Challenges in Medical Technology Transfer in Southeastern Mexico: A Multi-Actor Analysis within the Innovation Ecosystem

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Abstract
Technology transfer in the medical device sector expands access to innovation and drives improved health outcomes. Despite the critical importance of advanced medical devices, developing regions continue to face substantial challenges in innovation, technology maturation, and access to emerging healthcare solutions. This study analyzes the principal barriers perceived

throughout the medical technology transfer process in southeastern Mexico. Drawing on a multi-actor approach, the research integrates the perspectives of representatives from Technology Transfer Offices (TTOs), Higher Education Institutions (HEIs), and government agencies established across the region. The study gathered quantitative and qualitative data to examine participants' perceptions and experiences regarding the challenges associated with medical technology transfer, technology adoption, and the development of collaborative networks. The findings reveal broad agreement that insufficient financial incentives constitute the primary obstacle, while actor groups differ in their assessment of the regulatory framework's role. By synthesizing multiple perspectives, the study concludes that stronger public policy alignment and deeper institutional collaboration represent essential priorities for addressing the current challenges surrounding medical technology transfer throughout the region.

Keywords: technology transfer; medical devices; innovation.

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Introduction

Medical device innovation and its potential to improve population health have emerged as a primary research priority, driven by the growing global demand for accessible, effective technologies tailored to specific contexts (Piaggio et al., 2021). The Federal Commission for the Protection against Sanitary Risks (COFEPRIS) and the World Health Organization (WHO) recognize medical devices as essential technological components of healthcare delivery because they serve as the primary tools for detecting, managing, and monitoring a wide range of diseases and injuries (COFEPRIS, 2023; WHO, 2012). Given the social relevance and practical value of medical devices, the need for innovations that enhance healthcare delivery worldwide remains pressing, particularly in developing regions that contend with resource constraints and a strong dependence on imported technologies (Lamichhane & Neupane, 2022; Piaggio et al., 2021).

Medical device innovation encompasses the development and commercialization of instruments and equipment essential for diagnosing, treating, and managing diseases and injuries (WHO, 2012). Although access to advanced medical devices plays a pivotal role in modern healthcare, developing regions continue to encounter substantial challenges throughout the technology transfer process. Regulatory constraints, limited infrastructure, and insufficient technical and financial resources account for many of these obstacles (De Leon & Tejero, 2023; Warty et al., 2021). Furthermore, significant knowledge gaps continue to hinder a comprehensive understanding of how these barriers influence technology development, maturation, and local manufacturing capacity (Kale et al., 2024).

The manufacture of medical equipment and supplies in Mexico contributes substantially to both the national economy and the global supply chain (INEGI, 2022). Across Latin America, Mexico serves as the principal exporter of medical devices, while globally the country ranks seventh in export volume within this product category (Pineda, 2024). Nevertheless, domestic production remains concentrated on low-technology devices, including disposable medical supplies and non-electronic instruments, whereas the local development and manufacture of high-technology medical devices continue to lag behind (INEGI, 2022). Given the considerable potential of Mexico's medical device industry, identifying the barriers that constrain technology transfer represents a critical step toward designing effective improvement strategies.

Mexico has sought to strengthen its innovation ecosystem through institutional transformation, exemplified by the establishment of the Ministry of Science, Humanities, Technology, and Innovation (SECIHTI). Nevertheless, the gap between innovation generation and successful market entry persists. Accordingly, this study aimed to analyze the principal barriers perceived in medical technology transfer across southeastern Mexico by examining the experiences of three key actors within the regional innovation ecosystem: Technology Transfer Offices (TTOs), Higher Education Institutions (HEIs), and governmental agencies responsible for regulation and innovation support. By generating evidence from these complementary perspectives, this research seeks to inform policymakers, innovators, and healthcare stakeholders interested in strengthening the development, maturation, and market access of medical technologies in emerging economies.

Theoretical Framework

Technology Transfer Process.

Technology transfer involves the movement of specialized information, tacit knowledge, technical expertise, competencies, and equipment among organizations, thereby strengthening the technological and manufacturing capabilities of technology recipients. Within the medical device sector, this process encompasses collaborative initiatives and the exchange of knowledge and resources that ultimately generate tools and devices designed for healthcare applications (WHO, 2012).

