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Design for Sustainable Healthcare in a European context

A comparative analysis of Sustainable Healthcare and Design strategies in three European case studies.

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Abstract—**In recent years, interest in Sustainable Healthcare has grown globally: many environmental issues are attracting great interest because they also represent a high cost for National Health Services. Resource consumption and waste production have huge environmental and economic impacts, deeply affecting the costs of medical treatments. Much research in recent years has focused on education and policy strategies to face these issues, but Design research could play a key role to integrate them, acting upstream the production process. This study aims to provide an overview on different European approaches to Sustainable Healthcare and Design for Healthcare, defining potentials and limitations to their development. The developed methodology combines two different levels of analysis, including macro (region) and micro (hospital and wards) environmental issues. The analysis has been applied to three different European case studies (from Italy, Sweden and Denmark). This allowed to highlight pros and cons of current international scenarios in regards of Sustainable Healthcare and Design strategies and their implementation.**

Keywords- sustainable healthcare, sustainable design, health systems, dialysis

I. INTRODUCTION

The recent economic crisis had a huge weight on the Western National Health Services (NHSs), including deep cuts in healthcare spending, also for diagnostic and therapeutic procedures. The budget cuts have involved the entire supply chain of NHSs: the majority of supply chain decision makers says that their sector is still feeling the effects of economic recession (54% in North America and 43% in Western Europe) or considers the impacts have lessened but are still present (44% in North America and 49% in Western Europe) [1]. NHSs in Europe have addressed the crisis through short-term measures to control costs [2], but long-term improvements are needed to improve the economic sustainability of health systems.

A. Sustainable Healthcare: from economical to environmental sustainability

In this scenario, many environmental issues are attracting great interest because they also represent a high cost for NHSs [3]. Resource consumption and waste production have huge environmental and economic impacts, deeply affecting the costs of many medical treatments. The sustainability of healthcare systems is increasingly seen as a crucial objective to reach, even if it is difficult to agree on a common definition of Sustainable Healthcare and on common criteria to identify a sustainable healthcare system [4].

Much research in recent years has focused on education strategies and national/international policies to face the issues of sustainability. These strategies have been developed along three main lines of research:

1. improvement of waste sorting and management within healthcare facilities [5, 6];
2. implementation of Green Public Procurement schemes for healthcare supply chain [7;8];
3. development of educational programs to encourage staff to adopt more sustainable behaviors [9;10].

Although these lines can improve the long-term sustainability of NHSs, they are all focusing on the downstream end of the production process. Few researchers have addressed the role of Design in Sustainable Healthcare: can designers be helpful in promoting new environmentally sustainable systems of healthcare? Certainly, Sustainable Design research usually acts upstream the production process to improve the environmental sustainability of packaging, products and services, in order to reduce impacts during their entire life cycle [11]. Sustainable products and services cannot solve the problem on their own, but they may be essential to answer the new requirements stated by policy strategies and implement the educational programs towards Sustainable Healthcare. Therefore, a systemic approach to the research analysis is needed [12]: design issues and challenges have to be analyzed according to the context in which they occur [13]. So health policies and organizations have been examined in details before focusing on design aspects. This would allow to assess the actual contribution which Sustainable Design may make to the development of Sustainable Healthcare.

B. Sustainable Dialysis: starting from applied research

Design research is distinguished by the attention to applied research, focusing on design aspects that are often related to specific issues and case studies. The importance of context

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analysis and human-centered perspective in design projects [14] is even greater in the healthcare field. Therefore, it is very important to focus on a practical case study in order to analyze the potentialities of Design towards Sustainable Healthcare.

In the present study, we focused on chronic hemodialysis, that is particularly significant in terms of economical and environmental impacts. Chronic hemodialysis is a life saving treatment, presently sustaining life of over 2 million people worldwide who lost the function of the kidneys [15]. The estimate for 2025 is of about 4 million dialysis patients. Such numbers represent highly relevant challenges, not only to healthcare services and budgets but also to environment due to the great need for water, power and, not least, to the issue of waste production [16,17]. The problem of hospital waste is enormous: currently approximately 2 million chronic hemodialysis patients produce over 2,000,000 tons of waste per year that includes about 600,000 tons of potentially hazardous waste. Thus far, many health organizations have been focusing on dialysis: special programs, as 'Green Nephrology' [18] or 'Green Dialysis' [19], are addressing environmental management and sustainable procurement for dialysis. As mentioned above, waste reduction and resource optimization are important goals that many hospitals and healthcare providers are striving for. In spite of the growing demand, the offer of more sustainable products is still limited. This is also meant for hemodialysis, that requires the use of a great amount of packaging and disposable devices.

