (n=3), books and other data was used to form the literature review. Selected research articles (n=21) are presented in Appendix 3.

2.2 Environmental Sustainability in a Hospital

This section will present how the concept of environmental sustainability has been described in literature from the perspective of hospital system, environmental targets and

health care professionals. Furthermore, the guidance of environmental sustainability for health care is considered through global and national guidance and environmental programs. But first, the concept of environmental sustainability is clarified.

Sustainability is traditionally defined as meeting the needs of the present without compromising the ability of future generations to meet their own (World Commission on Environment and Development 1987). Sustainability in the field of health care can be seen as efficient use of resources and capital management or continuous process of improvement (Goh & Marimuthu 2016). Environmental sustainability brings the aspect of environment to the equation. Global organisation Health Care Without Harm (HCWH) is defining environmental sustainability in a health care setting as reduction of environmental impacts through efficient use of energy and resources, managing medical products and chemicals throughout their life-cycle and reducing pollution by managing waste and wastewater safely (HCWH 2017). Environmental sustainability has increased in public and private organisations in the last 50 years. Starting from achieving environmental regulations, the mindset has evolved to making organisations responsible to address their social and environmental impacts of processes. In health care, environmental sustainability requires extra attention as health care is dealing closely with people's lives. There can be no trade-offs that ensure environmental sustainability but puts the people at risk. (WHO 2017.)

There are still gaps in the evidence base of hospital sustainability (McGain & Naylor 2014) and continuous research is needed to identify how health care organisations can change their actions to more sustainable (Kangasniemi et al. 2014). Hospital buildings' architectural design and technology of environmental hospital devices have been studied relatively widely. Less research is done on clinical, psychological and social factors of health care professionals in relation to environmental care. (McGain & Naylor 2014.) One emerging theme is innovative care products such as biopolymers and their use (Unger et al. 2017).

2.2.1 Sustainable Hospital System and Stakeholders

It is believed that a whole system approach is the best way to gain mitigation in environmental impacts and the hospital system needs to be dynamic and flexible to integrate future supports and environmental concerns (Ryan-Fogarty et al. 2016). In other words, too strict and unyielding systems and policies can hinder good practices (Furukawa et al. 2016a). To achieve whole system sustainability, sustainability needs to be key organisa-

tional priority (Global Green and Healthy Hospitals 2011) with clear and updated guidelines (Kangasniemi et al. 2014). Leadership is needed at all levels (Global Green and Healthy Hospitals 2011) and the organisation can benefit from different leadership models, for example, preventive or demand management can be used to avoid unnecessary hospital produces which can be much more beneficial than changes to hospital procedures (McGain & Naylor 2014). Administration's role in environmental sustainability is to implement programmes, make decisions, supervise, evaluate, and give support to others (Kangasniemi et al. 2014).

In environmentally sustainable care different stakeholders have their own roles (Kangasniemi et al. 2014). Kallio et al. (2018) identified six groups of stakeholders; administrators, environmental managers, immediate leaders, environmental support people, staff and patients. This review is giving special interest on the actions of the staff or health care professionals as they have a significant impact on hospital environmental footprint. This is reviewed in more depth in paragraph 2.2.3. The hospital environmental sustainability can be enhanced with multi-professional cooperation (Kangasniemi et al. 2014). Environmentally-conscious operations in the hospital require awareness of both clinical and environmental stakeholders and environmental programs can help to bring together disparate stakeholders. In order to reach all stakeholders, both lateral and vertical communication is needed, and it is advisable to use different communication channels. Publishing reports and best practices, involving local community and peer institutions can be highly beneficial in informing and involving stakeholders to environmental practices. (Ryan-Fogarty et al. 2016.) Patients and relatives shouldn't be forgotten as they can offer valuable knowledge (Ryan-Fogarty et al. 2016) and furthermore, patients and relatives can participate in waste disposal and in the smart use of materials and water but require information to be able to participate (Kangasniemi et al. 2014).

2.2.2 Environmental Targets

Materials. In 1960's plastics entered strongly to health care. Materials originally made from glass, rubber, metal and woven were replaced with polyvinyls, polycarbonates and polystyrenes. Plastic devices were cheaper to produce but were also disposable and started to increase waste amounts in hospitals. (Unger et al. 2017.) During the last 30 years many reusable products have been changed to disposables in most specialties. The reason for shifting into single-use products seems to be beyond infection control and more connected

to cost, ease of use, difficulty making some reusables ready to use again, individual (doctor) preferences and marketing. (McGain & Naylor 2014.) The concern that single-use products would be safer than reusable products have later been showed wrong (Overcash 2012, Kangasniemi et al. 2014).

Material selection has a close connection to hospital waste levels. For instance, most of the medical waste in the operating rooms is coming from disposable surgical supplies such as drapes, gowns, basins, gloves and sponges coming in custom packs and individual packages. (Conrardy et al. 2010.) Single-use kits are preferred even though they produce more solid waste than reusables (McGain et al. 2012, Overcash 2012). Using reusable products in the operating room can decrease regulated medical waste by an average of 65% and as a result, the waste management costs will reduce (Conrardy et al. 2010). Furthermore, sometimes it is forgotten that some single-use devices can be reprocessed and used again (Conrardy 2012, Huffling & Schenk 2014, Kallio et al. 2018). Repairing and refurbishing products can also help to minimise the waste load (Conrardy 2012).

When selecting medical products there are three questions that help to evaluate the environmental impact of the product: can the product be recycled, is the product made of recycled materials and what method is used for disposal (Conrardy 2012). Life cycle assessment helps finding out the financial and environmental costs of a product over its entire life (McGain et al. 2012, McGain & Naylor 2014). Analysing strategies differ little between studies, but possible analysing targets are; CO₂ emissions, mineral use, aquatic and terrestrial ecotoxicity, solid waste (McGain et al. 2012), water (Conrardy 2012, McGain et al. 2012), and energy use. In addition, petrochemical costs and pollution produced in obtaining raw materials, manufacturing, transportation, use, reuse, maintenance, recycling and waste disposal can be calculated (McGain & Naylor 2014). Furthermore, the cost difference of single-use and reusables is an important aspect of product evaluation and selection. According to research, using reusable medical products is cheaper than using single-use disposable products (Conrardy 2012, McGain et al. 2012, McGain et al. 2017). For instance, McGain et al. (2017) study showed that converting from single-use to reusable anaesthetic equipment saved more than AUD\$30000 (around 19 000€) per annum.

However, comparing single-use and reusables isn't straightforward. The type of electricity that hospitals use has a connection to the relative environmental effects of reusable items. (Conrardy et al. 2010, McGain et al. 2017). McGain et al. (2012) found out that because

the study hospital used brown coal–sourced electricity, the environmental costs of the reusable kit were bigger than for the single-use kit. In the future, decreasing the water and energy consumed in cleaning and sterilisation reusables should be a priority. (McGain et al. 2012.) In addition, bio-plastics are suggested to be a better option for plastic. Petroleum-based plastics obtain their carbon from non-renewable resources like petroleum whereas bio-plastics are derived from renewable feedstocks. Biopolymer polylactide (PLA) is compostable and could reduce the amount of plastic waste in hospitals. (Unger et al. 2017.) The ethical side of producing products needs to be also valued. Single-use anaesthetic products in McGain et al. (2017) study were manufactured in Asian countries with low staff pay.

Waste. Hospitals create circa 15 kg (33 pounds) of waste per patient per day (Huffling & Schenk 2014) and around 20% of all hospital waste comes from the operating rooms (McGain & Naylor 2014). Reducing hospital waste will have positive financial and environmental effects (Huffling & Schenk 2014, McGain & Naylor 2014, Furukawa et al. 2016b). The amount of waste can be decreased in many ways for instance through reducing, reusing and recycling. The purchasing department is the first in row to impact the waste amounts (Conrardy et al. 2010.) Waste can be reduced by minimising the amount of materials purchased (Kangasniemi et al. 2014), including reusable products to order selection and decreasing single-use products and single packets (Conrardy 2012, Unger et al. 2016). Purchasing contracts can be added to have a requirement to reduce packaging (Ryan-Fogarty et al. 2016). Preferring easily recycled materials and promoting products made from recycled materials which reduce the use of virgin raw materials is beneficial (Kangasniemi et al. 2014). Furthermore, health care professionals' way of working can impact waste amounts positively or negatively (Conrardy 2010, Huffling & Schenk 2014, Furukawa et al. 2016b).

Hospital waste is traditionally classified to general and medical waste or infectious and non-infectious waste. However, it is possible to do even more detailed classification such as sharps, genotoxic waste, heavy metals, pathological waste, chemical waste, pharmaceutical waste, pressurized containers, radioactive waste, liquid waste, and hazardous waste. (Thakur & Ramesh 2015.) The segregation in hospitals should be done carefully. Proper waste disposal includes sorting all types of waste and recycling them. (Huffling & Schenk 2014, Kangasniemi et al. 2014, Thakur & Ramesh 2015.) Medical waste needs to be disposed of in a special way, but also general waste needs to be put into the right containers

for recycling to succeed (Kangasniemi et al. 2014). Adding more recycling bins to capture all recyclables and identifying black spots can improve waste recycling (Ryan-Fogarty et al. 2016). All waste from caring patients is not infectious or chemical and can be discarded as ordinary waste, used again or recycled without risking the environment or human health (Furukawa et al. 2016b). However, Furukawa et al. (2016b) showed that a large part of paper and plastic materials that were not in contact with the patient were thrown away as infectious waste. This is generating higher costs to the hospital and greater impact on the environment because treating specialised waste is more expensive and energy-intensive (Huffling & Schenk 2014, Furukawa et al. 2016b). Furthermore, according to Conrardy et al. (2010) all operating room staff doesn't know what regulated medical waste is. The waste ends up to one of the waste bags without thinking and understanding that disposing different waste has different charges.

Around 30% of all hospital waste is paper or cardboard and other 30% is plastic (McGain & Naylor 2014). There is excessive use of labels, paper and packaging in hospitals that shows in material resource wastes (Furukawa et al. 2016b). Paper waste at wards can be limited by using electronic health records (Turley et al. 2011) and having paperless meetings (Ryan-Fogarty et al. 2016). However, hospitals have increased the use of personal computers which generates more waste, so the use of information technology and computers needs to be planned carefully (Turley et al. 2011). It is advisable for hospitals to monitor waste streams and utilise available benchmarking for comparison and development (Ryan-Fogarty et al. 2016).

Energy. Health care consumes roughly 20% of all energy consumed in the public sector in developed countries (McGain & Naylor 2014). When evaluating the use of energy, both energy use and energy origin need to be considered (Kangasniemi et al. 2014). Fossil fuel-based energy has impacts to human health and the environment because greenhouse gases are releasing and contributing to climate change when they are burnt (Huffling & Schenk 2014). For the same amount of electricity, brown coal produces twice the CO₂ emissions than gas, and at least six times more CO₂ emissions than wind power (McGain et al. 2017). Thus, investing to clean and renewable energy is necessary (Burpee & McDade 2014, Kangasniemi et al. 2014).

Around half of the energy hospitals use goes to heating, ventilation, and air conditioning. Lighting and equipment take the second biggest portion of energy. (McGain & Naylor

2014.) Power management program can be used to guide energy use (Huffling & Schenk 2014). Furthermore, promoting the use of energy efficient equipment (Burpee & McDade 2014, Kangasniemi et al. 2014) and turning off devices not in use (McGain & Naylor 2014, Burke & Stowe 2015) are worthwhile actions. For instance, Burke & Stowe (2015) noticed that a range of equipment was left on out-of-hours. Estimated annual savings in individual departments if equipment would have been powered off ranged from 1095.58 € to 4533.41 €.

Even small changes in the temperature and lighting practises can be cost-effective. Optimal working temperature is often at circa 21°C (70°F) but some areas in the hospital need to be kept cool such as data centers, operating rooms and catheterisation laboratories. (Huffling & Schenk 2014.) If the hospital room temperature is raised during summer for 1°C and reduced 1°C during winter, annual cooling and heating costs can be reduced by 5% (McGain & Naylor 2014). Furthermore, utilising day-light and using shading and operable windows to reduce cooling and air conditioning in addition to improving thermal envelope can save a lot of energy (Burpee & McDade 2014). In addition, changing from incandescent lighting to fluorescent and to LED (Huffling & Schenk 2014, Furukawa et al. 2016a) and using occupancy sensors for lighting is recommendable (Huffling & Schenk 2014).

Energy consumption can be indirectly reduced by preserving natural resources, buying environmentally friendly products, recycling, promoting recycled materials, using supplies in a saving way, and minimising waste (Kangasniemi et al. 2014). It can be smart to investigate new innovations like biopolymers replacing plastics as the production of biopolymers requires less energy than fossil-fuel based plastics (Unger et al. 2017).