Viewed as a dynamic process, technology transfer engages multiple actors, including academia, industry, government, and technology transfer intermediaries (Tuxpan et al., 2024). Academia serves as the primary source of scientific knowledge and technological innovation, principally through research activities. Industry includes both technology providers and organizations that adopt and commercialize innovations. Government shapes the innovation environment through regulatory oversight, public policies, and incentives that encourage collaboration. Technology Transfer Offices (TTOs) operate as specialized intermediaries by providing expertise in intellectual property management, technology commercialization, and innovation management (Ix Caamal et al., 2016).

Interactions among these actors have traditionally been explained through helix-based innovation models, particularly the Triple Helix framework. This model conceptualizes innovation as a dynamic process driven by continuous interactions among universities, industry, and government, in which universities actively generate knowledge while public institutions cultivate conditions that foster innovation (Etzkowitz & Zhou, 2017).

The Triple Helix model departs from the traditional linear view of knowledge transfer by portraying governments as public entrepreneurs and highlighting the role of intermediary organizations, such as TTOs, in facilitating knowledge recombination and the commercialization of university research (Etzkowitz, 2003).

Furthermore, the framework identifies patent licensing and intermediary structures as key technology transfer mechanisms that align incentives and strengthen absorptive capacity across the innovation ecosystem (Cai & Etzkowitz, 2020). More recently, the Quadruple Helix model has expanded this perspective by incorporating end users as a fourth actor, thereby recognizing society's active role in innovation processes (Carayannis et al., 2022; Miller et al., 2018).

Helix models provide robust conceptual frameworks for examining interactions among actors within innovation ecosystems. In the context of medical devices in southeastern Mexico, these frameworks facilitate the identification of gaps in collaboration among key actors. Across developing regions such as southeastern Mexico, effective institutional interaction remains essential for shifting from an economy dependent on imported technologies toward a knowledge-based model supported by domestic innovation.

Within this setting, TTOs perform a critical intermediary function, while public policies designed to promote innovation help mitigate the financial and technical risks inherent in medical technology development. Nevertheless, this study acknowledges one important limitation: the absence of perspectives from industry actors. Ongoing research conducted by the authors seeks to address this limitation by incorporating the industrial sector into future analyses.

Potential Barriers and Enablers of Medical Technology Transfer

Medical technology transfer, particularly in developing regions, encounters challenges arising from the interaction of systemic, financial, regulatory, and cultural barriers. These obstacles restrict the translation of research and development outcomes into marketable innovations while ultimately limiting improvements in healthcare delivery. The most frequently reported challenges include inadequate healthcare infrastructure, insufficient funding, complex and inefficient regulatory frameworks, fragmented collaboration among key actors, and cultural resistance to change (Table 1) (González Sabater, 2011; WHO, 2012; Pérez-Orive & Ibarra Ponce de León, 2019).

Table 1. Potential Challenges in Medical Technology Transfer

Aspect	Description
Infrastructure	Includes, for example, unreliable electricity and communication networks that constrain the ability to use, evaluate, and adopt new medical devices (De Leon & Tejero, 2023).
Financial resources	Developing countries frequently lack the financial capacity required to acquire emerging medical technologies (Malik et al., 2024). Limited funding also constrains local planning, validation, and product design activities (De Leon & Tejero, 2023).
Regulatory frameworks	Complex, stringent, inconsistent, and poorly harmonized regulatory frameworks create significant obstacles to local production and technology transfer (WHO, 2012).
Interinstitutional collaboration	Insufficient coordination and collaboration among actors hinder efforts to build the capabilities and infrastructure required for effective technology transfer (Campo et al., 1999).
Cultural factors	Competing institutional agendas (WHO, 2012), together with resistance to adopting new technologies because of established practices or skepticism, may impede both innovation adoption and access to new medical technologies (Malik et al., 2024).

Source: Prepared by the authors based on the literature.