The present research aims at providing an overview on different approaches to Sustainable Healthcare, analyzing environmental strategies both at macro (Region) and micro level (hospital and dialysis wards). The main goal is to define potentials and limitations to the development of Design research for Sustainable Healthcare, by comparing three different European case studies on healthcare and dialysis from the point of view of environmental sustainability.

II. METHODOLOGY

A. Different levels of analysis

The complexity and interdisciplinarity of healthcare systems require a multi-level analysis that takes into account different aspects affecting the implementation of environmental sustainability strategies. Different stakeholders and their related responsibilities and tasks have to be considered in order to define a methodology that can be applied to different contexts and countries.

The analysis has been carried out considering two different levels of organization, each of which shows specific criteria of analysis (Figure 1).

1) Sustainable Healthcare at regional level: analysis of national/regional policies and regional organization as regards healthcare and its sustainability. The main criteria analyzed are:

a) Environmental management structure,

b) Responsibilities and tasks of the main stakeholders (Region, Hospital, Ward/unit)

c) Environmental strategies and policies

d) Green Public Procurement (GPP) schemes

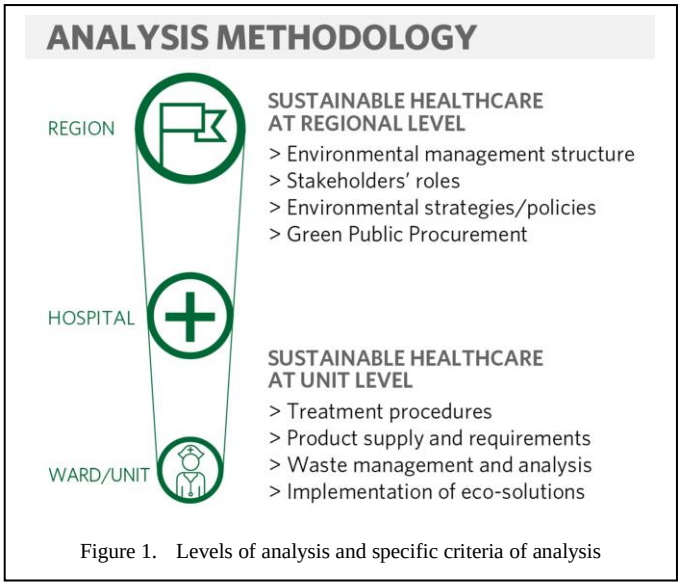

Figure 1. Levels of analysis and specific criteria of analysis

2) Sustainable Healthcare at unit level (dialysis): analysis of practical implementation of macro-strategies, focusing on waste and products choice and management in dialysis units. The following criteria have been considered:

a) Treatment routines and procedures

b) Product supply and requirements

c) Waste management and quantitative analysis

d) Implemented solutions for sustainability

The combination of these two levels allows to compare macro-strategies and regional organizations in relation to Sustainable Healthcare but, at the same time, it makes it possible to verify their implementation and effectiveness at a more specific level. The special focus on GPP and product supply and usage provides an overview on the potentials of Sustainable Design for healthcare.

B. Definition of European case studies

The methodology has been applied to three case studies from three European countries. This has been essential to compare different types of organizations and approaches to sustainability, as well as different procedures and ways of strategy implementation at hospital and ward level. The objective is not to classify countries/hospitals but to highlight common weaknesses and limits to Sustainable Healthcare, underlining the existing good practices and solutions that can be shared at international level. Furthermore, the case studies' application allowed to verify the methodology itself and its effectiveness in defining new paths towards Sustainable Healthcare and Sustainable Design diffusion.

The choice of the case studies resulted from the collaboration between the Department of Architecture and Design of Politecnico di Torino (Turin, Italy) and the NCSH - Nordic Center for Sustainable Healthcare (Malmö, Sweden). The NCSH is an an independent and interdisciplinary platform that brings together all stakeholders from Northern Europe in the field of Sustainable Healthcare, aiming at helping the healthcare sector and its suppliers of products and services to

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reduce their environmental impacts, while increasing economic sustainability. The common interest in Sustainable Healthcare led to a collaboration on the present research, through the involvement of Nordic regions and hospitals.

