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Sustainability maturity levels and solution approaches in inpatient care: An online survey among hospital executive boards in Austria

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ABSTRACT

Background: Global environmental changes as well as regional developments require expanded response and performance capabilities as well as an intensified willingness to innovate and change on the part of hospitals. The question arises: What current level of maturity and associated solutions can be identified and applied in Austrian hospitals regarding climate-influenced and sustainable patient care from the point of view of decision-makers and managers?

Methods: Based on a semi-structured literature search, an online survey was conducted among hospital management of Austrian hospitals (18/01/2024–25/01/2024; N = 401; n = 66; rr = 16.5%).

Results: It is useful to identify the current design and constructive objectives of climate-neutral and sustainable patient care in hospitals. In this respect, the sustainability maturity level regarding climate neutrality and sustainability in the Austrian hospitals were determined. In addition, relevant solutions for the conceptual design of climate neutrality and sustainability in hospitals were identified.

Conclusions: Our study shows that increasing demand for services and increasingly limited resource availability affect both the security of care and the quality of care in hospital care. In this regard, the increased focus on climate-influenced, climate-neutral and sustainable patient care in hospitals through targeted green hospital management can make an essential contribution.

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KEYWORDS

Sustainability maturity; green hospital management; Ishikawa diagram; decision makers perspective; Austria

Key points for decision makers

- Climate influence, climate neutrality and sustainability in hospitals as well as their design and control require sufficient transparency regarding essential goals, structures, processes and results as well as the associated challenges and solutions.
- To identify the current situation, it is important to assess the maturity of climate neutrality and sustainability, considering the different subjective perspectives of the actors, professions and stakeholders involved.
- Diverse solution approaches (e.g. lean & green management approach) and instruments (e.g. sustainability reporting) must be developed, adapted, implemented and evaluated via conceptual project and change management.
- Due to the limited availability of resources, it is important to intensify coordination between the professions and to consider cross-industry trends such as process optimization, service orientation, employee motivation, digitization, sustainability, and impact analysis.

1. Introduction

The hospital sector is a complex and compressed social space with a fragmented division of labor, a specialized range of services, and intensive use of resources. Particularly in developed industrial nations and health

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care systems, a substantial consumption of resources and associated impacts on the environment through the emission of greenhouse gases can be identified [1,2]. Due to changing requirements and reduced resource availability, it is important to establish climate-neutral resource use and sustainable design approaches in hospital care [3].

1.1. Sustainability in the hospital sector

In recent years, the horizons for action regarding the reduction of climate-damaging emissions have shortened, and the visible need for action and the associated awareness-raising have intensified [4,5]. In addition to global warming, the perceived increase in climate-related extreme events and the intensified discussion about possible or necessary changes to systems and actions, overarching objectives and regulatory frameworks are increasingly being changed and further developed [6]. The motivation here is to combine the necessary (e.g. emission reduction, circular economy, energy security) with the possible (e.g. renewable energy, social justice, individual preferences). This results in an enormous, almost unsolvable scheduling task that must be mastered at the various social and economic levels [7]. At the European level, this objective is being targeted with the development and implementation of the Green Deal, which aims to accelerate activities towards ecological-economic-social sustainability through the ‘Circular economy action plan – For a cleaner and more competitive Europe’, among other things [8].

1.2. EU Green Deal framework

Building on the European Union’s Green Deal, which pursues a comprehensive strategy to promote sustainability and climate protection, various initiatives and measures are being initiated with the aim of making the EU climate-neutral by 2050 and making society and the economy resilient to environmental change [9]. Non-financial reporting is one of the main objectives of EU directives and regulations such as the Environmental, Social and Governance (ESG), the Non-Financial Reporting Directive (NFRD), and the EU Taxonomy Regulation and Corporate Sustainability Reporting Directive (CSRD). These oblige organizations and companies to integrate environmental aspects into their actions and business practices and to report on them [10]. The EU Taxonomy Regulation defines a classification system that determines which economic activities (e.g. resource procurement, service provision) are considered ecologically sustainable (e.g. environmental protection, biodiversity). The six goals, according to the taxonomy (EU 2020/852), are climate protection, adaptation to climate change, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, as well as protection and restoration of biodiversity and ecosystems [11]. For hospitals and healthcare organizations, this means that they are increasingly confronted with the criteria of the taxonomy, especially if they receive public funding or seek investment funding. In addition, the CSRD requires intensifying non-financial reporting and providing and disclosing information on ESG practices. This includes disclosing the extent to which their activities comply with the criteria of the EU Taxonomy [12].

