World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Sustainable healthcare: Assessing the impact of green innovation on medical firm performance and patient outcomes

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World Journal of Advanced Research and Reviews, 2026, 30(02), 1595-1607

Publication history: Received on 13 April 2026; revised on 18 May 2026; accepted on 21 May 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.30.2.1440

Abstract

Healthcare organizations are under increasing pressure to adopt sustainable practices in response to growing environmental concern and regulatory demands. Green innovation is identified as a key strategy, though limited understanding exists around its impact on organizational performance and patient care. The purpose of this paper is to empirically explore the relationship between green innovation and performance outcomes in medical firms, and also whether firm performance mediates these relationships along with the moderating effects of both regulatory support and technological readiness. A quantitative cross-sectional survey was deployed to 223 healthcare practitioners from hospitals, pharmaceutical companies and medical devices manufacturers. Data were analyzed using Partial Least Squares Structural Equation Modeling with SmartPLS 4.0. The results substantiate that green innovation may substantially improve medical firm performance (β=0.65) and patient outlooks (β=0.58) Mediation of firm performance in green innovation–patient outcomes model. The pathways are positively moderated by both regulatory support and technological readiness, enhancing sustainability benefits. Green innovation is a strategic lever that enhances both organizational efficiency and patient care. Strong sustainability-performance nexus in healthcare: firm performance as a mediator, regulatory and technological contexts as amplifiers. Environmentally friendly operations should be of interest to healthcare administrators, as evidence suggests improved metrics associated with financial and clinical performance. Supportive policies and incentives adopted by policymakers must go hand in hand with organizations investing in technology infrastructure, as well as training for employees towards successfully scaling up green initiatives.

Keywords: Green Innovation; Medical Firm Performance; Patient Outcomes; Regulatory Support; Technological Readiness

1. Introduction

In recent years, the world has seen a major shift towards sustainability in different industries, which has been driven by an increase in environmental concerns, more challenging regulatory environment, and the call from the market for ethical activities. Healthcare, being the most critical sector, is one of the areas undergoing significant sustainability shifts [3]. The sustainability issue in healthcare has become more critical as it involves to lower the carbon footprints, decrease waste, and take up environmental-friendly technologies, without changing the quality of patient care [5]. Green innovation is a keystone in the sustainability model that not only contributes to the environment but also provides the impetus to organizational performance [2]. Adoption of an eco-friendly medical device, energy-efficient procedures, and a sustainable supply chain by healthcare companies can save them expenses and improve their environmental performance, as a result, they grow their competitiveness level.

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1.1. Research Objectives

The primary intention of this study is to assess the impact of green innovation not only on medical firm performance but also on patients' results. To achieve this goal, the study has defined a number of secondary objectives: The first of these examines the mediating effects etc. This study aims to discover how Medical Firm Performance is mediated by green innovation and patient outcomes. The second involves identifying moderating effects by analyzing the following. Here, the role of regulatory support and the level of technological preparedness affecting the impacts of green innovation are examined. Collectively, these objectives are focused towards the unveiling of the very impact of green innovation on one side and sustainability in healthcare movement alongside confirming and assuring the benefits that accrue to organizations as well at patients.

1.2. Significance of the Study

This has major implications not just for sustainable healthcare but for green innovation as well. We then introduce the concepts of mediation and moderation to model the impact of green innovation on health systems. To application, the findings provide some valuable insights for health workers, policy-makers and industry. Healthcare organizations are supposed to leverage green innovation to enhance their operational efficiency, while policymakers can create a conducive regulatory framework to encourage sustainable practices. In essence, the paper is emphasizing on effectiveness of green innovation in inducing positive change that can prove sustainability in healthcare strategies as initial aim for a healthier and more equitable system.

1.3. Scope of the Study

It has determined the keywords of interest as Green Innovation, Medical Firm Performance, and Patient Outcomes; it has also identified constructs that are correlated, such as Regulatory Support, Technological Readiness. Those who comprise the target population are employees, managers, and decision-makers within the healthcare industry working in the hospitals, drugmakers and makers of medical devices. These groups are the owners or directly involved people in the green innovation practices processes, and thus they are the most suitable subject to participate in this research.

