Journal of Shahrekord University of Medical Sciences
doi: 10.34172/jsums.1011 2025;27(2):73-79 http://j.skums.ac.ir

Original Article

Identifying features and strategies for enhancing the optimal national model for the development of health-related technologies

Shahnaz Seyedi Dolatabad[1], Hessam Zandhessami[2*], Hamed Afshari[3], Shirin Jalalinia[4]

[1]Department of Industrial Management, RO.C., Islamic Azad University, Tehran, Iran
[2]Department of Industrial Management, SR.C., Islamic Azad University, Tehran, Iran
[3]Department of Food Science and Engineering, C T.C., Islamic Azad University, Tehran, Iran
[4]Center for Development of Research and Technoligy, Deputy if Research and Technoligy, Ministry of Health and Medical education, Tehran, Iran

*Corresponding Author: Hessam Zandhessami, Email: h.zand@iau.ac.ir

Abstract

Background and aims: National and international medical agencies have developed innovative methods to expedite the market entry of promising new technologies and enable early patient access. By adopting insights from experts, key informants, and stakeholders in the field of medical equipment, the present study aimed to identify the most critical features of a national model for developing health-related technologies.

Methods: This study was conducted over a six-month period in 2023. Firstly, all documents related to the national model for developing health-related technologies, including regulations, standards, licenses, structures, procedures, and processes, were precisely reviewed by the research team. Subsequently, the strengths and weaknesses of the mentioned model were extracted from these documents. Next, a two-round Delphi technique was applied to identify additional features. More than four focus group discussions (FGDs) were conducted by the research team to determine solutions for the improvement of the national model. After that, the Delphi method was applied again to collect further suggestions.

Results: Most participants emphasized the importance of developing and implementing supportive strategies. Key findings included strengths of the ongoing process, challenges in marketing medical equipment nationally, policy-making and management aspects, and suggestions to improve processes.

Conclusion: While policymakers' and health managers' efforts are welcomed, such achievements will be ineffective if micro and macro programs are overlooked.

Keywords: Health, Technology, Marketing, Commercialization

Received: September 1, 2024, **Revised:** February 16, 2025, **Accepted:** February 17, 2025, **ePublished:** June 29, 2025

Introduction

Adopting the latest technologies is the primary driver of the economic productivity of societies, improving the quality of life and public health (1,2). Health is a basic human need, and no one in society can be considered healthy in isolation. The health of individuals and society depends on the availability of high-quality services tailored to the needs of the target population. One significant factor that can affect the health field quantitatively and qualitatively is the approach to developing domestic health-related technologies (3). According to this approach, macro policymaking for internal health technology development is a critical priority and urgent need for society (3).

Commercialization is an attempt to profit from innovation by converting new technologies into marketable products, processes, and services to sell them in the market (4). For many new technologies, commercialization involves scaling from prototype to mass production and acquiring more resources (5). In this process, strategies include different methods of exploiting technologies and research that researchers and startups need to move knowledge from concept to market (6). Evidence shows that the decision to commercialize a new technology is closely linked to the characteristics of the innovation system in which the company operates (6). Choosing the appropriate affective model and strategy is inevitable (2,5,7).

Analysis and management, including reducing the limitations to advancing competitive production technology and improving marketing development, are important issues in adopting the required policies in the field of medical equipment and technologies (8,9).

Aimed at providing the most optimal framework and appropriate model to facilitate medical equipment marketing laws, procedures, and processes, the present investigation, using a qualitative approach, focused on internal procedures and compared them with similar cases from developed countries abroad.

Using experts' perspectives, key informants, and stakeholders in the field of medical equipment, this study aimed to identify and analyze the strengths, weaknesses, challenges, and suggestions for improving the current processes of introducing medical equipment into the domestic market.

Materials and Methods

The present study provides part of the findings from a comprehensive study on promoting the processes involved in medical equipment marketing. This descriptive-analytical study was conducted in two stages. The first stage focused on determining and classifying the various features of the national model used to develop health-related technologies. The second step proposed solutions for improving the national model. For this purpose, all subjects gave their written informed consent to participate in the study. The study's objectives were explained to them, and they were assured of the confidentiality of their personal information. All persons were also allowed to withdraw at any stage of the research.

