

A Typology of Factors Influencing the Success of Science, Technology, and Innovation Policies in the Health Sector

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ABSTRACT

The present study seeks to identify and develop a typology of factors that influence the success of science, technology, and innovation (STI) policymaking in the health sector. Considering the complexities of the health innovation system and the multi-level nature of policymaking within it, this research employed a qualitative approach combined with thematic analysis. Data were gathered from two primary sources: a systematic review of relevant literature and semi-structured interviews with policymakers and experts in the health sector. Analysis of the collected data led to the identification of six overarching themes, each representing a critical dimension of effective STI policymaking in health.

The six identified themes are: (1) resource allocation and financial support, (2) social and ethical considerations, (3) legal and regulatory frameworks, (4) organizational factors, (5) macro-level governance, and (6) technical and technological capabilities, human resource development, and innovation management. The findings underscore that financial sustainability, institutional transparency, adherence to ethical principles, flexible and up-to-date regulations, inter-organizational coordination, and robust technological infrastructure are among the most essential prerequisites for successful innovation policies in the health sector.

The final analysis emphasizes that the effectiveness of STI policymaking depends on the synergistic operation of micro-level factors (human and technological capacities), meso-level factors (organizational and managerial structures), and macro-level factors (governance and economic frameworks) within a learning system. Based on these insights, the study proposes an integrated framework for analyzing and designing health innovation policies. This framework can serve as a foundation for developing national strategies, enhancing evidence-based policymaking, and improving the efficiency and performance of health systems.

Keywords: Science, technology, and innovation policymaking; Health industry; Thematic analysis; Policy success; Innovation governance

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INTRODUCTION

The concept of policy-making is intrinsically connected to government, state institutions, society, and public affairs, often reflecting the deliberate actions taken by authorities to manage public issues effectively. Nearly four decades have passed since policy-making gained recognition as a distinct paradigm worldwide (Ghasem-Aqa, 2018). It is generally understood as a purposeful set of actions undertaken by governing bodies to address societal problems, challenges, and needs (Origa, 2019).

One of the most concise and frequently cited definitions of public policy was offered by Thomas Dye, who argued that “public policy is anything a government decides to do or not to do” (Howlett & Ramesh, 2014). Peters, on the other hand, provides a broader perspective, highlighting the role of policy implementers and the impacts of policies. He defines public policy as the collection of government

actions that, directly or indirectly, shape the lives of citizens (Peters, 2018).

The policy-making process is typically conceptualized as a cyclical framework composed of five primary stages (Haji-Hosseini & Karim-Mian, 2019):

1. **Agenda Setting**
 - Identifying problems and attracting the attention of stakeholders and the public.
 - Influences from focusing events, media coverage, and pressure groups.
2. **Policy Formulation**
 - Analyzing policy options through technical, economic, and operational evaluation.
 - Engaging secondary actors and experts in the process.
3. **Decision Making**

- Selecting the most appropriate option based on political objectives and available evidence.
- 4. **Implementation**
 - Coordinating actors during policy execution.
 - Implementation challenges are among the primary reasons for policy failure.
- 5. **Evaluation and Feedback**
 - Assessing the alignment of actual outcomes with intended objectives.
 - Providing feedback to adjust policies and promote institutional learning.

Recent research highlights the significance of institutional capacity, the design and efficient application of policy instruments, and their strategic integration in achieving successful policy outcomes (Mojraji et al., 2021). Additionally, political, social, and institutional factors—

such as the influence of political elites (Manzir, 2025), interactions among stakeholders, and pressures from public opinion—are critical determinants in shaping effective policies.

Science, Technology, and Innovation (STI) policy is a branch of public policy that concentrates on allocating resources and guiding scientific and technological activities to generate public value. It encompasses decisions regarding research funding, the creation of support structures for innovation, and the conversion of research outcomes into economic and societal benefits. STI policy utilizes a range of instruments, such as research grants, the development of technological infrastructure, facilitation of technology transfer, and the establishment of innovative institutions (Lundvall & Borras, 2005).

As illustrated in Table 1, the three domains—science, technology, and innovation—can be analyzed separately in terms of policy tools and objectives (Haji-Hosseini & Karim-Mian, 2019).

Table 1 – Relationship Between Science, Technology, and Innovation Policy

Policy-making	Objectives	Instruments
Science policy	Scientific knowledge production	Provision of public research funding Establishment of (semi-)governmental research organizations (e.g., laboratories, universities, and research centers) Granting tax incentives to firms Provision of higher education Creation of intellectual property rights
Technology policy	Advancement and commercialization of technical knowledge	Public procurement Provision of public subsidies to strategic sectors Establishment of intermediary organizations (between research and industry) Workforce training and enhancement of technical skills Standardization Technology foresight Benchmarking from industrial sectors
Innovation policy	Overall innovative performance of the economy	Improvement of personal skills and learning abilities (through public education systems and worker training) Enhancement of organizational learning and performance (e.g., ISO 9000 standards and quality control) Improvement of access to information: information society Enactment of environmental regulations Establishment of corporate regulations Implementation of competition laws Protection of consumer rights Enhancement of social capital for regional development and industrial areas Smart benchmarking Smart foresight

Science, Technology, and Innovation (STI) policy is an emerging and fast-developing domain within industry and technology that has recently attracted considerable scholarly interest. While several studies have investigated factors influencing STI policy, there remains a lack of comprehensive research that systematically identifies and categorizes all the determinants of successful STI policy implementation.