Water. The use of water in hospitals consists of wash basins, sinks and showers (20-40% of total), toilets (15-30%), laboratories, cooling towers, macerators and sterilizers (15-40%), and food preparation (5-25%) (McGain & Naylor 2014). Water consumption can be reduced by investing to good quality technical solutions like new taps (Kangasniemi et al. 2014) and finding high water use equipment (Ryan-Fogarty et al. 2016). Furthermore, auditing water usage (McGain & Naylor 2014, Furukawa et al. 2016a), checking for leaks (McGain & Naylor 2014, Ryan-Fogarty et al. 2016), applying flow restrictors on hand basins and showers, installing dual flush toilets, and reclaiming water from dialysis units and sterilizers can save water from 10 to 25% (McGain & Naylor 2014). Automatic self-

closing taps (Furukawa et al. 2016a) and other water saving devices like automatic tap timers to surgical hand scrub in addition to replacing water use with other disinfectants can lead to significant water savings, up to hundreds of liters per tap per day (McGain & Naylor 2014). Water use is closely connected to energy consumption which underlines the importance of sustainable water use (Kallio et al. 2018).

Chemicals. Hospitals deal with a variety of chemicals every day. Chemicals are in many ways problematic as they are transmitted for example to waterways and therefore, can be toxic to aquatic life. (Huffling & Schenk 2014.) Toxic chemicals can be found from care products (Lipkin 2012, Huffling & Schenk 2014) toiletries, cleaners (Huffling & Schenk 2014), electronic devices (Lipkin 2012), and film-based radiological equipment (Turley et al. 2011).

Some of the intravenous (IV) access devices contain polyvinyl chloride (PVC). Chlorine is used in the making of PVC and making chlorine is a significant source of heavy metal pollution. Furthermore, disposing PVC is problematic because after hospital use, they normally require incineration. Burning PVC forms dioxins which are carcinogenic, persistent and bioaccumulative. However, there are PVC-free products available for IV infusion, and preferring PVC-free IV products will inspire, and pressure medical product manufactures to develop innovative technologies. (Lipkin 2012.) A chemical additive called Di-2-ethylhexyl phthalate (DEHP), used as a softener (Lipkin 2012), can be found in numerous health care products like IV bags and tubing, nasogastric tubes, urinary catheters, and blood administration sets (Huffling & Schenk 2014). Results from animal studies show that DEHP has developmental and reproductive effects. Many devices are nowadays available also in DEHP-free versions and because of the high demand their cost is comparable with devices containing DEHP. (Lipkin 2012, Huffling & Schenk 2014.)

Personal care products can contain harmful ingredients like formaldehyde, parabens, perfumes, fragrances, polyethylene glycol/cetareth/polyethylene compounds, and 1,4-dioxane. Synthetic, endocrine-disrupting chemical, triclosan, can be found in products like antibacterial soap, sutures, deodorant, toothpaste, and cosmetics. It is an antibacterial and antifungal substance. Most hospital soaps contain triclosan even though studies have shown that plain soap and water is enough to reduce bacterial counts on hands. Furthermore, many of the disinfectant cleaners have health risks. Safer choices and innovation

possibilities like using UV light to reduce infection and hospital-acquired infections should be considered. (Huffling & Schenk 2014.)

Pharmaceuticals. Pharmaceutical use has increased massively over the last twenty years resulting in increasing levels of waste and various effects to the environment. Biologically active, toxic and hormone disrupting pharmaceuticals have been found in drinking water, waterways and effluents all around the world. (Becker et al. 2010.) Only a small percentage of pharmaceuticals are metabolised in the body and most of the releases are from human and animal excretion (Becker et al. 2010, Lipkin 2012). Yet, part of the pharmaceuticals in the environment are accounted for by wrong disposal practices like flushing unused, unwanted or expired medication in addition to the production of pharmaceuticals (Becker et al. 2010).

It is estimated that even 50% of prescriptions and 80% of antibiotics might go unused and most of these are thrown to the trash, flushed down the toilet or rinsed down the sink. In hospitals, long-term care facilities, and other institutions the number is estimated to be 20-65%. (Becker et al. 2010.) Pharmaceuticals in the environment can be reduced by limiting the amount of medicine that goes unused. Patients should have information on the use and disposal of medications in the hospital, they need to be guided to finish their antibiotics, and offer them the minimum number of tablets or capsules required. (Lipkin 2012.) The efficiency of wastewater treatment plant and the type of contaminant determine which pharmaceuticals enter the environment. Wastewater treatment plants' drug removal rates are highly variable and because of the variety of pharmaceuticals no single technique can remove all traces. (Becker et al. 2010.) Hospitals usually have more efficient treatment plants that remove pharmaceutical from water. However, when patients are discharged, pharmaceuticals have better access to waterways. (Lipkin 2012.)

Because the population is living longer and younger people are diagnosed with more chronic diseases, prescription drug use will increase in the future (Becker et al. 2010). All hospitals should track and analyse their medication processes to see possibilities for improvement (Furukawa et al. 2016b). Possibly one fourth of all returned, unused medication could be used again (McGain & Naylor 2014). Changes in procurement practices like purchasing lower dosage anti-inflammatory vials can possibly lead to reductions in leftovers (Furukawa et al. 2016a). Because drug use is increasing, disposal mechanisms for pharmaceuticals need to be improved and regulatory practices optimised (Becker et al. 2010).

It is important to pack and store pharmaceuticals safely, before shipping for disposal (Kallio et al. 2018). At the moment pharmaceuticals don't have a preferred final disposal. Incineration and landfilling have challenges but are still better options than flushing medications down the drain. (Becker et al. 2010, Lipkin 2012.) In the future increased human excretion and the overuse of prescriptions should have more attention. Innovations for example in green chemistry can help to reduce and eliminate the use of hazardous substances by improving pharmaceutical absorption within the body. (Becker et al. 2010.)

Food. Hospitals throw away an average of 953 grams of food every day per patient (Dias-Ferreira et al. 2015). Dias-Ferreira et al. (2015) calculated that for Portugal it means 8.7 thousand tonnes of food waste annually and 35.3 million euros in economic losses. From the overall food that is served in hospitals, even 35% comes back uneaten and becomes food waste. Main course and bread are the food patients most often throw away (more than 50% of these items). Soup (12% wasted), dessert and fruit (10% wasted) were consumed better. Food that gets thrown away doesn't only cost money but has environmental impacts. Measures to reduce food waste are highly needed even though some food waste might be unavoidable. (Dias-Ferreira et al. 2015.) Food waste can be reduced by offering patient menus with portion sizes (Dias-Ferreira et al. 2015, Ryan-Fogarty et al. 2016), re-using unserved food when appropriate, giving notification of patient discharges to kitchen, reviewing periodically food waste (Ryan-Fogarty et al. 2016), and offering extended menu to choose from (Dias-Ferreira et al. 2015).

Food production contributes 15-31% of global greenhouse gas emissions. Hospital foods' CO₂ emissions can be calculated based on the weight of purchased food. Different hospital diets have different impacts on the greenhouse gas emissions. There may be significant differences between countries in carbon footprint due to different agricultural practices and dietary habits. Mediterranean diet has a lower environmental impact than meals with meat. Meat increases hospital menus' carbon footprint significantly, especially red meat. (Vidal et al. 2015.) Producing animal protein requires eleven times more energy than producing grain products. Hospitals environmental impact can be reduced by supporting sustainable fish and reducing the purchase of animal proteins. Menus can be designed according to seasons to coincide harvest times. (Wilson & Garcia 2011.) Buying local food reduces transportation and the use of fossil fuels (Wilson & Garcia 2011, Huffling & Schenk 2014) and furthermore supports the community (Wilson & Garcia 2011). By choosing sustainably grown (organic) foods from local sources, hospitals not only reduce

waste and environmental impacts (Wilson & Garcia 2011, Huffling & Schenk 2014, Ryan-Fogarty et al. 2016) but improve the conditions for farmers and animals (Huffling & Schenk 2014). When hospitals promote meat that is produced without antibiotics, they are helping the industry to turn away from using antibiotics for better growth (Huffling & Schenk 2014). Organic farming protects soil and water quality by avoiding pesticides and herbicides (Wilson & Garcia 2011).

Besides focusing on minimising the food waste and sustainable selection of food, kitchens should be encouraged to buy bio-based disposables in addition to napkins and paper towels that are made from recycled materials and with non-bleaching techniques as they are more sustainable. Kitchens should favour companies that reduce packaging waste and try to buy big containers instead of many smaller ones. Food services in health care consume a lot of resources and moving to environmentally sustainable practices can make a considerable difference. (Wilson & Garcia 2011.)

Travel and Transportation. Hospital travel includes ambulance, private and public transport. Car travel contributes significantly to CO₂ emissions. Travel in hospitals can be reduced in numerous ways. Travelling to the hospital and out can be made more sustainable by benefitting from surveys, making sustainable travel initiatives, reducing travel in single occupancy cars and by increasing public transport possibilities. (Ryan-Fogarty et al. 2016.) Public transportation can be made more approachable with providing real-time screens of buses and routes in addition to warm places to wait for the bus (Kallio et al. 2018). Encouraging car-pooling and cycling can reduce car transport significantly (McGain & Naylor 2014). Waste transportation costs and environmental effects can be minimised by mapping out the most convenient routes (Thakur & Ramesh 2015). Electronic health records have an own impact to travel. In-person visits can reduce up to 26% partly because of telephone consultations and ambulatory care visits by 7-11%. Doing online requests instead of mailed prescription refills saves in transportation and packaging. (Turley et al. 2011.)

2.2.3 The Role of Health Care Professionals

Health care professionals have a notable role in sustainable use of medical products (Conrardy 2012) and medication (Becker et al. 2010), recycling, and sustainable use of electricity and water (Kangasniemi et al. 2014, Ryan-Fogarty et al. 2016). Health care profes-

sionals refers in this study to professionals working closely with the patient in the hospital; in most cases nursing staff and medical doctors.

Environmentally sustainable care promotes healthy environmental practices and reduces burden to the environment (Kangasniemi et al. 2014). Patient rooms should not be stuffed full materials because extra materials often go to waste when patients are transferred or discharged. Contact isolation prestocking should be rethought so that all the patient rooms have only the equipment needed for the next shift as it is a common practice to discard all items in the contact isolation room to prevent transmitting infectious materials. (Huffling & Schenk 2014, Furukawa et al. 2016a.) Some antibiotic-resistance bacteria die on surfaces within days or weeks so in principle some infected equipment could be usable after a certain period. However, employees need to work together with infection control staff to get safe guidelines how to handle unused equipment. Linen waste amounts can be reduced by planning, using only linen needed and checking the room before getting new ones. If the ward doesn't have certain reusable items such as reusable pillows, they can be requested. (Huffling & Schenk 2014.) One way to reduce the use of resources is to evaluate the content of premade kits, such as intravenous start kits, catheter insertion kits and central line insertion kits. A part of the items of these kits frequently are thrown away without using. Reusing and donating can be used alongside recycling, for example, some equipment like tubs, trays, containers or blue wrap can be reused or given away. (Huffling & Schenk 2014.)

The use of medical technology is rising and so is the excessive energy use (Kangasniemi et al. 2014). The way health care staff uses electrical equipment can have a significant impact to the energy consumption (Huffling & Schenk 2014, Burke & Stowe 2015). Health care staff needs to be kept aware on sustainable use of energy. Education and making data relevant to staff with examples like, how many houses could be warmed with the energy used at work, are effective. One method to promote environmental way of working in the ward is to provide checklists for best practices. (Ryan-Fogarty et al. 2016.) Energy and cost savings are both possible by simple changes like turning of unused devices and lighting (Kangasniemi et al. 2014, Burke & Stowe 2015) and by unplugging electrical equipment when not in use (Huffling & Schenk 2014). Furukawa et al. (2016a) study showed that even though 70% of the hospital beds involved in the study had natural lighting, the lights were on the whole time of data collection. Both warm and cold-water use is linked

to energy consumption. Energy use can be reduced by washing linen only when needed and avoiding running water in vain. (Kangasniemi et al. 2014.)

As nurses form the largest professional group in hospitals, nurses are also major consumers of resources and generate a lot of waste (Furukawa et al. 2016a). Therefore, nurses can have a significant influence on the improvement of hospital environmental sustainability which should be acknowledged (Furukawa et al. 2016a) and involve nurses in decision making that impacts nursing practice (Lipkin 2012, Huffling & Schenk 2014, Kangasniemi et al. 2014). Nursing staff can help to create and promote environmentally responsible care and products (Lipkin 2012, Kangasniemi et al. 2014). Furthermore, nurses can spread sustainable practices in their team and promote actions that reduce the impact to the environment (Furukawa et al. 2016b). Nurses can become a part of purchasing committee which is promoting environmentally sustainable purchasing by evaluating goods across the lifecycle and by avoiding harmful products (Huffling & Schenk 2014). Nurses have valuable information on care practices and can offer their opinion in the ease of use, portability, adaptability, reliability, and durability of the electronic equipment they use every day and help the purchasing process (Lipkin 2012). In recycling, nurses can work as key recyclers by helping to start, support, or expand recycling programs (Huffling & Schenk 2014).