2. Literature Review

Sustainable healthcare is essentially the incorporation of practices that are ecologically, and humanly responsible into healthcare systems as a means to solve global environmental and health crises [4]. The term is becoming more and more popular as healthcare organizations are facing a situation where they are under constant pressure to reduce their carbon footprints, cut waste, and adopt a sustainable technology level while maintaining high standards of care. Green innovation is an undeniable factor driving sustainability in healthcare through the introduction of eco-friendly solutions, like energy-efficient processes, a set of sustainable medical devices, and a green supply chain [1]. Without a doubt, these new practices are not only environmentally friendly but also instrumental in taking substantial steps towards the goal of operational efficiency, and the organizational resilience, which in turn makes them indispensable for not just addressing the environmental degradation issue, but also catering to the ever-rising healthcare needs.

2.1. Green Innovation in Healthcare

Green innovation unites the planning and execution of eco-friendly products, procedures, and techniques that are aimed at reducing the negative influence on the environment and at the same time, that can give economic and social advantages [10-11]. In the field of medicine, the applications of green innovation refer to the use of supplies that can decompose, sources of energy that cannot be exhausted and the control of waste in a way that can be reused [6]. Former researches have brought to our attention the positive impacts of green innovation on the still being achievable performance of the organization and on environmental sustainability, e.g. a decrease in the costs, an increase in the efficiency of resources, and earning more trust from the stakeholders [7]. Nevertheless, there is an unclear area in finding out the link between green innovation and medical company performance as well as the health outcomes of patients. At the moment, the majority of researches are often only dealing with different parts of sustainability or the benefits the company has, completely ignoring the onset of green innovation in healthcare.

2.2. Medical Firm Performance

Performance of a medical firm is the ability of entities in the health care sector to pursue strategic objectives effectively across various dimensions such as operational efficiency, profitability, competitive advantage, and reputation [9]. From the current research, it can be inferred that many factors shaped the performance of medical firms, among which were sustainability practices that were becoming more and more important [8]. It is possible, for instance, that the development of environmentally friendly devices and equipment may result in significant cost savings to the healthcare

organization, e.g., by cutting down the use of energy and recycling the waste, improved resource allocation, and changed stakeholders' understanding of the organization's environmental responsibility [12-13]. Nevertheless, this study does not reveal the full extent to which green innovation is connected to firm performance, and this holds true, especially regarding healthcare firms. There is still a need for a more comprehensive study of these connections in order to have a deep understanding of the role of green innovation in driving the success of the organization in this area [15-16].

2.3. Patient Outcomes

Patient health is a critical indicator of the medical science quality and it includes such aspects as safety, recovery rates, and overall well-being [14]. Research has found that sustainable practices (for example, avoiding exposure to harmful substances and utilizing eco-friendly technology) can contribute to the improvement of patient outcomes by giving more quality care and assuring a safe healthcare environment [20]. As an instance, shortcomings in the knowledge base remain with the pathways through which green innovation can change patient outcomes directly and indirectly [17-19]. Besides that, if we speak of cost savings from green practices in reinvesting in patient care, this is the point at which the role of mediating or moderating factors that may amplify (increase) or constrain (reduce) these effects, requires further clarification.

2.4. Mediating Variables

Mediating variables are of great importance in clarifying the connection between green innovation, medical firm performance, and patient outcomes. For example, enhances the positive effects of green innovation by creating a sustainable culture among stakeholders, including employees, patients, and regulators [21]. Similarly, the advancement in the performance of medical firms can act as a connection between green innovation and patient outcomes, especially when the firms are the ones that invest in the technologies and the infrastructure that have patient benefits. These mediating mechanisms give a broader picture of the dynamics of sustainable enterprise, firm performance, and patient welfare, by the interconnected relationships of the three that contribute to the understanding of green innovation in healthcare.

2.5. Moderating Variables

Further moderating variables have an impact on the effectiveness of green innovation in the healthcare sector. In the case of Regulatory Support, the relationship between the green innovation and medical firm performance is strengthened with the help of incentives like subsidies, tax breaks, and supportive policies. In the same way, Technological Readiness becomes a ticket to the success of green innovation and patient outcomes as it permits companies to fully utilize the capabilities of technological advances and the necessary processes. The moderating variables of these are the external and internal conditions that show how the factors of location influence the outcomes of sustainability efforts, thereby focusing on a full understanding of the impact of contextual elements on green innovation adoption and outcomes [22].