The health industry is particularly influenced by rapid and transformative advances in science, technology, and

innovation. Innovations in healthcare facilitate the management and control of previously untreatable diseases and promote more efficient utilization of limited resources (Felsa & Hobner, 2021). Advanced technologies—ranging from cutting-edge pharmaceuticals to digital diagnostic tools and genetic therapies—can significantly improve patients' quality of life. For instance, artificial intelligence (AI) has demonstrated higher accuracy and speed than humans in early disease detection, such as cancer and diabetes, and in processing medical data, particularly

radiology images. By automating diagnostic and treatment procedures, AI reduces both time and costs. Moreover, AI enables remote patient monitoring, integration with Internet-of-Things devices, and enhanced precision in robotic surgeries (Ali et al., 2023). According to the Boston Consulting Group (BCG, 2025), radiology has been at the forefront of adopting AI and machine learning technologies in healthcare, given their exceptional effectiveness in image analysis and disease diagnosis.

STI policies are pivotal in ensuring that scientific and technological advancements yield tangible benefits for the health sector. During the COVID-19 pandemic, such policies played a key role in accelerating vaccine development, fostering international collaboration, and enabling the sharing of health data (Da Silva et al., 2021; Yoon, 2023). Nevertheless, research indicates that misaligned policies, limited institutional capacity, and ethical or cultural barriers can hinder the development and implementation of healthcare innovations (Da Silva et al., 2021). For example, a Financial Times report notes that an NHS review in the UK identified legal constraints and insufficient coordination among actors in the innovation ecosystem as obstacles to the deployment of technologies like AI and genomics. Similarly, the OECD's 2023 Science, Technology, and Innovation Outlook highlights that addressing major global challenges—including those related to healthcare, climate change, and energy—requires strategically targeted and well-funded innovation policies (OECD, 2023).

Ultimately, the integration of well-designed STI policies with robust institutional capacity and responsible innovation practices can enhance treatment outcomes, promote social equity, and drive economic growth within the health sector. Consequently, systematically identifying and classifying the factors that determine the success or failure of STI policies is critical for their effective design, implementation, and long-term impact.

2. Literature Review

Over the past century, and particularly since 2010, research on STI policy has expanded significantly at both the international and national levels. This study aims to classify the factors influencing the success of science and technology policies in the health sector. In a related study, Salami et al. (2010) examined the National Iranian Oil Refining and Distribution Company and categorized factors affecting STI policy into six groups: political, legal/regulatory, market-related, organizational, technological, and educational. Similarly, Hongbo et al. (2017) investigated the public healthcare sector in Benin using Root Cause Analysis (RCA) to identify underlying inefficiencies in healthcare technology and medical equipment management, highlighting several factors critical to effective policymaking in this context.

1. Policies focused on resource allocation, distribution, and management of outdated equipment.
2. Establishment of a General Directorate for Medical Equipment and Maintenance within the Ministry of Health.
3. Implementation of inventory maintenance policies.
4. Promotion of accountability and transparency among government employees.
5. Inclusion of technical stakeholders in the decision-

making process.

Recent studies have also explored the evolution of STI policies in the health sector in response to the COVID-19 pandemic. Guimaraes et al. (2021) proposed an STI policy framework for Brazil's health sector to address political crises and the pandemic, based on four main pillars: the integrated health system (SUS), the production of health goods and services, scientific and technological infrastructure, and coordinating policy institutions. The study highlighted several critical factors for effective policy-making, including:

- **Health research**, which requires an interdisciplinary perspective, the connection between basic research and practical needs, and addressing gaps in access to research resources.
- **Innovation in production**, which emphasizes strengthening health-related industrial and economic clusters through technology transfer and domestic development in pharmaceutical and vaccine production.
- Establishment of technology assessment and adoption institutions, which conduct cost-benefit evaluations for health technologies.

Yoon (2023) examined STI policies implemented in response to COVID-19 in leading innovation countries. Using OECD data, 886 policies from 56 countries were analyzed, revealing key factors for successful STI policy in healthcare: financial support for R&D, enhanced intersectoral and inter-agency governance, use of scientific advice and public communication, open science and data-sharing practices, and attention to vulnerable populations.

Da Silva et al. (2021) further emphasized the importance of integrated, cross-sectoral governance, ensuring that scientific research is effectively translated into practical and efficient actions—a critical factor for the success of STI policies during the pandemic. Likewise, Sheikh et al. (2021) analyzed the role of health information technologies in developing learning health systems in the UK. Their study highlighted the need for a comprehensive framework linking technology, data, and stakeholders. Success in these systems requires balancing innovation with security, active participation from public and private sector actors, and sustainable investment in digital infrastructure.