Nurses can make a change in reducing and eliminating pharmaceuticals throughout their life cycle from design to disposal because their expanding roles in health care and being normally the first in line to give guidance on pharmaceuticals. Nurses have four key roles in pharmaceuticals' life cycle; advocate, clinician, educator, and investigator. Nurses have a political advocacy to change policy and law and can put this into practice for example in hospital green teams or multidisciplinary work-groups. As clinicians, nurses can address source reduction of pharmaceuticals by guiding to other therapies than medication and by prescribing fewer toxic drugs. As educators, nurses can educate student nurses, co-workers and the public about pharmaceuticals in the environment. As researchers, nurses can consider various research questions, test hypotheses or work as an investigator in different studies. (Becker et al. 2010.)

Nurses have a responsibility and desire to care but also an ethical duty and a possibility to promote environmentally sustainable practices (Harris et al. 2009). However, with limited working time, staff prioritises patient care (Ryan-Fogarty et al. 2016). Nurses have stated

that they don't have time to act environmentally and advocate the practices of environmental care. If environmental advocacy was better seen as part of nursing, these practices could be integrated into daily routine. (Lipkin 2012.)

Environmental education. The studies have identified that health care professionals don't have enough competency on how to preserve the environment, how to use resources wisely, and how to manage waste (Furukawa et al. 2016a, Ryan-Fogarty et al. 2016). Health care professionals have a chance to affect climate policymaking processes, but it requires understanding the science, ability to analyse policy options, and clarifying what health benefits could be gained when preventing climate change (HCWH 2018b). With a proper training, nurses' decision-making competency in environmental sustainability can be enhanced (Huffling & Schenk 2014, Kangasniemi et al. 2014). When nursing services are more aware of environmental issues, they are also more willing to seek sustainable practices (Kangasniemi et al. 2014). Some employees may even have psychological issues like denial, ignorance, negative group thinking, and diffusion of responsibility towards environmental care. Psychological barriers can be managed with education for instance by spreading research on the subject. (Harris et al. 2009.)

Especially teaching hospitals have a good chance to educate their staff on environmental practices. Graduates spread the information as they move to other facilities and countries and eventually the benefits catch up with the society. Environmental education for all stakeholders has proven to be successful. Specific initiatives can be formed for current and future staff, students, patients, visitors, higher education partners, and local schools. (Ryan-Fogarty et al. 2016.) Good education of environmentally nursing involves identification of staff's environmental awareness first, and then teaching new information through diverse education like guidance, continuous training, self-study, information booklets, supervision, orientation, and annual updates (Kangasniemi et al. 2014). Nurses can themselves advocate that environmental education is offered for new employees and that everyone gets annual updates (Harris et al. 2009).

2.3 Guidance of Environmental Sustainability in Hospitals

2.3.1 Guidance on Global and National Level

From nation to nation health care is aiming to reduce its environmental impacts in diverse ways with different policies and resources guiding the process (Ryan-Fogarty et al. 2016).

Global sustainable guidance comes mainly from governments, corporations and non-governmental organisations. However, internet enables global movement from below as sustainable values send by active individuals spread quickly and forces even large organisations to open their structures and processes. (Benn & Dunphy 2007, 10.) Guidance for environmental sustainability in hospital comes for example from global organisations such as World Health Organization (WHO), HCWH and United Nations.

WHO is guiding health systems on a regional and national level. Environmental sustainability is guided with policy documents and policies like Health 2020 policy framework which gives policy-makers priorities and tools to improve the overall health of WHO's European region's 53 Member States (WHO 2013). Furthermore, WHO has also more detailed priorities such as to minimise negative impacts of chemicals and has implemented advanced policies and legislation to achieve environmentally sustainable management of chemicals (WHO 2016). United Nations has brought countries together in 2015 by launching Sustainable Development Goals. The agenda's aim is to end poverty, protect the planet, and ensure prosperity for all. The goals are meant to be achieved by 2030. Part of the goals aims directly to improve environment's current state by highlighting the importance of clean water and sanitation, affordable and clean energy, sustainable cities and communities, and responsible consumption and production. (United Nations 2017.) HCWH on the other hand, have composed guidelines for hospitals on how to protect the environment. HCWH's aim is to reduce health care's environmental impact by focusing on sustainable production, operations and use of buildings, chemicals, energy, food, pharmaceuticals, transportation, waste, and water. The organisation works worldwide, and the European department provides European policy makers guidance documents, briefings and best practices from leaders in sustainable health care. (HCWH 2018a.)

In Europe, European Union (EU) guides its members towards more sustainable Europe. EU has high environmental standards and it is pursuing to keep air, oceans, and other water resources clean to ensure that land and ecosystems are used sustainably. (EU 2018a.) EU's 7th Environment Action Programme is focusing to better implementation of legislation, better information by improving knowledge, better investment for environment and climate policy and lastly, full integration of environmental requirements and considerations into other policies (EU 2016).

National and local practices are mostly guided by national regulations (Kangasniemi et al. 2014, Ryan-Fogarty et al. 2016). It is paramount that state governments guide and support environmentally sustainable health care for example with clear, regulatory frameworks, low interest financing, tax incentives or providing funding for innovation (WHO 2017). According to Valentine (2012) environmental management is still in a state of infancy in many places. National leaders are in a key role in creating a sustainable society by having the potency to limit for example the consumption of natural resources (Valentine 2012).

2.3.2 Guiding Programs and Documents on Environmental Sustainability in Organisations

There are various environmental programs done with variable purposes. The aim of an environmental program is to define the framework on how the organisation is going to protect the environment. However, profitability is also important for organisations and in many cases successful environmental management has led to financial benefits. (Valentine 2012, Health Research & Educational Trust 2014.) Guiding programs and documents help organisations to meet their goals and in addition, makes it easier for people to find specific information (Carliner et al. 2006, 1-2). Successful guiding programs are based on research and they are monitored and evaluated regularly. Furthermore, they have a policy and regulation system, enough resources, clear guidelines, and training for employees. (Feeney 2013, Frieden 2014.) Promoting own sustainability is important for organisations also in terms of responsibility. People are increasingly aware of the climate change and demand responsible actions from service providers. (Benn & Dunphy 2007, 10-18.) Environmental programs need to be connected to operations and values of the organisation (Mårtensson & Westerberg 2016) and have strong leadership to be successful (Ryan-Fogarty et al. 2016). Organisations can introduce powerful sustainability through six steps; making the commitment (1), creating a supportive culture for environmental sustainability (2), supporting and financing environmental sustainability (3), setting goals and measurement, reporting and evaluating change (4), celebrating and sharing success (5) and continuing to assess and identify new opportunities (6). However, each hospital needs to think the best way for them and their goals to pursue environmental sustainability (Health Research & Educational Trust 2014).

2.4 Summary of the Literature

In order to successfully implement environmental sustainability in a hospital, the hospital system needs to be dynamic and flexible and not have too many policies that hinder new

practices. The role of the leadership is significant as sustainability needs to be introduced in all levels of the hospital. There are several possible sustainability targets for hospitals to evaluate and improve practices such as waste prevention and recycling, reducing water and energy use and focusing on safe and smart use of toxic chemicals and pharmaceuticals. Health care professionals use a lot of resources and can have a meaningful impact to hospital sustainability. Nevertheless, these professionals have too little environmental training. With right education health care professionals can be competent in environmental issues and moreover, provide information to others like patients and relatives. Guidance on environmental sustainability on a global level is mainly delivered by governments, corporations, and non-governmental organisations. National regulations guide national and local practices. Environmental programs' priority is to protect the environment and programs have shown to have beneficial environmental benefits and furthermore, economical benefits for the hospitals. However, there is no scientific evidence what kind of environmental programs for hospitals exists and what an environmental program should contain. This study's aim is to provide international perspective on the contents of European hospitals' environmental documents. The ultimate aim is to offer a guideline for making and evaluating an environmental program of a hospital.

3 AIM OF THE STUDY AND RESEARCH QUESTIONS

The aim of this study is to provide international perspective on the contents of European hospitals' environmental documents. The ultimate aim is to offer a guideline for making and evaluating an environmental program of a hospital.

The research questions are:

1. What are the environmental sustainability targets in environmental documents?
2. What are the different stakeholders and their roles in environmental documents?
3. What are the means of establishing an environmentally sustainable hospital system?

4 DATA AND METHODS

4.1 Document Analysis

Documents can contain relevant information and help to explain unknown settings (Miller & Alvarado 2005, Rapley 2007, 10-14, Prior 2010, 417, 432). As there is limited research knowledge regarding hospital environmental documents, a qualitative document analysis was chosen as a research method. This study followed the phases of a document analysis after Bowen (2009); searching (1), selecting (2), appraising (3), and analyzing the data of documents (4). The documents were appraised carefully as they were not originally meant for research purposes (Bowen 2009) and in addition, their source was estimated; where, when, and by whom the documents were created (Miller & Alvarado 2005). As documents are open to manipulation or can be banned, censored or forged, the originals were saved throughout the research process (Prior 2008, 230).

4.2 Data Collection and Selection

The data collection in this study focused on internet sources as environmental documents are often public documents published on the internet. The data was collected using the Google search engine (Phase 1). This study used purposeful sampling strategy and selected information rich sources that reflected the aims of the study till saturation (Phase 2) (Miller & Alvarado 2005). The inclusion criteria for the documents were English language, documents were valid and in use (by date) or they had ended at most three years ago, and the documents described environmental sustainability in European hospitals (Phase 3).

As the Internet is a wide source of data and Google's search tools differ from scientific databases, the search process was approached from the start as emergent, not precise, and the search terms and limitations were kept open for modification during the search phase. Different limitations were tried to make the quantity of the results reasonable (May 2011, Gray et al. 2012, 106). Because it is not possible to combine numerous lines of search groups to Google, this study used multiple searches with different combinations of the search words and limitations (Table 1).

Table 1. Search words, hits and limitations in Google searches.

| Search Words | Hits | Limitations to Searches |
|---|-------------|---|
| <i>hospital environmental program</i> | 89 | |
| <i>hospital environmental framework</i> | 5 | |
| <i>hospital environmental guideline</i> | 26 | |
| <i>hospital environmental guidelines</i> | 28 | |
| <i>hospital environmental model</i> | 62 | |
| <i>hospital environmental document</i> | 9 | |
| <i>hospital environmental manual</i> | 74 | <i>Search words need to be found on title & results in English language</i> |
| <i>hospital sustainability program</i> | 79 | |
| <i>hospital sustainability framework</i> | 1 | |
| <i>hospital sustainability guideline</i> | 0 | |
| <i>hospital sustainability guidelines</i> | 2 | |
| <i>hospital sustainability model</i> | 8 | |
| <i>hospital sustainability document</i> | 5 | |
| <i>hospital sustainability manual</i> | 0 | |
| <i>hospital environmental program</i> | 307 000 000 | <i>Search words need to be found on text and results in English language</i> |
| <i>hospital Europe program</i> | 112 000 000 | |
| <i>environmental care in European hospitals</i> | 139 000 000 | |
| <i>hospital environmental program</i> | 2 320 000 | <i>No limitations to the searches</i> |
| <i>hospital environmental program AND Europe</i> | 2 470 000 | |
| <i>sustainable hospitals in Europe</i> | 3 100 000 | |
| <i>Documents selected through Google searches:4</i> | | |
| <i>Documents selected through Snowball sampling:6</i> | | |
| <i>Total number of documents: 10</i> | | |

The search results were organised by relevance and all pages useful to research were viewed. The time frame was set to give hits that are published at most ten years ago to help narrow down the search results. When it seemed that relevant documents were no longer found from a certain search, browsing was terminated. The search was not systematic and used in addition Snowball sampling when useful web pages or documents were found from original search. The search was originally planned to carry out with Google search engine's advanced search and limit the search words in titles. This narrowed down the search results too much and documents were not found. After the search was expanded to cover all areas of web pages, documents started to come across.

As the searches were done on the Internet, the nature of the documents that could be found was unclear and therefore the inclusion criteria developed along with the research process. At first it was supposed to include documents that are valid at the time being and are in use. When the data collection started, the inclusion criteria was changed to that either the documents are valid or that they have ended at most three years ago. The change was made because the search brought up programs that had ended last year and they would have been rejected even though they contained suitable information and could be consid-

ered current. The research data consists of documents guiding environmental sustainability in European hospitals. A total of ten documents were chosen from the Google search and with the help of Snowball sampling. Nine of the selected documents fitted the inclusion criteria and were valid or ended within three years. One document was published in 2011 but was selected because it offered central and valuable information.

4.3 Selected Data

The selected data consisted of documents from eight different organisations (Table 2). The links to the documents can be found from references under the name of the organization. Two of the documents were in two parts and the rest consisted of one document. The purposes between of the documents were different as six of the documents were environmental programs/strategies (Sweden, Sussex/UK, Hertfordshire/UK, Yorkshire/UK, Newcastle/UK & Ireland), three were guiding documents for environmental practices (HCWH (2pcs.) & Ireland), and one was a report of what have been done (Iceland). All offered information in the line of the study's research questions. The documents from Sweden, Iceland and Ireland addressed factors of individual hospitals. One of the organizations was HCWH, working at a global and European level and four of the organizations were a part of National Health Service trust (NHS), which offers health services in the UK. All the documents addressed environmental factors but in different manners. Some of the documents were made only for the environmental purposes, while others were closely connected to health promotion. Most of the organisations structured the documents according to the environmental targets, but the documents from the NHS were built around the aim of how to reduce carbon. Still, documents followed the structure of presenting an aim and establishing methods on how a hospital can achieve it. The extent of the documents varied between 8 and 44 pages. Total number of pages analysed was 202.

