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DEVELOPMENT OF MANAGEMENT MODEL FOR INNOVATION PLATFORM IN MEDICAL ARTIFICIAL INTELLIGENCE INDUSTRY IN CHINA

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Abstract

This study aims to develop an innovation platform management model to address issues in medical AI Industry in China and promote its future development. The first step is to analyze the existing problems, opportunities and innovative solutions in the medical AI industry in China by literature analysis and in-depth interview with five experts. The second step is to evaluate the consistency of innovation platform management elements for the medical AI industry in China by expert confirmation process with 17 experts. The final step is to create the innovation platform management model and confirm by 5 experts. The findings of this study are as follows: (1) It identified 5 aspects, 11 themes and 35 elements for innovation platform management in medical AI industry in China. Experts agree on the necessity of a multi-faceted approach to foster innovation, emphasizing the importance of data privacy, domain knowledge base development, interdisciplinary talent cultivation, clinical-AI integration, organizational management. (2) The proposed management model presents a comprehensive framework encompassing five aspects: infrastructure management, technology innovation management, application scenarios management, policy and regulation management, and platform organization management. This study emphasizes the importance of stakeholder collaboration and the utilization of the innovation platform to facilitate the industry development.

Keywords: Management Model, Innovation Platform, Medical Artificial Intelligence, Platform Empowerment

Introduction

Artificial Intelligence (AI) has revolutionized healthcare with its advanced data processing capabilities and optimization abilities, impacting various medical applications (Sun, Gao & Wu, 2021). However, integrating AI and the medical industry remains challenging, such as inexplicable diagnosis results, unguaranteed medical safety and unformed service loop. Despite these hurdles, the medical AI field garners significant attention for

its potential growth. To foster industry development, China government has introduced policies promoting innovation platforms that carry out technology innovation and provide open sharing services. These platforms, led by tech giants or governments, facilitate interdisciplinary collaboration to tackle complex tasks and provide various support to the innovation activities (Hao, 2021).

Deepening integration of AI to medical industry increases complexity of management demands towards innovation platforms. Science and technology innovation platform needs to explore management models and integrate new resources to provide better innovative solutions. Developing a management model suitable for the future development demands of the medical AI industry has become an urgent task, addressing the lack of research on platform empowerment at multiple levels and its impact on the symbiotic relationship among various industrial stakeholders.

This study tries to fills this gap by using an in-depth interview and expert confirmation process based on literature analysis. It aims to identify problems and opportunities facing the medical AI industry, analyze the management elements of innovation platform, and develop a management model. The main research objective is to develop the platform management model for the industry's future development, exploring key factors driving successful emerging industry and determining optimal management practices and organizational collaborations to support this process with the following objectives:

1. To analyze the existing problems, opportunities, and innovative solutions in the medical AI industry in China.

2. To evaluate the consistency of innovation platform management elements for the medical AI industry in China.

3. To create and evaluate the innovation platform management model for the future development of the medical AI industry in China.

Literature Review

Medical AI in China confronts hurdles in medical data, algorithm, talents, clinical application, ethics and law. (Tomičić & Lazić Mosler, 2022) (Zhu & Lv, 2022). Regulatory gaps impede high-quality data collection, data sharing and patient privacy protection, alongside the absence of medical data standardization, limiting AI's practical use to experimental stages (Shi & Liu, 2021). Algorithm challenges provoke skepticism regarding AI's Interpretability and potential bias due to the 'black box' opacity of AI diagnostics (El Kafhali et al., 2023). Clinical application barriers are multifaceted, encompassing costliness and technical uncertainty that restrict AI products to solving clinical issues, failing to streamline services or alleviate physician burdens s (Ji, et al., 2022). Interdisciplinary talent is scarce, particularly. Those adept in both AI and clinical medicine, with the current

educational system in China favoring specialized applications over integrated innovation (Wang et al., 2020). Commercialization is at a low rate and monetization models are undefined (Luo, 2021). Ethical and legal dilemmas, particularly regarding data security, risk liability and supervision, are gaining prominence (Shen et al., 2023).

The medical AI industry's future development hinges several aspects such as infrastructure, technology innovation, application scenario, policies, and regulations. The infrastructure includes factors such as high-performance computing, advanced algorithms, and big data (Liu et al., 2023). Experts recommend China prioritize building data standardization and norms, drawing from international best practice for medical data management (Liao et al., 2021). AI algorithms are pivotal in healthcare but require increased interpretability, accountability, and transparency (Reddy et al., 2020). For the technology innovation aspects, key to medical AI's growth are breakthroughs in core technologies (Qiu et al., 2023) and cultivation of innovative talents. China is urged to bolster AI research to compete internationally, focusing on new AI chip and large AI models. Cultivating AI talent through research and startups, as well as interdisciplinary education, is essential for technology advancement (Zhao & Zhuang, 2023).