Some studies have focused on specific technologies within healthcare. For instance, Hossein et al. (2021) investigated the adoption of blockchain technology in the health sector using bibliometric analysis to identify trends and challenges. Key factors for successful policy implementation for blockchain in healthcare include:

- **Decentralization**, reducing centralized vulnerabilities in the health system and enabling secure access to patient and provider data, such as electronic health records.
- **Transparency**, ensuring traceability of data changes using smart contracts and fostering trust among stakeholders through immutable transaction records.
- **Security and privacy**, protecting data from both intentional and unintentional tampering through cryptographic algorithms.
- **Inter-organizational collaboration**, facilitating data exchange across heterogeneous systems and health sector entities, such as hospitals and

laboratories.

Another study examined the impact of the COVID-19 pandemic on the adoption of Internet of Things (IoT) technologies across multiple sectors, with a particular focus on healthcare. By reviewing consultancy reports, scientific literature, and expert interviews, the researchers found that COVID-19, as a macroeconomic shock, substantially accelerated technological developments within healthcare systems. Factors influencing policy-making for IoT technologies included the rising demand for health-oriented wearable devices and biosensors, changes in regulations and organizational procedures, and the adoption of faster and more flexible technology approval processes, which collectively increased social and policy acceptance. The study highlighted that sustained success depends on coordinated, transparent, and adaptive policies, coupled with active stakeholder engagement. Key priorities identified were investments in data infrastructure, standardization, workforce training, and regulatory transparency (Omair et al., 2021).

In a related study, the use of artificial intelligence (AI) in healthcare was investigated (Li & Yoon, 2021). The research emphasized AI's transformative potential within health systems and highlighted the importance of well-designed policy frameworks to facilitate its effective adoption. The study identified several key factors that are critical for the successful implementation of AI-related policies:

- **Managerial and policy support**, including significant investments by hospitals in AI technology and establishing legal frameworks for the use of health data while safeguarding privacy.
- **Integration of AI into clinical processes**, including reducing diagnostic errors and enhancing patient engagement through smart applications.

The study concluded that effective AI policy in healthcare requires transparent regulations to ensure accountability and ethical use, investment in secure infrastructure and human resources, and promotion of collaboration among public institutions, private enterprises, and academic organizations to develop localized technologies.

Global institutions have also examined STI policies in healthcare. The United Nations (UN) highlighted the crucial role of science, technology, and innovation in achieving Sustainable Development Goal 3 (SDG 3), which seeks to ensure health and well-being for all. The UN report emphasized three main areas: primary healthcare, poverty-related diseases, and control of infectious disease outbreaks. Key success factors for STI policy in healthcare include digital and data-driven innovations, deployment of emerging health technologies, sustainable R&D investment, institution-building, strengthening national innovation ecosystems, intersectoral coordination, alignment of STI policies with industrial and trade strategies, and international collaboration through research networks, technology transfer, and shared intellectual property (UN, 2021).

Similarly, **UNESCO (2024)** stressed that STI policy tools should:

- Be tailored to national capacities and health priorities.
- Be managed effectively and transparently, with clear institutional roles.

- Be continuously monitored and evaluated to facilitate organizational learning.
- Cover all stages of the health innovation cycle.
- Promote investment in human capital, digital technologies, and health information infrastructure.
- Enhance transparency and enable meaningful participation of stakeholders in healthcare.

The OECD (2024) report also highlighted key STI policy actions, including financing, infrastructure development, enabling technologies, skills, strategic information, community engagement, international cooperation, and inter-agency coordination. Specifically for healthcare, the report emphasized aligning STI and public health policies, enhancing digital health capabilities, and strategically supporting innovations that address population health challenges.

Health-related information and data are of critical importance, as they are directly linked to individual well-being and privacy. Consequently, ensuring their protection has been a key focus of many researchers. West et al. (2014) examined the role of public and private sectors in shaping Health Information Technology (HIT) policies and Health Information Exchange (HIE) in the United States. Their study indicated that successful HIT and HIE policy implementation relies on alignment between federal and state policies (e.g., federal funding allocated to local projects), active private sector engagement in policy design and execution, and the establishment of flexible and transparent regulatory frameworks that can respond to diverse state needs.

Another study explored the challenges and strategies in policy-making for electronic health information exchange in the U.S. According to this research, developing sustainable financial models through public-private partnerships, evaluating the impact of HIE on care quality and cost reduction, coordinating federal and state policies, and implementing technical and privacy standards are crucial factors influencing policy success (Marchibroda, 2007). Similarly, Dixon et al. (2010) proposed an evaluation framework for the National Health Information Network (NHIN) in the U.S., highlighting that:

- Effective policy for HIE requires a **combination of robust technical standards, flexible legal frameworks, and ongoing value assessment**.
- Conducting **formative evaluations** helps identify challenges early and allows adjustments in strategy.
- Coordination among **local and national stakeholders** is essential to reduce policy conflicts and increase network adoption.

Studies have also addressed developing countries. Bagherian and Sattari (2022) examined the challenges, success factors, and failures of Health Information Systems (HIS) implementation in these contexts. They categorized critical factors into human, organizational, financial, and technical domains. Their findings suggest that successful HIS implementation in developing countries requires simultaneous attention to all four categories. Furthermore, system flexibility and active stakeholder participation are vital for overcoming existing challenges.

