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Sustainability in Healthcare: Methods and Tools for the Assessment

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Abstract. Background: Healthcare sector has a significant impact on the environment and people well-being. Therefore, it is interesting to understand how healthcare contributes to sustainable development. Objective: The study aims to perform a literature review on the methodologies applied to quantify environmental impact in healthcare with an attention to telemedicine activities. Methods: Scopus and PubMed databases were investigated between 2018 and 2022. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) frameworks was followed for article selection. Results: From initial 183 articles, 50 full-studies were included. Life-cycle assessment method proved to be a standard for assessing the impact of devices used in clinical practice. Indeed, for the investigation of care activities a unique methodology was not defined. The assessment of telemedicine is mainly based on avoided travels, and a standard methodology is still missing. Conclusions: To move toward a sustainable development other aspects of sustainability should be investigated.

Keywords. Sustainable Development, Environmental Impacts, Healthcare, Telemedicine

1. Introduction

Sustainable development has gained increasing prominence, becoming a crucial aspect for a wisely use of resources. Its main objectives are resumed in the 17 Sustainable Development Goals (SDGs), proposed by the United Nations to address the most important global issues. The SDGs have provided a global development framework to guide countries toward economic, social and environmental sustainability [1]. Healthcare is an important aspect of SDGs, as it ensures the well-being and health of individuals and communities [2]. The primary aim of the healthcare sector is the diagnosis, treatment and prevention of diseases; however, a low efficient use of resources causes a severe environmental impact and consequently harm the health of people [3]. Therefore, it is necessary to understand how sustainable development is applied into care processes. In particular, healthcare field has been still defined as highly impactful on the environment [4]. However, while SDGs define a qualitative guidance [1], there is still a need to understand how to objectively assess the ecological impact in health care and which are some possible solutions. There are several activities that could be considered to reduce

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the environmental impact. Among these, telemedicine has been widely adopted in recent years and it is considered an effective solution to make the healthcare greener [5-6].

According to the mentioned context, the present study aims at identifying which methods and tools are available in literature to measure and to quantify the environmental sustainability in the healthcare field. An investigation of the state of the art is performed on topics related to the impacts caused by the instrumentation and the organization of care processes, with an attention on telemedicine techniques. In detail, the review will introduce the search methodology and the selection process of the articles. Results are presented in graphs; finally, discussions and conclusions are drawn.

2. Methods

Before performing the literature review, a research protocol has been defined. The strategy includes rules for searching articles and setting of inclusion and exclusion criteria. The Preferred Reporting Items for Systematic and Meta Analysis (PRISMA) framework has been followed to investigate scientific papers and provide findings.

2.1. Search strategy

The review has been conducted involving Scopus and PubMed databases. The search terminology is related to the environmental assessment and healthcare field (e.g., “environmental sustainability”, “environmental impact”, “healthcare”); the Boolean operators AND OR are used to combined terms. These words are searched in the title, abstract and keywords of all articles of the selected databases. The research includes articles between 2018 and 2022, allowing for an assessment of the recent evolution of this issue, which has generated interest since last decade [7].

2.2. Screening and eligibility

Articles are considered eligible for the study if they reach the following inclusion criteria:

- Assessment of environmental impact of healthcare field;
- Identification of main environmental indicators, such as emission of CO_2, CO_2e, wastes production, energy consumption, …;
- Assessment of environmental impacts of processes related to the care of patients and hospital activities;
- Application of one or more numerical methods with quantitative results;
- Use of English language.

For a more comprehensive investigation there is no restriction on medical specialties or telemedicine techniques. Studies not considered in the evaluation are: qualitative studies and reviews, papers with different context and aim, or related to pharma industry and hospital building assessment.

2.3. Data synthesis, analysis and presentation

After a first screening of titles and abstracts, inclusion and exclusion criteria are applied as previously described. The final list is imported in Excel and analyzed. Information is extrapolated and subdivided according to the aim, the objects of investigation, and the applied methodologies. Tables are created to summarize and facilitate the read of data. Finally, interpretation and discussions on results are drawn.

3. Results

The literature review has been conducted between November and December 2022, following the search process represented in PRISMA framework of Figure 1a.

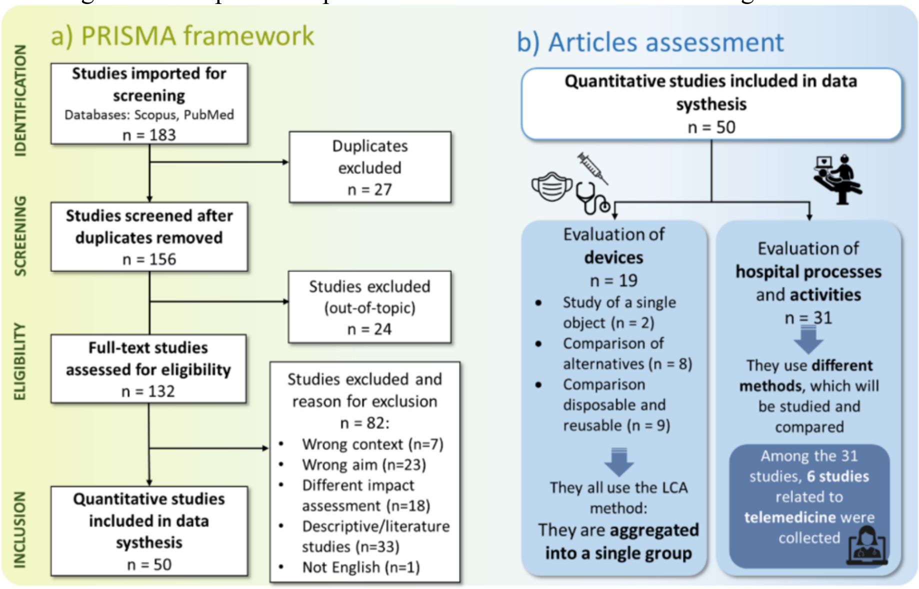

Figure 1. Process of articles selection (a) and first analysis of contents (b)

The research led to the identification of 183 articles, of which 27 have been excluded because duplicates. After an initial screening, 24 studies have been considered out of topic and eliminated. Once applied the previously descried inclusion criteria, 82 items have been removed. Hence, 50 articles based on quantitative approaches have been considered in the review. Most of the studies have been conducted in Europe (n = 28; 56%), USA (n = 9; 18%) and Asia (n = 6; 12%). Others involved Australia (n =5; 10%), Africa (n = 1; 2%) or multiple continents (n = 1; 2%).