These interconnected challenges create substantial obstacles to the effective transfer and adoption of medical device technologies. At the same time, they highlight opportunities for improvement that can inform strategies designed to strengthen innovation and technology transfer, particularly across emerging regions.

Innovation and the Medical Device Sector in Mexico

Mexico's medical device industry represents a strategic component of the national economy and plays an increasingly important role in global supply chains (INEGI, 2022). Nevertheless, the sector continues to face a major challenge: domestic production remains concentrated on low-technology products, including disposable medical supplies and non-electronic equipment (INEGI, 2022). Meanwhile, the country's dependence on imported advanced medical devices underscores a persistent gap in local innovation and technological development (INEGI, 2022; Pineda, 2024).

In recent years, Mexico has promoted an innovation model aimed at achieving greater technological self-sufficiency in the healthcare sector. A notable example involves the creation of Innova Bienestar, a state-owned public organization dedicated to the development of highly specialized medical equipment (Conahcyt, 2023). The private sector has likewise strengthened its contribution through organizations such as the Mexican Association of Innovative Medical Device Industries (AMID, 2023), which has emerged as a critical driver of innovation within the national industry. Within this innovation ecosystem, Technology Transfer Offices (TTOs) perform an essential intermediary role by managing intellectual property and facilitating

navigation through complex regulatory pathways (Cima-Cohuo et al., 2025). Higher Education Institutions (HEIs), in turn, constitute the primary source of scientific knowledge and technological innovations with significant industrial application potential (Tuxpan et al., 2024).

The development of innovation clusters in strategic regions such as Yucatán and Baja California has become a central component of Mexico's innovation strategy. The Baja California cluster ranks as the country's leading medical device hub in terms of production capacity and the number of participating companies (Flores Gracia & Bonal, 2016). On the Yucatán Peninsula, the Yucatán Science and Technology Park and the ITC Heuristic Innovation Center have emerged as key institutions promoting the development of regional innovation clusters. Despite these initiatives, medical device technology transfer continues to encounter substantial barriers, including inadequate infrastructure and complex, time-consuming regulatory frameworks.

Metodology

This study adopted a mixed-methods approach with a descriptive, non-experimental research design. Data were collected from a convenience sample comprising Technology Transfer Offices (TTOs), Higher Education Institutions (HEIs), and government agencies, including the Ministry of Science, Humanities, Technology, and Innovation (SECIHTI) and the Mexican Institute of Industrial Property (IMPI), using both quantitative and qualitative instruments. The first instrument consisted of a questionnaire adapted from the World Health Organization (WHO, 2012), combining multiple-choice and open-ended questions addressing challenges associated with medical technology transfer. The second instrument comprised a structured interview designed to explore the role of government agencies in fostering innovation and development, as well as their perceptions of the principal barriers affecting technology transfer. Combining these instruments enabled a comprehensive examination of the perceptions and experiences of multiple actors within the innovation ecosystem of southeastern Mexico.

Sample

The study employed a non-probability convenience sample based on the voluntary participation of key institutional actors from southeastern Mexico. The final sample comprised 14 strategic representatives distributed as follows: seven representatives from TTOs ($n_1 = 7$), four representatives from HEIs ($n_2 = 4$), and three senior officials from government agencies responsible for regulation and innovation support ($n_3 = 3$).

The TTO sample drew upon the classification provided by RedOTT México (2025), which identified nine operational offices across the states of Yucatán, Campeche, and Quintana Roo. However, two offices listed in the directory did not participate because they had suspended operations when the researchers established contact. The HEI sample relied on information provided by the Secretariat of Research, Innovation, and Higher Education of Yucatán. All higher education institutions offering programs related to the biomedical field entered the sampling frame because of their direct relevance to the medical device sector.

Government organizations included institutions responsible for research, science and technology, public policy development, technology transfer regulation (SECIHTI), and intellectual property management (IMPI). The final sample size reflected participant availability

and accessibility during the study period. Researchers directed recruitment and data collection to the director, principal officer, or technology transfer coordinator within each participating institution.

Before data collection began, institutional representatives received detailed information regarding the study's objectives, the voluntary nature of participation, and the commitment to maintain confidentiality throughout the research process. Accordingly, this study safeguarded both the identity and the integrity of all participants.