1.3. Stages of development of sustainability in hospitals

The topic of climate neutrality and sustainability in the hospital sector is increasingly becoming the focus of strategic management in Austria. Both the objectives and the design can be divided into the following four fields of action ecological, economic, technological and social sustainability. The ecological field of action for sustainability in hospitals involves minimizing environmental impact, increasing resource efficiency, and promoting environmentally friendly practices, such as reducing energy consumption, managing and recycling waste, and obtaining LEED certification [13–15]. The economic field of action relates to the organization’s long-term financial stability and the efficient use of scarce resources, such as financial controlling and reporting and public-private partnerships [16]. The technological field of action for sustainability in hospitals involves integrating innovative technologies to improve procedure efficiency, ensure quality patient care, and reduce profound environmental pollution (e.g. electronic patient records and energy-efficient medical technology) [17–21]. Lastly, the social field of action refers to creating a safe, supportive, and inclusive environment for patients, employees, and society (e.g. patient-centered medicine and employee work-life balance) [22–25].

It is the task of management and decision-makers to develop and implement strategies and practices that contribute to the long-term health of patients, to the motivational qualification of employees, to the increased efficiency of hospital processes and to the noticeable reduction of environmental impact. A central step here is assessing the prevailing situation and thereby deriving the current sustainability maturity of the respective hospital. For the determination and assignment of sustainability maturity, orientation towards a meaningful sustainability readiness level is recommended [26]. A corresponding 10-point sustainability readiness level scale (absent; reactive; ad hoc; initial; developing; defined; advanced; innovative; leading; excellent; fully established), was therefore developed and implemented for the online survey. This scale ranges from absent (0) to fully established (10) sustainability initiatives in hospitals, although both extremes are unlikely to be found [27].

2. Methods

A multi-method approach is suitable for an intensive consideration and structured analysis of climate neutrality and sustainability in the hospital sector. The chosen research design included both a semi-structured literature analysis and a comprehensive online survey among management and decision-makers in Austrian hospitals.

2.1. Literature review on challenges, maturity dimensions and options for action

The identification of possible environmental requirements, objectives, challenges, and solutions in connection with climate neutrality and sustainability in hospitals was carried out by means of a semi-structured literature review. For this purpose, research was carried out in relevant national and international databases (e.g. PubMed, Cochrane Library, Emerald Collections, ScienceDirect College Edition, SpringerLink) using targeted keywords or keyword combinations (e.g. inpatient care, sustainability, maturity level, climate change, system change, options for action, Sustainability Maturity Model, etc.). The identified articles, studies and reports were reviewed and their contents interpreted in the context of the research question. Furthermore, the results of the literature research were incorporated into the development and design of the online survey among managers and decision-makers in Austrian hospitals.

2.2. Online survey on the perspective of decision-makers in hospitals

To identify possible environmental requirements, objectives, challenges and solutions in connection with climate neutrality and sustainability as well as the qualitative-subjective assessment of sustainability maturity in Austrian hospitals, an online survey of the perspective of managers and decision-makers was carried out. For this purpose, a standardized online questionnaire was created based on the results of the literature review and expert discussion creative expert workshop (n = 12, 11/2023). Based on a pre-test (n = 5), the number of objectives, challenges and factors influencing climate-influenced and sustainable patient care in Austrian hospitals was reduced, the phrasing of the questions were adapted, and the response options were made more concrete. The online survey was conducted from 18/01/2024–25/01/2024 (8 days) using the unipark survey tool [28]. 401 members of the top management (specifically: CEOs/administrative directors N = 112, n = 21, rr = 18.8%; medical directors N = 111, n = 13, rr = 11.7%; chief nursing officers N = 104, n = 15, rr = 14.4%; technical directors N = 74, n = 10, rr = 13.5%; other/no information n = 7) of Austrian hospitals were contacted by means of their personal e-mail address. The total number of responses was n = 66, resulting in a response rate of rr = 16.5%. The participating experts represented 23% small size hospitals (i.e.; < 200 beds; < 500 employees), 65% medium size hospitals (i.e.; 200–599 beds; 500–1,999 employees) and 12% maximum size hospitals (i.e.; > 600 beds; > 2,000 employees).

3. Results

The sustainable and climate-neutral provision of services and use of resources in hospitals represents an increasingly relevant management challenge. The first step for management and decision-makers is to

determine the current starting situation as precisely and meaningfully as possible. The focus here is on the current level of sustainability maturity, the future challenges, and the associated solutions.

