



Identifying Key Criteria and Prerequisites for the Establishment of Green Hospital Systems in Iran: A Qualitative Analysis

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Abstract

Introduction: Hospital administration through green management is essential to reduce costs and mitigate the environmental footprint of healthcare. In Iran, hospitals account for an estimated 7–10% of total public sector energy consumption, and medical waste generation exceeds 250 tons daily, much of which is disposed of without adequate treatment. These factors impose heavy financial and ecological burdens, underscoring the urgency of transitioning toward sustainable hospital systems. Therefore, this study aimed to identify key prerequisites for establishing green hospitals in Iran.

Methods: This qualitative study employed conventional content analysis. Twenty-seven participants—including hospital managers, environmental health specialists, and academic experts—were selected through purposive and snowball sampling until data saturation was achieved. Data were collected via semi-structured interviews and analyzed using the Graneheim and Lundman framework in MAXQDA version 2018. Trustworthiness was ensured through Lincoln and Guba's criteria.

Results: Eleven components and 45 actionable items were identified as prerequisites for green hospital development. The most critical areas included waste management (e.g., segregation, mercury reduction), energy management (e.g., optimization of HVAC and lighting), and water management (e.g., low-flow systems, recycling). These domains formed the basis for a locally adapted framework.

Conclusion: The findings highlight the urgent need for Iranian hospitals to adopt comprehensive and context-specific green hospital criteria. Policymakers and hospital managers should use the identified framework to reduce environmental harm, cut operational costs, and improve healthcare quality.

Keywords: Green hospital, Sustainability, Prerequisites, Iran, Healthcare management

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Introduction

Public health and environmental crises now converge, amplifying societal vulnerability. Climate change, pollution, and unsustainable resource use exacerbate global disease burdens, overwhelming healthcare systems worldwide (1). Healthcare systems, particularly hospitals, paradoxically intensify these crises through energy-intensive operations, excessive resource use, and waste generation, undermining the very public health they aim to protect. The healthcare sector is recognized as a major global polluter (2, 3). In Iran, this challenge is particularly evident, as hospitals face increasing pressures from both rising healthcare demands and the environmental impacts of unsustainable operations (4).

In many developed countries, hospitals have turned to

green management and the concept of green hospitals as a solution to mitigate these issues (4, 5). Green hospitals minimize environmental impacts and disease transmission by adopting sustainable waste, water, and energy practices, pollution control, and environmentally oriented governance (6-8). International experiences provide valuable models: in the United States, the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) framework evaluates hospitals across six sustainability dimensions—energy management, laboratory operations, water use, waste management, pharmaceuticals, and green space—offering tiered certifications (licensed, silver, gold, platinum) (9). Similarly, the Green Guide for Health Care has introduced 12 criteria for European hospitals, including location, water and energy management, healthy nutrition,



indoor environment quality, recycling, pollutant control, and health gardens (10, 11).

In Iran, however, studies evaluating green hospitals have primarily relied on ISO-based checklists (2, 8). ISO standards chiefly address broad environmental management systems and lack healthcare-specific operational requirements (11). As Shabani et al. reported in their comparative study, while ISO offers a general environmental framework, hospitals in different countries have developed localized models tailored to their contexts (7). This suggests that reliance on ISO in Iran provides only partial guidance. Therefore, there is a pressing need for context-specific frameworks that reflect the realities of Iranian hospitals (7, 12).

The status of green hospitals in Iran remains unsatisfactory. According to data from the General Support Department of the Social Security Organization, among 69 social security hospitals, only 19 (28%) had succeeded in implementing or fully establishing green hospital initiatives by 2017 (7, 8, 13-15). Although these statistics are valuable, they are outdated. More recent reports (post-2020) from the Ministry of Health and WHO have indicated that progress has been slow and fragmented, highlighting the need for updated evidence and stronger policymaking (5).