Table 2. Background Information of the Documents.

| Background Information | Karolinska University Hospital | Health Care Without Harm | Sussex Community NHS Foundation Trust | East and North Hertfordshire NHS Trust | Hull and East Yorkshire Hospitals NHS Trust | The Newcastle upon Tyne Hospitals NHS Foundation Trust | The National University Hospital of Iceland | Cork University Hospital |
|--|--|--|---------------------------------------|--|---|--|---|---|
| <i>Country and Number of Documents</i> | Sweden 1 | Global /Europe 2 | UK 1 | UK 1 | UK 1 | UK 1 | Iceland 1 | Ireland 2 |
| <i>Names of the Documents</i> | Environmental and Sustainability Program | A Comprehensive Environmental Health Agenda for Hospitals and Health Systems Around the World & Energy Efficiency in the Healthcare Sector | Care Without Carbon | Sustainability Strategy | Sustainable Healthcare Strategy | Sustainable Healthcare Strategy | Environmental Management at Landspítali University Hospital | Sustainable Healthcare Change Programme & Green Charter |
| <i>Publication Year or Validity Period</i> | 2012–2016 | 2011 & 2017 | 2014–2020 | 2015–2020 | 2017 | 2016–2020 | 2012–2017 | 2016–2017 & 2014 |
| <i>Number of Pages</i> | 17 | 44 & 8 | 32 | 15 | 24 | 12 | 10 | 20 & 20 |
| <i>References Listed</i> | X | X & X | – | – | – | – | – | – & – |
| <i>Abbreviation Used in This Study</i> | Sweden | HCWH | Sussex/UK | Hertfordshire/UK | Yorkshire/UK | Newcastle/UK | Iceland | Ireland |

4.4 Data Analysis

The data analysis phase combined elements of thematic analysis and content analysis (Phase 4). The deductive analysis used an observation matrix (Appendix 4) in the analysis process. The matrix was formed based on the literature review by raising relevant themes of the phenomena to the matrix. With the help of the matrix, the relevant data was collected from the documents and pre-organised into the matrix. (Vaismoradi et al. 2013.) The tentative observation matrix was modified and developed further as the cumulative information simultaneously increased from the literature review and from the documents (Polit & Beck 2014, 300-302).

The analysis process was done after Elo and Kyngäs (2008) and contained three phases; preparation, organising and reporting. The preparation started with skimming and reading through the material multiple times to get a wholesome sense of the data. Next, the data relevant to research questions was selected and placed into the observation matrix. In the organisation phase the sentences in the matrix were further categorised and subcategories were generated to present the research topic. The reporting phase is written open in this paragraph and the results of the analysing process is written in the results part. (Elo & Kyngäs 2008.) The thematic and content analysis are similar to some extent. The selection and categorisation of the data follow both analysing models. However, as the data was collected into the matrix, it could also be counted, and this was used in results to highlight data differences and similarities and is more related to content analysis model. (Vaismoradi et al. 2013.)

5 RESULTS

5.1 The Environmental Sustainability Targets

The environmental targets analysed in this study are presented in Table 3 by each organisation and how they were addressed. All the organisations (n=8) addressed the targets of waste and energy. Seven of the organizations addressed the targets of water and material issues and six organisations the target of travel and transportation. Chemicals and pharmaceuticals were addressed the least; four of the organisations addressed chemicals and three pharmaceuticals. Health Care Without Harm addressed all the eight environmental targets when The Newcastle upon Tyne Hospitals NHS Foundation Trust addressed the targets the least, with a total of four targets.

Table 3. Environmental Targets by Each Organisation.

| Environmental Targets | Karolinska University Hospital | Health Care Without Harm | Sussex Community NHS Foundation Trust | East and North Hertfordshire NHS Trust | Hull and East Yorkshire Hospitals NHS Trust | The Newcastle upon Tyne Hospitals NHS Foundation Trust | The National University Hospital of Iceland | Cork University Hospital |
|--|---------------------------------------|---------------------------------|--|---|--|---|--|---------------------------------|
| <i>Sustainable Material Choices and Purchasing</i> | X | X | X | X | X | – | X | X |
| <i>Sustainable Waste Management</i> | X | X | X | X | X | X | X | X |
| <i>Optimising Energy Use</i> | X | X | X | X | X | X | X | X |
| <i>Optimising Water Use</i> | X | X | X | X | X | X | – | X |
| <i>Minimising the Use of Toxic Chemicals</i> | X | X | X | – | – | – | X | – |
| <i>Smart Use of Pharmaceuticals</i> | X | X | – | X | – | – | – | – |
| <i>Sustainable Hospital Food and Food Services</i> | – | X | – | X | X | X | X | X |
| <i>Sustainable Travel and Transportation</i> | – | X | X | X | X | – | X | X |

5.1.1 Sustainable Material Choices and Procurement

In the documents the sustainable material choices and purchasing focused on reviewing current purchasing practices and products, and furthermore, including environmental sustainability into planning.

The documents guided hospitals into reducing the demand of resources and increasing the efficiency (Yorkshire/UK) for example by managing procurement locally and by improving stock management (Hertfordshire/UK, Yorkshire/UK). According to the documents, hospitals need to review their procurement practices and establish a purchasing agenda that considers the products' environmental impact from production to ultimate disposal (HCWH, Hertfordshire/UK, Sweden, Yorkshire/UK). Furthermore, specific and measurable sustainability criteria were developed into tendering process and contracts (Iceland, Sweden, Sussex/UK, Yorkshire/UK). Sustainable products were actively researched, and the development of sustainability certification schemes was enhanced to broaden the range of sustainable products (Sussex/UK). Disposable products were replaced with reusable ones when possible (HCWH, Iceland) in addition to preferring products that generate less waste, last longer, and use less raw materials and packaging (HCWH).

5.1.2 Sustainable Waste Management

In the documents sustainable waste management focused on waste prevention and reduction, recycling and waste treatment.

Waste Prevention and Reduction. Waste prevention and reduction focused on policies and processes aiming to change practices in the hospital. The documents saw the procurement department as an important player in the pursuit of successful waste management in hospitals (Sweden). Procurement policies and tendering processes were important tools for improvement (Hertfordshire/UK, Sussex/UK). Waste was reduced with various actions such as promoting collaboration with major supply chain partners (Sussex/UK), avoiding toxic materials (HCWH), minimising the use of disposable items (Sweden) and encompassing waste prevention into pharmaceutical orders (HCWH, Sweden) for example by favoring oral treatment over injections (hazardous waste) when possible (HCWH).

There were also possibilities mentioned outside the actual patient care such as promoting paper-light and paperless IT solutions to reduce paper consumption in all departments (Hertfordshire/UK). Furthermore, the consumption of plastic bottles was reduced by offering filtered water in the canteen (Ireland) and limiting the purchase and sale of bottled water (HCWH).

Recycling. Recycling focused on sorting, segregating, and auditing waste. According to the documents, it is important to sort waste carefully at its source (HCWH, York-

shire/UK). Minimum level of recycling was to recycle non-hazardous waste (HCWH). However, it was highlighted that the organisations can benefit from high levels of recycling (Yorkshire/UK). One part of successful recycling was labeling and guidance. The documents guided to sign garbage bins clearly and to follow the instructions and segregation guidelines carefully. (Ireland.) Hospitals had an advanced opportunity to recycle food waste (Ireland, Hertfordshire/UK, Iceland), office supplies (ink cartridges and postage stamps), and electronics (mobile phones, batteries, florescent tubes) (Ireland). In addition, plastic, paper, textiles, cardboard, glass, old furniture, aluminum cans as well as paper and plastic cups were recycled (Ireland). The waste diverted from landfill was used for energy generation, recycling or reusing (Newcastle/UK). Residual waste was turned into resource opportunity (Sussex/UK) by composting food waste and using cooking oil in fuel production (Iceland).

Waste Treatment. Waste treatment focused on innovative practices and cooperation with different stakeholders. Documents highlighted the possibility to introduce new technology to treat waste without burning. On existing practices, it was seen useful to encourage authorities to establish secure landfills for non-recyclable waste (HCWH) but on the other hand, cooperation with waste contractors, suppliers and other stakeholders was seen as a possibility to achieve zero waste to landfills on all operations (Sussex/UK).

5.1.3 Optimising Energy Use

In the documents optimising energy use focused on the use of sustainable energy sources and reducing energy use.

Sustainable Energy Sources. Sustainable energy sources focused on the energy sources and locations where the energy was generated. The documents favoured renewable energy sources (Sweden) or focused to use nothing but renewable energy sources (HCWH, Sussex/UK). All new buildings were encouraged to have clean and renewable energy (Iceland). It was considered vital that the financing mechanisms support the shift to renewable energy (HCWH). In addition to choosing the source of energy, the location where the energy was generated was evaluated. Documents suggested generating energy on site (HCWH, Newcastle/UK) or using community energy sources (HCWH).

Reducing Energy Use. Reducing energy use focused on energy efficiency in technology and human practices. Pursuing greater energy efficiency was seen central (Sussex/UK,

Sweden). The use of energy was guided by developing policies and processes that target reduction in energy use for example by implementing energy conservation and efficiency programs for existing and new buildings, improving the energy efficiency of old houses by shifting to cleaner boiler fuels (HCWH), and by installing low energy equipment (Yorkshire/UK). In addition, energy usage was adjusted according to need (Hertfordshire/UK).

Temperature, heating and air-conditioning was in close connection to energy reduction. Heat loss was reduced by improving thermal insulation (Yorkshire/UK). Turning thermostats down a few degrees in winter or cool climates and up in summer or warm climates helped to control the energy consumption (HCWH). The recommended temperature for heating was 20 degrees and for air-conditioning 19-21 degrees (Ireland). Heating was controlled by closing doors and windows (HCWH). Energy use was furthermore reduced by turning off unnecessary lights and utilising daylight instead of artificial light (HCWH) in addition to making lighting more efficient (Hertfordshire/UK) with date controls and new lighting equipment (Yorkshire/UK).

IT infrastructures' energy consumption was reduced with power management techniques (Sussex/UK). IT systems and hardware were changed to more energy efficient choices like cloud-based systems (Hertfordshire/UK). Furthermore, printing facilities were centralised in each area to reduce the number of printers needed and energy consumed (Yorkshire/UK).

5.1.4 Optimising Water Use

In the documents optimising water use focused on water conservation.

Water was conserved by metering water use and installing water-efficient technologies and techniques (HCWH, Sussex/UK, Yorkshire/UK) such as efficient faucets (HCWH, Hertfordshire/UK) and toilets (HCWH, Ireland). Constant improvement and exploring how to further reduce water use were considered (Hertfordshire/UK). Furthermore, making sure leaks were reported and repaired (HCWH, Yorkshire/UK, Ireland), eliminating seal and cooling water on medical air compression and vacuum pumps, and retrofitting refrigeration systems (HCWH) in addition to recycling waste water within the renal unit (Hertfordshire/UK) were beneficial actions. Moreover, switching from film-based radiological equipment to digital that doesn't require water was recommendable (HCWH).

5.1.5 Minimising the Use of Toxic Chemicals

In the documents minimising the use of toxic chemicals focused on planning and changing current procedures.

The documents guided hospitals to plan how they are going to handle and minimise the use of toxic chemicals (HCWH, Sweden). Hospitals were encouraged to consider the environment when planning the use of chemical products (Sweden). Organisational chemical guidelines were seen as a useful way to achieve individual goals (HCWH, Sweden) like substituting hazardous chemicals with safer options (Sweden). According to the documents, hospitals should aim to reduce the number of hazardous substances used (Sussex/UK). This was done by decreasing or eliminating the amount of PVC, phthalates (Iceland, Sweden), DEHP and latex in purchased goods (Iceland). Detergents can also contain environmentally toxic ingredients, hence; environmentally friendly options were chosen (Iceland).

5.1.6 Smart Use of Pharmaceuticals

In the documents the smart use of pharmaceuticals focused on reducing pharmaceuticals and safe disposal of pharmaceuticals.

Reducing Pharmaceuticals. Reducing pharmaceuticals focused on preventive actions and more efficient medicament management. Sustainable and centralised procurement and distribution that controls the quantities of medication given to patients was introduced (HCWH). The number of discarded drugs and environmentally hazardous pharmaceuticals were reduced and furthermore, the effect of pharmaceuticals to the environment was evaluated (Sweden). Pharmaceutical waste was limited by planning more efficient medicine management processes in the pharmacy and wards (Hertfordshire/UK), for instance, purchasing pre-filled antibiotic syringes to limit excess medication going to waste (Sweden). The documents aspired to eliminate all medical errors, which, among other things, can reduce the use of medication (Sweden).