3.1. Sustainability maturity in Austrian hospitals

In order to determine the current level of climate neutrality and sustainability in the hospital sector, it is advisable to survey experts both on the degree of maturity of climate neutrality and sustainability in general (e.g. external assessment) as well as the development and starting levels in their individual hospital (e.g. self-assessment) [29–31]. On the basis of the assessments of the managers and decision-makers in Austrian hospitals, a radar chart of sustainability maturity of Austrian hospitals can be created (Figure 1). The figure depicts that the assessments are in the middle range between 5 and 6 ($m = 5.5$). This shows that, according to the assessment of the participants, climate neutrality and sustainability are already a relevant and targeted topic, but that there is still a need for action and potential for improvement.

Looking at the twelve different dimensions of climate neutrality and sustainability in Austrian hospitals, it becomes clear that the respective arithmetic mean (m) results in a qualitative-subjective maturity level of 4 ('developing') for two dimensions: patient orientation and qualification ($m = 4.9$) and administration and documentation ($m = 4.9$). These dimensions are central to patient-centered and knowledge-based health care in hospitals but have a rather non-specific effect on the concrete design of hospital service provision. The survey results show a maturity level of 5 ('defined') for the majority of organizational dimensions: marketing and public relation ($m = 5.0$), human resources management and recruiting ($m = 5.3$), employee orientation and qualification ($m = 5.6$), buildings, hospital technology and IT infrastructure ($m = 5.6$), innovation and competitiveness ($m = 5.6$), organizational leadership and management ($m = 5.7$), support processes and provision of resources ($m = 5.8$), devices, technologies, hardware and software ($m = 5.8$). The highest sustainability maturity levels are recorded in purchasing, logistics and supplier management ($m = 6.1$) as well as data privacy and security ($m = 6.1$). (Figure 2) This can be interpreted by considering both the participation of external partners and profit organizations and by the influence of external