A distinctive focus of this study is on teaching hospitals. These hospitals, which utilize substantial government funds, are mandated not only to provide healthcare but also to educate future healthcare professionals and adhere to national standards. Consequently, they are expected to act as role models in implementing sustainability initiatives. Public funding creates an obligation to demonstrate accountability, efficiency, and environmental stewardship. Furthermore, national policy discussions and societal expectations reinforce the role of teaching hospitals as pioneers in adopting green practices (12, 16, 17). Despite this, evidence shows that many teaching hospitals in Iran have not yet achieved green certification, underscoring a significant implementation gap (13).

Among developing countries, Singapore has served as a successful model by adopting a green productivity strategy, leading to measurable results in energy and waste management. For example, through innovative energy-saving techniques and rigorous waste segregation, Singaporean hospitals achieved a 14% reduction in energy use, a 25% reduction in water use, and a 50% reduction in paper consumption over 34 months, generating total savings of \$1.872 million (12, 14, 15). Such international examples illustrate both the feasibility and economic benefits of transitioning to green hospital systems.

As a result, hospitals and healthcare systems in many countries—including Iran—are seeking to establish green hospitals to reduce harmful environmental impacts, protect public health, and reduce costs simultaneously (12, 16, 17). Nevertheless, progress in Iran has been uneven, with limited adoption of comprehensive models.

Therefore, this study was conducted to identify the necessary prerequisites and requirements for establishing green hospitals in Iran. By systematically engaging

experts in hospital management, environmental health, and sustainability, this research aimed to produce a stakeholder-informed, context-specific framework that can serve as a practical guide for hospital managers and policymakers. Such a framework is expected to clarify actionable priorities, strengthen sustainability policies, and accelerate the adoption of green hospital practices in the Iranian healthcare system.

Methods

The present research is of a qualitative type using the content analysis method with an inductive approach, which was carried out in 2021. Qualitative content analysis is a method of analyzing written, spoken or visual messages, and as a research method, it is considered a systematic and purposeful method to describe a phenomenon. This method allows the researcher to examine the topics to be considered to understand them more.

The studied population in this research included faculty members in the field of healthcare management with relevant work experience and academic background, hospital managers with at least five years of managerial experience, environmental and environmental health experts, managers of social security hospitals that have pioneered green hospital initiatives in Iran, and experts from the Credit Unit of the Ministry of Health and Medical Education. The final research sample consisted of 27 experts in the fields of management, environmental sciences, and environmental health. Participants were selected using purposive sampling combined with the snowball method to ensure diversity and expertise.

Inclusion criteria were: (1) a minimum of five years of professional or managerial experience in a relevant field; (2) academic or professional expertise in hospital management, environmental health, or green hospital initiatives; and (3) willingness to participate and share professional experiences.

Exclusion criteria were: (1) less than five years of professional experience; (2) lack of direct involvement in healthcare management, environmental health, or green hospital projects; and (3) unwillingness to participate.

The samples were selected by conducting 27 individual interviews, each interview lasting between 20 and 45 minutes. Due to the fact that no new cases appeared after conducting the interviews and it was felt that there was a state of saturation in the data, the interviews were stopped. The demographic characteristics and details of the study participants are summarized in [Table 1](#). Participants were selected using purposive sampling combined with the snowball method to ensure diversity and expertise. Participants are referred to in the text using the code 'M' followed by a number (e.g., M-21) to maintain confidentiality, where 'M' stands for 'participant' or 'interviewee.'

The data collection tool was semi-structured open and in-depth individual interviews, which were used to start the interview with a number of general questions

Table 1. The information of participants

Work experience (years)	Gender		Contributors
	Female	Male	
4-8 (average 6)	1	1	Hospital support assistants
15-25 (average 20)	2	3	Health management
8-10 (average 9)	0	2	Treatment assistants
8-10 (average 9)	4	4	Environmental Health
1-15 (average 8)	3	2	Environmental experts
4-5 (average 3)	0	5	Hospital managers

as guiding questions to clarify specific issues. In the first stage, these questions were designed by reviewing the texts and the opinions of the guidance professors and expert advisors. The interviews started with the question: “What prerequisites and requirements should hospitals have in order to be able to reach the degree of greenness?” And based on the participant’s answer, it continued until the answer did not deviate from the main topic.