Integrating AI into medical scenarios is essential to advancing the medical AI industry, driving technology upgrades, and forming a data-driven business loop. To penetrate deeply, AI must integrate into the entire clinical process, while broadly it should enhance primary care and tiered medical services, with future healthcare aiming for increasing efficiency and tailored treatments (Yuan et al., 2020). Market growth is promising, yet still nascent, requiring policy support and strategic planning. Countries are launching AI strategies, with China emphasizing applications like medical imaging, while others focus on basic research (Luo, 2021). Ethics and law emphasize the need for a comprehensive governance system and a balance of innovation with ethical risk control (Braun & Harasimiuk, 2023).

Innovation platforms play a crucial role in medical AI technology and industry development, as they provide innovative solutions by integrating resources, supporting innovation activities and enabling medical AI application (Lu, 2020). Innovation platforms create value through capability aggregation, adapting to external environments, and resource restructuring. Recommendations for industry future development include building structure system and collaborative mechanisms, improving top-level design and building open ecosystems (Chen, 2022).

Based on the literature review, this study will identify the problems and opportunities in the development of the medical AI industry and the innovative solutions of the innovation platform. An in-depth interview will be used to explore and supplement the platform management elements and an expert confirmation process will be adopted to evaluate the management elements and the model. Eventually the optimal management model for the innovation platform will be developed for the future development of the medical AI industry.

Methodology

This study adopts an in-depth interview to obtain the insights of the experts based on the results of literature review, which is often used by sociologists to explore a multitude of substantive and theoretical topics (Davis Hicks, 2004), because it allows them to probe in detail people's subjective experiences, meaning-making, and unspoken assumptions about the social world in general (Orrange, 2003). Five experts from the stakeholders in the medical AI industry, including university and research institute, medical AI enterprise, hospital, and investor were used in semi-structured in-depth interviews with mostly open-ended questions, which allows the interviewees to express deep feelings and rich detail about specific experiences (Wu, 2019; Yang & Sun, 2005). The most important question in an in-depth interview is the "probe," a question asked to follow up and explore issues brought up by the interviewee (Lucas, 2014). The feedback content is encoded and analyzed to search for models or themes, and the data is categorized under each theme to form a series of indicators.

An expert confirmation process of 17 experts is used to evaluate management elements and another panel of 5 experts is used to further evaluate the model after the management model is established. Its core is to consult relevant experts' opinions anonymously, make statistics, analyze expert opinions, and finally obtain more extensive expert collective results after the survey. It is necessary to use the experience of numerous experts to quantify the indicators of the research object, and then provide an analytical basis for specific problem research.

The selection of an expert panel is essential to both in-depth interview and expert confirmation process to ensure the validity and reliability of results. The size, heterogeneity, and appropriate knowledge of the expert panel should be taken into consideration (Belton et al., 2019) (Goluchowicz & Blind, 2011). Criteria for selecting appropriate experts is pre-defined to ensure all relevant characteristics and qualifications are present (Goluchowicz & Blind, 2011) (Okoli & Pawlowski, 2004). The criteria for selecting experts in this study include the following: Experts from different stakeholders of the medical AI industry; minimum of 5 years' experience in medical AI or related field; and minimum of bachelor's degree in education.

A variety of stakeholders who are engaged in the medical AI industry is included in this study. The setting allows for drawing on first-hand experience and comprehensive thematic knowledge from diverse experts in the medical AI industry to create an overall future scenario in the innovation platform, leading to higher accuracy than individual evaluations (Gracht, 2012).

The experts of this study are selected with snowball sampling method whereby a process is started with a small group of initial contacts. These participants then introduce the researcher to additional potential

participants from the target population. This cycle of referrals continues, until the desire sample size is achieved (Wright & Stein, 2005).

Results and Discussion

1. This study identified 5 aspects, 11 themes and 35 elements for innovation platform management in medical AI industry in China. highlighting a multi-faceted approach to foster innovation, emphasizing the importance of data privacy, domain knowledge base development, interdisciplinary talent cultivation, clinical-AI integration, organizational management.

(1) Data analysis from in-depth interview.

By in-depth interview the elements of problems, opportunities and innovative solutions in the medical AI industry are obtained. There are three parts of data analysis, namely problems and challenges analysis, opportunities and trends analysis, innovative solutions of innovation platform analysis.

From problems and challenges analysis, six key themes emerged: medical data, algorithm, clinical application, talents, commercialization, ethnics and law. Among all the 19 elements that were proposed by experts, the most frequently identified challenges were the lack of data standards and sharing mechanisms and the scarcity of interdisciplinary talents. These issues were recognized by all experts, highlighting the critical need for standardization and talent development within the medical AI field. The second high frequency challenges were: Without their own core algorithms, most Chinese companies use fine-tuned model on foreign open-source algorithms; Lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products. The third one was element: Unclear of business model and monetization model, which was mentioned by 3 experts.

