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Organizational and Human Factors in Green Medical Informatics – A Case Study in Dutch Hospitals

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Abstract. Medical Informatics brings methods and solutions that could support reducing healthcare's ecological footprint. Initial frameworks for Green Medical Informatics solutions are available, however these do not address organizational and human factors. Including these factors in evaluation or analysis of (technical) interventions aimed at making healthcare more sustainable, is essential for improving usability as well as effectiveness of these interventions. Interviews with healthcare professionals from Dutch hospitals led to preliminary insights into which organizational and human factors impact the implementation and adoption of sustainable solutions. Results indicate that forming multi-disciplinary teams is considered an important factor for realizing intended outcomes in terms of reducing carbon emissions and waste. Some other key factors mentioned are formalizing tasks, allocating budget and time, creating awareness and changing protocols to promote sustainable diagnosis and treatment procedures.

Keywords. SEIPS model, Sustainable Healthcare, Human and Organizational Factors, Quality Improvement

1. Introduction

The negative effects of the current climate crisis on global health makes it more crucial than ever for all of us who can, to take action. Among others, healthcare professionals are important agents for transforming healthcare to become more sustainable. Fortunately, the field of Medical Informatics (MI) brings promising methods and solutions for accelerating this essential transformation of healthcare systems [1].

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Initially, researchers and practitioners in the MI discipline focused on improving sustainability in healthcare by decreasing carbon emissions from travel with e-health solutions [2]. Later, other methods and solutions from MI emerged to mitigate the environmental impact of healthcare. Examples include the use of data analytics, Green IT and Lean Six Sigma [3].

Recently, perspectives on how MI can support the mitigation of the climate crisis have expanded. The Green Mission framework describes how MI solutions can be structured and categorized based on their application domain to either mitigate the environmental impact or increase resilience of healthcare systems to climate change [4]. The i-Climate framework provides actions to reduce environmental impact of MI solutions themselves [5]. In this paper we use the term Green Medical Informatics (Green MI) to refer to the application of methods, concepts or solutions from the MI discipline to mitigate the environmental impact or increase resilience to climate change for healthcare systems.

Even though some frameworks representing possibilities or applications of Green MI are now developed, none of these have included characteristics of organizations, individuals, their jobs and interactions. These organizational and human factors can be used to understand how people interact with tools and technology in the complex healthcare system and help increase the success of solutions [6].

This paper reports on the results obtained from a first explorative case study to identify which factors are important for implementation and adoption of Green MI solutions in hospitals. These results can be used to study and optimize sustainability improvements in healthcare systems and to further develop the emerging field of Green MI.

2. Methods

Semi-structured interviews with twelve healthcare professionals affiliated to eight different Dutch hospitals geographically spread across the country were conducted, transcribed and analyzed using thematic content analysis based on the SEIPS 2.0 quality improvement model [7]. The interviews aimed to identify barriers and facilitators for quality improvement projects that focused on reducing the climate impact of hospitals by implementing supporting innovations. Interview themes were: strategic direction, implementation, adoption and infrastructure.

Participants were recruited based on their active project involvement for sustainable healthcare innovations during at least six months before spring of 2021 in three ways: by search on social media (Facebook and LinkedIn), by calling or mailing general hospital contact centers and by following references from other participants.

Participants were medical doctor (N=3), environmental coordinator (N=3), medical assistant (N=2), (assistant)manager (N=2) or medical technician (N=2).

Two coders independently coded each interview. Results were reviewed in a workshop with human factors researchers and practitioners.

3. Results

Eighty-three percent of the participants confirmed to be part of an interdisciplinary team that was specifically established with the aim to reduce the environmental footprint of the processes constituting their daily work, also called ‘Green Teams’. Two Green Teams

were focused on a single organizational unit (an operating room and a radiology laboratory) while the other Green Teams were operating hospital-wide. No additional participants were recruited by the followed search method.

The intercoder reliability for codes related to the work system was 0.79 and was 0.88 for codes related to processes as indicated by the Krippendorf alpha-binary in Atlas.TI. Figure 1 presents the factors of the work system for each of the main elements of the SEIPS 2.0 framework that were mentioned by more than one participant. For Internal Environment and for Tasks no additional factors were mentioned. Most factors mentioned are related to Person(s) where factors related to management and Green Team members were most often described.