Determining various features of the national model for the development of health-related technologies

At this stage, firstly, all documents related to the development of health-related technologies as part of the national model, including regulations, standards, licenses, structures, procedures, and processes, were carefully studied by the members of the research team. After that, the strengths and weaknesses of the existing model were extracted from these documents. Then, sessions were held by the researchers to review and discuss the extracted factors. Subsequently, the identified features were categorized into different groups based on shared attributes. Any irrelevant or redundant elements were also eliminated during this phase. In the next step, the Delphi technique was applied in two rounds to identify additional features (10). For this purpose, 15 experts participated in this phase. Inclusion criteria included experience in executive and research activities related to the development of health technology and familiarity with relevant regulations, standards, licenses, structures, procedures, and processes. An exclusion criterion was unwillingness to participate in the study and the presence of illogical or inconsistent views compared to other experts (10).

Under the supervision of a scientific committee, the list of key stakeholders was determined using the snowball sampling method. Experts were contacted via phone or email with an explanation of the study's scope and goals and were invited to participate. A list of categorized features was sent to the experts to conduct the Delphi method. They were asked to suggest further strengths and weaknesses related to health technology development and those identified through document analysis (10). They were also requested to provide feedback on the existing categorization. Subsequently, the responses were compiled and evaluated, leading to the incorporation of the suggested features. The updated list was then returned to the experts for a second round of review and feedback. After collecting and analyzing these final inputs, the list of features underwent a final revision (10).

Representing solutions for the improvement of the national model

In this step, more than four focus group discussions (FGDs) were conducted by the research team to determine solutions for improving the national model (11). The key questions raised in these sessions included: *How do you evaluate the role of policymaking in developing and marketing health-related technologies? What strategies do you suggest to improve the current regulatory framework for medical equipment? What interventions or programs could effectively support domestic medical equipment manufacturers? How can collaboration between academic institutions and industry be strengthened to foster innovation?* (11).

Following the discussions, the suggestions were grouped into several categories based on their similarities. These studies were designed based on the previously extracted features to solve problems in this field. Afterward, the Delphi method was used again to collect more suggestions. For this purpose, a list of the extracted suggestions was emailed to the experts who were asked to express their opinions on the items and their categories (11). They were also asked to provide further suggestions in addition to those represented in the list. Then, this information was collected and integrated into the prepared list of suggestions (11). This updated list was subsequently sent back to the experts for re-evaluation. Finally, the gathered information provided the final list of suggestions (10).

Analysis of findings

This research was conducted using a descriptive approach, and data was analyzed using Microsoft Word and Excel software (12,13).

Results

Characteristics of the experts

To obtain expert opinions, 15 experts in the fields of health technologies, medical equipment, sociology, entrepreneurship management, and policymaking participated in the study. Table 1 presents the demographic and professional characteristics of the experts.

Various features of the national model used for the development of health-related technologies

According to the results, the main category of findings was formed and divided into two parts:

strength points of the ongoing process and challenges of national medical equipment marketing. These categories provide a detailed summary of the key insights derived from the experts. Table 2 reports the major themes, sub-themes, and features affecting the development of health-

Table 1. Demographic and Professional Characteristics of the Experts

Participant ID	Field of study	Position	Work history (y)	Age (y)	Gender	Other details
P1	Health technologies	Researcher	12	45	Male	Specialization in medical device design
P2	Medical equipment	Industry manager	15	47	Female	Expertise in regulatory affairs
P3	Pharmacology	Academic professor	20	55	Male	Emphasis on health policy implications
P4	Entrepreneurship management	Technology development manager	10	40	Male	Innovation incubator center
P5	Health policy	Government Official	18	48	Male	Engagement in national health planning
P6	Biomedical engineering	Entrepreneur	8	38	Female	Founder of a medical innovation start-up
P7	Health economics	Consultant	14	52	Male	Expertise in market analysis
P8-P15	Various fields	Various roles	5-25	35-60	Mixed	Participants from diverse sectors related to health technology

Table 2. Themes, sub-themes, and features affecting the development of health-related technologies

Theme	Sub-Theme	Features
Advantages of ongoing processes	Government supervision	Strict regulations, periodic quality control, adherence to standards
	Meeting standards and qualifications	Accreditation processes, mandatory licenses
	Evidence-based planning	Utilization of successful experiences, scientific document reviews
Challenges in national medical equipment marketing	High costs and pricing issues	Price fluctuations, high tariffs, unaffordable research-based production
	Bureaucratic inefficiencies	Lengthy approval processes, exclusivity in importing advanced equipment
	Infrastructure and certification limitations	Lack of certification labs, inadequate research-commercialization links

related technologies.