On the ranking list of six themes of problems and challenges, talents challenge was most important and recognized by all experts, clinical application was the second important and recognized by 4 experts. Algorithm and core technologies challenges as well as commercialization problems were regarded as the third importance, which received 3 experts' comments respectively.

Opportunities and trends analysis revealed four main aspects: infrastructure, technology innovation, application scenario, policies and regulations, and eight themes, including medical data, algorithm, key core technology, innovative talents, clinical application, commercialization, industry polices, ethnics and law.

Among all the 25 elements of opportunities and trend that proposed by experts, promoting deep integration between clinical demands and AI technology and providing industrial policy support to connect the entire industry chain were seen as the most promising opportunities. There were four elements ranked in the second important place and mentioned by 3 experts respectively: Establish medical data standards and norms; Improve algorithm accuracy; Cultivate interdisciplinary talents in medicine and AI; Policies and regulations should be predictable and sustainable.

The elements in technology innovation aspect and the elements under commercialization theme were diversified with low frequency. It seemed that experts hoped to find more solutions but had not reached consensus yet.

The platform organization aspect includes two themes of role positioning and development trends. The survey reveals that clinical resources and scenarios, commercialization supports, underlying algorithms and large models for medical AI industries had the highest median value and were seen as crucial by experts, while connecting and sharing for role positioning is unanimously recognized by experts.

Based on the elements identified from both literature review and in-depth interview the researcher makes a summary and got 5 aspects, 10 themes and 41 elements for innovation platform management in medical AI industry.

(2) Data analysis from expert's survey.

There were 8 items with a median value of 3.0 and below or an inter-quartile range of 2 and above. It indicated these elements were general or less important, or the consistency of expert evaluations of the importance of them were general or low. These 8 items should be removed and there were 33 items left.

Among all the elements that evaluated by experts, ten items were considered highly compliant, including "protect medical data privacy", "develop domain knowledge base", "cultivate interdisciplinary talents", "meet demands of segmented scenes", "integration between clinical demands and AI technology", "business loop and pilot projects", "priority to products that have passed project review and approval for entering clinical application", "develop its own underlying algorithms and large model for industry use", "provide clinical resources and application scenario", "commercialization and promotion supports".

Experts' feedback also suggested augmenting the infrastructure aspect with computing power considerations, recommending the introduction of cloud service providers or public computing power supplies to reduce R&D costs and enhance the platform's innovation capabilities.

2. The proposed management model presents a comprehensive framework including five aspects: infrastructure management, technology innovation management, application scenarios management, policy and regulation management, and platform organization management. All the elements together constitute an efficient, flexible, and sustainable management framework, which helps to promote the rapid development and application of medical AI technology in China.

Results of creating and evaluating management model.

The management model of innovation platform in medical AI industry was created and presented a comprehensive framework encompassing five management aspects: infrastructure management, technology innovation management, application scenarios management, policy and regulation management, and platform organization management.

Infrastructure management forms the groundwork and commences with medical data, algorithms, and computing power. Technology and innovation management, driven by key core technologies and innovation talents, fuels the medical AI ecosystem. Application scenarios management focuses on the clinical application and commercialization of AI in healthcare. Policy and regulation management fosters an innovative yet ethically compliant environment. Finally, platform organization management acts as a central facilitator. It outlines the platform's strategy, promotes open innovation, and fosters collaboration among stakeholders to harness resources, share knowledge, and propel the medical AI industry towards growth and innovation. These components work together to foster a robust organic system for innovation and growth within the medical AI sector.

The management model has passed the evaluation of all experts. Based on the findings, a management model was created and evaluated, consisting of 5 management aspects, 11 management themes and 35 elements as shown in Figure 1.