The analysis has been extended to three European regions and one specific hospital for each region:

- Piedmont Region > San Luigi Gonzaga University Hospital (Turin, Italy);
- Skåne Region > Skåne University Hospital (Malmö, Sweden);
- Hovedstaden Region > Frederiksberg Hospital (Frederiksberg, Denmark).

Even if the three regions are slightly different in terms of their area and population, the selected hospitals are similar in size and they all have small-medium dialysis units that can be compared in regard of strategies implementation and complexity of organization.

III. Results: Limits and Potentials Towards Sustainable Healthcare

The double-level analysis allowed to highlight pros and cons of current situations at macro and micro level, relating to Sustainable Healthcare strategies and their development.

A. Sustainable Healthcare in regional organizations and policy strategies

Figure 2 summarizes the cross-case comparative analysis according to the analysis at macro level. The study showed how the presence of environmental coordinators for each level of organization is essential to promote and translate environmental strategies into practice. This is especially important at ward/unit level, where the presence of a staff member specialized in environmental sustainability is very important to implement and improve sustainable strategies, translating them into practice.

At the same time, the organizational complexity may create a risk of top-down initiatives, while a less complex organization can increase horizontal communication and self-initiatives.

In all cases, environmental coordinators or the staff involved in environmental issues do not have much say in the matter of product purchasing: this may be an obstacle for the diffusion of more sustainable products.

Finally, a holistic approach to Sustainable Healthcare is necessary because of its interdisciplinary and inter-sectoral complexity: a systemic approach allows to consider different environmental, economical and social issues, addressing them on the large scale.