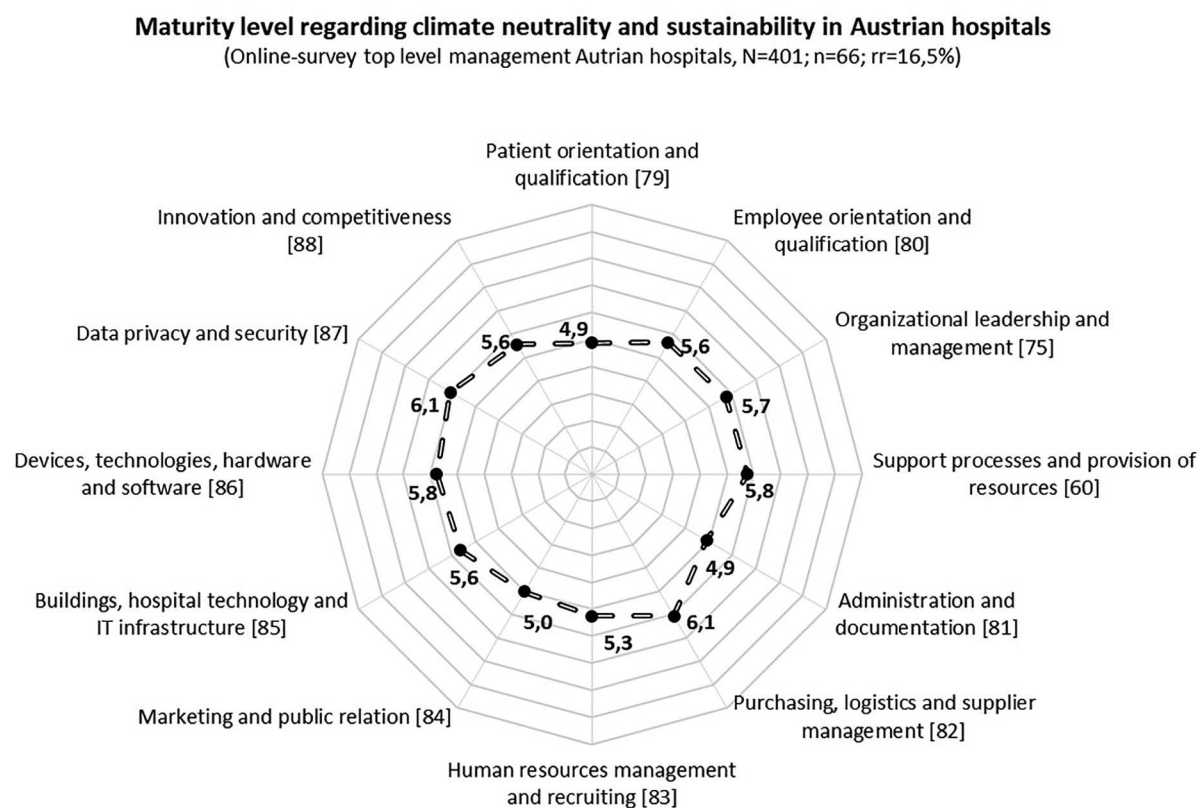


Figure 1. Radar chart of sustainability maturity of Austrian hospitals.

Maturity level		Dimension
4	developing	▪ patient orientation and qualification (m=4.9) ▪ administration and documentation (m=4.9)
5	defined	▪ marketing and public relation (m=5.0) ▪ human resources management and recruiting (m=5.3) ▪ employee orientation and qualification (m=5.6) ▪ buildings, hospital technology and IT infrastructure (m=5.6) ▪ innovation and competitiveness (m=5.6) ▪ organizational leadership and management (m=5.7) ▪ support processes and provision of resources (m=5.8) ▪ devices, technologies, hardware and software (m=5.8)
6	advanced	▪ purchasing, logistics and supplier management (m=6.1) ▪ data privacy and security (m=6.1)

Figure 2. Sustainability maturity level of different dimensions of Austrian hospitals.

regulations and standards in these sectors [32,33]. To interpret the assessments of management and decision-makers regarding sustainability maturity in Austrian hospitals, a comparison with the digital maturity level in Austrian hospitals is useful. An online survey among management and decision-makers in 2022 (N = 374, n = 49, rr = 13.1%) showed a lower digital maturity level in Austrian hospitals for dimensions 1 (3.6), 2 (4.0), 3 (4.3), 4 (4.6) and 12 (4.0). In contrast, dimensions 5 (5.4), 6 (5.6), 7 (5.2), 8 (5.7), 9(5.4), 10(5.9) and 11 (5.6) show comparable levels of maturity regarding digitization and sustainability in Austrian hospitals [34].

3.2. Challenges regarding sustainability in Austrian hospitals

The requirements and implementation options towards climate neutrality and sustainability in hospitals confront both external and internal challenges. External challenges can be broken down into the sectors of global change, society and environment, health care system, and patient behavior. These challenges include climate change, legal requirements, financial conditions, global supply chains, public expectations and technological developments. Compared to internal challenges, there are limited options for action and room for maneuver. Internal challenges in connection with climate neutrality and sustainability in hospitals can be grouped into the sectors of organization and communication, range of services, and health professionals or employees. These challenges mainly relate to organizational structures and processes, technical infrastructure and applications, financial resources and priorities, as well as employee-related qualification and management. (Figure 3) [35]

According to the participating management and decision-makers of Austrian hospitals, the main challenges regarding climate neutrality and sustainability in hospitals vary in their significance and severity. In particular, the complexity and susceptibility to disruption of supply chains, the lack of transparency of practicable solutions and know-how, as well as the diversity of inconsistent standards and legal regulations are major challenges for the design and further development of climate neutrality and sustainability in Austrian hospitals. In contrast, non-transparent market structures and comparisons of offers, resistance to cultural change as well as incomplete circular economy and recycling methods pose secondary challenges regarding the design and further development of climate neutrality and sustainability in Austrian hospitals. (Figure 4) These assessments may be due to the previous concentration on the profession-specific structures, processes and competencies as well as favorable resource availability and focus on a linear economy. In contrast, climate neutrality and sustainability tend to focus on the circular economy, resource conservation and long-term planning and responsibility horizons, which are currently given comparatively less importance and appreciation. In the future, it will be important to devote more attention to the visibility and prioritization of the strategic topic of climate neutrality and sustainability as well as to the development of an adapted resource use concept, a holistic system model and a derived sustainable business model. (Figure 4) [42–53].