Voluntary participation, obtaining full and informed consent from participants, granting them the right to withdraw at any stage, making the results available to participants upon request, and observing ethical principles of interviewing---including confidentiality of responses and protection of information---were among the ethical considerations observed by the researcher. The protocol for this study was approved by the Ethics Committee of Kerman University of Medical Sciences (Ethical code: IR.KMU.REC.1401.172).

In this study, MAXQDA version 2018 software and conventional content analysis method were used for data analysis. The qualitative data analysis process was carried out based on the steps proposed by Granheim and Landman. The analysis followed these specific steps:

1. Transcription and immersion: All interviews were transcribed verbatim and reviewed multiple times to gain familiarity with the data.
2. Identifying meaning units: The text was broken down into the smallest meaningful units containing a single concept (e.g., “implementation of waste segregation systems” or “adoption of energy-efficient lighting”).
3. Open coding: Each meaning unit was assigned a descriptive code through line-by-line analysis.
4. Grouping codes into subcategories: Similar codes were grouped into subcategories based on their relationships (e.g., codes related to “LED lighting,” “HVAC optimization,” and “smart energy monitoring” were grouped under “energy conservation strategies”).
5. Forming main categories: Subcategories were further abstracted into main categories through continuous comparison (e.g., subcategories of energy management, water conservation, and waste reduction formed the main category “resource management”).

To ensure the trustworthiness of the data, we applied the four criteria proposed by Lincoln and Guba: Credibility, dependability, confirmability, and transferability. Specific strategies included:

- **Credibility:** Prolonged engagement with data, peer debriefing with three faculty members, and member checking with selected participants
- **Dependability:** Maintaining detailed audit trails of all analytical decisions
- **Confirmability:** Using software to track the coding process and analytical decisions
- **Transferability:** Providing thick descriptive data of the context and participants

The results of the analysis were shared with three academic experts to verify the credibility and confirmability of the findings.

Results

A total of 27 interviews were conducted with 27 participants. The participants included 5 hospital managers, 5 environmental experts, 8 environmental health specialists, 2 former vice presidents of treatment, 5 health service management specialists, and 2 hospital support assistants.

The findings related to the requirements and criteria for setting up a green hospital in Iran according to the perceptions of the participants were compiled in 11 components and 45 actions as follows. The following is a description of each of the dimensions: The main concepts and sub-concepts extracted from the expert interviews regarding the requirements and criteria for establishing green hospitals are presented in [Table 2](#).

Waste, energy, and water management

One of the main concepts was the perception of the participants about waste management. Waste management is one of the most important dimensions that have been taken into consideration in all hospital models, along with water and energy fields, due to its great importance. Wastes are produced in hospitals, clinics, and other medical centers, as well as medical and pharmaceutical research centers. “Wastes from operating rooms, blood bags, plastic and glass bottles, syringes and needle heads, surgical gloves, blood and blood products, and medicines are among the materials that can be seen in the composition of medical waste.” (M-21) The participants in the research also paid enough attention to this component and considered things such as reducing waste, reducing medical waste, reducing mercury, reducing internal waste, and separating waste in the hospital to reduce costs.

Energy management, water management, and laboratory departments due to the presence of hazardous materials were important aspects that experts emphasized a lot. “Management of hazardous materials, modification of the heating and cooling and ventilation systems of the hospital, creation of standards to reduce energy consumption such as electricity, gas, electricity consuming panels, lighting inside and outside the hospital are the things that increase the cost. Also, in order to be more economical, the water management of the laundry house parts should be taken seriously” (M-19).