In the present study, by reviewing literature on factors influencing STI policy success in the healthcare industry and incorporating expert opinions, a qualitative thematic analysis was conducted. The identified factors were

classified into six primary themes:

1. Resource allocation and financial support
2. Social and ethical considerations
3. Legal and regulatory aspects
4. Organizational factors
5. Macro-level (governance and policy) factors
6. Training, technical and technological capabilities, and innovation management

These findings are presented in a summary table. To date, no prior research has systematically categorized the factors affecting STI policy success in healthcare in this manner.

3. Research Methodology

This study is applied research and, due to its qualitative nature, employs a qualitative research approach. Initially, a literature review was conducted to examine relevant scholarly articles and publications. To enrich the findings further, semi-structured in-depth interviews were carried out with experts, continuing until data saturation was reached, which occurred after the tenth interview. Subsequently, thematic analysis was applied to extract the key concepts.

Thematic analysis is a straightforward yet highly effective method for analyzing qualitative data and textual materials. It is particularly valuable when prior research on a phenomenon is limited, theoretical frameworks are underdeveloped, or context-specific variables need to be identified. In recent years, thematic analysis has become increasingly popular in public policy research. It is widely used to identify and categorize policy-related factors and outcomes, explore the perspectives of policymakers and managers, and investigate weaknesses in policy processes. Additionally, this method facilitates the study of factors affecting policy implementation, identification of recurring policy arguments, analysis of policy content, understanding policymakers' perceptions, and examination of various policy components. Therefore, thematic analysis is regarded as a practical and effective approach in policy research (Kamali, 2018).

3.1 Thematic Analysis

Thematic analysis is a systematic approach to identifying, analyzing, and reporting patterns within qualitative data. It transforms dispersed and diverse information into rich and

detailed data (Abedi Jafari et al., 2011). In this method, raw data are coded, and codes are then grouped into themes and concepts (Castleberry & Nolen, 2018).

The method generally involves three main steps (Abedi Jafari et al., 2011):

1. **Decomposition and description** of the text
2. **Explanation and interpretation** of the text
3. **Integration and synthesis** of the text

Since the purpose of this study is to identify factors influencing the success of STI policy in the healthcare industry, these factors were extracted using thematic analysis of relevant articles and sources.

Step 1: Articles related to STI policy in healthcare were collected from databases such as Scopus, Google Scholar, and Web of Science using keywords including *health tech policy*, *STI policy*, *STI policymaking*, and *STI in healthcare*. A total of 34 relevant articles were identified. Semi-structured in-depth interviews with experts were also conducted to enrich the data, reaching saturation at the tenth interview.

Step 2: The selected articles were reviewed to identify factors affecting STI policy success in healthcare. Large language models (LLMs), including ChatGPT and DeepSeek, were used to assist with key-point extraction and summarization.

Step 3: The identified factors were coded, and interview data were analyzed using MAXQDA software, with manual coding performed to ensure accuracy.

Step 4: Finally, the factors were classified into six overarching themes based on expert input:

- a) Resource allocation and financial support
- b) Social and ethical considerations
- c) Legal and regulatory aspects
- d) Organizational factors
- e) Technical and technological capabilities, human resource training, and innovation management
- f) Macro-level factors

Overall, in addition to the six overarching themes, 37 organizing themes and 199 codes were identified. The thematic structure is illustrated in Figure 1. This classification was reviewed and refined based on expert feedback, and recommended adjustments were applied.

