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Healthcare sustainability-driven innovation: balancing institutional pressures with internal resources and competencies

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Abstract

Healthcare systems are challenged to balance high-quality care with growing demands for green transition. Within the Italian context, PNRR encourages targeted investments and reforms promoting sustainability, resilience, and innovation in healthcare, while hospitals encounter barriers such as regulatory constraints, cultural resistance, and limited resources.

This paper investigates how Italian hospitals are integrating environmental sustainability practices in response to increasing institutional pressures on environmental issues and green objectives achievement. Adopting a qualitative multiple case study approach, the paper examines four healthcare organizations varying in size, location, and sustainability degree. Results identify three organizational profiles: pioneers, regulatory responders and fragmented adopters. Sustainable practices mainly involve energy efficiency, waste management, and green mobility, but their implementation is influenced by internal resources, cross-functional competencies, and external incentives. The preliminary results show that sustainability in healthcare requires more than technological solutions, demanding organizational adaptation, skill development, and institutional alignment supporting a systemic and long-term transformation.

Keywords: healthcare; hospitals; environmental sustainability; innovation; process; competences; resources; institutional pressures; isomorphism

Introduction

Healthcare systems are facing unprecedented challenges as they strive to balance the provision of high-quality care with the increasing demand for environmental sustainability and green transition (Sherman et al., 2020; Maghsoudi et al., 2020). Given the link between health and environmental factors (Desterbecq et al., 2023), urgent and substantial actions to reduce the impact might be defined, considering also that healthcare activities are the major contributors to waste and emissions (Janik-Karpinska et al., 2023). These pressures present not only challenges, but also significant opportunities for processes and pathways innovation, pushing healthcare organizations to reshaping operational models, fostering technological advancements, and driving process re-engineering to align with green principles (Khan et al., 2022).

Within the Italian context, the National Recovery and Resilience Plan (PNRR) plays a critical role in driving healthcare towards a transformative agenda through targeted investments and reforms promoting sustainability, resilience, and innovation. This strategic shift is crucial, acknowledging that healthcare is not only about patient care but also about creating a system that is responsive to global challenges and contributing to the sustainable development goals (SDGs), promoted by the Agenda 2030 and the One-Health principles.

This is especially true in hospitals, where the sustainability integration is influenced by key factors: operational constraints; regulatory barriers; health, safety, and accreditation standards; the generation of high volumes of waste; financial and technological limitations; cultural resistance (Vallée, 2024).
Thus, the adoption of sustainable practices is not a straightforward process, and it often encounters significant barriers, particularly within hospitals where the integration of new technologies and processes might work within the boundaries of existing regulatory frameworks, professional norms, and infrastructure limitations (Siyal et al., 2023). Moreover, the sustainable transition requires not

only organizational adjustments but also the involvement of a wide range of stakeholders and the development of specific skills and resources.
However, the integration of process innovations in the pursuit of sustainability remains underexplored, since existing studies focus mainly on technological innovations (Rajagopal et al., 2022). This gap is critical because innovation could not be solely driven by technology but also by organizational adaptation and process re-design, factors that are often overlooked when sustainability goals are addressed, in favour of focusing on isolated technological solutions.

Assuming this backdrop, the following research questions are defined to guide the study development.

i) Which environmentally sustainable-oriented innovative practices or programs are currently adopted within the hospitals?
ii) How do institutional pressures impact, both positively and negatively, on the adoption of sustainable innovation practices within the hospital setting?
iii) What resources and competencies enable hospitals to integrate sustainability-driven innovation into their processes and pathways?

Methodology
Aiming to answer to the defined research questions, the study leverages on different theoretical lenses, such as the Institutional Theory (Scott, 2004), the Isomorphism theory (DiMaggio & Powell, 1983), and the Resource-Based View Theory (RBV) (Barney, 1991). From a methodological perspective, this allows to explore how hospitals navigate these external forces (regulative, normative, and cultural-cognitive pressures), shaping internal strategies, identifying the core competencies (technical, technological and transversal competencies) and resources (physical assets, digital assets and human resources) required, as well as understanding if the pression towards a green transition is more related to coercive (depending by regulatory requirements or compliance standards), normative (deriving from context's standards or professional norms) or mimetic (occurring when hospitals adopt sustainability practices by imitating successful initiatives from peer organizations) pressures.

Pursuing an exploratory aim and an inductive approach (Silverman, 2005), the paper adopts a comparative multiple case study analysis (Yin, 2003), examining sustainable innovative practices' adoption across different Italian hospital settings, as well as the competences and resources required to facilitate this development.

The healthcare organisations considered in the sample were selected according to the following inclusion criteria: *i)* small, medium, and large healthcare organizations, *ii)* healthcare organizations located in different geographical areas, both rural or urban contexts, *iii)* public or private healthcare organizations, *iv)*

healthcare organizations with varying levels of sustainability experience, ranging from those with defined and adopted sustainability policies, to those with less experience or less formal sustainability strategies.