Strengths of the processes of national medical equipment marketing

During the discussions, government supervision of the production and marketing of health-related equipment was highlighted as one of the most significant strengths of the current processes. Additionally, most participants stressed the importance of adherence to necessary standards and qualifications, as well as obtaining the required licenses from the right relevant health authorities. Periodic quality control of processes, product accreditation, and assurance of the quality of health-related products were also identified as notable strengths.

Another important aspect considered necessary in formulating and implementing programs was the use and interpretation of scientific evidence and related documents. This approach provides the best opportunity to benefit from successful experiences and lessons learned from previous related initiatives.

Challenges of the processes of national medical equipment marketing

Based on the analysis and aggregation of the perspectives provided regarding the weaknesses and challenges in the production and supply processes of national health-related products, the following issues were identified:

- Significant increase in the price of medical equipment and incompatibility of domestic product pricing with market fluctuations
- Illogical customs tariffs for medical goods
- Time-consuming approval process by the General Directorate of Medical Equipment
- Exclusivity in importing advanced equipment and devices by some companies
- Lengthy order registration process
- Inefficiency in the licensing process (e.g., long review times, inappropriate expertise)
- High costs of customs tariffs
- Lack of international certification laboratories
- The unaffordability of research-based production compared to imports
- Accumulated debt of medical centers to suppliers of medical equipment
- Incompatibility of most university research institute projects with real needs and their lack of success in their commercialization.

Representing solutions for the improvement of the national model

According to the results, the proposed solutions were categorized into two main themes:

(1) Policy-making and management

(2) Suggestions and solutions to improve processes.

Table 3 reports themes, sub-themes, and corresponding solutions for improving the national model.

Policy making and management

The study's findings show that improving management skills is one of the most important elements for program success. In the innovation process, moving from the initial stage (idea generation) to laboratory development, prototype construction and evaluation, and finally to mass production, involves increasing levels of risk and cost. Therefore, it is necessary to establish a balance between the risks and benefits at each stage, which requires

Table 3. Themes, sub-themes, and features affecting the development of health-related technologies

Theme	Sub-Theme	Features
Policy making and management	Importance of systematic management	Balancing risks and costs, fostering interdisciplinary collaboration
	Role of supervisory institutions	Oversight by National Standards Organization and Food and Drug Organization
	Stakeholder collaboration	Creation of councils, strengthening network systems among stakeholders
Suggestions and solutions for process improvement	Economic and financial support	Customs fee reduction, transparency in currency allocation
	Process optimization	Accelerating product clearance, reducing order registration time

systematic planning and supervision under a systematic management framework.

Based on the findings, the General Department of Medical Equipment should serve as the leading authority for policy-making and management regarding mandatory instructions, quality control protocols, and the evaluation of medical equipment. Moreover, most experts emphasized the importance of the supervisory role of legislative and executive institutions, particularly Iran's National Standards Organization, and the application of specific approaches aligned with ISO international standards.

The Food and Drug Administration was also identified as a key national supervisory body responsible for the internal marketing management of health-oriented products. One practical proposal emphasized the formation of a council consisting of manufacturing, import, and distribution companies, along with medical centers, to periodically manage all medical equipment needs and related statistics, and to report problems to the relevant administrators.

Another point raised in this regard was the need to pursue effective extra-structural communication and strengthen the networking system among the stakeholders in the health-related product sector. One key informant pointed out that "collaboration between new technology companies and large companies is one of the main strategies to overcome financial problems and expand industrial-scale production for direct access to the market."

Suggestions and solutions to improve processes

Many participants highlighted that a comprehensive economic evaluation of new health technologies requires a careful analysis of various economic aspects during the stages of identification and prioritization. Experts believe that accurately estimating opportunity costs (or lost potential profits) is essential for ensuring the success of these programs.