Instruments and Data Analysis

Questionnaire. The questionnaire originated from the instrument developed by the World Health Organization (WHO, 2012). It included five questions addressing general knowledge transfer processes and an additional set of eleven questions focused on barriers and opportunities in technology transfer.

These items covered research and development, patents and licensing, commercialization, collaborative networks, regulatory issues, and overall actors perspectives (Table 2). The original instrument underwent several adaptations, primarily involving technical translation into Spanish and contextual modifications to reflect the Mexican innovation environment. Two experts in technology transfer evaluated these adaptations to ensure content clarity, relevance, and contextual appropriateness. Their assessment supported the content validity of the revised instrument for the regional setting.

The questionnaire incorporated both closed-ended multiple-choice items and open-ended questions. Open-ended responses complemented the quantitative findings by providing additional explanations and contextual insights.

Quantitative data underwent descriptive statistical analysis, whereas qualitative responses were analyzed separately to enrich the interpretation of quantitative results. Researchers distributed the questionnaire through an online survey platform between January and June 2025. Initial contact with TTOs occurred through the support of RedOTT, followed by individual communication via institutional email. HEIs and government agencies received direct invitations through telephone calls and institutional email correspondence.

Table 2. Questionnaire Content on Barriers to Technology Transfer

Category	Questions
Research and Development	Examine perceived barriers affecting medical device research and development activities.
Patents and Licensing	Assess how current intellectual property procedures influence research and development efforts.
Commercialization	Identify the principal barriers to the commercialization and technology transfer of medical devices.

Category	Questions
Collaborative Networks	Explore the challenges and opportunities associated with establishing collaborative networks that support technology transfer.
Regulation	Examine barriers associated with the current regulatory system and gather proposals for regulatory improvement.
Overall Perspective	Identify the principal perceived barriers affecting access to and the transfer of medical device technologies.

Source: Prepared by the authors.

Interviews. The interview guide drew upon the instrument developed by Tuxpan et al. (2024). The protocol included six open-ended questions addressing each institution's role in knowledge transfer, the key factors driving technology development, and mechanisms that promote technology transfer. Data collection began by contacting participants via email and telephone to schedule interview sessions.

Researchers conducted all interviews individually and remotely, with an average duration of approximately 30 minutes. At the beginning of each session, participants received an explanation of the study's objectives and provided informed consent before the interview commenced. With participants' prior authorization, all interviews were audio-recorded and subsequently transcribed verbatim for analysis.

Qualitative data underwent deductive thematic analysis following the approach proposed by Miles et al. (2014), with two researchers independently participating in the coding process. The researchers analyzed responses separately using a priori categories derived from the dimensions of the quantitative instrument presented in Table 2.

Data analysis relied on NVivo software (Version 14). The researchers discussed and resolved any coding discrepancies through consensus. During the reporting stage, the analysis incorporated representative excerpts that best illustrated the central themes, thereby providing evidence for the areas of convergence and divergence identified across the different actor groups included in the study.

Results

Barriers to Research, Development, and Innovation

Representatives from the Technology Transfer Offices (TTOs) reported that they collaborate most frequently with academic institutions and private organizations (5 of 7) on research and development activities. Representatives from Higher Education Institutions (HEIs), by contrast, indicated that their collaborations occur primarily with other academic institutions (3 of 4), while partnerships with private organizations remain comparatively limited.

The data suggest that TTO representatives regard limited financial resources as the most significant barrier to research and development, followed by insufficient financial incentives or limited prospects for return on investment. HEI representatives expressed similar views, likewise

identifying limited financial resources and a lack of financial incentives among the most critical challenges affecting innovation.

Representatives from government agencies also identified limited financial resources and insufficient incentives as the principal obstacles. However, the governmental perspective introduced two additional dimensions. One interviewee highlighted the existence of territorial disparities in science, technology, humanities, and innovation capabilities, particularly in Maya-speaking municipalities, which restrict knowledge transfer beyond the state's capital despite the technological development potential of these communities. Another participant emphasized the limited social appropriation of science, arguing that it reduces demand for innovative technological solutions while reinforcing the disconnect between academic research and the needs of productive sectors.