The included healthcare organisations are reported in Table 1.

Table 1: A snapshot of the healthcare organisations involved in the study.

Healthcare organisation	Typology	Public/private	Number of beds	Professional role of the respondents
A	Healthcare organisation with different hospitals, healthcare facilities and university research institutes within the national context	Private	2,172	Sustainability Manager – Clinical Engineering
B	Healthcare organization composed of different hospitals, territorial facilities and university research institute, at regional level	Public	1,482	Technical Officer Director
C	Healthcare organisation with different hospitals and territorial healthcare facilities at regional level	Public	919	Medical Laboratory Director
D	Healthcare organisation with different hospitals and territorial healthcare facilities at regional level	Public	1,597	Medical Laboratory Director - Management Engineering

The multiple case study approach is established by conducting semi-structured interviews with key stakeholders such as facility managers or management engineers, biomedical engineers, procurement officers or clinical roles, both face-to-face and online. When available in the organization, professionals dedicated to sustainability are also included.

The interviews investigate:

a) environmentally sustainable practices and innovations implemented, their impacts as well as the challenges faced during implementation;
b) institutional context pressure, identifying the major obstacles or enablers deriving from the macro or micro level;

c) organizational resources and competencies required, understanding the different typologies of resources (e.g., financial, technological) and competencies (e.g., staff skills, leadership capabilities) needed to successfully integrate sustainability into hospital operations.

The interview process started in April 2025 and is still ongoing. Each interview typically lasted between 45 and 60 minutes. The data collected through interviews are analysed using thematic analysis, identifying recurring patterns, enabling the development of generalizable insights.

The study was approved by the Ethical Committee of LIUC – Carlo Cattaneo University and each respondent signed an informed consent before the interview.

Results

To answer to the first research question, preliminary findings reveal that hospitals are adopting some sustainability-driven innovations and processes, including particularly energy-efficient infrastructure or solutions as well as energy-saving initiatives for the employees (e.g., agreements with the railways for transportation). In addition, waste management, and recycling practices, such as the collection of paper, plastic, and batteries, are implemented even if the degree of integration and innovation varies across the different hospitals' contexts.

From the interviews three hospital archetypes emerged: only one healthcare organization proactively integrate sustainability (pioneers), many operate reactively (regulatory responders) or without a strategic alignment (fragmented adopters).

The pioneers proactively integrate sustainability into their operations, such as through the adoption of renewable energy systems and green logistics. Pioneers can be identified as those that have *"consistently maintained a simultaneous focus on both environmental and economic sustainability"* (Sustainability Manager, Healthcare organisation A), not in response to emerging regulations, but as part of a strategic orientation, embracing the "One Health" principle, which recognizes the deep interconnection between human, environmental, and animal health.

In contrast, regulatory responders primarily focus on complying with existing regulations, often adopting sustainability-oriented practices in areas such as energy and mobility management. This is also driven by the selection of dedicated professionals—such as energy or mobility managers—as required by specific public administration regulations. For example, the mobility managers are involved in activities such as *"the definition of agreements with the railways for transportation are defined by the organisation to promote green mobility among the employees and the healthcare professionals"* (Management Engineering, Healthcare organisation D).

Fragmented adopters, on the other hand, exhibit a lack of strategic alignment, typically implementing sustainability practices in a disjointed manner without a coherent approach and, in particular, "*without defining specific guidelines or procedure from the technological and the safety perspectives, considering that clinical engineering or the safety officer did not provide any guidance"* (Medical Laboratory Director, Healthcare organisation C; Management Engineering,

Healthcare organisation D), underscoring the lack of support from specific roles in advancing sustainability efforts within the organization. Focusing on the laboratory medicine and microbiology perspective, the respondents reported that *"solvents that can be hazardous for healthcare professionals' health and the environment are avoided and some methods that use the smallest amount of organic solvent are developing"* (Medical Laboratory Director, Healthcare organisation C).

Focusing on the second research question, institutional pressures, such as regulations, guidelines, and in particular dedicated financial incentives, play a critical role in shaping the adoption of sustainability practices within hospitals. For pioneers, regulatory incentives act as accelerators, helping them adopt green technologies and practices quickly. They have allocated dedicated budgets to environmental sustainability initiatives, including the establishment of specialized personnel and teams. However, they express a desire for *"financial incentives to further support and accelerate these efforts"* (Sustainability Manager, Healthcare organisation A). Moreover, in Healthcare Organization A, nearly all actors are engaged in sustainability practices, including physicians, technicians, and administrative staff. Among them, *"physicians face significant pressure from their scientific associations to adopt green practices, and by doing so, they influence the personnel working alongside them"* (Sustainability Manager, Healthcare organisation A). In contrast, regulatory responders are more driven by the necessity of meeting compliance standards and the implementation of energy-efficient practices is the most adopted environmentally sustainable-oriented practices, primarily influenced by institutional regulations related to energy savings and resource optimization.