The following solutions were identified:

- Establishment or managing the pricing of health-related equipment production and provision
- Empowering medical centers to repay their postponed debts to medical equipment suppliers
- Supporting domestic manufacturers in the field of medical equipment, considering quality and competition
- Reducing customs fees
- Increasing the clearance process for goods while enhancing the accuracy and efficiency of procedures
- Reducing the time required for product order processing
- Promoting transparency and prioritization in the allocation of foreign currency
- Adjusting prices in accordance with market fluctuations
- Establishing and operating a comprehensive data system for the statistics and figures related to the required goods
- Monitoring importing companies to ensure the delivery of imported goods to the actual customers of equipment

One of the participants noted that" Strategic alliance is another form of cooperation. A joint venture is the most common form of collaboration in which one or more partners form a separate legal entity through equity ownership, sharing complementary skills and resources to create and manage it. The larger the number of partners, the greater the likelihood of success".

Discussion

Although few studies have comprehensively explored different aspects of promoting health-related technology marketing, the present research primarily focused on identifying the most important features of an optimal national model for the development and expansion of health-related technologies. Using a robust qualitative approach, the current research offers several key insights into detecting existing challenges and overcoming the challenges associated with the commercialization of national health technologies.

Previous research on technology commercialization, particularly in response to financial, managerial, structural, and marketing challenges, has provided solutions to overcome issues such as the "Death Valley" crisis or unpredictable market fluctuations (14). This evidence shows that although fundamental solutions such as the establishment of research and production units within growth centers and the allocation of pre-industrial production costs in early stages (formation, growth, and maturation of technology units and health product developers) have brought some success, there has been no success in permanent commercializing and resoling long-term challenges (3,15).

The healthcare sector is undergoing a fundamental transformation, with emerging needs leading to unprecedented advancements in technological capabilities (16). Participatory approaches, particularly

those involving cooperation with prominent national and international institutions and companies, are essential. Key strategies include the formation of subsidiaries in the fields of "design and manufacturing" and "marketing and sales," as well as the establishment of research institutes for conducting pre-clinical and clinical studies. These are some critical strategies for evaluating the feasibility of identified needs and for planning the production of health-related technologies (8,17,18).

In the review and analysis of successful experiences, researchers have emphasized that under comprehensive management, specialists in health technologies have mainly focused on the technical aspects of the innovation (19-21). In contrast, commercialization and specialized business operations are assigned to specialists in these fields (22). The findings of these studies have policy and management implications for policymakers and managers of knowledge-based companies involved in the commercialization of advanced health-related technologies (23-26).

Given the common problems faced by technology start-up companies in commercializing health technologies, various investigations have proposed many solutions across financial, managerial, structural, and marketing dimensions to prevent or overcome potential crises (24,27).

Policy initiatives such as the approval and implementation of executive instructions, the establishment of supportive facilities for emerging health technology companies, and the creation of academic science parks, technology transfer offices, and business growth centers have been proposed as primary supports (7,28,29). However, it is essential to prepare plans for their long-term sustainability, institutional independence, and sustainable development

While several studies have investigated different aspects of promoting health-related technologies marketing, the present study primarily focused on identifying the most critical features of an optimal national model for the development and expansion of health-related equipment (30). Using a comprehensive qualitative approach, this study provides several valuable insights into the key challenges facing national commercialization efforts and proposes strategies to overcome them (31).

Previous research addressing the commercialization of technologies in the face of financial, managerial, structural, and marketing challenges has proposed various solutions to overcome issues such as the "Death Valley" crisis (the gap between technology development and successful market adoption), and the unpredictability of market dynamics (2,14). These studies highlight that although fundamental measures such as establishing research and production units in growth centers and the allocation of pre-industrial production funding during early stages have yielded short-term success, long-term sustainability in commercialization remains an unresolved challenge (5,14).

The healthcare system is transforming significantly, with new demands driving unprecedented technological advancements. The findings of this study findings align with those of Pagoto and Bennett, who highlight the importance of participatory approaches that involve collaboration with prominent national and international institutions. They also advocate for the establishment of specialized subsidiaries focused on "design and manufacturing" and "marketing and sales" as critical strategies for evaluating the feasibility of health-related technologies and ensuring their successful commercialization (32). This aligns with Agarwal et al's findings which emphasized the importance of interdisciplinary collaboration between academia and industry in bridging the gap between research and commercialization (33).

In reviewing successful commercialization efforts, researchers have pointed out that specialists in health technologies often focus primarily on the technical aspects of innovation, while overlooking critical management and policy considerations (19,21). This study highlights that effective commercialization requires not only technical expertise but also a robust policy and management framework. The findings of this study echo the conclusions of Kim et al and Aghaei, who argue that policy and management strategies play a crucial role in overcoming the challenges faced by knowledge-based companies in the commercialization of health technologies (34,35).