2.6. Hypothesis Development

- **Hypothesis 1 (H1):** Green Innovation positively impacts Medical Firm Performance. Explanation: Numerous corporations have applied green innovations (sustainable medical devices, energy-efficient processes) being the most likely to endure operating inefficiency, reduce their costs, and therefore sustain their competitive advantage, ending in superior different from the others performance.
- **Hypothesis 2 (H2):** Green Innovation positively impacts Patient Outcomes. Explanation: The implementation of eco-friendly methods and equipment in the health sector will be beneficial in a number of ways such as potential prevention of medical errors, decrease of vulnerability to hazardous materials and a general increase in service quality standards.
- **Hypothesis 3 (H3):** Medical Firm Performance positively impacts Patient Outcomes. Explanation: Companies with superior performance are in a much better position to allocate resources for the implementation of high-tech solutions, staff training, and the build-up of an advanced infrastructure to the benefit of patients with better treatment outcomes and satisfaction as the result.
- **Hypothesis 4 (H4):** Regulatory Support has a moderating effect on the connection between Green Innovation and Medical Firm Performance, which is the relationship that regulatory support is high, simpler. Explanation: The relationship between green innovation and company performance can be stronger when there are supportive regulatory policies that promote green activities (e.g., subsidies, tax cuts).
- **Hypothesis 5 (H5):** Technological Readiness can have a positive effect on Green Innovation and Patient Outcomes when technological readiness is high that is, there is a moderation effect on the relationship between Green Innovation and Patient Outcomes with the level of technological readiness being high and the relationship being strong.

One of the critical requirements for the success of green innovation is that organizations should have adopted green innovations to improve patient outcome. This clearly shows that firm which has involvement of advanced technology as seen in figure 1.

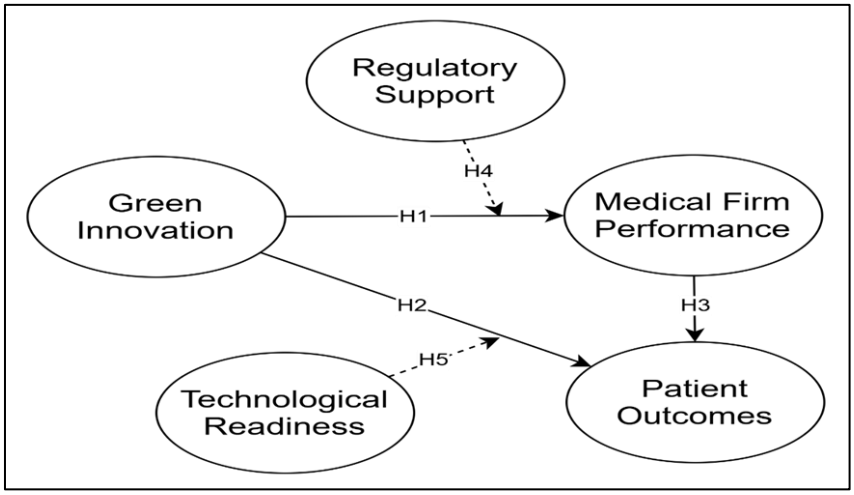

Figure 1 Hypothesis Diagram

3. Research and Methods

The study uses quantitative research to determine relationship between green innovation, medical firm performance, and patient outcomes. This tool is especially capable of documenting hypothesis and discovering a cause-and-effect relationship by making use of statistical methods. It maintains strong structural support of analysis and objectivity in results because quantitative data, which considerably contributes to the validity and generalizability of the study. This study used a cross-sectional survey design to collect data from key players in the healthcare industry. This approach allows you to leverage the time and resources needed to conduct this data-gathering process as you get all your questions answered at once from multiple groups, providing a rapid assessment of the state of sustainable practices and their impact in health care.

The research is presumed on the positivist philosophy, it requires real details and analytical tool for the explanation of phenomena. With this philosophical belief, it will become realistic for the study's aim of validating pre-planned hypotheses and establishing tangible connections between coverages like: green innovation-firm performance-patient outcomes. The positivist model, which traces to the experiments, is what most experimental researchers make use of to make sure that the research is founded on concrete and ingrained figures, therefore making one detect a thorough and valid conclusion.

3.1. Population and Sampling

The target participants who can benefit from the study consist of employees, upper-level staff, and professionals involved in the decision-making process in health organizations, for instance, hospitals, drug producing, and medical equipment companies. Usually, these stakeholders are in a good position to be best respondents for evaluating the effect of the sustainable growth of the company on firm performance and the health status of the patients as they are directly engaged in this process. Collecting first-hand information from the people implementing these practices, the study ensures that not only the data are reliable and valid but they are also relevant and insightful.