Patents and Licensing

Most participants considered existing patenting and licensing procedures to support local research and development (6 of 7 TTO representatives and 3 of 4 HEI representatives). Nevertheless, one TTO representative noted that "although patents aim to stimulate private investment, lengthy procedures and the lack of mature technologies can discourage innovators." Likewise, HEI representatives acknowledged that patents facilitate the implementation of medical devices within the domestic market but also emphasized that "limited support for researchers and persistent obstacles to testing and experimental validation continue to hinder technological advancement."

Data obtained from government agencies revealed divergent perspectives regarding patents and licensing. Representatives from the Mexican Institute of Industrial Property (IMPI) argued that the current procedures promote local technological development by providing legal certainty. As one interviewee explained, "the barrier to obtaining patents and licenses does not arise from the administrative process itself but rather from the still-emerging culture of scientific entrepreneurship within universities."

According to this perspective, researchers often lack a commercial orientation, which limits their ability to transform inventions into viable business models capable of generating licensing opportunities. Similarly, representatives from the Ministry of Science, Humanities, Technology, and Innovation (SECIHTI) identified the limited intellectual property culture within the research community, combined with insufficient support for technology maturation, as the principal barriers preventing research outcomes from progressing toward patent registration and commercial licensing.

Commercialization

All HEI representatives identified insufficient funding as the principal barrier to the commercialization and transfer of medical devices. In addition to financial constraints, TTO representatives highlighted limited local manufacturing capabilities and the availability of products that fail to meet local needs as major obstacles to successful commercialization.

Responses to the open-ended questions revealed that TTO representatives expressed particular concern about the high cost of available medical devices and the lengthy accreditation process

required by the Federal Commission for the Protection against Sanitary Risks (COFEPRIS). More specifically, participants noted that "at times, the main difficulty lies in finding specialists who can provide guidance on complying with the regulatory requirements necessary to facilitate market entry for these technologies," and that "even when a functional device has been developed, the country lacks the manufacturing infrastructure needed to produce it at small scales." HEI representatives likewise identified the high cost of equipment and the difficulty of acquiring specialized technologies as significant constraints.

As one participant explained, "equipment costs remain high and acquisition proves difficult, while commercialization requires compliance with accreditation standards." They further indicated that many technologies become abandoned during the early stages of development and never reach sufficient maturity for commercialization.

Representatives from government agencies identified limited business knowledge among academic researchers as the primary barrier to commercialization. According to their perspective, researchers frequently develop technically sound solutions but fail to advance beyond the proof-of-concept stage because they lack expertise in business model development and intellectual property management.

They further argued that, although knowledge generation occurs successfully, innovation efforts often stall because of the shortage of pilot plants and certified prototyping laboratories. This structural deficiency prevents many projects from progressing through the intermediate stages of technology maturation and ultimately reaching commercial-scale production.

Collaborative Networks

TTO representatives (6 of 7) identified insufficient incentives, limited actor engagement, and inadequate information regarding public health needs as the principal barriers to establishing collaborative networks that support medical device technology transfer. Respondents indicated that many institutions lack the infrastructure and resources required to mature emerging technologies, while industry demonstrates limited willingness to invest during the early stages of development.

These findings reveal a disconnect between early-stage innovation and the investment necessary to scale promising technologies. Representatives from government agencies, including SECIHTI, shared this perception, acknowledging fragmented collaboration among actors. As one participant explained, "a disconnect persists between academic research and the needs of productive sectors, limiting the consolidation of the innovation ecosystem."

TTO representatives proposed several strategies to strengthen collaborative networks, including regional and local workshops, technical cooperation initiatives, knowledge-sharing mechanisms, specialized training programs, financial support, government- and industry-sponsored networking opportunities, and coordinated efforts to reinforce the regional innovation ecosystem. HEI representatives similarly identified limited information about public health needs as the principal barrier to effective collaboration. They further emphasized the need for greater research funding for universities and private companies, increased financial resources to

support prototype development and validation processes, and dedicated personnel and budget allocations specifically intended to facilitate collaborative initiatives.