Safe Disposal of Pharmaceuticals. Safe disposal of pharmaceuticals focused on improving practises and informing on safe disposal methods. Safe disposal of pharmaceuticals started by increasing the recycling of medicines in the hospital (Hertfordshire/UK) and informing safe disposal methods for unused and expired medication (HCWH). Hospitals ensured that

pharmaceutical waste was treated and disposed according to guidelines. Take-back contracts were established with the manufacturers, so hospitals were able to return excess pharmaceuticals. Furthermore, take-back programs were introduced to patients to make the return of unused medication easier. (HCWH.)

5.1.7 Sustainable Hospital Food and Food Services

In the documents the sustainable hospital food and food services focused on the selection of sustainable food and improving food services from purchasing to distribution.

According to the documents, it was recommendable for the hospitals to choose local, organic (HCWH, Iceland, Ireland, Newcastle/UK, Yorkshire/UK) and seasonal food (Newcastle/UK). Buying food from sustainable sources (Hertfordshire/UK) in addition to requesting food that was produced without synthetic pesticides, hormones or antibiotics given to animals without diagnosed disease (HCWH) was considered as important. In addition to food offered to patients, practices in the canteen were evaluated. Vegetarian food was offered more often. (Iceland.) The purchasing, distribution and storage of food was developed (Yorkshire/UK). The implementation of sustainable food procurement was done step-by-step, starting with small changes (HCWH). Life cycle cost analysis (Yorkshire/UK) and food miles (Hertfordshire/UK) were used as tools in food procurement decisions.

5.1.8 Sustainable Travel and Transportation

In the documents the sustainable travel and transportation focused on support and improvement practises in a hospital setting.

Hospital's climate footprint and pollution were reduced by developing transportation and service delivery strategies (HCWH). It was seen beneficial to measure how people travel to and from the hospital (Yorkshire/UK) and frequently look for more sustainable alternatives for car travel (Sussex/UK). Furthermore, strategies for telemedicine and communication by e-mail were developed (HCWH). The location of the hospital was considered important in the pursuit of less travel and transport (HCWH, Sussex/UK). Providing health care in locations that are accessible and don't require unnecessary travel (HCWH) and furthermore, optimising the size and layout of the hospital campus (Sussex/UK) were seen central.

5.2.1 Health Care Professionals

The documents chose different ways to refer to the environmental actors in the organisation; Sweden, Sussex/UK, Hull&East/UK and Newcastle/UK used the term "we".

HCWH, Hertfordshire/UK and Ireland used the term "staff", when Iceland referred to itself with a term "Landspítali". As this is a study focusing on a hospital setting, the term health care professionals is used in the results.

The documents focused to health care professionals' roles in sustainability closely connected to everyday working in the hospital. Health care professionals had a possibility to reduce waste in different ways daily. Food waste was reduced by ordering and giving only the amount of food the patient will eat. The use of disposable cups was reduced by encouraging staff to bring their own mug to work. The amount of paper waste was reduced by favoring printing in two-sided mode and handout form for PowerPoints along with reusing envelopes and using scrap paper instead of sticky notes. (Ireland.) In addition, waste was reduced by refilling print cartridges (Iceland) and printing in draft or greyscale print (Ireland).

Energy consumption was reduced by introducing TLC – Turn Off, Lights Out & Close the Doors (Ireland). Turning off and unplugging equipment when not being used each evening, weekends and before holidays (Ireland) in addition to utilising energy saving mode on all electronic devices was recommended (Hertfordshire/UK, Ireland). Encouraging employees to take the stairs and not the elevator was connected to energy saving practises (Ireland). To reduce water, health care professionals were encouraged to use only the amount of water needed and to not use toilet as a waste bin (Ireland). Furthermore, pharmaceuticals were reduced by addressing in-patient dosage and using automated medication dispensers (Sweden) in addition to prescribing small quantities of new medication (HCWH) and avoiding unnecessary prescriptions (Sweden). Free samples of medication were not given to patients as they often become unused and thus create waste (HCWH).

5.2.2 Governing Body

Governing body included leaders', administration's and other responsible roles inside a hospital and focused on establishing enough resources, monitoring the progress, and imbedding environmental sustainability into the whole organisation.

Implementing an environmental program was the responsibility of divisions, departments

and central staff. Divisions and central staff made sure there are enough resources for environmental work and included environmental goal to organisational planning and control systems. (Sweden.) Sustainability was made a key organisational priority with education, goal setting, accountability, and by incorporating these matters in all external relations and communication. Sustainability goals were implemented to all departments and therefore leadership was needed on all levels. The organisational culture change was made possible by supporting the leadership. (HCWH.) Training senior leaders on sustainable development and making sure that senior leadership supported sustainable health care delivery was central (Sussex/UK). Furthermore, sustainability was added into all directors' job descriptions to attract working force with a right state of mind (Yorkshire/UK).

It was seen as important to have people supporting sustainability at board level (Newcastle/UK). Leadership competencies of environmental impacts were improved with an annual board leadership programme (Sussex/UK). Establishing a steering group with representatives from different disciplines (nursing, medicine, finance, maintenance and engineering, estates, biomedical engineering, and security) to advice and oversee the direction, coordination and implementation of sustainability strategies was recommendable (Ireland). Furthermore, sustainable development committee was used to make sure sustainability targets were supported and achieved, there were enough resources to achieve aims and goals, and that they were in line with national strategies and objectives (Hertfordshire/UK).

5.2.3 Other Stakeholders Inside a Hospital

Other stakeholders' roles inside a hospital were described with a few examples and through the roles of patients and relatives. The documents valued cooperation across borders (Sweden) and cooperation with the cleaning services provider was seen as a way to increase waste recycling (Hertfordshire/UK). Patients and relatives were included by giving them a chance to influence planning by consulting their expectations and opinions on successful sustainability and by educating them on environmental sustainability (Hertfordshire/UK). Patients were involved in wards by encouraging them to take maximum 3-minute showers (Ireland). Furthermore, patients and relatives were included by arranging sustainability awareness events for patients and visitors annually (Newcastle/UK).

5.2.4 Stakeholders Outside a Hospital

In the documents the stakeholders outside a hospital focused mostly on suppliers and community but this section goes through all the stakeholders mentioned. With its' position and buying power, a hospital can influence the public, partners, and suppliers to act more sustainably (Sussex/UK). The documents guided hospitals to establish dialogues with interested parties on sustainability initiatives (Hertfordshire/UK, Sweden). The dialogue between stakeholders was supported already in the environmental strategy (Sussex/UK) and stakeholders were given a chance to influence on the hospital environmental and sustainability activities (Sweden) and goals (Yorkshire/UK).

Suppliers. The documents guided hospitals to focus purchasing power to environmentally responsible products and favour manufacturers and suppliers that are innovative and can expand the availability of sustainable products on the market (HCWH). Cooperation with the supply chain partners was a way to encourage partners to offer more sustainable products and services (Iceland, Sussex/UK). Suppliers and contracts were managed by using a clear sustainability criterion (Sussex/UK), for instance, requiring that all major procurement contracts pursue to reduce waste (Hertfordshire/UK), by favouring local and sustainable vendors (HCWH, Ireland, Yorkshire/UK), and by purchasing products from suppliers that can present chemical ingredients and safety testing data (HCWH). Furthermore, suppliers were requested to consider environmental management and disclose their carbon emissions (Yorkshire/UK). Hospital sustainable procurement policy was promoted to all potential suppliers (Sussex/UK).

Community. Cooperation with the community and advocating sustainability was beneficial in order to reach organisational goals and establish further possibilities (HCWH, Hertfordshire/UK, Sussex/UK). This was done by improving and protecting water supplies (HCWH) and furthermore by working together with waste contractors, public transport (Sussex/UK), energy partners (Hertfordshire/UK), property owners, and operational entrepreneurs (Sweden). Local and sustainable food was promoted in the hospital by holding a farmers' market for the community and by having community gardens on hospital grounds (HCWH).

Other Stakeholders. Cooperation with other hospitals was considered as valuable in the documents (Iceland, Sussex/UK, Sweden). Hospitals offered support to other hospitals in the implementation of sustainability strategies and initiatives (Sussex/UK). Furthermore,

hospitals valued others' input and asked for help when needed (Sweden). Cooperation with other hospitals regarded as a possibility to increase buying power for sustainable purchasing (HCWH). Collaboration with companies (Iceland) and finance agencies (HCWH) to forward the development of sustainable health care was promoted. Furthermore, having a representative in national sustainability meetings, seminars, conferences (Newcastle/UK), and campaigns (Sussex/UK) was a way to spread awareness. International cooperation with different stakeholders was also seen as beneficial (Iceland).

5.3 The Means of Establishing an Environmentally Sustainable Hospital System

This section goes through the means addressed in documents on how to establish an environmentally sustainable hospital. Table 5. presents how the means were addressed by each organisation.

Table 5. The Means of Establishing an Environmentally Sustainable hospital by Each Organisation.

| <i>Means</i> | <i>Karolinska University Hospital</i> | <i>Health Care Without Harm</i> | <i>Sussex Community NHS Foundation Trust</i> | <i>East and North Hertfordshire NHS Trust</i> | <i>Hull and East Yorkshire Hospitals NHS Trust</i> | <i>The Newcastle upon Tyne Hospitals NHS Foundation Trust</i> | <i>The National University Hospital of Iceland</i> | <i>Cork University Hospital</i> |
|--|---------------------------------------|---------------------------------|--|---|--|---|--|---------------------------------|
| <i>Planning and Integration</i> | X | – | X | X | X | X | – | X |
| <i>Acquiring and Retaining High-Value Employees*</i> | – | – | X | X | X | X | – | – |
| <i>Raising Awareness*</i> | X | – | X | X | – | – | X | X |
| <i>Environmental Education*</i> | X | X | X | X | X | X | – | X |
| <i>Evaluation</i> | X | – | X | X | X | X | X | X |
| <i>Reportage</i> | – | – | X | X | – | X | X | – |
| <i>Follow-Up</i> | – | – | X | X | – | – | – | X |
| <i>Innovation and Research</i> | – | X | X | – | – | – | – | – |

(*Belongs to the mean of human capital)

5.3.1 Planning and Integration

The planning and integration focused on making the environmental sustainability an organisational priority in addition to defining aims and values and improving cost-efficiency.

The environmental planning started from the organisational level (Sweden), by including sustainability into wider strategic and operational system and making sure clinical strategies and procurement were aligned with sustainable principles (Newcastle/UK, Sus-

sex/UK). Furthermore, it was checked that the environmental program didn't conflict with other strategies (Sussex/UK, Sweden) or the vision, mission or values of the hospital (Sweden). It was seen important that hospitals prioritised sustainability and made it a part of all planning and construction phases of development (Yorkshire/UK), business plans, and major projects (Newcastle/UK). It was seen as a core value to establish who is coordinating the environmental program (Sweden) and involve staff into the planning phase (Sussex/UK). Moreover, highlighting the commitment of the environmental program with a fitting, environmental or goal-orientated name, was encouraged (Sussex/UK).

The focus of environmental programs was on long-term improvements such as reduced environmental impact and value for money (Hertfordshire/UK). Value and goal setting focused on setting clear values and goals for the environmental program. For instance, improving resource efficiency (Sussex/UK, Sweden), maximising productivity, enhancing care quality (Sussex/UK), making the environment healthier or aiming that every opportunity contributes to healthy environments (Hertfordshire/UK). Furthermore, hospitals established themselves as an environmental role model and supporter in the community (Hertfordshire/UK). Setting targets with a certain timeline and per cent for different areas such as reducing energy (HCWH, Ireland, Sweden), water (Ireland), waste (Ireland, Sweden), toxic chemicals (Sweden), single-use products (Sweden), the use of non-renewable resources (Sussex/UK), greenhouse gases (Hertfordshire/UK, Newcastle/UK, Sussex/UK, Sweden, Yorkshire/UK), and travel (Ireland) was used. It was also possible to target national or international environmental certifications to further support sustainable way of working (Sussex/UK).

Improving cost-efficiency was seen possible when environmental sustainability was considered in the budget and in long-term plans (Sweden). The documents had finance and sustainability team working together on environmental impacts and financial data. The results were presented to service managers. (Sussex/UK.) Costs were reduced by limiting the demand of resources and by increasing efficient resource use (Yorkshire/UK). Hospitals established a budget for different areas such as for waste management (HCWH). Furthermore, exploring sources for external funding was advisable (Hertfordshire/UK).

5.3.2 Human Capital

Human capital includes acquiring and retaining high-value employees, raising awareness, and environmental education.