Table 2. Concepts and sub-concepts related to the experts' views regarding the requirements and criteria for setting up green hospitals

Row	Dimensions or subject	Subtopic	
1	Waste Management	Reducing waste Reducing mercury	Waste segregation List of warehouse materials
2	Energy Management	Adjusting cooling and heating and air conditioning systems	Lighting management Water protection and items related to it
3	Diagnostic and care department	Green purchase of the diagnostic department Staff training Management of surgical supplies	Management of solvents Cleaning glassware Water flow regulators
4	Water management	Establishing principles and guidelines Building water consumption management	Personnel training Bathrooms and toilets
5	Cafeteria and food service	Water consumption management Energy Management	Using the latest technologies waste reduction
6	Cleaning and disinfection	Effluent control Control of cleaning materials	Reduction and correct use of disinfectants
7	Administrative department of the hospital	Lighting office Equipment	Paper Education
8	Hospital pharmacy department	Management of broadcast and distribution agents Management of obsolete drugs	Separation of waste Separation of dangerous drugs
9	Green hospital system	Commitment of managers Creating guidelines Responsibilities and related documents Internal audits and program analysis	Creation of different working groups targeting Survey
10	Hazardous materials management, laundry	Management and instructions Regular training program	Water consumption management Chemical management
11	Gardening and green spaces	Management of water lines, pumps and valves	Low volume irrigation

Green hospital system

Another main concept revealed by interviews with experts was the green hospital system. Since the participants emphasized on determining the principles and guidelines of green management in the hospital, defining responsibilities, training personnel, and creating goals, it was determined that having a green management system in the hospital is necessary to achieve green standards. One of the officials of the hospital stated, "At the stage of implementation and establishment of the management system of green hospital, I must have an implementation plan for these 7 actions that we must add in our management style. You always have training and you should hold it, but this time we want to have specific to the PONT trainings under the title of optimal use of resources, specific trainings under the title of green hospital, which means that when you say that I am holding a green hospital class, it means that you are actually talking about optimal use of resources. Then, we should be able to self-audit in the working group that we have in the credit department or to empower that subgroup. We must relate our human resource performance evaluation system to the optimal use of resources. And then the accountant will report to us how much savings have been created based on the work we have done, so we can reward our colleagues and share them from that savings" (M9).

Diagnostic and care department

The analysis of the data from the interviews revealed another main concept called the diagnosis and care section. The results of this study showed that the diagnostic and care departments play an important role in reaching the standards of the green hospital, as well as reducing costs in the hospital. Diagnostic and care departments usually use complex and energy-consuming medical equipment. To create green hospitals, it is important to try to optimize energy consumption in these departments. "If we want to

run a green hospital, we need to know the departments, we need to know where there is waste of resources, where there is harm, where we have hazardous materials in the care departments, this includes the use of energy saving technologies, monitoring the consumption of electricity and gas, and creating artificial intelligence control systems to control the temperature of the rooms and lighting" (M21). Therefore, the purchase of materials, the management of surgical supplies, materials and solvents, and the training of personnel in these departments were considered important in this concept.

Cafeteria and food service

Another main dimension of the Green Hospital was the cafeteria and food services. The results of the study showed that cafeterias and food services in hospitals can also play an important role in achieving green hospital standards. Promotion of fresh and seasonal ingredients, management of food waste, reduction of resource consumption, use of modern ordering systems, and interaction with other green hospitals are among the most important measures that can be taken in this field. "In general, cafeterias and food services in hospitals can contribute to the realization of green hospital standards by observing the principles of environmental management, attention to health and safety, and optimal use of resources. These actions play an important role in improving the environment and improving quality services for patients" (M22).