Regulatory Framework

TTO representatives generally did not regard regulation itself as a primary obstacle. Instead, they emphasized the need for greater access to information, wider dissemination of regulatory requirements, and specialized training on technology transfer regulations. For example, participants noted that despite the complexity of medical devices, "there are no practical guidelines, follow-up meetings, or periodic updates to laws and standards that facilitate regulatory compliance and make the process more accessible."

In contrast, HEI representatives viewed regulatory compliance as a significant barrier, highlighting limited institutional support and more stringent regulatory requirements than those found in other countries. TTO respondents further explained that insufficient funding, high accreditation costs, bureaucratic procedures, and prolonged review periods represent substantial obstacles associated with the current regulatory framework. HEI representatives echoed this perception, arguing that existing regulatory requirements create particular difficulties during the early stages of technology transfer.

To address these challenges, TTO representatives proposed streamlining licensing procedures, establishing faster administrative processes, providing clearer and context-specific regulatory guidance, and expanding advisory services to support compliance with regulatory requirements. They also advocated the creation of public-private financing mechanisms, stronger collaboration between academia and industry, and "a regulatory framework that supports pilot testing and early-stage validation, thereby accelerating the introduction of medical devices into the market while improving public access." HEI representatives similarly recommended more flexible regulatory requirements, revisions that would improve access to government funding, and stronger partnerships with industry. In addition, they emphasized the importance of increasing investment in research and expediting review and testing procedures to reduce approval timelines.

Overall Perspective

Most TTO representatives (6 of 7) identified the high cost of medical devices and the difficulty of complying with regulatory requirements as the primary factors limiting access to medical technologies in Mexico. Most HEI representatives shared this assessment, likewise identifying these two issues as the principal barriers to broader access.

Responses to the open-ended questions further revealed that TTO representatives emphasized limited support for the development and maturation of medical devices. HEI representatives expressed concern over the limited availability of medical-grade components, arguing that existing regulatory requirements further constrain access to these resources. As one participant explained, "the reduction in financial resources allocated to the healthcare sector has shifted research to a lower priority. Universities and research centers provide few incentives to train professionals in this field, while physicians often perceive medical technology developers merely as technicians, diminishing both the scope of their work and the value of the profession."

Participants also highlighted high equipment costs, expensive financing, and the perception that educational and research institutions operate with insufficient resources and limited incentives.

The interviews also revealed differing perspectives regarding the hierarchy of criteria used to acquire medical technologies. Government agency representatives indicated that quality, safety, and price constitute the dominant purchasing criteria, whereas the innovative nature of a technology receives secondary consideration. This market reality creates an additional challenge for locally developed technologies: innovation alone does not ensure successful adoption. Medical devices must also demonstrate cost competitiveness while satisfying rigorous safety and regulatory standards. Nevertheless, government representatives acknowledged that limited access to innovation financing remains a cross-cutting challenge affecting the development and commercialization of medical devices throughout the region.

Discussion

The primary objective of this study involved analyzing the perceptions of representatives from Technology Transfer Offices (TTOs), Higher Education Institutions (HEIs), and government agencies (SECIHTI and IMPI) in southeastern Mexico regarding the principal barriers affecting medical technology transfer. The findings reveal substantial convergence with the structural barriers previously documented in Mexico's health innovation ecosystem (e.g., Cima-Cohuo et al., 2025; Tuxpan et al., 2024).

The identification of limited financial resources and insufficient economic incentives as the most significant obstacles to the development, validation, and commercialization of medical devices aligns with Mexico's broader macroeconomic context. For instance, national expenditure on research and development remains at approximately 0.5% of GDP, a level substantially lower than that of other emerging economies such as Brazil (1.28%) (Pérez-Orive & Ibarra Ponce de León, 2019). Limited funding not only constrains innovation but also prevents the development of essential infrastructure, including pilot plants and certified prototyping laboratories. These findings therefore point to structural challenges that extend well beyond simple budget limitations, emphasizing the need to strengthen intermediate innovation infrastructure capable of supporting technologies through advanced stages of commercial maturation.