Furthermore, consistent with Singh and colleagues' findings, this study suggests that the common challenges faced by health technology startups require integrated solutions across financial, managerial, structural, and marketing domains (36). By providing targeted support for startups such as reducing regulatory barriers and improving access to funding, we can mitigate the risks associated with early-stage commercialization (15,24).

Policy solutions such as creating academic science parks, technology transfer offices, and business growth centers have been widely proposed as primary support mechanisms for emerging health technology companies (11). However, as emphasized by Kim et al, these initiatives must be accompanied by long-term sustainability plans to ensure the ongoing success and independence of such companies. Without these plans, the effectiveness and impact of these programs may diminish over time (34).

This study provides valuable insights into the factors influencing the successful commercialization of health-related technologies, emphasizing the need for a holistic approach that integrates technical, managerial, and policy perspectives. Comparing the findings with existing literature underscores the need for developing comprehensive national frameworks that support the short-term implementation and long-term sustainability of health technology commercialization efforts. Future research should focus on testing these strategies in different contexts and evaluating their impact on long-term sustainability.

Although one limitation of qualitative research is its limited generalizability, this study strived to gather comprehensive data by using the points of view of a wide

list of key informants and experts in the field of health-related product commercialization, as well as group discussions with the stakeholders.

Conclusion

National policies and programs for the production and commercialization of health-related products need to be reviewed and revised based on reliable scientific evidence and stakeholders' opinions. The results of this study can serve as a valuable resource for evaluating ongoing programs and developing a suitable model for advancing and promoting health-related technologies. Based on the findings, the most essential features of an optimal national model for the development of the health-related equipment include:

- Ensuring quality insurance in accordance with the standards of the Ministry of Health and Medical Education
- Addressing the variety of medical equipment and avoiding the complexity of these products in their function and usage
- Enhancing the reliability, productivity, and overall performance of medical equipment
- Promoting interdisciplinary synergy in the development and exploitation of medical equipment through broad interaction between engineering universities and industry
- Facilitating intellectual property protection processes and supporting the production and commercialization of health-related technologies
- Reducing various costs in all aspects of health-related production
- Providing extensive support for knowledge-based start-ups in the fields of medicine and health
- Establishing the necessary infrastructure to meet the national technological needs of the country
- Training specialized professionals in medical and related fields
- Increasing communication skills and ensuring effective engagement with domestic and foreign commercial companies
- Enhancing familiarity with export regulations and procedures
- Increasing investment in university research and academic innovation projects.

Accordingly, policy measures should prioritize these areas.

Acknowledgments

This study is part of a Ph.D thesis conducted at the Roudehen Branch of Islamic Azad University, Tehran, Iran. The authors thank the cooperation of the key informants who participated in this research and extend sincere appreciation to the research team, for their valuable time and commitment to the study.

Authors' Contribution

Conceptualization: Hessam Zandhessami, Hamed Afshari, Shirin Jalalinia, Shahnaz Seyedi Dolatabad.
Data curation: Hessam Zandhessami, Hamed Afshari.
Formal analysis: Hessam Zandhessami, Hamed Afshari.
Funding acquisition: Shirin Jalalinia, Shahnaz Seyedi Dolatabad.
Investigation: Shirin Jalalinia, Shahnaz Seyedi Dolatabad.
Methodology: Hessam Zandhessami, Hamed Afshari, Shahnaz Seyedi Dolatabad.
Project administration: Hessam Zandhessami, Hamed Afshari.
Resources: Shirin Jalalinia, Shahnaz Seyedi Dolatabad.
Software: Shirin Jalalinia, Shahnaz Seyedi Dolatabad.
Supervision: Hessam Zandhessami, Hamed Afshari.
Validation: Hessam Zandhessami, Hamed Afshari.
Visualization: Hessam Zandhessami, Hamed Afshari, Shahnaz Seyedi Dolatabad.
Writing–original draft: Shirin Jalalinia, Shahnaz Seyedi Dolatabad.
Writing–review & editing: Hessam Zandhessami, Hamed Afshari, Shahnaz Seyedi Dolatabad.

Competing Interests

The authors declare no conflict of interests.