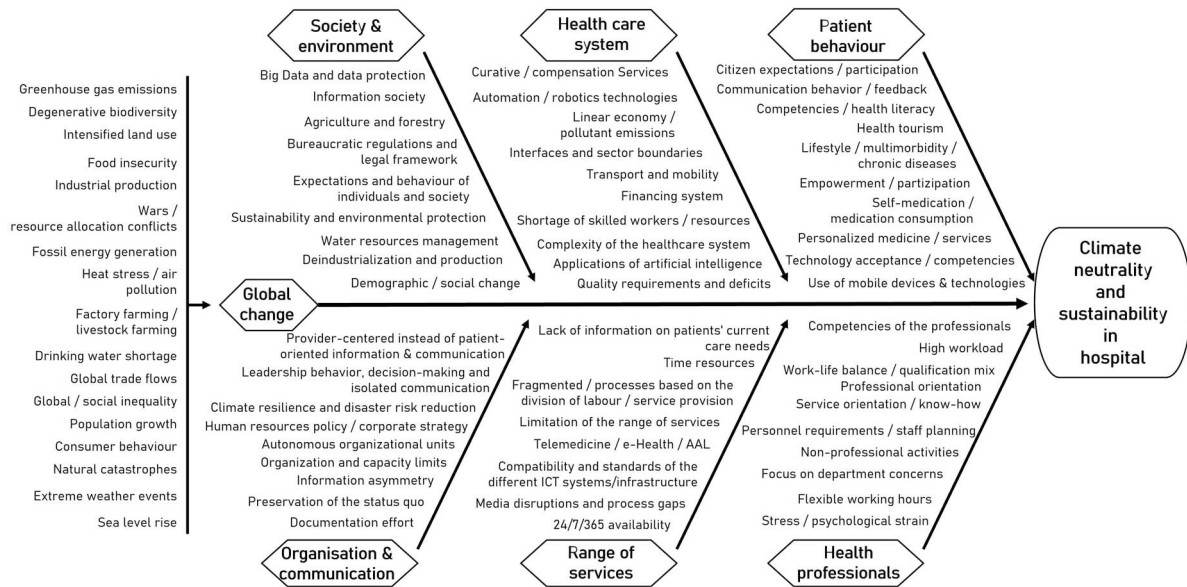


Figure 3. Ishikawa diagram regarding climate neutrality and sustainability in hospitals [36–41].

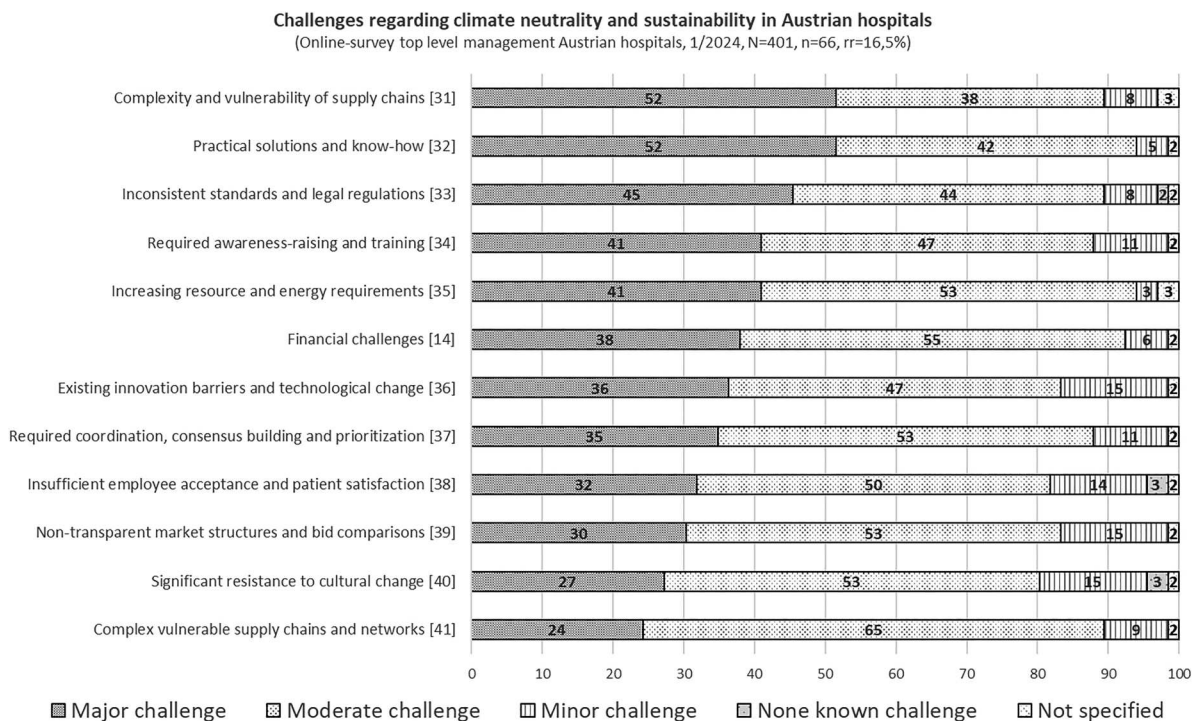


Figure 4. Challenges regarding climate neutrality and sustainability in Austrian hospitals.