One of the most notable divergences concerns perceptions of the regulatory framework. While government agencies (IMPI and SECIHTI) regard existing regulations as a source of legal certainty, academic actors and TTO representatives perceive them as burdensome, bureaucratic, and costly obstacles. This divergence reflects previously documented shortcomings in institutional guidelines. Earlier studies have shown that regulatory frameworks often remain outdated or insufficiently clear (Tuxpan et al., 2024), creating potential conflicts of interest for researchers working within public institutions, who may fear administrative sanctions when attempting to commercialize their innovations (Hernández-Mondragón et al., 2016).

Likewise, the limited culture of scientific entrepreneurship identified by government representatives complements the disconnect among key innovation actors described in previous research (Pérez-Orive & Ibarra Ponce de León, 2019). The findings suggest that although researchers possess substantial technical expertise, they frequently lack training in business

model development and intellectual property management. This gap creates an additional barrier between scientific discovery and successful technology licensing. In southeastern Mexico, this challenge becomes even more pronounced because of limited public engagement with science and fragmented collaboration among innovation actors.

The findings also highlight several opportunities for improvement. From a public policy perspective, promoting technology transfer in southeastern Mexico requires more than generic financial subsidies. Effective policy should prioritize regulatory reforms that reduce commercial uncertainty and lower accreditation costs while simultaneously strengthening collaboration between academia and industry. Such initiatives could substantially improve both access to and the transfer of medical technologies tailored to national needs. SECIHTI highlighted the operation of the ECOS Network, which connects more than 1,725 participants to align academic capabilities with real productive-sector demands. The agency also emphasized the importance of implementing strategies that address structural challenges, including the development of specialized human capital and the promotion of socially relevant applied research.

This study contributes to a broader understanding of the challenges that constrain innovation and technology transfer in developing regions (Kale et al., 2024) by incorporating the perspectives of key actors within the innovation ecosystem. In doing so, it extends previous findings reported by Cáceres Gómez and Becerra Ardila (2022), De Leon and Tejero (2023), Lamichhane and Neupane (2022), and Vasan and Friend (2020), while providing an empirical foundation for designing strategies that strengthen medical device technology transfer. Nevertheless, these findings should be interpreted in light of several research limitations, including the relatively small sample size, the absence of industry participation as a key actor, the study's geographic focus, and its descriptive and exploratory scope. Future research should incorporate larger and more diverse samples that include additional actors—particularly industry, government, and civil society—and should explore collaborative strategies capable of strengthening regional medical technology innovation ecosystems.

Conclusions

This study offers significant strategic value by adopting a multi-actor perspective, thereby providing a comprehensive understanding of the challenges surrounding medical technology transfer in southeastern Mexico through the integration of insights from Technology Transfer Offices (TTOs), Higher Education Institutions (HEIs), and government agencies. This approach proves essential not only for identifying shared barriers, particularly limited financial resources, but also for revealing critical differences in actors' perceptions of the regulatory framework. Such evidence can assist policymakers in harmonizing regulations, strengthening technology transfer management, and promoting the development of infrastructure that supports technology maturation.

Ultimately, the value of this multi-actor perspective lies in its ability to align academic capabilities with the needs of productive sectors, thereby establishing the foundations for greater technological sovereignty in healthcare. By reducing dependence on imported medical technologies and fostering locally developed solutions with substantial social impact, these

efforts can strengthen innovation ecosystems and improve healthcare outcomes across developing regions.

This study contributes significant strategic value by adopting a multi-actor perspective, which affords a holistic understanding of the challenges surrounding medical technology transfer in southeastern Mexico by integrating the views of TTOs, HEIs, and government agencies. This approach proves fundamental for identifying not only shared barriers, such as the lack of funding, but also critical divergences in perceptions of the regulatory framework, thereby enabling decision-makers to harmonize regulations, professionalize technology management, and foster technology maturation infrastructure. Ultimately, the relevance of this approach lies in its capacity to link academic capabilities with real productive needs, laying the foundations for technological sovereignty in health that reduces dependence on imports and generates solutions with high social impact in developing regions.

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