Acquiring and Retaining High-Value Employees. It was seen beneficial in the documents to hire people with an environmentally positive mind and furthermore retaining these high-value employees. There were many means of taking sustainability into account in human resources. First, the documents guided hospitals to add sustainability into human resource policies (Newcastle/UK, Yorkshire/UK) and practices (Yorkshire/UK). This was done by adding sustainability in job descriptions to highlight sustainable way of working (Yorkshire/UK) and retaining high calibre staff who are carrying out the hospital's values (Hertfordshire/UK). It was valuable to ensure that staff development processes entailed the shift to more sustainable way of working (Sussex/UK). To secure the workforce also in the future, hospitals encouraged young people to familiarise themselves into hospital work through internships (Hertfordshire/UK).

Raising Awareness. In order to achieve environmental sustainability, the staff needs to be aware of environmental factors related to their work. According to the documents, hospitals should establish a culture where staff knows the link between health care and sustainability and furthermore, a culture where sustainability actions are instinctive (Sweden). Consulting staff when making environmental priorities and plans, finding out what their view on sustainability is and how they would reduce waste and act more sustainably was seen as beneficial (Hertfordshire/UK). Encouraging clinical staff to include sustainability in their everyday job (Hertfordshire/UK, Sussex/UK), raising the awareness of the staff by launching a staff engagement campaign (Sussex/UK), and organising educational activities and awareness events of sustainability goals regularly was seen useful (Sweden). Raising awareness at wards was done by utilising sub-metering to target energy consumption at ward and department level and the results were used to raise the awareness of employees (HCWH, Hertfordshire/UK) and improve the use of energy (Hertfordshire/UK, Yorkshire/UK). One possibility to promote sustainability initiatives and keep staff informed on environmental issues was establishing an environmental advocate for each ward and/or department (Ireland). In addition, staff was engaged through a new hospital website (Sussex/UK) and Facebook groups (Iceland). Encouraging grass-roots action and awarding those who embrace sustainability was a manner of supporting innovation in sustainable health care delivery (Sussex/UK).

Environmental education focused on the planning of environmental education and education subjects. Providing information on sustainability to staff was important (Ireland) and according to the documents, all employees in all roles need to be aware of the hospital en-

vironmental program (HCWH, Sweden) and how to produce sustainable care (HCWH, Yorkshire/UK). Documents guided hospitals to review the existing training program first, and then introduce sustainability in aspects needed (Sussex/UK). The sustainable education was adapted into everyone's role in the hospital (Sussex/UK) and also students were involved in the environmental training (Ireland). The pursuit of behavioural change was used in the documents (Hertfordshire/UK) in addition to raising awareness on sustainable issues and what could be done (Ireland, Hertfordshire/UK, Newcastle/UK). Education on recycling (Yorkshire/UK) and how to minimize energy and water use (Yorkshire/UK), travel (Sussex/UK, Yorkshire/UK), and printing (Sussex/UK) were used. Professionals who prescribe pharmaceuticals were a priority when implementing an environmental program (HCWH, Sweden). The documents encouraged working together with the clinical staff to reduce unnecessary prescribing and dispensing of medicines (Hertfordshire/UK).

5.3.3 Evaluation, Reportage and Follow-Up

Evaluation. Evaluation of the environmental programs focused on regular reviewing and improving. Reviewing and upgrading the existing infrastructure regularly (Yorkshire/UK), making an analysis of strengths and weaknesses in the sustainability context (Sweden), and reviewing environmental progress to identify targets for improvement (Ireland) were useful practices in the documents. Documents guided to validate environmental performance each year with a third-party validation (Sussex/UK) and benchmark work against other hospitals' sustainability indicators (Hertfordshire/UK, Sussex/UK). The documents guided hospitals to make sure they met current guidance and legislation (Yorkshire/UK). Having an annual staff (Ireland, Newcastle/UK, Sussex/UK) and public opinion survey (Hertfordshire/UK) to improve engagement and benefit from the results in planning for the future was supported (Hertfordshire/UK, Sussex/UK). The targets of the documents were evaluated in various ways. Energy consumption was audited regularly, and the results were utilised to update the environmental programs (HCWH, Ireland). Water consumption measurement was seen as central (HCWH, Ireland, Newcastle/UK, Yorkshire/UK) and furthermore the hospital water quality was analysed regularly (HCWH). Auditing waste included auditing waste streams (Newcastle/UK, Yorkshire/UK), high temperature disposal, heat treatment, landfill, and energy recovery. In addition to targets, carbon emissions, gas, oil, and costs were evaluated. (Newcastle/UK.)

Reportage. The reportage of the environmental programs focused on reports to different stakeholders. The documents guided hospitals to publish the environmental program and annual sustainability reports on progress (Hertfordshire/UK, Newcastle/UK, Sussex/UK) in addition to reporting performance reports to board biannually (Sussex/UK). Environmental activities were regularly published to the public (Iceland) and experiences were shared with other health care providers (Sussex/UK). The documents suggested to benefit from social media when publishing improvements and plans (Hertfordshire/UK).

Follow-Up. The documents advised hospitals to set out new objectives each year and ensure responsibilities to meet them (Hertfordshire/UK).

5.3.4 Innovation and Research

Innovation and research focused on continuity. Hospitals did continuous research on different areas to improve their work (Sussex/UK) and to remove barriers for innovation (HCWH), for example researching new means how to eliminate greenhouse gas emissions and achieve net zero CO₂ emissions (Sussex/UK).

5.4 Summary of the Results

The results divided into three main categories; the environmental sustainability targets, the stakeholders and their roles and the means of establishing an environmentally sustainable hospital system. The environmental targets (procurement, waste, energy, water, chemicals, pharmaceuticals, food, travel and transportation) highlighted the many ways hospitals could work more efficiently, reduce consumption, and change old practices into more sustainable ones. The stakeholders of the documents addressed the roles and responsibilities of different parties inside and outside a hospital from professionals to patients and relatives. The means of establishing an environmentally sustainable hospital system shed light on the most efficient way of making environmental sustainability a whole system approach by incorporating it to all practices from hospital planning and integration, to human resources and environmental education as well as evaluation practices. Furthermore, innovation and research were important factors to improve practices.

6 DISCUSSION

6.1 Review of the Results

This study showed that hospital environmental documents have valuable information on hospital environmental sustainability and environmental programs in hospitals are very much needed but they require intelligent planning and implementing. The study organisations addressed environmental sustainability with different focuses regarding environmental sustainability targets, stakeholders and hospital means needed. The clear content differences can be seen in tables three, four and five which showed how targets, stakeholders and means were addressed by each organisation. There were differences on how comprehensively environmental sustainability content areas were addressed which indicates the fact that there isn't a clear way on how environmental documents should be pieced together. Next, the three sections of results; the environmental sustainability targets, the stakeholders and their roles and the means of establishing an environmentally sustainable hospital system are discussed closer.

Environmental sustainability targets. From the eight environmental targets of the literature review, the smart use of pharmaceuticals and minimising chemicals were addressed the least even though pharmaceuticals and chemicals are impacting to the wellbeing of the environment (Becker et al. 2010, Huffling & Schenk 2014) which highlights the need for guidance of safe use of these substances. There were inconsistency in previous research with the use of chemicals; Huffling and Schenk (2014) argues that plain soap and water are enough to reduce bacterial counts on hands when McGain and Naylor (2014) suggest replacing water use with other disinfectants to save water. It is necessary to understand how important a role the environment has in antibiotic resistance and what negative outcomes antimicrobials have when released into the environment (Singer et al. 2016). Antibiotic resistance and the use of medicaments can be reduced by the actions of the health care professionals and should be guided in order to be remembered and efficient. For example, doctors can have an impact on the amount of antibiotics and other medications by always prescribing considerately and trying non-medical options first. This requires doctors to keep themselves up to date also other than medical therapies and consider the environment when making care decisions. (HCWH 2015.)

Waste prevention and reduction was enhanced in the documents through policy and process changes, for instance, procurement policies were updated. Previous research high-

lights the change back to reusable products which would reduce the waste amounts in hospitals (Conrardy et al. 2010, Conrardy 2012, McGain et al. 2012, Overcash 2012, Huffling & Schenk 2014, Unger et al. 2017, Kallio et al. 2018). Minimising the use of disposable items was a goal for one study organisation but it seems that the new revolution that the previous research is waiting for is still to come. The literature review offered many possibilities for sustainable material choices and purchasing. The documents mentioned to establish a purchasing agenda that considers the products' environmental impact from production to disposal which is backed up in previous research. However, this could have been written open with criteria set for products for example in the form of life cycle assessment. (Conrardy 2012, McGain et al. 2012, McGain & Naylor 2014.) As mentioned in the literature review, the use of plastic has increased rapidly from the 1960's (Unger et al. 2017) and even though the reusables produce less waste (McGain et al. 2012), are more affordable (Conrardy 2012, McGain et al. 2017), and the safety of reusables has been showed to be as good as single-use products' (Kangasniemi et al. 2014), single-use products are still mainstream. Single-use products are the familiar products for most health care professionals and changing the course will need a change in the minds of the governing body and the health care professionals which requires more awareness of environmental sustainability.

The results of this study offered different possibilities on waste treatment. HCWH saw it useful to encourage authorities to establish secure landfills for non-recyclable waste, when Sussex/UK saw that cooperation with waste contractors, suppliers and other stakeholders was a possibility to achieve zero waste to landfills on all operations. Previous research highlights thorough segregation and recycling (Huffling & Schenk 2014, Kangasniemi et al. 2014, Thakur & Ramesh 2015). In 2010 the total waste production in the EU was 2.5 billion tons. Only 36% was recycled and the rest was either landfilled or burned, even though around 600 million tons could be recycled or used again. European legislation guides waste management and it is based on the waste hierarchy which means managing waste in the following order; prevention, reuse, recycling, recovery and the last option, disposal. EU promotes recycling but doesn't clearly state which the recommendable option is; incineration or landfilling. (EU 2018b.) Documents used in this study were built around aims and targets. It might be most beneficial to set a target from day one to segregate all waste and recycle everything, in case possible in the country/area in question.

Food production nowadays is focusing to produce large amounts of standardised foods which in turn often loses the focus of environmental sustainability. Hospitals can impact in the creation of more sustainable food systems by preferring for example climate smart and community supported agriculture, rural development and farmer's markets. (Gaitán-Cremaschi et al. 2019.) Furthermore, approximately 22% of the global greenhouse gas emissions come from the agriculture. Livestock production systems account for about 80% these emissions. (Chapman et al. 2019.) Vegetarian and vegan diets are connected to lower greenhouse gas emissions (González-García et al. 2018). In the documents of this study, only one mentioned them offering vegetarian food more often. It would be a great possibility for hospitals to set a clear target of offering more sustainable, vegetarian food. For example, vegetarian diet options could be on the menu as one of the choices daily and once a week hospital could offer only vegetarian food. For vegetarian choices to be sustainable, considerations on their life cycle stages needs to be performed (Corrado et al. 2019). Geographical and seasonal considerations should be done in all hospitals on all food procurement processes, which means that North-European hospital menus will differ from South-European menus. In addition, hospitals should broaden environmental sustainability from food to all actions in food services such as choosing bio-based disposables (Wilson & Garcia 2011) if there isn't a possibility to use reusable cutlery, plates or cups.

The documents offered broader options on how to operate sustainable travel and transportation than the literature review done for this study. The results discussed new technologies for shuttles (hybrid, electric, and bio-fuel) and employees and visitors were encouraged to walk, cycle, car pool and use public transport. One addition to the documents could be to consider the group of people who can't for some reason use the possibilities mentioned above and are required for some reason to use their own car. This group could be offered some incentives to choose environmentally sustainable option for a private car. For example, NHS Foundation Trust in the UK is offering electric vehicle charging points at community hospitals (NHS Foundation Trust 2015).

The energy and water use in documents followed the line of the literature. The documents favoured sustainable energy sources which is also the preferred option in previous research (Burpee & McDade 2014, Kangasniemi et al. 2014, McGain et al. 2017). In addition, the documents followed the water conservation theme as previous research (Kangasniemi et al. 2014, McGain & Naylor 2014, Furukawa et al. 2016a).

The stakeholders and their roles. There was valuable information found on stakeholders and their roles in the documents. However, one challenge for the section of health care professionals was that none of the documents specified different professions with different tasks but instead presented on a general level what they want to achieve and how they are going to accomplish it. Choosing to write on a general level might also explain why only five organisations out of eight seem to be addressing the role of environmental sustainability for health care professionals. Not clarifying the people who will do the work can easily lead to the problem that people are not aware of what is expected from them, resulting in poor results in achieving targets and aims. (Anderson 2015, 282-286.) Cawsey et al. (2012) proposes to address responsibility charting; who will do what, when, where, why and how. The section of governing body was also missing a clear focus of who oversees what. It might be that hospitals have a non-public document for more detailed information, but as environmental programs are not yet an established practice, writing open all planned actions would most likely benefit the hospital itself and furthermore other organisations.