3.3. Solutions and instruments of sustainability management in Austrian hospitals

In order to overcome the identified challenges regarding climate neutrality and sustainability in Austrian hospitals, a wide range of solutions and instruments of sustainability management are available. (Figure 5) The spectrum ranges from short-term reactive measures (e.g. energy-efficient lighting, reduction of single-use plastics) to long-term strategic concepts (e.g. implementing green building standards, sustainable mobility solutions). These instruments and approaches are designed to meet external requirements (e.g.

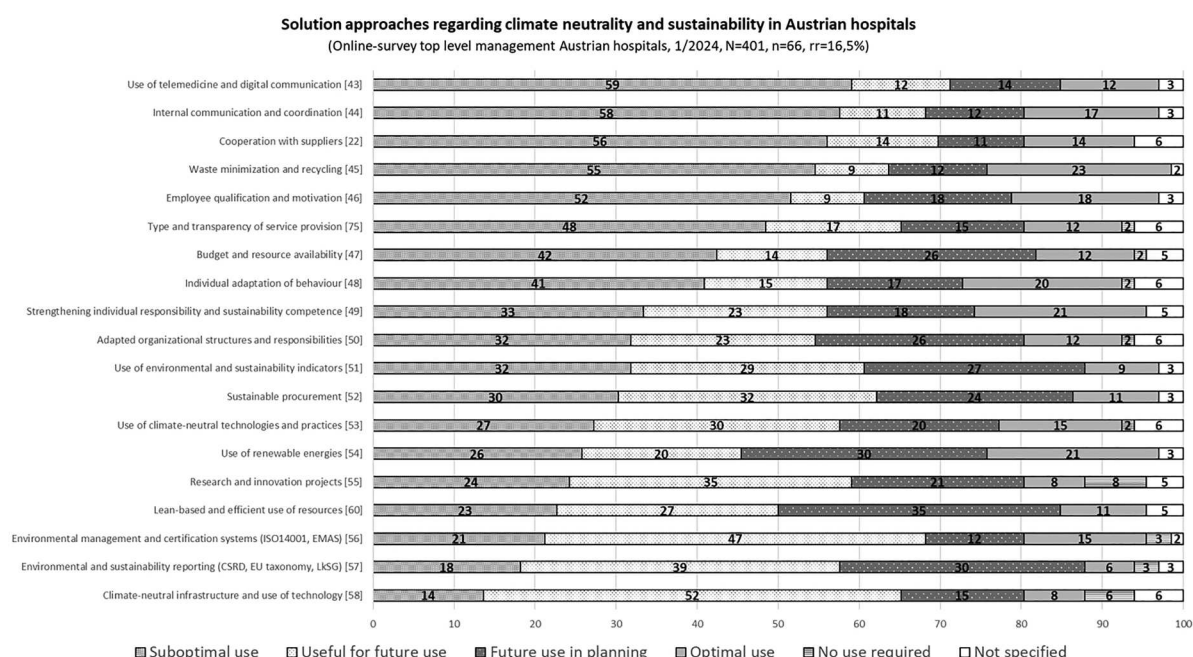


Figure 5. Solutions regarding climate neutrality and sustainability in Austrian hospitals.

LEED certification, sustainability reporting) and to use internal design options (e.g. telemedicine and digital communication, waste minimization and recycling, staff qualification and motivation, lean-based and efficient use of resources). From the point of view of the surveyed managers and decision-makers in Austrian hospitals, many different solution approaches are already being used at least suboptimal (e.g. telemedicine and digital communication, internal communication and coordination, cooperation with suppliers, waste minimization and recycling, personnel qualification and motivation). In contrast, the respondents see future potential and requirements for long-term strategic concepts to promote climate neutrality and sustainability in Austrian hospitals (e.g. use of renewable energies, lean-based and efficient use of resources, strengthening of individual responsibility and sustainability competence). (Figure 5) [53–69]

4. Discussion

System design, process development and performance measurement are the central tasks of strategic management in hospitals. Regarding sustainability and climate neutrality of inpatient care, in addition to the overarching objectives, a holistic management concept must be developed and implemented operationally. This requires a comprehensible and practicable roadmap [70].