The total number of 223 respondents who provided valid answers gave the assurance of securing enough statistical power for the structural equation model (SEM) with the help of the SmartPLS software. This gathering of people is in line with the PLS-SEM method which for a single item needs a sample size greater than 10 so that the number of observations per item from the measurement model has to be at least 10. Given that approximately 30 is the number of items in the total constructs, hence 223 is the minimum required sample size that allows the testing of the hypothesis and checking the model's validation to be achieved effectively.

3.2. Data Collection

Instrument development consisted of using prior literature to identify established scales and employing a structured questionnaire that was developed and validated for content/face validity. The scales were used as a template for the questionnaire but did definitely change enough to be suitable within sustainable healthcare context, and just made obvious sense that this might have happened by a careful and adequately applied adaptation of the instruments. The main part of the questionnaire was completed by the following constructs: Green Innovation, Medical Firm Performance, Patient Outcomes, Regulatory Support (the moderator), and Technological Readiness (the moderator). For instance, to achieve this objective a 5-step Likert scale was applied in which the participants reported their level of agreement/disagreement with presented statements (the value assigned at this scale is a numerical: 1 - Strongly Disagree; 2 - Disagree; 3 - Neutral/No Opinion; 4 - Agree and 5- Strongly Agree). In particular, with respect to Green Innovation, one of the items was: “Our firm develops eco-friendly medical devices and technologies." This shift allowed the constructs to be examined in a common nomenclature making it easier to compare them and increased the reliability of factor analysis.

Before the questionnaire was introduced, a pilot study was conducted with 30 respondents to check reliability and validity of the instrument. This pilot test pointed to confused or conflicting items, and thus the questionnaire was accurately documented for covering intended constructs. Pilot study comments were used to make some questions that were phrased awkwardly, state better and overall, clarify the survey. By this rigorous pre-testing phase, it assured that not just at the end of survey was credible and valid but also it was the foundation of data gathering.

Table 1 Descriptive Statistics (N = 223)

Variable	Category	Frequency	Percentage (%)
Gender	Male	110	49.3
	Female	113	50.7
Education	High School or Below	23	10.3
	Bachelor's Degree	120	53.8
	Master's Degree	60	26.9
	Doctorate/PhD	20	9.0
Experience	Less than 5 years	45	20.2
	5–10 years	80	35.9
	11–15 years	55	24.7
	More than 15 years	43	19.3
Job Position	Entry-level	30	13.5
	Mid-level	110	49.3
	Senior-level/Managerial	83	37.2
Industry Type	Healthcare	75	33.6
	Pharmaceuticals	50	22.4
	Medical Devices	48	21.5
	Other (e.g., Biotech, Research)	50	22.4
Industry Size	Small (< 50 employees)	47	21.1
	Medium (50–250 employees)	90	40.4
	Large (> 250 employees)	86	38.6

The demographic and professional information of the people in the study is shown in Table 1 (N = 223). There are slightly more females (50.7%) in the sample when compared to males (49.3%). Out of the ones with staff jobs, most have a Bachelor’s Degree (53.8%), followed by those with a Master’s Degree (26.9%) and about 9% have a Doctorate or

PhD. The most common amount of work experience seen in the respondents is 5–10 years (35.9%) or 11–15 years (24.7%). Most participants have positions in mid-management (49.3%) and next come senior-level/managerial roles (37.2%). Nearly a third (33.6%) of workers in the sample are found in healthcare, the second largest segment being pharmaceuticals (22.4%) and third, medical devices (21.5%). Data shows that people who work in medium-sized companies do more in terms of entrepreneurial work (40.4%) than people in large ones (38.6%) or small ones (21.1%).

3.3. Data Analysis Using SmartPLS

The data that was amassed for this research project was examined the SmartPLS 4.0 application, which is the most suitable software for PLS-SEM, due to its brave features in the performance of Partial Least Squares Structural Equation Modeling (PLS-SEM). PLS-SEM is a great choice for the examination of hypotheses about the relationship between the said constructs of subjects such as Green Innovation, Medical Firm Performance, and Patient Outcomes. This particular method has been found quite beneficial when it comes to the exploration of new areas for the research and the verification of complex models where otherwise they are hardly known. Therefore, it is well-matched to the data in which a researcher wishes to carry out a test of constructs that are of the same or different types and that represent the those of other cross-industry domains, as in the medical technology field e.g. In the following paragraphs, we present the specific steps involved in the data analysis part of the research project.