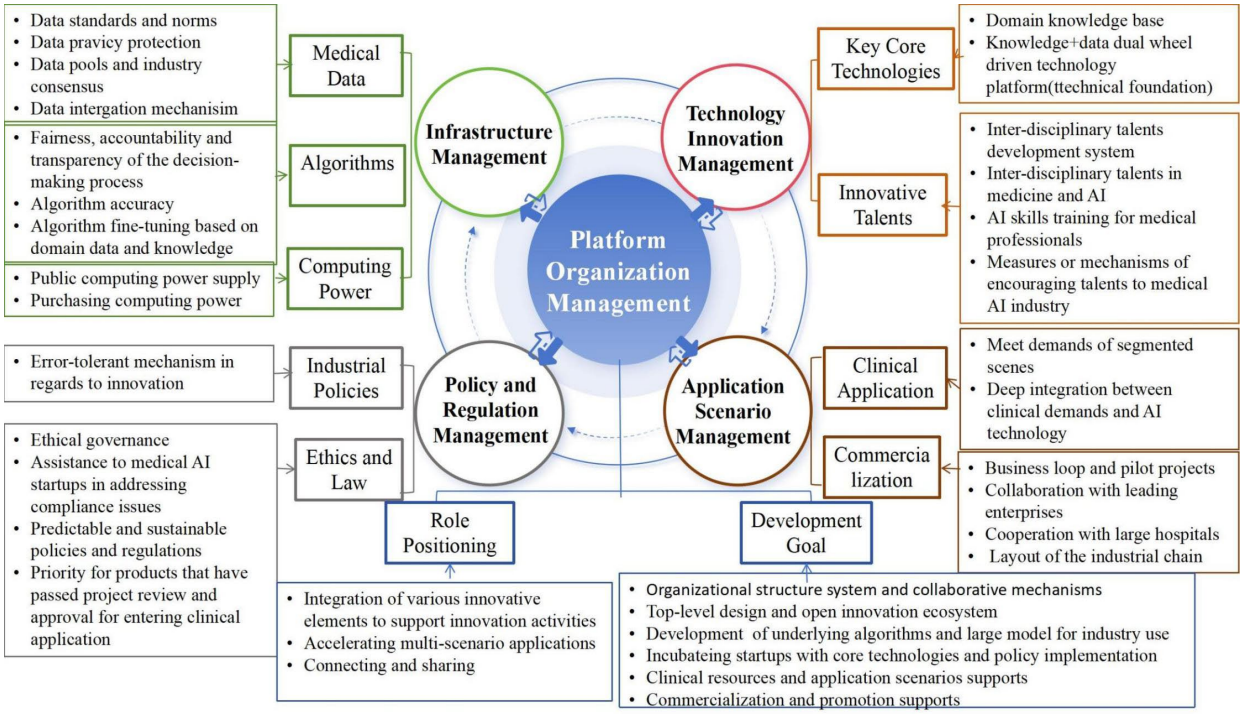

Figure 1 The management model

Discussion

1. A call for the collaboration of various stakeholders in medical AI industry development

The study findings reveal that there are many challenges that seriously constrain the application of medical AI technology and development of medical AI industry. Experts agree on the necessity of a multi-

faceted approach to foster innovation, emphasizing the importance of data privacy, domain knowledge base, interdisciplinary talent, integration between clinical needs and AI technology, the platform organization management. It indicates that the development of innovation industry is influenced by multiple factors which involve stakeholders across multiple sectors—university and research institutes, medical AI companies, healthcare professionals, policymakers, and investors. It highlights the importance of coordinated development among various stakeholders in industrial development (Bombaywala & Riandita, 2015) (Tripathi et al., 2024) (Li, et al., 2022). There is an urgent need for collaboration between stakeholders in order to integrate external knowledge sources in the innovation process (Bombaywala & Riandita, 2015), form multi-actor network and dynamic behavioral relationship (Tsujimotoi et al., 2018), with each actor playing a distinct role (Tripathi et al., 2024). Stakeholders collaboration could cultivate interdisciplinary talents both in quantity and quality, develop data standardization and security policies that well matched to the needs of the medical practice and aligned with products and technologies currently being developed in the market.

2. How the innovation platform has been utilized to facilitate the development of medical AI industry. The research results show the crucial role of the innovation platform in the medical AI ecology, serving as connector, enabler, and toolbox for collaboration, knowledge sharing, and resource access, organized as an innovative business ecosystem (Gawer, Cusumano. 2014) (Tsujimotoi, et al., 2018). The success of the platform hinges on defining their unique value propositions and clear road maps, focusing on core competencies like AI algorithm development, clinical scenarios and commercialization supports. Drawing from theories of platform empowerment, industrial symbiosis, and synergy, the study explores how open innovation systems function: facilitation of the innovation process for individual companies and creation of an innovation community (van der Borgh et al., 2012). Value co-creation is central to platform empowerment, which facilitates stakeholder collaboration through structure, organization, technology, and scenarios. Industrial symbiosis emphasizes mutual benefit, driving network evolution for optimal symbiotic energy. Synergy theory underscores efficient collaboration, where the platform ecosystem's overall value exceeds its parts. In order to making good use of innovation platforms to facilitate industry development, innovation platform should establish collaborative mechanisms and organizational structures to attract stakeholders and resources, promoting a synergistic environment for mutual growth.

Recommendations

Practical guidelines: develop practical and feasible guidelines based on the management model and select pilot implementation, making it a model for the innovation platform management in medical AI industry.

Performance Evaluation: develop a framework for evaluating the performance of innovation platform, which focus on developing metrics and indicators to assess the effectiveness, efficiency, and sustainability of innovation platform management in achieving development goals. There should be a regular reassessment on the management model to incorporate feedback, adapt to changing technologies, environment, and organization, and refine strategies for optimal performance.

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