Ethical Approval

This study has been approved by the Ethics Committee of Islamic Azad University, Roudehen Branch (Approval Number 113448800 606036156016162728049).

Funding

This study was supported by the Roudehen Branch of Islamic Azad University, Tehran, Iran.

References

1. Eng TR. Population health technologies: emerging innovations for the health of the public. Am J Prev Med. 2004;26(3):237-42. doi: 10.1016/j.amepre.2003.12.004.
2. Gnidchenko A, Mogilat A, Mikheeva O, Salnikov V. Foreign technology transfer: an assessment of Russia's economic dependence on high-tech imports. Foresight STI Gov. 2016;10(1):53-67. doi: 10.17323/1995-459x.2016.1.53.67.
3. Grewal D, Hulland J, Kopalle PK, Karahanna E. The future of technology and marketing: a multidisciplinary perspective. J Acad Mark Sci. 2020;48(1):1-8. doi: 10.1007/s11747-019-00711-4.
4. Mamrayeva DG, Toxambayeva AB, Mamrayeva GB, Rodina LA. Theoretical aspects of studying of the innovations commercialization process. Bull Karaganda Univ. 2020;100(4):79-92. doi: 10.31489/2020ec4/79-92.
5. Lehoux P, Daudelin G, Williams-Jones B, Denis JL, Longo C. How do business model and health technology design influence each other? Insights from a longitudinal case study of three academic spin-offs. Res Policy. 2014;43(6):1025-38. doi: 10.1016/j.respol.2014.02.001.
6. Wang YC, Phillips F, Yang C. Bridging innovation and commercialization to create value: an open innovation study. J Bus Res. 2021;123:255-66. doi: 10.1016/j.jbusres.2020.09.052.
7. Kim J. Performance-based development funding using market mechanisms: a public–private partnership social financing model for medical equipment technology in developing countries. Prog Dev Stud. 2015;15(3):257-69. doi: 10.1177/1464993415578982.
8. Pagoto S, Bennett GG. How behavioral science can advance digital health. Transl Behav Med. 2013;3(3):271-6. doi: 10.1007/s13142-013-0234-z.
9. Johanson J, Vahlne JE. business relationship learning and commitment in the internationalization process. J Int Entrep. 2003;1(1):83-101. doi: 10.1023/a:1023219207042.
10. Dlikilili X, van Rooyen J. An application of a two-step Delphi model in identification of factors affecting the competitive performance of the South African citrus industry. In: 2018 Annual Conference. Cape Town, South Africa: Agricultural