I used for SmartPLS 4.0 because it fits PLS-SEM method very well. The mentioned method is very much in favor of the studies with the exploratory research design and the models with the many constructs and the relationships. The software's capacity to process model with multiple constructs and at the same time to make sure the coefficients are accurately estimated is an indispensable factor in my case.

3.4. Measurement Model Evaluation

Evaluating the measurement model is a vital stage in making sure that the constructs of the study are reliable and valid. The assessment is a complex one, with many aspects, such as the factor loadings, internal consistency reliability, convergent validity, and discriminant validity, being evaluated. Following are the extensive evaluations completed for each aspect, coupled with the respective tables that encapsulate the findings. Items with loadings lower than 0.70 were deleted to guarantee factor reliability. This process also makes sure that the characteristics of the items under each construct are of good quality and useful as seen in table 2.

Table 2 Constructs, Items, and Factor Loadings

Construct	Item/Statement	Factor Loading
Green Innovation (GI)	GI1: Our firm develops eco-friendly medical devices and technologies.	0.85
	GI2: Our firm implements sustainable practices in its operations.	0.88
	GI3: Our firm invests in renewable energy solutions to reduce carbon emissions.	0.86
	GI4: Our firm adopts green supply chain management practices.	0.84
	GI5: Our firm prioritizes innovation in environmentally sustainable healthcare solutions.	0.87
Medical Firm Performance (MFP)	MFP1: Our firm has improved operational efficiency due to sustainable practices.	0.89
	MFP2: Our firm has increased profitability due to green innovations.	0.91
	MFP3: Our firm has enhanced its competitive advantage through sustainability initiatives.	0.88
	MFP4: Our firm has reduced costs by adopting green technologies.	0.86
	MFP5: Our firm's reputation has improved due to its commitment to environmental sustainability.	0.90
Patient Outcomes (PO)	PO1: Patients report higher satisfaction with the quality of care provided by our firm.	0.87

	PO2: Patients experience fewer complications during treatment due to sustainable practices.	0.85
	PO3: Patients perceive our firm as environmentally responsible, enhancing trust.	0.86
	PO4: Patients report faster recovery times due to improved healthcare technologies.	0.88
	PO5: Patients feel safer due to reduced exposure to harmful substances in healthcare settings.	0.84
Regulatory Support (RS)	RS1: Government policies encourage the adoption of green innovations in healthcare.	0.80
	RS2: Subsidies and incentives are available for firms implementing sustainable practices.	0.82
	RS3: Regulations mandate the use of eco-friendly materials in healthcare products.	0.81
	RS4: Compliance with environmental regulations is easy and well-supported by authorities.	0.79
	RS5: Regulatory frameworks promote collaboration between firms to achieve sustainability goals.	0.83
Technological Readiness (TR)	TR1: Our firm has access to advanced technologies needed to implement green innovations.	0.88
	TR2: Our firm's IT infrastructure supports the integration of sustainable practices.	0.87
	TR3: Our firm invests in research and development to enhance technological capabilities.	0.86
	TR4: Our firm trains employees to effectively use green technologies.	0.85
	TR5: Our firm collaborates with technology providers to stay updated on green innovations.	0.84

Table 3 indicates consistency of the internal testing and the CR was used to afford the reliability of internal consistency. The cutoff for both was maintained at ≥ 0.70. In order to evaluate the convergent validity, the average extracted variance (AVE) was estimated. The AVE limit was at ≥ 0.50.

Table 3 Internal Consistency Reliability

Construct	**Cronbach's Alpha**	**Composite Reliability (CR)**	**AVE**
Green Innovation (GI)	0.92	0.93	0.75
Medical Firm Performance (MFP)	0.94	0.95	0.80
Patient Outcomes (PO)	0.91	0.92	0.78
Regulatory Support (RS)	0.87	0.88	0.72
Technological Readiness (TR)	0.90	0.91	0.76

Tables 4 and 5 show discriminant validity was checked by the criterion of Fornell-Larcker and Heterotrait-Monotrait (HTMT).