A preliminary analysis (Figure 1b) showed that 19 (38%) articles have evaluated devices impacts used in clinical practice (e.g., personal protective equipment, gowns, surgical instruments, …). All studies have applied the same method, based on Life Cycle Assessment (LCA); therefore, to highlight the different methods and approaches used for environmental assessment, these papers have been grouped into a single category. Only a few of the most significant ones are reported [33-34]. The main topics of remaining 31 studies are included in Figure 2. Half articles (n = 25; 50%) concern care processes and hospital activities and principally investigate wastes (n = 7 [4, 8-13]) or transportations phases (n = 1 [14]), the impact generated by a set of activities (n = 11 [15-23]), by a hospital (n = 4 [2, 7, 24-25]) or by a public health (n = 2 [26-27]). In these studies, methodologies are not concordant. A significant number uses the LCA approach (n = 11); other methodologies are sporadically applied (n = 14). The last set of articles (n = 6; 12%) proposes telemedicine as a possibility to reduce the environmental impacts caused by healthcare sector, defining new methodologies for effect assess. Most studies investigate televisit activities (n = 5 [28-32]), while only one article is related to telescreening (n = 1 [3]). However, in all cases, the reduction of travel between patients' house and hospital and its correlated issues are involved. The applied methods are varied and include questionnaires, different databases, but the final result is to calculate the carbon footprint. Only in a single case LCA approach is involved.

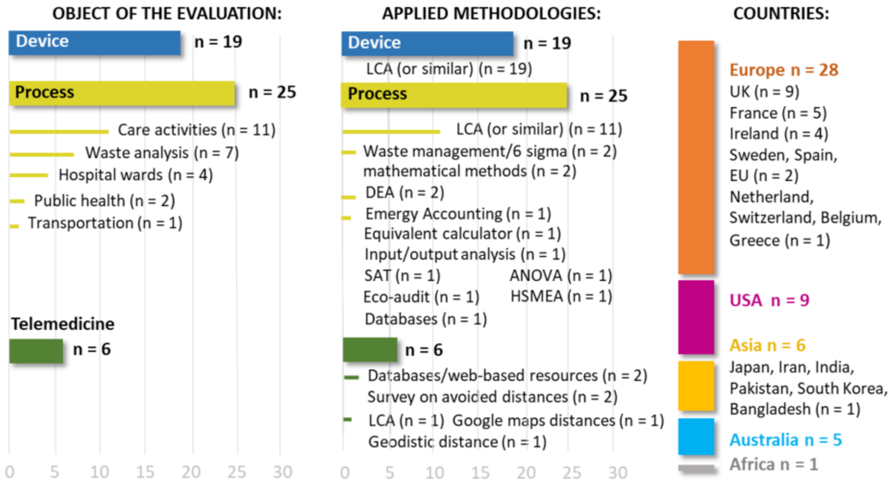

Figure 2. Extrapolation of data from selected scientific papers

4. Discussion

Healthcare is responsible for a great amount of greenhouse gas emissions [4]; it is urgent to understand the most impactful aspects and limit their negative effects on environment [33]. During the review process, some methods and tools, which analyze health sector and environmental perspective, have been detected. A very common approach is the assessment of the ecologic footprint of devices used during the daily practice. Other studies address the problem considering activities and entire processes of care. In both cases, LCA proved to be the most chosen approach; however, the limited availability of information and the complexity of the problem often lead to a simplified LCA. In order to tackle the complexity of these systems, other articles propose methods based on processes and workflow analysis, coming from the management world and adapted to the healthcare sector (e.g., risk or waste management). A small part, on the other hand, has developed mathematical models. As mentioned in the introduction, the descripted methodologies allow to operationalize the SDGs and encourage a productive utilization within impact assessment [1]. The most discussed goals are "responsible consumption and production" (SDG 12), "climate action" (SDG 13), "life beyond water" (SDG 14) and "life on land" (SDG 15). To address sustainable development, future developments should also consider other goals.

The replacement of face-to-face activities with telemedicine solutions has been proposed as a chance to decrease the environmental impact [30-31]. Despite the limited number of researches included in the review, a high interest was noted in televisit processes. All evaluations concern the travel of patients and its correlated impacts (e.g., distance avoided, type of transportation, saved time, saved cost, …). Thus, studies are assumed to be limited to a direct environmental impact generated by telemedicine (SDG 13). As defined by Lokmic-Tomkins et al. [5], an objective and shared methodology for telemedicine sector still seems to be lacking. The need to develop new methods for the inclusion of more SDGs has emerged. Nevertheless, an extension of research is required, to improve and update telemedicine related state of the art.

In conclusion, a great interest is addressed to issues related to environmental impacts and health sector. Many studies are developing increasingly comprehensive assessments, including direct and indirect impacts. The trend of introducing telemedicine within care processes makes it necessary to define methodologies to objectively and formally assess all the impacts caused by its implementation. In this way, it will be possible to define guidelines for moving telemedicine and healthcare toward sustainable development.

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