Economics Association of South Africa (AEASA); 2018. doi: 10.22004/ag.econ.284731.
11. Djalalinia S, Ramezani Tehrani F, Malek Afzali H, Peykari N, Baradaran Eftekhari M. Community mobilization for youth health promotion: a lesson learned from Iran. Iran J Public Health. 2012;41(4):55-62.
12. Graneheim UH, Lindgren BM, Lundman B. Methodological challenges in qualitative content analysis: a discussion paper. Nurse Educ Today. 2017;56:29-34. doi: 10.1016/j.nedt.2017.06.002.
13. Mayring P. Qualitative content analysis. In: Flick U, von Kardoff E, Steinke I, eds. A Companion to Qualitative Research. SAGE Publications Ltd; 2004. p. 159-76.
14. Gbadegeshin SA, Natsheh AA, Ghafel K, Mohammed O, Koskela A, Rimpiläinen A, et al. Overcoming the valley of death: a new model for high technology startups. Sustain Futur. 2022;4:100077. doi: 10.1016/j.sftr.2022.100077.
15. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. Nurse Educ Today. 2004;24(2):105-12. doi: 10.1016/j.nedt.2003.10.001.
16. Sheikh A, Anderson M, Albala S, Casadei B, Franklin BD, Richards M, et al. Health information technology and digital innovation for national learning health and care systems. Lancet Digit Health. 2021;3(6):e383-96. doi: 10.1016/s2589-7500(21)00005-4.
17. Mesma Khosroshahi E, Soltanzadeh J. A historical analysis on the challenges of development and commercialization in a knowledge-based medical equipment company. Journal of Improvement Management. 2021;15(3):201-20. doi: 10.22034/jmi.2021.284091.2553. [Persian].
18. Agarwal R, Dugas M, Gao G, Kannan PK. Emerging technologies and analytics for a new era of value-centered marketing in healthcare. J Acad Mark Sci. 2020;48(1):9-23. doi: 10.1007/s11747-019-00692-4.
19. Becker U. Mass production in medical technology demands top precision in tiny details. Kunst Int. 2015;105(11):22-4.
20. Long G, Mortimer R, Sanzenbacher G. Evolving provider payment models and patient access to innovative medical technology. J Med Econ. 2014;17(12):883-93. doi: 10.3111/13696998.2014.965255.
21. Weinfurt P. Biomedical technology assessment: the 3Q method. In: Weinfurt P, ed. Synthesis Lectures on Biomedical Engineering. Springer; 2010. p. 1-101.
22. Leitner KH, Bergner S, Rybnicek R. The role of heads of departments in the commercialization of university research. J Bus Econ. 2021;91(3):353-78. doi: 10.1007/s11573-020-01003-y.
23. Zakery A, Saremi MS. Knowledge and intellectual capital in internationalizing SMEs, case study in technology-based health companies. J Intellect Cap. 2021;22(2):219-42. doi: 10.1108/jic-02-2020-0048.
24. Singh S, Prakash C, Ramakrishna S. Three-dimensional printing in the fight against novel virus COVID-19: technology helping society during an infectious disease pandemic. Technol Soc. 2020;62:101305. doi: 10.1016/j.techsoc.2020.101305.
25. Sharma A, Jha S. Innovation from emerging market firms: what happens when market ambitions meet technology challenges? J Bus Ind Mark. 2016;31(4):507-18. doi: 10.1108/jbim-12-2014-0265.
26. Hilbers ES, de Vries CG, Geertsma RE. Medical technology at home: safety-related items in technical documentation. Int J Technol Assess Health Care. 2013;29(1):20-6. doi: 10.1017/s0266462312000694.
27. Hong JW, Park SB. The moderating effect of information support and technology support between quality and satisfaction: focused on B2B market of medical instrument. Information. 2017;20(5B):3497-504.
28. Mackintosh M, Koivusalo M. Health systems and commercialization: in search of good sense. In: Mackintosh M, Koivusalo M, eds. Commercialization of Health Care: Global and Local Dynamics and Policy Responses. London: Palgrave Macmillan; 2005. p. 3-21. doi: 10.1057/9780230523616_1.
29. Sebastianski M, Juzwishin D, Wolfaardt U, Faulkner G, Osiowy K, Fenwick P, et al. Innovation and commercialization in public health care systems: a review of challenges and opportunities in Canada. Innov Entrep Health. 2015;2:69-80. doi: 10.2147/ieh.s60790.
30. Wang J, Lee JJ. Predicting and analyzing technology convergence for exploring technological opportunities in the smart health industry. Comput Ind Eng. 2023;182:109352. doi: 10.1016/j.cie.2023.109352.
31. Julian E, Gianfrate F, Sola-Morales O, Mol P, Bergmann JF, Salmonson T, et al. How can a joint European health technology assessment provide an 'additional benefit' over the current standard of national assessments? Insights generated from a multi-stakeholder survey in hematology/oncology. Health Econ Rev. 2022;12(1):30. doi: 10.1186/s13561-022-00379-7.
32. Bennett MM. Scale-jumping in the Arctic Council: Indigenous permanent participants and Asian observer states. In: Observing the Arctic. Edward Elgar Publishing; 2020. p. 54-81.
33. Agarwal R, Guerra M, Moeen M, Aversa P. Creating New Industries: The Generative Role of Heterogeneous Actors. 2024. Available from: http://dx.doi.org/10.2139/ssrn.5050978.
34. Kim D, Kwon J, Kim D, Kim E. Factors affecting the performance of government R&D support programs in pharmaceutical enterprises. J Sci Technol Policy Manag. 2024. doi: 10.1108/jstpm-12-2023-0228.
35. Aghaei I. Discovering Institutional Dynamics of Entrepreneurial Business Environment Development Evidence from MENA's Oil-Richest Countries [dissertation]. Gazimağusa, North Cyprus: Eastern Mediterranean University; 2019.
36. Singh S, Singh S, Chikhale M, Dhir S. Critical success factors for emerging technology adoption, strategic flexibility, and competitiveness: an evidence-based total interpretive structural modeling approach (TISM-E). Glob J Flex Syst Manag. 2024;25(3):601-28. doi: 10.1007/s40171-024-00408-w.