4.1. Dimensions of sustainability management in hospitals

The online survey, which was conducted among management and decision-makers, focused on determining the overall sustainability maturity level of Austrian hospitals. This is specified by applying a corresponding maturity model or, furthermore, by identifying relevant dimensions of maturity (e.g. patient orientation and qualification) as well as associated instruments and measures (e.g. electronic patient record). Twelve dimensions for climate neutrality and sustainability in hospitals were identified. These dimensions represent an overarching significance or orientation for value creation and service provision in hospitals and have specific characteristics regarding climate-neutral and sustainable transformation. (Figure 6) As part of the online survey, participants were asked to subjectively assess the status of the twelve maturity dimensions for their hospital. The rating scale ranged from absent (0) to fully established (10). Based on this, it is important to identify, develop, apply and evaluate appropriate solutions and measures (e.g. further training on the topic of sustainability). This requires suitable and meaningful indicators (e.g. recycling rate,

No	Dimensions	Description
1	Patient orientation and qualification	Patient orientation refers to the overarching recipients or users of the interdisciplinary and division of labor activities in the hospital. Sustainability refers to both primary medical, nursing and therapeutic services (e.g., surgical services, imaging diagnostics) as well as service and communication services (e.g., food provision, patient records). [79]
2	Employee orientation and qualification	Employee orientation refers to the central service providers of knowledge-based health services in the hospital. Sustainability refers both to the actual work services (e.g., deployment planning, provision of work equipment) and to the supporting communication, qualification and motivation services (e.g., intranet, employee training). [80]
3	Organizational leadership and management	Organizational management includes the institutional, functional and procedural design and control in the hospital. In this regard, sustainability refers to information, communication and control activities (e.g., communication platform, digital knowledge database). [75]
4	Support processes and provision of resources	The provision of necessary resources at the point of care in the hospital takes place via non-professional or specialized support processes. Sustainability here enables efficient and effective design of information, work equipment and people (e.g., point-of-use supply, workflow design). [60]
5	Administration and documentation	Administration and documentation includes documentation, proof and communication tasks that relate to all work processes within an organization. Sustainability enables barrier-free and resource-saving access to relevant data, information and knowledge (e.g., automated data capture, central hospital information system). [81]
6	Purchasing, logistics and supplier management	Initiation and implementation of external procurement and internal provision of relevant production factors at the respective point of use. Sustainability ensures resource-saving and barrier-free procurement, use and removal or reduces this to a minimum (e.g. circular economy, recycling, regional procurement). [82]
7	Human resources management and recruiting	Human resources management includes the procurement, deployment, and provision of the required employees. Sustainability here essentially refers to training and raising awareness among employees, efficient personnel planning and management, and the creation of a safe and healthy working environment (e.g., mobile working, personnel deployment planning, employee retention). [83]
8	Marketing and public relation	Marketing includes promoting the hospital's image and communicating with external and internal cooperation partners and stakeholders. Sustainability supports the promotion of environmentally friendly practices, capacity utilization, and trust and satisfaction among patients, suppliers, and the public (e.g., patient loyalty, ecological awareness, green literacy). [84]
9	Buildings, hospital technology and IT infrastructure	The structural infrastructure of a hospital is determined by buildings, hospital technology and IT infrastructure, which form the basic prerequisite for the provision of services in the hospital. Sustainability refers to the binding of resources and the consumption of raw materials for the construction and maintenance of the basic infrastructure (e.g., nearly zero energy hospital building, intelligent building automation). [85]
10	Devices, technologies, hardware and software	The devices and technologies used in patient care largely determine the hybrid and knowledge-based healthcare services in hospitals. Sustainability influences the variable resource consumption and emissions (e.g., telematics infrastructure, sterile goods processing). [86]
11	Data privacy and security	The security and data protection measures protect data, meet legal requirements and reduce a hospital's environmental impact. Sustainability contributes to climate neutrality, optimizes energy consumption, reduces paper use and increases the efficiency of workflows (e.g., secure mobile computing, process automation, power system reliability). [87]
12	Innovation and competitiveness	The innovation and competitiveness (output) of hospitals is determined by the efficient use of resources (input) and the provision of high-quality services (throughput). Sustainability promotes, among other things, energy-efficient technologies, optimized performance processes and increased circular economy (e.g., sterile supply, leadership in energy and environmental design, remote patient monitoring). [88]

Figure 6. Dimensions regarding climate neutrality and sustainability in hospitals.

energy consumption, CO₂ emissions, single-use product quota) [71,72]. Consequently, the corresponding strategic fields of action for hospital management must be brought together in an overarching sustainability concept [70].