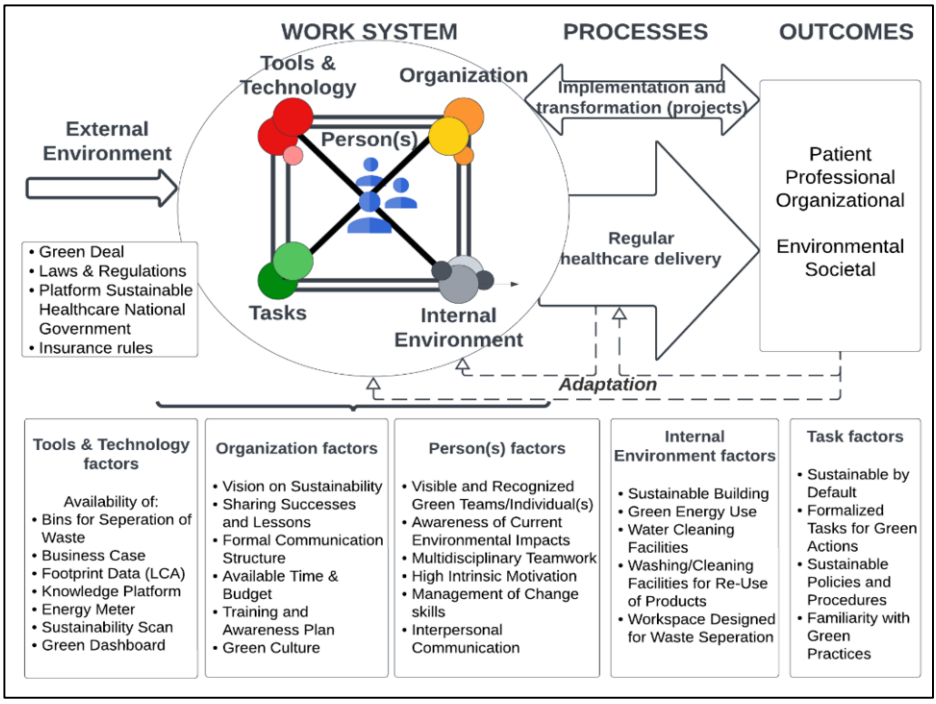

Figure 1. Factors mentioned (n>1) for main elements of SEIPS2.0 framework, based on Holden et al., 2014.

Processes described by participants were categorized in two groups as presented under 'Processes' in Figure 1. The first group focuses on implementation and transformation of the standard way of working, for example by introducing new systems or tools, changing protocols or process flows or by changing tasks. These processes are typically performed by a project team. The second group includes processes that are part of regular healthcare delivery, examples include performing diagnostics or treatment of patients as well as small adaptions not disruptive to the (original) way of working.

Participants indicated that for both types of processes the collaboration between active (clinical) agents and facility services employees (waste management, building maintenance) is essential and that supply management is an important co-agent. None of the participants was involved in improving the resilience of healthcare systems to climate change. Most processes did not involve ICT components but involved physical tools and infrastructure. One participant mentioned collaboration with patients to be important. All factors mentioned related to one of the elements of the SEIPS 2.0 model, however two

additional aspects were added to the outcomes-element of the model: environmental and societal outcomes.

4. Discussion

The purpose of the current study was to determine which organizational and human factors are most important for successfully making hospitals more sustainable. Although the study was based on a small sample of participants in a single country, it offers first insights into potentially relevant factors to influence this success. Insights gained from this study may be of assistance in building a sustainability focus into established quality improvement practices.

The generalizability of results of this study is subject to certain limitations. For instance, results are limited to the Dutch hospital setting and the findings are presented on one level, while organizational and human factors play a role on multiple or even across organizational levels. Another limitation is that results of this study are based on information provided by healthcare professionals rather than empirical data.

In spite of its limitations, this study adds to our understanding of relevant organizational and human factors for making hospitals more sustainable. The challenge now is to use this knowledge to optimize hospital work systems and processes in order to become more sustainable. A natural progression of this work is to enhance existing models and frameworks used in quality improvement initiatives, such as SEIPS 2.0, by adding a sustainability focus. This focus could support healthcare to generate better outcomes in terms of environmental and social impact and accelerate improvements towards meeting international sustainability goals.

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