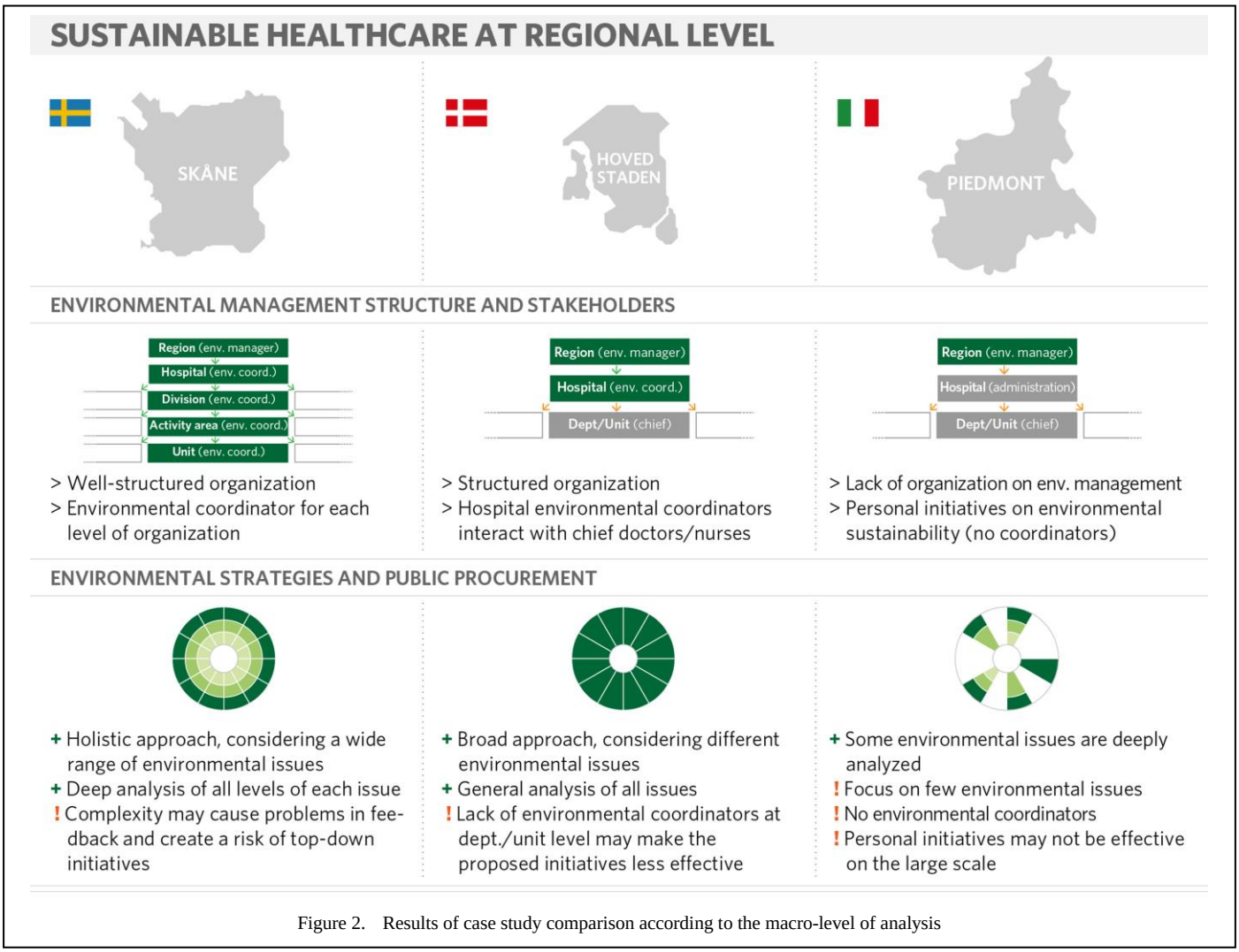

Figure 2. Results of case study comparison according to the macro-level of analysis

B. Sustainable Healthcare in practical implementation at the unit level

Figure 3 shows the comparison of the three case studies according to the analysis at micro level. In this case, the research has focused on dialysis units but many issues and solutions are applied or can be applied to the other wards.

First, GPP effects are mainly seen in the use of new technologies/products for waste management, even if the adoption of eco-innovative solutions is not always possible because of the slow pace of change in public procurement and the rigidity of product categories (e.g. a company providing new solutions for integrated rubbish boxes must be able to participate and win both the tendering procedures for the garbage bins and the garbage bags).

In all cases, there are few dialysis products that optimize material consumption and promote recycling: the focus on product quality is rarely connected to environmental sustainability.

A systemic approach is essential in designing new products, because effective solutions may integrate ward infrastructures and products/equipment (e.g. the creation of an on-line water system in the ward makes it possible to avoid the use of several saline solution bags).

Waste sorting is effective only where an official or unofficial environmental coordinator encourages and provides support to nurses. In all the three dialysis units, the lack of space and the complexity of product disassembly and/or waste sorting (e.g. too many categories of waste) make waste management more difficult.

Lastly, staff autonomy is important to promote personal development and sense of initiative of individuals, but at the same time a higher organization for environmental issues is needed. Indeed, the subjectivity of initiatives may lead to excellent results (because of personal awareness) but it is not reliable and effective on the large scale.