4.2. Sustainability-related green hospital concept

A corresponding green strategy is required for the overarching targeting, planning, control, implementation, and evaluation of the climate-neutral and sustainable orientation of service provision and resource use in hospitals [72]. An overarching green strategy in hospitals is essential to systematically and holistically pursue sustainability goals. Such a concept serves to orient and support the communication of goals and

content, coordination of resources and measures, as well as cooperation between internal employees and external suppliers or stakeholders. The environmental analysis (e.g. Carbon Footprint Analysis, SWOT analysis), the objectives (e.g. UN Sustainable Development Goals, security of supply), the current design (e.g. sustainability maturity, resource use), the envisaged solutions (e.g. use of renewable energies, circular economy) and the relevant measurement indicators (e.g. CO₂ emissions per patient (t CO₂e/patient) [73], active pharmaceutical ingredients – APIs in hospital effluents (µg/L) [74], nitrous oxide in the surgical theater's environment (ppm N₂O) [75]) can be identified and combined as central contents. Ultimately, it is important for the managers and decision-makers in the respective hospitals to develop individually specific green hospital strategies. Therefore, the developed sustainability maturity model, the identified sustainability maturity level of Austrian hospitals, the overarching objectives, the relevant challenges and possible solutions are useful to consider [55].

4.3. Roadmap to improve climate neutrality and sustainability in inpatient care

The developments towards a climate-neutral and sustainable hospital require a targeted and coordinated approach. This requires qualified and conceptual change management [76]. With regard to the future orientation and establishment of a green hospital strategy in inpatient patient care, it is important to pursue a conceptual approach and a corresponding roadmap. This sustainability governance change model for organizations in the healthcare sector should be based on the 8-step approach according to Kotter [77], although this is only a rough process model. This process model should be expanded, adapted and specified as part of a hospital-specific sustainability project (e.g. specific project management, self-assessment of the sustainability maturity level, prioritization of possible solutions and measures, development of an individual green business model, establishment of a strategic green performance measurement) [78–82]. In concrete terms, this means developing a targeted sustainability strategy regarding, for example, circular economy and/or employee awareness [83]. Furthermore, initial quick wins must be implemented (e.g. digitization, electronic medical record) [84]. Furthermore, successes must be measured and communicated (e.g. reduced water consumption, impact dialogue) [78].

5. Conclusion

Patient care and service provision in hospitals are central value-added processes for society and a relevant economic sector. At the same time, hospitals and the entire healthcare system are essential players in terms of climate-damaging emissions [85]. These different realities must be reconciled by means of a green hospital strategy and corresponding commitment. Based on the results of the online survey and the associated research, a wide range of existing challenges as well as possible solutions, measures and instruments can be identified. These must be individually adapted and implemented according to requirements, maturity and available resources and qualifications. In connection with these results, it becomes clear that climate neutrality and sustainability also represent a central and future-relevant challenge and strategic task in the Austrian hospital system. To overcome these challenges, it is necessary to develop and apply a variety of solution approaches (e.g. lean & green management approach) and instruments (e.g. sustainability reporting) in conjunction with conceptual project and change management. Optional limitations of the empirical results lie in the operationalization and adaptation of possible solutions and their implementation in the respective hospital (e.g. lack of legal obligation, employee resistance to change). The response rate is comparable to similar expert surveys [34]. Given the high level of expertise of the participating experts (CEOs, administrative directors, medical directors, chief nursing officers, technical directors), the response rate of 16.5% represents an acceptable and representative value. The aim here is to improve the sustainability maturity level in the respective hospital through adapted sustainability strategies and guidelines [86], regular audits and KPI-based monitoring [87], as well as comprehensive stakeholder involvement [88]. The study results identify concrete needs for action (Figure 4) and possible options for action (Figure 5) to strengthen climate neutrality and sustainability in Austrian hospitals. Future research needs to include the qualitative assessment of possible internal and external influencing factors (e.g. expert interviews, paired comparisons) as well as the identification of impact chains and medium-term effects on the sustainability of hospital care (e.g. impact assessment, impact evaluation).

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