Other stakeholders inside a hospital were addressed only by two organisations. Previous research highlights that the hospital environmental sustainability is shared between multiple stakeholders inside a hospital (Harris et al. 2009, Kangasniemi et al. 2014, Kallio et al. 2018). Documents mentioned cooperation with cleaning services but if environmental policy is pursued as a whole system approach as recommended (Ryan-Fogarty et al. 2016) hospitals need to think more comprehensively on their processes. Possibilities could be cooperating with the pharmacy, engineers, estate technicians, electricians, janitors, laundry staff, media staff, payroll, receptionists, security, volunteers and even the gift shop for example. All the departments and stakeholders inside a hospital have an impact to the hospital environmental sustainability. All stakeholders need to know one another, make their work transparent to others and think together how all processes could be made more efficient and sustainable. An environmental program is a great chance to indicate the basis for cooperation between different stakeholders and departments. Furthermore, the role of an environmental manager (Kallio et al. 2018) didn't appear clearly in the documents but might help to tie together various aspects and stakeholders of environmental sustainability in a hospital.

The means of establishing an environmentally sustainable hospital system. There was a difference between the organisations and the level of addressing different means of estab-

lishing an environmentally sustainable hospital. Innovation and research were the means least addressed (by only two organisations), even though continuous research is highlighted in previous research (Kangasniemi et al. 2014). Furthermore, innovative mind set in a hospital could help to encourage employees and administration to find new solutions to environmental challenges. However, innovation requires vision, will and good leadership and it can't be just a word written in the organisational agenda. (Tidd & Bessant 2014, 106-120.)

Environmental education was addressed by seven out of eight organisations and therefore it seems to be an important aspect of environmental sustainability. However, when comparing documents' education contents to environmental targets, the documents only suggested education on five targets out of eight. Another content missing from the education in the documents was answering what kind of pedagogical models are the most useful in teaching environmental matters and who will be doing the teaching. Environmental education should first identify staff's environmental awareness and then teach information needed through diverse education (Kangasniemi et al. 2014). Previous studies show that health care professionals have too little training and information on environmental sustainability (Furukawa et al. 2016a, Ryan-Fogarty et al. 2016). Furthermore, HCWH (2018b) wrote that health care professionals can contribute to climate policymaking processes, but they need to understand the science behind it. Environmental education to all stakeholders has proven to be successful (Ryan-Fogarty et al. 2016). Two examples from previous studies show the evident need of environmental education; Conrardy et al. (2010) found out that all operating room staff didn't know what regulated medical waste is which led into false sorting of waste and higher cost to the hospital. In addition, Furukawa et al. (2016b) showed that a large part of paper and plastic materials that were not in contact with the patient were thrown away as infectious waste, resulting in higher cost for the hospital.

6.2 Future Prospects

As health care can act as a major positive or negative agent for climate change (Kangasniemi et al. 2014, McGain & Naylor 2014, HCWH 2016), it is crucial to understand the underlying environmental factors. It is vital, that hospitals have started to develop environmental programs. Based on this study's data collection phase, and in some degree difficulty to find programs on-line, suggests that there are a lot of hospitals still lacking a

program or programs are not published on-line. Valentine (2012) supports this by arguing that environmental management is still in a state of infancy in many companies. It is unfortunate if programs are not being created but also if they are kept inside the organisation as successful environmental work requires multi-professional cooperation (Kangasniemi et al. 2014), cooperation with different stakeholders (Feeney 2013, Ryan-Fogarty et al. 2016) and benchmarking (Ryan-Fogarty et al. 2016). Additionally, the previous research offers great selection of everyday actions that would be rather easy to implement in an organisation. Some of the aims and targets in the chosen documents were only presented in an organisational and general level, but by adding these grass roots level actions into the programs with the organisation-wide aims and targets would make the environmental programs more comprehensive.

Making a course change in large organisation requires time management, financial capital and exceptional planning. One possibility to manage time and costs needed to plan and implement an environmental program could be introducing Lean principles to the operations of the hospital. Lean operations focus on eliminating waste (physical and non-physical) through continuous improvement and focusing on what the customer wants, in this case considering the best interest for both the patient and the environment. For instance; implementing Lean management into the procurement practises and to the whole hospital supply chain, with the focus on environmental respect, could help to find sustainable suppliers and products, establish strong supplier connections, reduce transport, packing and packaging and ultimately lead to more sustainable hospital processes. Additionally, applying Lean principles to the use of care and medical products in wards, as well as inventory management, could reduce the number of products thrown away because of expiry or inefficient ways of working. (Heizer et al. 2017, 676-691.)

Lastly, the environmental documents analysed in this study consist of valuable pieces. If these pieces were brought together and implemented to hospitals from the whole system view, while communicating with stakeholders outside the hospital – the benefits for hospital environmental sustainability could be powerful. The knowledge does already exist, the next thing needed is enthusiasm to seize on the matter of environmental sustainability, the culture of sharing experiences and strong support from guiding institutions.

6.3 Study Ethics and Trustworthiness

As one of the aspects of research ethics and trustworthiness is to know well the research method in use, the study process started with familiarising to the method of document analysis (Austin 2013, 359-360). Ethical aspects of research were considered throughout the research process from topic selection to publication (Gray et al. 2012, 159-192, Austin 2013, 359). The study data consisted of public, environmental documents and therefore there was no need to keep the data anonymous or get research permission from the organisations or from an ethical board (Gray et al. 2012, 172-173, Polit & Beck 2014, 88-89). When the topic was selected, ends and means of the study were reflected and it was decided that the possibility to enhance environmental sustainability and moreover the health of the environment is worth starting the research process (Munhall 2012, 491-494). Moreover, this study had a goal of developing new knowledge and move practice forward (Savin-Baden & Major 2013, 333). Another ethical consideration in this study were the actions of the researcher (Gray et al. 2012, 159-192). This study was completed without misconduct such as; fabrication, plagiarism or falsification of any kind (Polit & Beck 2014, 92) instead, competence, respectfulness, worthiness and trust were valued (Austin 2013, 359).

This study used Lincoln and Guba's (1985) evaluation criteria for trustworthiness. *Credibility* of this study was increased by familiarising to the research topic before starting the data collection. This was done through systematic literature review. The chosen research articles' quality was appraised with Hawker's et al. (2002) evaluation criteria. The abstract and title, introduction and aims, methods and data, sampling, data analysis, ethics and bias, findings or results as well as transferability or generalizability, and implications and usefulness were evaluated. Points from one to four (four being the highest) were given to each question, resulting in maximum result of 36 points. The chosen articles got points from 21 to 36. All the points can be found from appendix 3. Furthermore, tentative document searches were conducted to strengthen the conceptual understanding and search word selection for the topic. The quality of the chosen documents and the collection phase were important. As this study was based on documents found on the Internet, certain considerations were set in the beginning of the study on which terms the documents were accepted as part of the research data. Each documents' source was estimated carefully, and it needed to be clearly defined on the source website which organisation has made the document and for what purposes. Each document needed also fit the conceptual framework of the study. (Bowen 2009, Gray et al. 2012, 106.) Only two of the organisations published

references they had used to write the documents which decreases the credibility of the original data. However, the fact that the documents were not made for research purposes meant that the researcher could not have influenced on the content of the research data in contrast to interviews. By writing the literature review alongside data collection and analysis, helped to recognise important content and link it to previous research. (Bowen 2009.) The *credibility* and *dependability* of the study process was strengthened by working together with two more experienced thesis advisers (Austin 2013, 359-360). (Lincoln & Guba 1985, 301-318.)

The observation matrix composed for data collection with the help of systematic literature review, together with study results are the key elements of this study's *transferability*. The observation matrix and results can be used as an evaluation tool for existing programs or as an example when creating new environmental programs. However, it needs to be recognised that this study reviewed 21 research articles and eight organisations and therefore, the observation matrix and results could be more advanced if there were more extensive data behind them. Furthermore, the study results are based on eight Northern European organisations that had published the documents in the English language and most likely for language reasons the Southern Europe was not represented. Due to the challenge of finding environmental programs from European hospitals in the English language, four organisations from the UK were selected, as their programs varied in content. (Lincoln & Guba 1985, 316.)

The *confirmability* of the study was confirmed by writing the study process open from the start of the study until reporting phase. This included description of research design, data sources, collection and analysis, in addition to providing raw data for observation for others and presenting the observation matrix (Appendix 4) compiled from previous research for the data collection phase. Furthermore, by offering the developed observation matrix and documents used to inspection, it is possible for another researcher to repeat the study. (Lincoln & Guba 1985, 318-327, Gray et al. 2012, 64.)

Lastly, the documents are always independent from the researcher and they are done for different purposes than research, in contrary to qualitative interviews where the researcher and interviewee impact each other (Bowen 2009). Because of this, it can be argued that the documents' independency and researcher's objectivity are increasing the trustworthiness of the study.

7 CONCLUSIONS

According to this study, there are three central elements that should be addressed when creating an environmental program for a hospital:

1. The environmental targets (materials and procurement, waste, energy, water, chemicals, pharmaceuticals, food, travel, and transportation) with fitting aims and actions for how to reach them.
2. The different stakeholders (health care professionals, governing body, other stakeholders inside a hospital, and stakeholders outside a hospital) with clear role descriptions on who is in charge of what.
3. The means of how an environmentally sustainable hospital is established (planning and integration, human capital considerations, evaluation, reportage and follow-up, and innovation and research).

International and national institutions guiding environmental care should take a detailed approach to environmental sustainability in hospitals and in order to make this, more comprehensive research data on environmental sustainability in hospitals is needed. As approaching environmental sustainability from a whole system approach is desired, research in multidisciplinary groups could be more than beneficial in order to understand all the connections and processes inside a hospital. Furthermore, especially environmental education in hospitals could be improved with research on the contents and different pedagogical possibilities. Lastly, educating nursing students already in basic studies on environmental sustainability would send skilled workforce on the field from the start.

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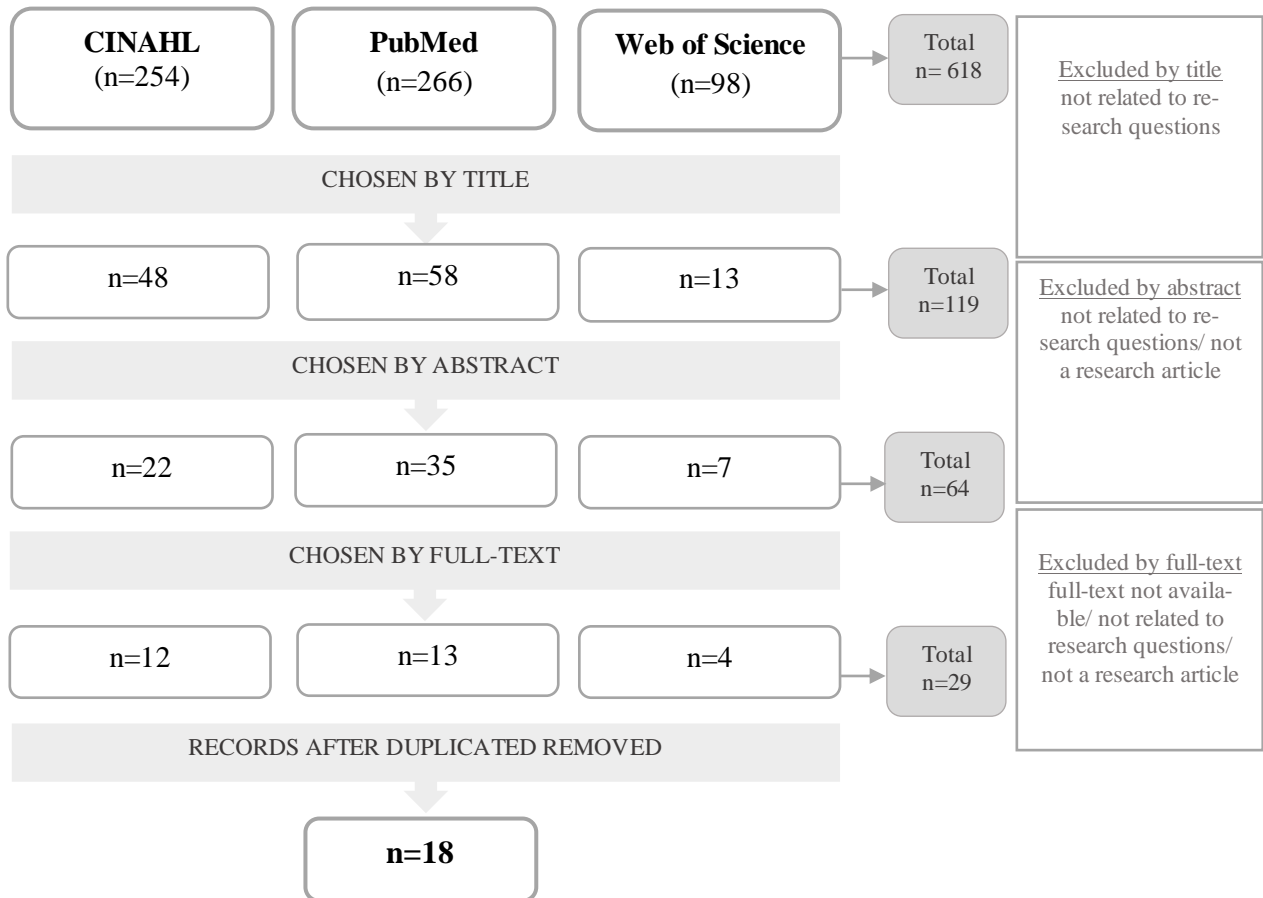
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Appendix 1. Search words and limitations.

| Search Words | Database | Limitations |
|--|-----------------|---|
| hospital OR hospitals OR patient* OR staff OR nurse* AND "environmental* respons*" OR "environmentally friendly" OR eco-friendly OR "environmental effect*" OR "environmental impact*" OR "environmental practice*" OR "environmental sustainability" OR "environmentally sustainable" OR greening OR footprint | CINAHL | Peer reviewed, last ten years and English language |
| hospital OR hospitals OR "patient care" OR staff OR nurse* AND "environmental responsibility" OR "environmentally friendly" OR eco-friendly OR "environmental effect" OR "environmental impact" OR "environmental practice" OR "environmental sustainability" OR "environmentally sustainable" OR greening OR footprint | PubMed | Search words in title/abstract, last ten years and English language |
| hospital OR hospitals OR "patient care" OR staff OR nurse* AND environmental* respons* OR environmentally friendly OR eco-friendly OR environmental effect* OR environmental impact* OR environmental practice* OR environmental sustainability OR environmentally sustainable OR greening OR footprint | Web of Science | Search words in title, last ten years and English language |

Appendix 2. Numbers of search results, article selection and reasons for exclusion.