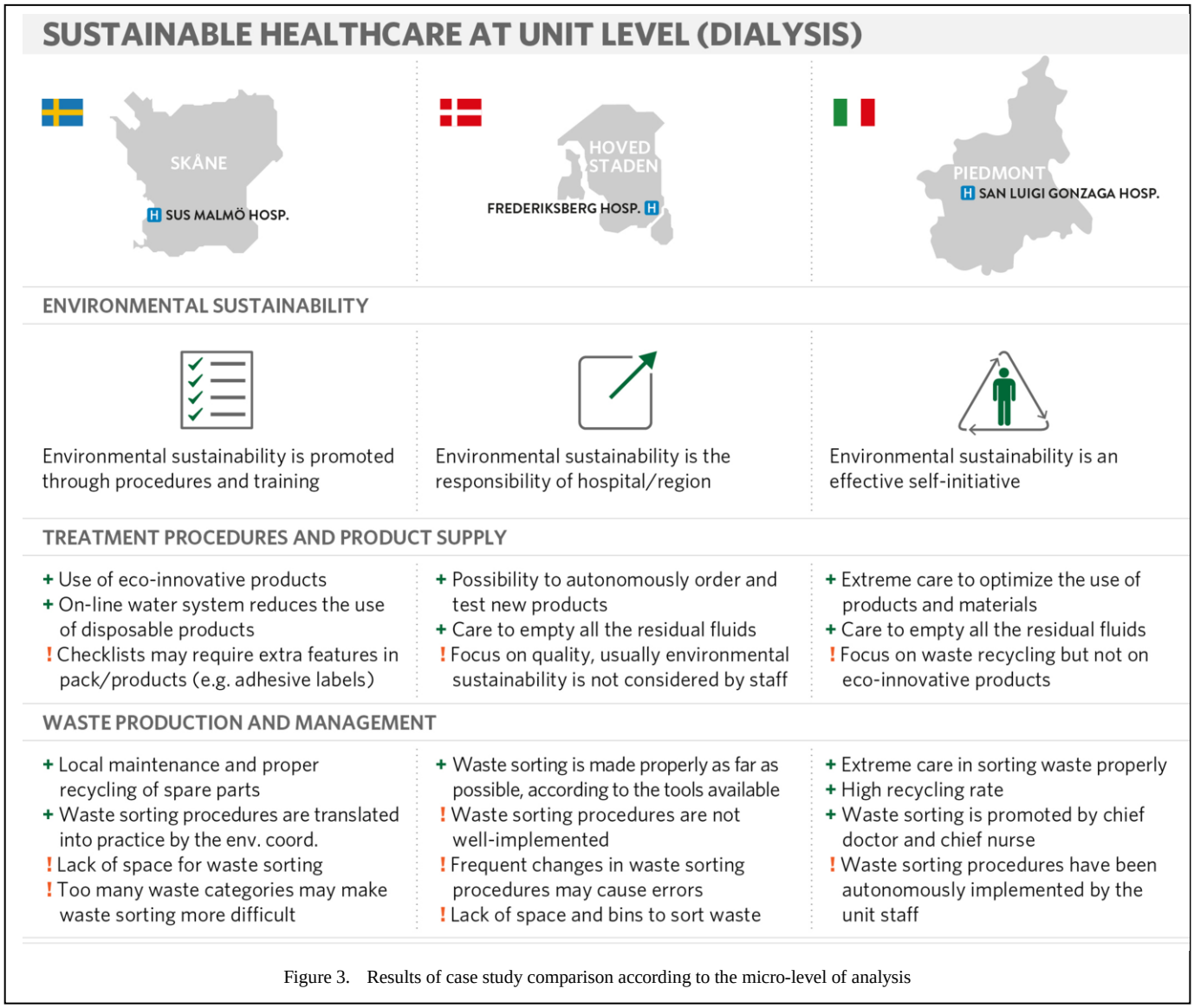

Figure 3. Results of case study comparison according to the micro-level of analysis

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IV. CONCLUSIONS

The growing attention towards environmental sustainability in the healthcare sector is leading to the implementation of new policies and strategies to enhance the diffusion of a Sustainable Healthcare approach. Europe plays a leading role in this field, even if there is a gap between environmental legislations and concerns of different European countries.

The present study compared three European case studies (Italy, Sweden, Denmark), analyzing them according to different levels of environmental organization: from regional policies to hospital strategies, to the final implementation at ward level. Special attention was given to product/equipment and their procurement system, since there is a lack of research in the area of Design for Sustainable Healthcare.

Overall, the analysis showed interesting development potentials for Sustainable Healthcare and for Design research in this field. The complexity of the topic requires a holistic approach in order to integrate educational, management and technical aspects, addressing them through different disciplines and sectors. In particular, the role of environmental coordinators at all levels of organization is fundamental to promote environmental awareness of staff and patients, that is essential to make sustainable innovations effective. On the other side, environmentally sustainable solutions and strategies have to be planned in a systemic perspective, not focusing on the individual issue but considering all aspects as a whole system. This is important also from a Design point of view. GPP schemes need to overcome the rigid category division, as well as the distinction between clean technologies and health technologies [20]. Only in this way new design solutions can be implemented in a systemic perspective. Furthermore, new tools and methods are needed to enhance interdisciplinary design: environmental sustainability adds new requirements to products and systems, so different stakeholders should be put in relation, avoiding hierarchical structure that may complicate communication. The designer's role within the team is to guide the designing process through the complexity of healthcare systems, creating a dialogue between final/intermediate users and producers, with the aim of creating new effective eco-solutions.

Further work is planned to move from Sustainable Design to Systemic Design research, addressing its practical application to chronic hemodialysis. The goal is to design a new sustainable system which includes packaging, devices and equipment, to help healthcare providers achieve the objectives of financial and environmental savings. The presented analysis will be applied in the project, in order to create a solution suitable for different international contexts.

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