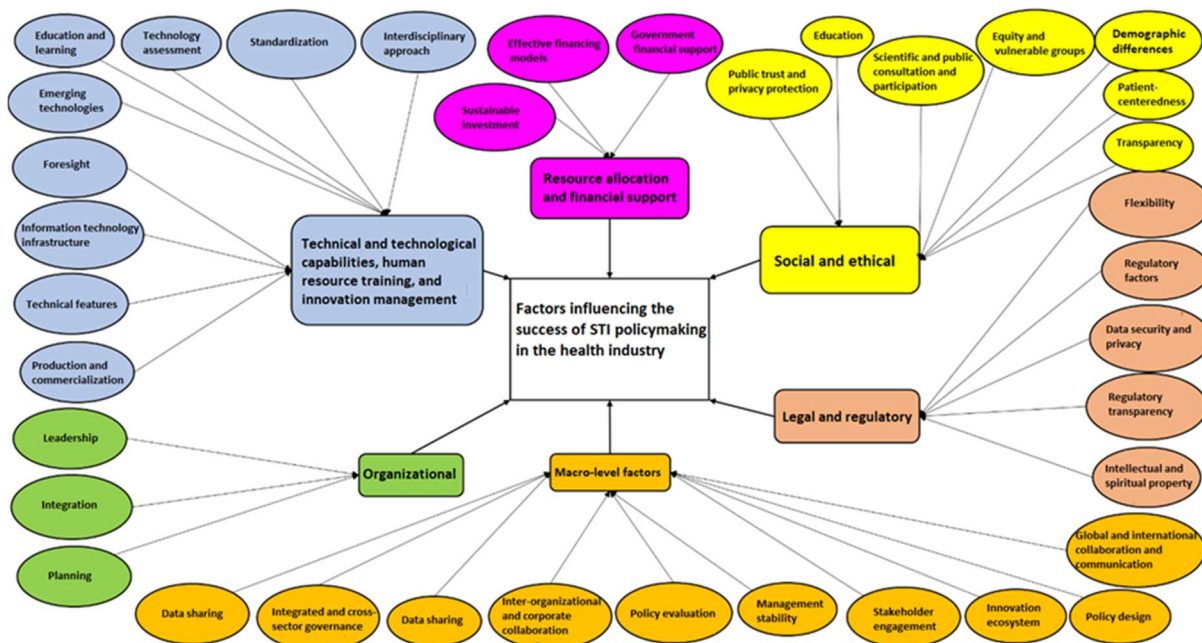


Figure 1 – Network Structure of Themes

4- Data and Theme Analysis

Overarching Theme 1: Resource Allocation and Financial Support

Organizing Themes: Government Financial Support – Influential Financing Models – Sustainable Investment

Resource allocation and financial support are among the most crucial prerequisites for effective science, technology, and innovation (STI) policymaking in the healthcare sector. Policies backed by adequate financial and institutional resources generally exhibit greater sustainability and impact throughout all stages of innovation—from research and development to commercialization. The literature indicates that government support is provided not only through direct funding but also via tax incentives, research grants, and service infrastructures such as incubators and accelerators. These mechanisms help establish a robust foundation for the development of the healthcare innovation ecosystem. Interviews with experts highlighted the importance of ensuring sustainable funding and strong political commitment. According to participants, insufficient resources or budget instability are key factors contributing to policy failure. They also noted that the limited engagement of the private sector and venture capital represents a significant gap in healthcare policy. These observations are consistent with theoretical studies emphasizing the need for innovative financing models, including public–private partnerships and quality-based payment mechanisms. In summary, this theme emphasizes that financial sustainability is vital for the continuity of innovation. Policies relying solely on short-term support often falter, undermining stakeholder trust. Conversely, multi-source financing strategies involving government, industry, and international institutions provide a stable and enduring foundation for advancing the healthcare innovation system.

Overarching Theme 2: Social and Ethical

Organizing Themes: Transparency – Patient-Centeredness – Demographic Differences – Equity and Vulnerable Groups – Public and Scientific Consultation –

Education – Public Trust and Privacy

The social and ethical dimension of healthcare innovation policies is closely linked to public legitimacy and societal acceptance. Literature suggests that transparency, accountability, and adherence to ethical standards in the collection and use of health data are essential for the successful implementation of STI policies in the healthcare sector. Policies that lack a clear ethical framework are prone to public distrust.

Interviews with experts indicated that individuals are particularly concerned with privacy, data security, and equitable access. Participants emphasized that any breach of public trust could undermine policy effectiveness. They also highlighted the necessity of considering cultural and demographic diversity when designing policies, as those that clash with local values or create disparities in access often face social resistance.

In addition, prioritizing patient-centered care and social equity is crucial for the long-term success of healthcare policies. Effective policies not only focus on technological efficiency but also ensure patient satisfaction and well-being. Engaging patients and vulnerable groups in decision-making processes represents a form of democratization in policymaking, which enhances legitimacy and societal acceptance.

The findings further underscore the importance of education and capacity building. Educating patients, healthcare professionals, and the public about emerging technologies is critical for bridging the digital divide and fostering informed participation. Overall, the analysis demonstrates that healthcare policies are most successful when ethical principles, social equity, and transparency are deeply integrated into policy design and implementation.

Overarching Theme 3: Legal and Regulatory

Organizing Themes: Intellectual Property – Regulatory Flexibility – Legal Transparency – Data Security and Privacy – Oversight Mechanisms

Flexible legal and regulatory frameworks form the institutional foundation for implementing healthcare

innovation policies. The literature indicates that intellectual property laws can strengthen support for innovation, but they must also balance technological monopolies with public access to healthcare technologies. Interview data emphasize that clear, up-to-date, and technology-aligned laws are essential for the successful implementation of policies. Participants identified lack of transparency and overlapping regulations as major barriers, stressing the need for continuous regulatory review and the establishment of regulatory sandboxes to test and adapt innovations safely. Regarding privacy, both theoretical and field data converge on a key point: patient data security is fundamental to public trust. Interviews highlighted that any unauthorized use or mishandling of data could threaten the legitimacy of the entire digital health system. In sum, robust yet flexible legal and regulatory structures, combined with strong oversight and attention to privacy, are critical for ensuring the effectiveness and credibility of STI policies in healthcare.

The analysis of this theme indicates that the success of policymaking depends on the presence of dynamic and flexible legal frameworks—frameworks that both facilitate innovation and protect the rights of patients and society.

Theme 4: Organizational Organizing Sub-Themes: Leadership – Integration – Planning

At the organizational level, the presence of effective and strong leadership is a fundamental factor for the success of health innovation policymaking. Literature reviews indicate that support from senior leaders and the allocation of sufficient resources are the most significant drivers of organizational progress. Additionally, in terms of planning, setting clear and realistic objectives, providing access to technical infrastructure, allowing adequate time for staff training, precisely defining roles to ensure synergy and avoid duplication, and evaluating organizational performance in line with policy goals all play a critical role in organizational success.