Appendix 3. Articles chosen for literature review (1/3).

| Author, Year & Country | Purpose of the Study | Methods and Sample Size (n) | Main Results | Hawker Appraisal |
|---|---|--|--|----------------------|
| Becker J, Méndez-Quigley T & Phillips M. 2010. USA. | To discuss the nursing role and environmental impact of the pharmaceutical life cycle. | Review. | It is possible to reduce or eliminate pharmaceutical waste in the environment in five areas; design, approval and regulation, production, use and discharge and disposal. Nurses role is essential in all phases. Nurses' key roles are advocate, clinician, educator and investigator. | 22 |
| Burke N & Stowe J. 2015. Ireland. | To present energy efficiency in the radiography department from an Irish perspective. | Out-of-hours end-use energy surveys. n=4 (radiography departments). | A range of equipment was left on out-of-hours such as workstation and desktop displays, computers, printers and CR plate readers. Estimated annual savings in individual departments if equipment would be powered off ranges from 6656 kWh to 27,542 kWh and 1095,58-4533,41€. | 29/32 (No. 5 n/a) |
| Conrardy J, Hillanbrand M, Myers S & Nussbaum G. 2010. USA. | To evaluate the effects of using reusable surgical basins, gowns and table and Mayo stand covers in place of disposable products. | Concept comparison project. n=12 (surgical services). | Using reusable surgical basins, gowns and Table and Mayo stand covers instead of disposable products is preferable. Using reusable products decreased regulated medical waste generated by an average of 65% and reduced the cost of waste disposal. Surgeons and surgical technologists preferred the reusable products. | 31 |
| Dias-Ferreira C, Santos T & Oliveira V. 2015. Portugal. | To present a comprehensive characterization of plate waste (food served but not eaten) and elaborate possible waste reduction strategies. | A case study. Plate waste was audited and weighted for 8 weeks. | Some wards generate more waste than others. On average each patient throws away 953 grams food daily. In total the wasted food is 35% of the food served. 8.7 thousand tonnes of food waste is thrown away every year at hospitals across Portugal. | 33 |
| Furukawa P, Cunha I & Pedreira M. 2016. Brazil. | To evaluate the environmentally sustainable actions in the medication process from prescription receipt by the pharmacy to waste discard by nurses. | Before and after study, using the Lean Six Sigma methodology. | After the intervention; in the pharmacy was a reduction of 74.8% of chemical, infectious and sharps waste, an increase of 33.3% of common recyclable and 20% of common non-recyclable. In nursing was a reduction of 22.5% of chemical, infectious and sharps waste, an increase of 22.9% of common recyclable and an increase of 20% of common non-recyclable. | 27 |
| Furukawa P, Cunha I, Pedreira M & Marck P. 2016. Brazil. | Examine sustainable actions nursing team performed in an intensive care unit during medication processes. | Before and after study, using the Lean Six Sigma methodology. Data collected via observation. n= 648 (medication processes). | Post-intervention results indicated that intervention to improve environmental sustainability resulted in: reduction of materials such as plastic bags (37.1%) and hormonal anti-inflammatory drugs (67.1%), increased removal of labels from plastic bags to be recycled (146.9%) and proper waste disposal (32.2%). The financial savings included; 59.9% reduction in cost of handling infectious waste and sharps because of decreased generation, 37.1% reduction in plastic bags purchases because their use for transporting medication decreased and 40.7% reduction by purchasing lower dosage anti-inflammatory vials. | 32 |

Appendix 3. Articles chosen for literature review (2/3).

| | | | | |
|--|---|--|--|----|
| Harris N, Pisa L, Talioaga S & Vezeau T. 2009. USA. | To provide ideas how nurses can lead hospital greening initiatives. | Review. | Nurses have excellent personal and professional resources to practice environmental care. Nurses can promote the health of three interconnected entities: the patient, the worker, and the environment. (Self) education and making an effort to impact system policies are important tools for nurses. | 28 |
| Huffling K & Schenk E. 2014. USA. | To evaluate the environmental sustainability of the Intensive Care Unit (ICU) and provide concrete actions that ICU nurses can make to decrease environmental health risks. | Review. | There are four clear areas that ICU nurses can affect by their actions; energy use, waste, toxic chemicals and the healing environment. Nurses can reduce the amount of energy used by promoting for example Energy Star-rated equipment, optimizing temperature, turning lights, computers and televisions off when not in use and utilizing light and warmth of the sun (or closing blinds on sunny days to prevent overheating). With recycling nurses can be key recyclers and expand the recycling program. Chemicals can be reduced by promoting more sustainable options for example Di-2-ethylhexyl phthalate- free IV- equipment. | 23 |
| Kallio H, Pietilä A-M, Johnson M & Kangasniemi M. 2018. Finland. | To identify the key elements of hospital environmental responsibility in care processes and stakeholders involved. | Qualitatives study with semi-structured interviews and document analysis. n=5 (university hospitals) | Aim of the environmental responsibility in hospital care is avoiding unnecessary emissions. This was guided with authorities and ethics. Responsibility contained targets of sustainable use of materials, electricity, water and transport. Stakeholders involved were administrators, environmental manager, immediate leaders, environmental support people, staff and patients. Implementation phase was promoted with collaboration, education and different initiatives. | 36 |
| Kangasniemi M, Kallio H & Pietilä A-M. 2014. Finland. | Synthesise studies related to environmental issues in nursing. | Critical interpretive synthesis. n=11. | Nurses are in a key role to promote and develop environmentally responsible nursing as the largest group of professional in the hospital, but actions need to made in all levels of the hospital. Patients and relatives have their own role in waste disposal and the use of materials and water. Environmental work requires clear guidelines, regular education and multi-professional cooperation. | 33 |
| Lipkin N. 2012. USA. | To inform IV nurses of environmental effects that health care has and suggest clear and direct course of action how to improve it. | Feature. | IV nurses can make positive impact on the environment by: offering their experience and promoting sustainable choices when purchasing supplies, remembering proper management of electronic equipment (purchase, service and disposal), embracing sustainable use and disposal of medication in care practices and guiding patients on sustainable use of medication. | 21 |
| McGain F & Naylor C. 2014. UK & Austaralia. | To find out which extent hospital environmental sustainability has been studied and key issues for policy, practice and research. | A systematic review. n=76. | Key themes identified: hospital design, direct energy consumption, water, procurement, waste, travel, psychology and behaviour. Other themes are more researched than others, such as hospital buildings and research on devices and technologies used to reduce environmental effects. Less research on clinical, psychological and social aspects of sustainable care. | 33 |
| McGain F, McAlister S, McGavin A & Story D. 2012. Australia. | To compare financial costs and environmental effects of reusable and single central venous catheter insertion kits. | A life cycle assessment. | The reusable catheter insertion kits were less expensive than the single-use kits. The study hospital used brown coal-sourced electricity and the environmental costs of the reusable kit were considerably greater than those of the single-use kit. In future, decreasing water and energy consumed in cleaning and sterilization reusables should be a priority. The type of electricity hospitals use is connected to the environmental effects of reusables. | 32 |

Appendix 3. Articles chosen for literature review (3/3).

| | | | | |
|---|---|---|---|----|
| McGain F, Story D, Lim T & McAlister S. 2017. Australia. | To compare financial and environmental costs of reusable and single-use anaesthetic equipment. | A life cycle assessment. | Using single-use anaesthetic equipment costs more than using reusable alternatives. In Australia converting from single-use to reusable anaesthetic equipment saved more than AUD\$30000 (£18000) per annum but increased the CO ₂ emissions by almost 10%. UK resulted in 84% reduction in CO ₂ emissions and in the USA 48%. Australia more than doubled its' water use. The CO ₂ offset is highly dependent on the power source mix and water consumption is bigger for reusable equipment. | 34 |
| Overcash M. 2012. USA. | To compare reusable and disposable perioperative textiles. | Review. | Reusable textiles have massive sustainability benefits when compared to same disposable products; energy (200-300%), water (250-330%), carbon footprint (200-300%) volatile organics, solid wastes (750%) and instrument recovery. Cost, protection and comfort are reasonably similar. | 28 |
| Ryan-Fogarty Y, O'Regan B & Moles R. 2016. Ireland. | To evaluate systematic implementation of environmental programmes in a university hospital. | An evaluation of a systematic implementation of environmental programmes. | Environmental programmes have proved to be successful. Greatly beneficial is that it brings together disparate stakeholders. To be able to act sustainable the awareness of both clinical and environmental stakeholders needs to be raised and programmes can enable that. | 32 |
| Thakur V & Ramesh A. 2015. India. | To identify trends in healthcare waste management. | Review. | Health care waste can be categorised in different ways. One of the most simple way to categorise health care waste is; general waste and medical waste. Health care waste management consists of generation, composition, segregation, transportation, storage facilities and final disposal. Waste management can be improved with technological advancements, introducing emission standards to incinerators and strict standards to non-burn disposal technologies. | 31 |
| Turley M, Porter C, Garrido T, Gerwig K, Young S, Radler L & Shaber R. 2011. USA. | To introduce a model to evaluate the environmental impact of electronic health records. | Health Footprint as a framework. | Decreased paper consumption, avoided transportation, reduced carbon impact by using personal computers instead of personal desktops and avoided plastic waste from x-rays. Digitizing decreases toxic chemicals as x-ray films contains silver, developing films requires hydroquinone and the increased use of digitized images leads to smaller use of lead. Annually comes 45 tons of personal computer waste that contains lead and mercury. Switching to electronic records means higher energy consumption. | 30 |
| Unger S, Hottle T, Hobbs S, Thiel C & Campion N. 2017. USA. | Compare environmental impacts of single use disposable devices with increased biopolymer content vs. petroleum-based. | Comparative life cycle assessment. n=62 (waste audits of hysterectomies). | Biopolymers reduced life-cycle human health impacts, acidification and cumulative energy demand but needs significant agricultural inputs to manufacture. Integration of biopolymers is correlated with reductions in carcinogenic impacts, non-carcinogenic impacts and respiratory effects. | 33 |
| Vidal R, Moliner E, Pikula A, Mena-Nieto A & Ortega A. 2015. Spain. | To quantify the carbon footprint of different patient diets in a Spanish hospital. | Comparison of diets with streamlined variation. n=18 (different diets). | Hospitals diets have an influence on the carbon footprint of a hospital and greenhouse gas emissions. CO ₂ emissions associated with food consumption can be calculated easily. Mediterranean diet was associated with lower environmental impact than diets with meat, especially red meat. | 32 |
| Wilson E & Garcia A. 2011. Canada. | To explore green initiatives in food service operations. | Review. n=31 (publications). | Food services in health care consume greatly resources. Supporting environmentally friendly practices can make a significant difference. By promoting energy efficient equipment, bio-based disposables and smart packages, non-toxic cleaning solutions, organic and locally produced food can hospitals' food services lower their environmental effect considerably. | 26 |

The Environmental Targets

- *Waste Prevention & Recycling*
- *Reducing Energy Use and Changing to Renewable Energy*
- *Reducing Water Use*
- *Minimizing the Use of Toxic Chemicals*
- *Smart Use of Pharmaceuticals*
- *Sustainable Material Choices and Purchasing*

The Stakeholders

- *Health Care Professionals*
- *Leaders*
- *Administration*
- *Multiprofessional Cooperation*
- *Other Professionals Inside Hospital*
- *Patients and Relatives*
- *Stakeholders Outside Hospital*

Means of Actualising an Environmentally Sustainable Hospital

- *Guidelines & Programs*
- *Updated Guidelines*
- *Aims, Targets, Values & Innovation*
- *Cost-Efficiency*
- *Valuation, Follow-up & Reportage*
- *Staff*
- *Environmental Education*