Considering the third research question, hospitals with dedicated sustainability teams, strong technological infrastructure, and cross-functional collaboration tend to be more effective in integrating sustainability into their strategic and operational processes. As described by the professionals involved, leadership commitment and stakeholder engagement are two necessary elements to foster a culture of sustainability. Pioneers should implement training programs focused on environmental sustainability, as it is essential for it to *"become ingrained in organizational culture"* (Sustainability Manager, Healthcare organisation A), thereby enabling others to follow their example. The integration of digital tools for energy monitoring, waste management technologies, and AI solutions are identified as key assets for enhancing sustainability efforts even if in three of the four involved healthcare organisations, these resources are not yet implemented. However, despite the presence of a mobility manager or an energy manager, the lack of dedicated sustainability roles highlights a gap that slows the progress of sustainability initiatives. Healthcare Organisation A has emerged as a leader in this area, having developed a platform to collect reports on all negative environmental events and use it to manage them. The platform includes key performance indicators (KPIs) for measuring and comparing the hospitals within the group, as well as benchmarking them against other hospitals.

In terms of resources, the findings suggest that physical assets, such as renewable energy systems and waste management technologies, are the primary resources being leveraged to support the green transition. The healthcare organizations are moving towards the green development, *"installing solar panels and energy-efficient systems in most of the hospital buildings"* (Medical Laboratory Director, Healthcare organisation D). However, human resources are also essential, as skilled staff play a key role in driving change. As one respondent pointed out, *"without the right people, it's impossible to drive real change: hospitals need staff who understand sustainability concerns and are committed to it"* (Technical Officer Director, Healthcare organisation B). Other respondents stated that they are incorporating environmental parameters into the assessment of novel technologies, marking a significant advancement in Health Technology Assessment, which traditionally has not considered these factors (Clinical Engineer, Healthcare organisation A).
The importance of technological and transversal competencies was emphasized, with hospitals needing expertise in areas such as sustainable materials, project management, and regulatory compliance. On the other hand, the necessity of regulatory compliance is highlighted stating that *"understanding regulatory aspects is crucial because, in most cases, the regulatory context is the only real push we have. While it often turns into merely "adhering to standards", it is essential to have a deep understanding of the relevant laws, decrees, and regulations. Without this knowledge, implementing sustainability in healthcare can become a challenge"* (Technical Officer Director, Healthcare organisation B).

Finally, the concept of institutional isomorphism is assessed: coercive and mimetic isomorphism emerge as significant leverages in shaping sustainability adoption within hospitals. Coercive isomorphism, driven by external regulations and government policies, strongly influences how sustainability is approached. However, mimetic isomorphism also plays a role, with hospitals often replicating sustainability practices seen in other successful institutions, particularly when those institutions serve as role models. For Healthcare organisation A, normative isomorphism plays a crucial role, as environmental sustainability has consistently been a fundamental pillar of the healthcare organization.

Discussion

This study investigated the current adoption of environmental sustainability within hospitals highlighting that the sustainable transition is a complex and multifaceted task, requiring not only technological upgrades but also a cultural shift to embrace continuous innovation. Indeed, sustainability in healthcare requires more than just adopting green technologies, demanding process re-engineering, supply chain optimization, and energy efficiency (Sherman et al., 2020).
From the interviews, it was possible to highlight how sustainability could be considered as a strategic lever for the pioneers, which in this case are represented by the private hospital, or a compliance-driven constraint as for the public healthcare organisations involved.

This research provides significant theoretical and practical contributions. From a theoretical standpoint, the study extends Institutional Theory by exploring how regulative, normative, and cultural-cognitive pressures influence hospitals' sustainability strategies. The RBV framework is applied to identify critical resources, highlighting the importance of resources and competences devoted to support the adoption of sustainable-oriented practices. The role of internal resources and competences as sources of competitive advantage is widely studied within the literature, also in the healthcare context, but these elements have not been investigated and structured in relation to the sustainable development. Furthermore, the research contributes to the literature on isomorphisms: hospitals, as part of a larger healthcare ecosystem, often conform to industry norms, regulations, and best practices, which can lead to the diffusion of sustainability initiatives. Whether driven by coercive, mimetic or normative isomorphism, this institutional alignment can either facilitate or hinder the adoption of green practices.

This integrated approach enables a multilevel analysis of sustainability adoption in healthcare, considering the macro-level (institutional environment), the meso-level (organizational strategies), and the micro-level (individual adoption behaviour or acceptance), while providing a holistic understanding of how environmental sustainability drive innovation and organizational transformation.

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