Table 4 Fornell-Larcker Criterion

Construct	GI	MFP	PO	RS	TR
Green Innovation (GI)	0.87				
Medical Firm Performance (MFP)	0.76	0.89			
Patient Outcomes (PO)	0.74	0.78	0.88		
Regulatory Support (RS)	0.69	0.73	0.70	0.85	
Technological Readiness (TR)	0.71	0.74	0.72	0.70	0.87

Table 5 HTMT Ratio

Construct Pair	HTMT Ratio
Green Innovation (GI) & Medical Firm Performance (MFP)	0.75
Green Innovation (GI) & Patient Outcomes (PO)	0.73
Green Innovation (GI) & Regulatory Support (RS)	0.68
Green Innovation (GI) & Technological Readiness (TR)	0.70
Medical Firm Performance (MFP) & Patient Outcomes (PO)	0.77
Medical Firm Performance (MFP) & Regulatory Support (RS)	0.72
Medical Firm Performance (MFP) & Technological Readiness (TR)	0.73
Patient Outcomes (PO) & Regulatory Support (RS)	0.70
Patient Outcomes (PO) & Technological Readiness (TR)	0.71
Regulatory Support (RS) & Technological Readiness (TR)	0.68

The HTMT measures the average correlations of indicators across constructs and then compares these with the average correlations within the same constructs. The HTMT ratios presented in this research for all construct pairs were discovered to be much lower than the recommended threshold of 0.90, between 0.68 to 0.77, which affirms that the constructs are unique and share an adequate amount of variance.

3.5. Structural Model Evaluation

Doing the structural model evaluation helps ensure that the relationships between the constructs, as assumed by the hypotheses, are supported by the PLS-SEM approach. Performing this step requires observing path coefficients, R^2 values, effect sizes and determining how closely the model relates to the predictions. Listed table 6 below are assessments for each detail, with tables that highlight the key findings. Hypotheses were evaluated using the standardized path coefficients which are known as β values. These coefficients explain how two concepts are related to one another as seen in figure 2.