Cleaning and disinfection

The results of the analysis of the interviews revealed another aspect of the green hospital under the title of cleaning and disinfection, which is very important and plays an important role in achieving the standards of the green hospital. Correct and optimal use of cleaning and disinfecting materials, use of environmentally friendly

materials, proper waste management, training and awareness of medical staff and hospital staff are among the most important measures of this component. For example, one of the participants mentioned about the correct management of waste in the discussion of disinfectants: Both the selection of cleaning and disinfecting materials should be environmentally friendly, which will have the least negative effects on the environment, and the waste related to cleaning and disinfecting materials should be properly disposed of and managed to prevent environmental pollution. This includes the separation and management of hazardous waste” (M17). Therefore, managing cleaning and disinfecting materials in environmentally friendly ways and implementing strategies to reduce chemical consumption in hospitals can help achieve green hospital standards and reduce negative impacts on the environment and human health.

Administrative departments of the hospital

The administrative department of the hospital also plays an important role in achieving the standards of the green hospital. This administrative department can help improve the hospital's environmental performance by managing resources and providing financial and human resources, formulating and implementing policies and strategies, and interacting with other departments. For example, formulating and implementing policies and strategies, managing financial and human resources, interacting with other medical departments, technical departments, and food service departments to realize the standards of the Green Hospital. Another participant stated that “green hospitals need expert teams that can follow environmental goals and ensure compliance with standards.” The administrative department can help in attracting, training, and developing human resources with expertise in the field of environment...” (M5).

Hospital pharmacy department

Another main component of achieving a green hospital is the pharmacy department of the hospital and compliance with the necessary standards. According to one of the officials of the hospital, the pharmacy department is one of the major departments of the hospital that plays an important role in achieving the standards of the green hospital. Pharmacies can play an important role in green hospitals by formulating appropriate environmental strategies and actions, sustainable use of drugs, reducing the production of hazardous waste, and promoting environmentally friendly approaches in the promotion of drugs and pharmaceuticals. These include the sustainable use of medicines (choosing medicines and medicinal substances with low impacts on the environment), managing pharmaceutical waste, promoting medicines that have the least impact on the environment, and promoting the optimal use of medicines. Also, the pharmacy department should cooperate with other departments of the hospital, such as the medical department, the administrative department, and the technical department,

to fulfill the standards of the green hospital and promote the supply of environmentally friendly pharmaceutical resources.

Hazardous materials management, laundry

Another component was achieved to achieve the standards of the Green Hospital for the management of hazardous substances. Hazardous substances include chemical drugs, pollutants, hazardous chemicals, medical waste, and other substances that have the potential of harming the environment and human health. One of the interviewees stated: “We must reduce the consumption of hazardous chemicals in the hospital, manage hazardous waste, choose materials to buy and use in the hospital that are environmentally friendly, control and monitor our medical equipment... many of these equipment contain high-risk materials” (M. 11).

Gardening and green spaces in the hospital

Gardening and creating green spaces in hospitals is one of the important aspects of green hospitals that can help improve the quality of the hospital environment and the well-being of patients and medical staff. To achieve the goals of the Green Hospital in the field of gardening and green spaces, the participants should bring the use of local plants, choose local plants that are compatible with the regional climate, use advanced technologies such as automatic irrigation systems, and create outdoor and sports spaces. For example, they pointed out that “if we use new technologies for irrigation, we will cause less damage to the environment, and it will help the hospital in reducing costs... Even the existing technologies can be used for the lighting of green spaces” (M 21). In general, gardening and creating green spaces in hospitals can help improve the well-being and quality of the hospital environment and improve the morale and health of patients and medical staff. These measures help fulfill the green hospital standards and improve the environmental and biological conditions in hospitals.

Discussion

This study aimed to define the criteria for establishing green hospitals in Iran, identifying 11 key components emphasized by health leaders. These components included waste management, energy management, water management, sustainable operations, pollution control, environmental management, hazardous materials management, staff education, infrastructure optimization, patient-centered environmental practices, and monitoring/evaluation systems. Each component is discussed below in accordance with the results.

Waste Management

Waste management was emphasized as a critical dimension in all hospital models. The participants highlighted reducing general and medical waste, proper segregation, and minimizing hazardous materials to reduce costs and environmental impact (M-21, M-15). These findings

align with the findings of prior studies highlighting waste management as a foundational strategy for green hospitals (12, 18,19-21).