Overall, this theme emphasizes that health innovation policies are effective only when implementing institutions possess strong managerial capacity and transformational leadership, and when processes are carried out in an integrated and systematic manner.

Overarching Theme 5: Macro Factors

Organizing Themes: Data sharing – Integrated and cross-sectoral governance – Inter-organizational and corporate collaboration – Policy evaluation – Managerial stability – Stakeholder participation – Innovation ecosystem – Policy design – Global and international cooperation and communication

At the macro level, science, technology, and innovation (STI) policymaking in the healthcare industry is successful when governance, managerial, and institutional structures function cohesively and in coordination. Data show that data sharing and open science provide the infrastructure for evidence-based decision-making. Lack of access to comprehensive data or refusal to exchange data between countries leads to deficiencies in healthcare policies.

Regarding cross-sectoral governance, the emphasis is on collaboration among universities, industry, government, and the private sector. The presence of multiple uncoordinated institutions results in resource wastage and policy overlaps. Existing literature and interviews

emphasize the need for inter-institutional and interdisciplinary structures and adopting a multi-level systemic approach. Inter-organizational and corporate collaboration is also critical for linking knowledge production with market needs. Participation of research centers, companies, and non-governmental organizations facilitates technology transfer and enhances innovation capacity. In the policy evaluation dimension, data highlight the role of continuous monitoring systems in organizational learning. Successful policies are those capable of continuous revision and adjustment. Conversely, the absence of evaluation mechanisms leads to a gap between policymaking and implementation. The managerial stability theme indicates that frequent changes in managers and budgets disrupt policy implementation and create institutional instability. Continuity in management is essential for sustaining innovative programs. Regarding stakeholder participation, findings emphasize that meaningful involvement of patients, healthcare professionals, universities, and civil society in decision-making ensures social acceptance and policy effectiveness. Symbolic participation is ineffective and must be transformed into active, structured engagement. The innovation ecosystem focuses on institutional development, human resource training, and strengthening public-private collaboration. This ecosystem forms the backbone of the national healthcare innovation system.

In policy design, having a clear logic model, reliance on scientific evidence, and defining national priorities are essential. Policies without a data-driven foundation tend to fail in implementation. Finally, global cooperation and communication are critical for knowledge and technology transfer. Data show that alignment with international standards and development of joint scientific networks enhances national policy capacity, while sanctions and external restrictions can create serious obstacles. Overall, the macro theme emphasizes that the success of healthcare policies depends on institutional synergy, managerial stability, continuous evaluation, and multi-level stakeholder participation. At the international level, alignment with global scientific and technological systems is a key condition for the sustainability and effectiveness of innovation policymaking in healthcare.

Overarching Theme 6: Technical and Technological Capabilities, Human Resource Training, and Innovation Management

Organizing Themes: Education and learning – Foresight – Information technology infrastructure – Emerging technologies – Technology assessment – Interdisciplinary approach – Production and commercialization – Standardization – Technical characteristics

The findings of this theme indicate that developing technological capabilities and managing innovation in the healthcare industry require investment in education, infrastructure, and emerging technologies. Education and learning play a fundamental role in the success of technology-related policies. The data suggest that investment in higher education, STEM skills, and lifelong learning is essential for training specialized human resources. Interviews also emphasized the importance of educating healthcare staff and patients in using digital technologies to reduce organizational resistance. Technology without adequate training can be ineffective or

even harmful.

Regarding foresight, identifying and analyzing emerging technology trends through horizon scanning is essential. This approach helps policymakers adapt regulations and policies to rapid scientific advancements.

Information technology infrastructure serves as the technical foundation of the healthcare innovation system. Developing electronic health record (EHR) systems, telemedicine platforms, and integrated data networks is critical. Data indicate that the absence of a coherent data infrastructure leads to inaccurate decision-making, and the alignment of new technologies with operational structures is a prerequisite for success. Emerging technologies such as artificial intelligence, biotechnology, the Internet of Things, and robotics offer transformative opportunities to improve healthcare services. Data show that traditional STI policies need revision to align with these technologies. Interviews highlighted the dependency of healthcare systems on knowledge-based technologies and the importance of technology transfer from leading countries.

In the area of technology assessment, emphasis is placed on establishing institutions and networks to evaluate the cost-benefit and social and economic impacts of technologies. Continuous evaluation of technological effectiveness is a key tool for attracting investment and improving performance.

An interdisciplinary approach in health research is a prerequisite for innovation development. Data highlight the need for collaboration among engineering, medical, humanities, and data science fields to bridge the gap between research and practice. Such collaboration accelerates the development of healthcare technologies and ensures effective knowledge translation into practical applications.

In the production and commercialization domain, data emphasize the importance of implementation science and knowledge translation mechanisms. Supporting startups, creating an initial market for domestic technology products, and government support for purchasing healthcare services are key factors for success.

Standardization is also a critical element of technology management. Data indicate that developing technical standards for system interoperability and data security enables effective health information exchange. Finally, the technical characteristics of technologies include user-centered design, ease of use, data security, and ongoing support. Interviews stressed the importance of technology flexibility and adaptation to local needs.