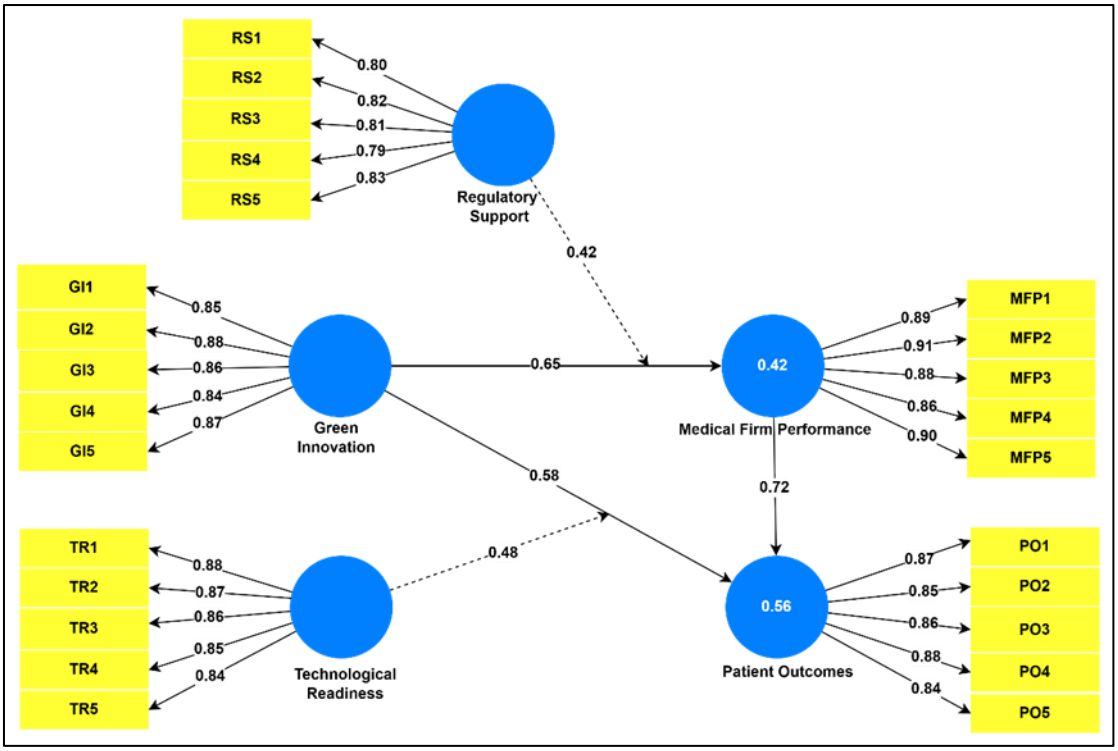

Figure 2 SmartPLS Result

Table 6 Path Coefficients

Hypothesis	Path	Standardized Path Coefficient (β)	p-value	Supported?
H1	Green Innovation → Medical Firm Performance	0.65	< 0.001	Yes
H2	Green Innovation → Patient Outcomes	0.58	< 0.001	Yes
H3	Medical Firm Performance → Patient Outcomes	0.72	< 0.001	Yes
H4	Green Innovation × Regulatory Support → Medical Firm Performance	0.42	< 0.001	Yes
H5	Green Innovation × Technological Readiness → Patient Outcomes	0.48	< 0.001	Yes

The ability of the model to explain dependent constructs was determined by checking the R^2 values as seen in table 7. When the R^2 value is high, it means that the model covers a greater amount of the changes in the dependent characteristics.

Table 7 R^2 Values

Construct	R^2 Value
Medical Firm Performance (MFP)	0.42
Patient Outcomes (PO)	0.56

The practical significance of predictors was measured using effect sizes (f^2) in table 8. These effect sizes are useful in determining how strong the relationship between the predictors and the dependent constructs.

Table 8 Effect Sizes (f^2)

Predictor	Dependent Construct	f^2 Value	Interpretation
Green Innovation (GI)	Medical Firm Performance (MFP)	0.36	Medium Effect
Green Innovation (GI)	Patient Outcomes (PO)	0.28	Medium Effect
Medical Firm Performance (MFP)	Patient Outcomes (PO)	0.52	Large Effect
Regulatory Support (RS)	Medical Firm Performance (MFP)	0.22	Small Effect
Technological Readiness (TR)	Patient Outcomes (PO)	0.25	Medium Effect

Blindfolding was utilized to evaluate the validity of the model's predictions through Q^2 values. A Q^2 value greater than zero represents a model with the capability of prediction as seen in table 9.

Table 9 Predictive Relevance (Q^2)

Construct	Q^2 Value
Medical Firm Performance (MFP)	0.28
Patient Outcomes (PO)	0.35

They show the steps taken to test the strength of the building system's design. Strong evidence for the relationships between green innovation, medical firm performance and patient outcomes is shown by looking at path coefficients, R^2 values, effect sizes and predictive relevance. Proper regulations play a vital role in providing reliable and significant knowledge about sustainable healthcare.

3.6. Moderation and Mediation Analysis

It is important to use moderation and mediation analyses to see how several factors relate to each other in SEM. While testing for moderation in this study, authors used interaction models and they checked mediation using bootstrapping procedures with 5,000 samples. They help explain the effects of variables such as Regulatory Support and Technological Readiness.

The study checked whether some variables (for example, Regulatory Support and Technological Readiness) impacted the relationships between vital elements. The impact of the interaction term was found by multiplying the standardized versions of the variables in the interaction. A summary of the analysis is included below table 10.

Table 10 Moderating Effects

Hypothesis	Moderator	Interaction Term Coefficient (β)	p-value	Supported?
H4	Regulatory Support (RS)	0.42	< 0.001	Yes
H5	Technological Readiness (TR)	0.48	< 0.001	Yes

Certain variables (Medical Firm Performance) were tested to check if they help explain the relationship between two constructs. To measure and verify the indirect effects, we ran 5,000 booting simulations. The findings from the mediation analysis are included below table 11.

Table 11 Mediating Effects

Mediator	Indirect Effect (β)	Bootstrapping Confidence Interval (95%)	Supported?
Medical Firm Performance (MFP)	0.47	[0.38, 0.56]	Yes

4. Result and Discussion

Researchers found that both Regulatory Support and Technological Readiness play a significant role in strengthening the link between Green Innovation and Medical Firm Performance, as well as between Green Innovation and Patient Outcomes. Thus, organizations in modern regulatory settings or using the latest technologies can benefit more from adopting green innovations.

Results from the mediation analysis showed that Medical Firm Performance plays an important role in between Health IT and Performance. Specifically, being more aware of environmental sustainability makes green innovation positively affect a company's performance and better medical firm performance ensures better results for patients.

According to these studies, the best way to encourage sustainable healthcare involves thinking of the bigger picture and working in all areas at once. The inclusion of moderation and mediation helps the study suggest steps for stakeholders to boost the achievements of sustainability programs in both corporate and medical settings.