Energy Management

Efficient energy utilization, including renewable energy sources and energy-efficient devices, was considered essential. Proper energy management in diagnostic and care departments helps reduce operational costs and environmental impact, which is consistent with the results of previous studies (18,19-23).

Water Management

Water conservation measures, including recycling and optimal usage in hospital operations, were reported significant for achieving green standards. Participants emphasized that water management is a key factor in sustainable hospital operations (18, 19).

Sustainable Operations

Sustainable operations, including eco-friendly procurement, green building practices, and efficient administrative processes, were reported necessary. Scientific management, new technologies, creation of guidelines, and staff training contribute significantly to sustainable operations, confirming the findings from prior studies (12, 20).

Pollution Control

Controlling emissions and environmental pollutants in hospitals was identified as a key factor. Participants stressed monitoring air, water, and chemical pollutants, which aligns with the results of previous evidence (1, 7, 21).

Environmental Management

The establishment of environmental management systems, including green hospital working groups and clear guidelines, was reported as vital. Experienced and committed managers were identified as critical for improving hospital performance in this area (12, 20, 6).

Hazardous Materials Management

Proper handling of chemical drugs, pollutants, and medical waste was emphasized. Effective protocols and staff training prevent environmental contamination and protect human health, in line with the results of previous studies (12, 7).

Staff Education

Continuous education and training of hospital personnel were identified as essential for maintaining green practices. Educated staff contribute to better compliance with green standards, which is consistent with the results of prior research (18, 19).

Infrastructure Optimization

Optimizing hospital infrastructure, including eco-friendly equipment and energy-efficient facilities, was recognized as critical. Infrastructure improvements facilitate

the implementation of sustainable operations across departments (5, 12, 22).

Patient-Centered Environmental Practices

Participants highlighted the role of cafeterias and food services in promoting green practices. Measures such as using fresh and seasonal ingredients, reducing food waste, and sustainable ordering systems contribute to overall hospital sustainability (21).

Monitoring and Evaluation Systems

Robust monitoring and evaluation systems were considered necessary to ensure compliance with green standards. Regular audits, performance assessments, and reporting mechanisms support continuous improvement, consistent with the international models and ISO standards (5, 12, 22).

This study provided a comprehensive framework for green hospitals in Iran. The findings underscore the need for integrated strategies across environmental, operational, and human resource domains, supported by managerial commitment and government leadership. Future studies can use these components to evaluate hospital performance and implement targeted interventions to enhance sustainability.

Conclusion

According to the findings of the present study, the hospitals of Iran need a scientific and local framework to achieve the green certificate and benefit from it. When hospitals are familiar with the general framework and the requirements and criteria for setting up a green hospital, they can identify and remove the obstacles ahead.

Hospitals can benefit from advantages of establishing an environmental management system. With an environmental management system, hospitals can identify and reduce environmental pollution, reduce energy, water and waste disposal costs, control the use of dangerous substances, limit the release of pollutants in the air, improve the quality of medical services provided to the patient, improve the moral image of the organization and its responsibility towards the society, comply with applicable laws and regulations and reduce its operating costs. Hospitals should encourage employees to actively participate in reducing pollution, improving performance, reducing costs, and improving environmental performance. The sooner the environmental management system is implemented, the better the hospital will be in achieving future innovations and complying with new regulations.

Actions and measures in the direction of green hospitals should not be considered as limiting works or obstacles to the quality of services and comfort of patients, but on the contrary, it should be seen as a rich and challenging vision for leading hospitals. In fact, the implementation of the best environmental and green practices goes hand in hand by improving safety, quality, and saving costs, as well as improving the health protection of employees and patients. The green hospital system should be considered a green package that has a holistic approach to the health

care sector.

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Competing Interests

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Ethical Approval

The protocol for this study was approved by the Ethics Committee of Kerman University of Medical Sciences (Ethical code: IR.KMU.REC.1401.172).

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