In summary, the success of healthcare innovation policies depends on the integration of three key pillars: human resource education and capacity development, sustainable technological infrastructure, and an interdisciplinary approach for effective innovation management. Policies that simultaneously strengthen these elements have the highest potential for effectiveness and sustainability.

5- Summary and Conclusion

The aim of this study was to identify and categorize the factors influencing the success of science, technology, and innovation (STI) policy in the healthcare industry. Based on findings from a systematic literature review and semi-structured interviews with experts, six overarching themes were identified: “Resource Allocation and Financial Support,” “Social and Ethical,” “Legal and Regulatory,” “Organizational,” “Macro-level Factors,” and “Technical

and Technological Capabilities, Human Resource Training, and Innovation Management.” These themes serve as an analytical framework to explain the various dimensions of success in STI policy within the healthcare sector.

The results showed that sustainable financial resource allocation and effective governmental support are among the most critical prerequisites for successful innovation policies in healthcare. In addition, private sector engagement, venture capital investment, and the use of multi-source financing models can enhance the sustainability and continuity of policy implementation.

In the social and ethical dimension, adherence to transparency, justice, privacy, and patient-centeredness are essential elements that ensure the legitimacy and public acceptance of policies. Without public trust, even highly efficient technological policies are likely to fail. Therefore, active participation of diverse stakeholders, including patients, professionals, and civil society organizations, must be institutionalized in the decision-making process.

From a legal and regulatory perspective, the presence of clear, up-to-date, and flexible laws plays a key role in supporting innovation. Successful policymaking must balance the protection of intellectual property with equitable access to healthcare technologies. Continuous updating of regulations and the establishment of regulatory sandboxes for innovation are effective strategies in this regard.

At the organizational level, transformational leadership and integrated management are highly determinant. Coordination among executive units, clear definition of roles and responsibilities, and the existence of continuous planning and evaluation systems are key factors influencing the achievement of policy objectives.

At the macro level, the findings indicate that integrated governance, inter-organizational and cross-sectoral collaboration, data sharing, continuous policy evaluation, and managerial stability form the foundation of successful policy systems. Synergy among ministries, universities, industry, and civil society, along with international coordination in science and technology, can enhance the country’s learning and innovation capacity.

Finally, the theme of “*Technical and Technological Capabilities, Human Resource Training, and Innovation Management*” highlighted that investment in education, IT infrastructure development, foresight, and attention to emerging technologies—such as artificial intelligence, the Internet of Things, and biotechnology—is essential to ensure the sustainability of health innovation policies. Continuous technology assessment, development of technical standards, and an interdisciplinary approach are also key requirements for successful policy implementation. Overall, the results indicate that the success of STI policymaking in healthcare arises from the interaction of three levels: micro (human and technological), meso (organizational and institutional), and macro (governance and economic). These three levels must operate synergistically within a flexible and learning-oriented system. According to the final analysis, designing sustainable and effective healthcare policies requires integrating financial, ethical, legal, institutional, and technological components within a unified framework.

The findings of this study can serve as a basis for developing more comprehensive and evidence-based health policies and can facilitate improvements in innovation governance within the national healthcare system. At the same time, by

providing a coherent categorization of influential factors, this research paves the way for future studies on evaluating the impact of science and technology policies and measuring success indicators in healthcare.

REFERENCES:

1. Jalili, G. A. (2018). **Polymaking: Concepts, models, and processes.** *Journal of New Research Approaches in Management and Accounting*, 2(4), 106–114. Retrieved from <https://www.majournal.ir/index.php/ma/article/view/47>
2. Haji-Hosseini, H., & Karim-Mian, Z. (2019). **The polymaking process and governance of science, technology, and innovation.** *Science and Technology Policy*, 12(2), 71–86.
3. Salami, S. R., Taghavi-Fard, M., & Soltanzadeh, J. (2010). **Identifying factors influencing science and technology polymaking (Case study: National Iranian Oil Refining and Distribution Company).** *Strategic Studies in Oil and Energy*, 2(6), 43–60.
4. Abedi-Jafari, H., Taslimi, M., Faghihi, A., & Sheikhzadeh, M. (2011). **Content analysis and thematic networks: A simple and efficient method for identifying patterns in qualitative data.** *Strategic Management Thought (Andisheh Modiriyat)*, 5(2(10)), 151–198. <https://www.sid.ir/fa/journal/ViewPaper.aspx?id=164389>
5. Kamali, Y. (2018). **Methodology of thematic analysis and its application in public policy studies.** *Public Policy*, 4(2), 189–208. <https://doi.org/10.22059/ppolicy.2018.67875>
6. Ali, O., Abdelbaki, W., Shrestha, A., Elbasi, E., Alryalat, M. A. A., & Dwivedi, Y. K. (2023). A systematic literature review of artificial intelligence in the healthcare sector: Benefits, challenges, methodologies, and functionalities. *Journal of Innovation & Knowledge*, 8(1), 100333.
7. Bagherian, H., & Sattari, M. (2022). Health information system in developing countries: a review on the challenges and causes of success and failure. *Medical journal of the Islamic Republic of Iran*, 36, 111.
8. The Boston Consulting Group. (2025). Artificial Intelligence and Machine Learning Stake a Claim on Medtech. BCG. <https://www.bcg.com/publications/2025/ai-and-machine-learning-stake-claim-on-medtech>
9. Castleberry, A., & Nolen, A. (2018). Thematic analysis of qualitative research data: is it as easy as it sounds? *Currents in pharmacy teaching and learning*, 10(6), 807–815.
10. da Silva, R. G. L., Chammass, R., & Novaes, H. M. D. (2021). Rethinking approaches of science, technology, and innovation in healthcare during the COVID-19 pandemic: the challenge of translating knowledge infrastructures to public needs. *Health Research Policy and Systems*, 19, 1–9.
11. Dixon, B. E., Zafar, A., & Overhage, J. M. (2010). A Framework for evaluating the costs, effort, and value of nationwide health information exchange. *Journal of the American Medical Informatics Association*, 17(3), 295–301.
12. Flessa, S., & Huebner, C. (2021). Innovations in Health Care-A Conceptual Framework. *International journal of environmental research and public health*, 18(19), 10026. <https://doi.org/10.3390/ijerph181910026>
13. Guimarães, R., Morel, C. M., Aragão, É., Paranhos, J., Palácios, M., Goldbaum, M., ... & Kropf, S. (2021). Health Science, Technology and Innovation Policy (ST&I/H): an update for debate. *Ciência & Saúde Coletiva*, 26, 6105–6116.
14. Hounbo, P. T., Zweekhorst, M., Bunders, J., Coleman, H. L. S., Medenou, D., Dakpanon, L., & Buning, T. D. C. (2017). The root causes of ineffective and inefficient healthcare technology management in Benin public health sector. *Health Policy and Technology*, 6(4), 446–456.
15. Howlett, M., & Cashore, B. (2014). Conceptualizing public policy. In *Comparative policy studies: Conceptual and methodological challenges* (pp. 17–33). London: Palgrave Macmillan UK.
16. Hussien, H. M., Yasin, S. M., Udzir, N. I., Ninggal, M. I. H., & Salman, S. (2021). Blockchain technology in the healthcare industry: Trends and opportunities. *Journal of Industrial Information Integration*, 22, 100217.
17. Lee, D., & Yoon, S. N. (2021). Application of artificial intelligence-based technologies in the healthcare industry: Opportunities and challenges. *International journal of environmental research and public health*, 18(1), 271.
18. Lundvall, B. Å., & Borrás, S. (2005). Science, technology and innovation policy. *The Oxford handbook of innovation*, 599–631.
19. Manazir, S. H. (2025). Public policy formulation or policy panopticon? Revisiting the role of political elites in policymaking. *Humanities and Social Sciences Communications*, 12(1), 1–14.
20. Marchibroda, J. M. (2007). Health information exchange policy and evaluation. *Journal of biomedical informatics*, 40(6), S11–S16.
21. Mukherjee, I., Coban, M. K., & Bali, A. S. (2021). Policy capacities and effective policy design: a review. *Policy sciences*, 54(2), 243–268. <https://doi.org/10.1007/s11077-021-09420-8>
22. OECD (2023), OECD Science, Technology and Innovation Outlook 2023: Enabling Transitions in Times of Disruption, OECD Publishing, Paris, <https://doi.org/10.1787/0b55736e-en>.
23. OECD (2024), Agenda for Transformative Science, Technology and Innovation Policies, OECD Science, Technology and Industry Policy Papers, OECD Publishing, Paris,
24. Origa, J. (2019). *The Public Policy Process: Conceptual Framework for Understanding Policy Processes and Opportunities for Influencing Policy Outcomes*. ZBW.
25. Peters, B. G. (2018). *American public policy: Promise and performance*. Cq Press.
26. Sheikh, A., Anderson, M., Albala, S., Casadei, B., Franklin, B. D., Richards, M., ... & Mossialos, E. (2021). Health information technology and digital innovation for national learning health and care systems. *The Lancet Digital Health*, 3(6), e383–e396.
27. Umair, M., Cheema, M. A., Cheema, O., Li, H., & Lu,

- H. (2021). Impact of COVID-19 on IoT adoption in healthcare, smart homes, smart buildings, smart cities, transportation and industrial IoT. *Sensors*, 21(11), 3838.
28. UNESCO. 2024. Science Technology and Innovation Policy Instruments for the Sustainable Development Goals: A Global Outlook. M. R. Galindo Moreno. Paris, UNESCO.
29. United Nations. (2021). Using science, technology and innovation to close the gap on Sustainable Development Goal 3, good health and well-being. UNCTAD.
30. Vest, J. R., Campion Jr, T. R., Kern, L. M., Kaushal, R., & HITEC investigators. (2014). Public and private sector roles in health information technology policy: Insights from the implementation and operation of exchange efforts in the United States. *Health Policy and Technology*, 3(2), 149-156.
31. Yun T. (2023). Review of science and technology innovation policies in major innovative-oriented countries in response to the COVID-19 pandemic. *Biosafety and health*, 5(1), 8–13. <https://doi.org/10.1016/j.bsheal.2022.12.001>