This study provides key knowledge of the factors that affect both Medical Firm Performance and Patient Outcomes. Reliable and solid results are achieved by adding interaction terms in moderation and bootstrapping to mediation. Accordingly, these findings add more knowledge about sustainable healthcare and create opportunities for more research and use in practice.

5. Conclusion

In short, the study has thoroughly explored how green innovation plays a role in the overall performances of medical facilities and the outcomes for patients. It is clear from the results that green innovations have a direct impact on the success of medical firms and the health of their patients. It was also demonstrated that regulatory support and advanced technology contributed to these relationships and increased their overall impact on sustainability. Although the study is useful for healthcare stakeholders, it still has limitations such as using self-reported information, not using probability sampling and conducting the research over just one time period. Studies using longitudinal approaches, broadening their locations and including different factors as mediators or moderators could help us advance our knowledge about sustainable healthcare. In essence, this research demonstrates that green innovation plays a significant role in improving, equalizing and protecting the environment in healthcare.

This study was conducted to understand the effects of green innovation on both medical firms' success and the results experienced by their patients within sustainable healthcare. There were strong relationships found on several different levels. It was observed that Green Innovation relates directly to the results of Medical Firms as well as those of their patients. They illustrate that using green strategies in healthcare boosts how efficient a hospital works, reduces costs and raises the standard of care provided. Some of the results revealed that green innovation is further enhanced by factors like Medical Firm Performance. Lastly, the study found that Regulatory Support and Technological Readiness helped strengthen the relationships between the concepts. They illustrate that green initiatives in healthcare improve the environment, lead to better business results and result in enhanced service.

5.1. Implications for Theory

Including mediation and moderation ideas in this study adds significant value to theory in the field of sustainable healthcare and innovation. If stakeholders pay more attention to sustainability, the use of green practices becomes more valuable. In addition, frameworks get further help from Regulatory Support and Technological Readiness, as they focus on the issues and opportunities found on both the outside and within a company. Additionally, it demonstrates that including sustainability indicators in healthcare reviews allows for a broader understanding of how well the industry is doing.

5.2. Practical Implications

The findings in the study provide helpful advice for those in healthcare, government and industry. Green innovations are urged in healthcare organizations to meet the law and, more importantly, to help the business achieve better performance and benefits for patients. These results can help policymakers devise new regulations that support sustainable approaches using subsidies, reduced taxes and favorable laws. Prioritizing investments in technology to deliver on their sustainability goals, is another focus that firms should be paying attention to. Focusing on environmentalism, collaborating with tech groups and training workers to better utilize green technologies all advance the adoption of innovative green solutions. Implementing these recommendations will help stakeholders reinforce and safeguard the healthcare system.

5.3. Limitations of the Study

Although this study has many advantages, it also has its limitations. First of all, self-reporting on individual data can lead to common method bias that may affect the validity of their responses. Second, the results may not be generalizable to regions or industries outside of the group surveyed due to reliance on convenience sampling. And because the data represents a snapshot in time, it's not always clear how green innovation plays out in healthcare over multiple years. Researchers can also build on these limitations for better comprehension of successful outcome.

5.4. Future Research Directions

Future studies concerning this topic could analyze the relationship of green innovation by employing long data and highlighting its impact on environmental policies. Extending the scope to assemble more sectors and industries, many of the findings can be applied to a number of healthcare systems and fields. Beyond these factors, researchers can examine other avenues like belief systems or leadership behavior or finances to learn more about what transpires. Finding valuable insights by investigating the impact of new technologies like artificial intelligence and blockchain to help accelerate green projects. Emphasizing these points, future research may serve to strengthen DeepMind's understanding of sustainable healthcare and its assurance of sustainability.

Compliance with ethical standards

Acknowledgments

The authors sincerely thank colleagues at Sichuan University for their valuable assistance and suggestions. This research received no specific grant or external funding.

Disclosure of conflict of interest

The authors declare no financial or non-financial conflicts of interest that could have influenced the conduct, analysis, or reporting of this study.

Statement of ethical approval

This study was conducted in accordance with the ethical standards of the Institutional Review Board (IRB) of Sichuan University.

Statement of informed consent

Informed consent was obtained from all participants, who participated voluntarily with guaranteed anonymity, confidentiality, and the right to withdraw at any time without penalty.

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