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Research on the Evolution of Internet-of-Medical-Things Platforms from Telemedicine to Resource Collaboration - From the Perspective of Action Design Research and Value Co-creation

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Abstract: Driven by the national strategies of "Internet-plus-Healthcare" and national health informatization, numerous domestic telemedicine systems have realized basic interconnection among medical institutions. Nevertheless, they generally suffer from practical drawbacks including solidified functions, insufficient incentives for multi-party participation, and low-level resource collaboration. To address the dilemma of "emphasizing connection while neglecting collaboration" in telemedicine, this paper adopts Action Design Research (ADR) as the core methodology and integrates the value co-creation theory to explore the internal mechanism for internet-of-medical-things platforms to transform from simple telemedicine systems into multi-party resource-collaboration platforms. This study first analyzes three major pain points of current telemedicine platforms: insufficient user participation, deficient data governance, and inadequate resource collaboration. Secondly, a dynamic evolution model for value co-creation on internet-of-medical-things platforms is constructed, distinguishing two development levels: resource sharing and capacity co-building. Furthermore, a "value-contribution points" incentive mechanism is designed, a multi-modal effectiveness evaluation framework is established, and a maturity-assessment tool for social value co-creation is developed. Finally, an iterative design path for platforms is formulated. The research indicates that the transformation from telemedicine to resource-collaboration platforms cannot rely merely on technological upgrading. Instead, a multi-agent value co-creation mechanism shall be established to continuously optimize platform rules and functions through the "build-intervene-evaluate" cycle. This research provides theoretical references and implementable tool templates for healthcare informatization enterprises in platform development and for health authorities in regulatory innovation, facilitating the implementation of hierarchical diagnosis and treatment and the outreach of high-quality medical resources to grassroots medical institutions.

Keywords: *Internet-of-Medical-Things; Smart Healthcare; Action Design Research; Value Co-creation; Resource Collaboration; Telemedicine*

I. INTRODUCTION

Policies such as the 14th Five-Year Plan for National Health Informatization and Opinions on Promoting the Development of "Internet-plus-Healthcare" continuously advance the deep integration of new-generation information technologies with healthcare services. Telemedicine applications including remote consultation and remote surgical teaching have been widely deployed, and some platforms have connected thousands of medical institutions and tens of thousands of physicians online. In practice, however, most telemedicine systems remain at the basic stage of "device interconnection and video-based consultation". As passive tool-oriented systems, they have not formed a value-co-creation ecosystem with in-depth participation from physicians, medical institutions and patients, resulting in problems such as idle resources, weak participation motivation and obstructed knowledge flow. Hence the full value of such systems cannot be unlocked.

Existing studies mostly focus on the technical realization and system architecture of telemedicine, yet discussions on the transformation mechanism of platforms from simple "connection" to in-depth "collaboration" remain insufficient. The value co-creation theory has been widely studied for e-commerce, short-video and other commercial internet platforms, while its application in the highly-regulated, multi-interest-stakeholder scenario of internet-of-medical-things awaits further exploration. Meanwhile, Action Design Research (ADR) is suitable for tackling complex practical problems in the field of information systems. Through the "build-intervene-evaluate" cycle, it integrates theories iteratively with real-world business scenarios and provides an appropriate methodological support for research on smart-healthcare platforms.

Accordingly, this paper puts forward the following research questions: How can internet-of-medical-things platforms evolve from functionally limited telemedicine systems into multi-agent resource-collaboration platforms? How shall the realization path, incentive mechanism and evaluation system for multi-party value co-creation be constructed? Adopting the mindset of Action Design Research and combining literature review, interview surveys and multi-source log-data analysis, this paper builds a dynamic value-improvement model for internet-of-medical-things platforms, designs supporting incentive mechanisms and assessment tools, and extracts core design principles for platform transformation, so as to offer new insights for the construction of smart-healthcare platforms.

II. LITERATURE REVIEW AND THEORETICAL FOUNDATION

A. Research Status of Telemedicine and Internet-of-Medical-Things Platforms

With network communication and Internet of Things

technologies, telemedicine breaks geographical barriers and realizes cross-hospital consultation, remote surgical teaching and device interconnection, promoting the outreach of high-quality medical resources to grassroots levels. Practical cases such as the "De-Yi Cloud" system can connect a large number of physicians and medical institutions and deliver remote services. Still, most platforms focus on online workflow migration and ignore the design of incentive schemes for multi-agent collaboration.

Traditional telemedicine systems follow a linear service model where medical institutions deliver services and patients passively receive them. By contrast, internet-of-medical-things resource-collaboration platforms operate as network-oriented ecosystems. Physicians, grassroots hospitals, patients and technology service providers all become value participants. They not only realize device and data interconnection (resource sharing), but also facilitate the circulation and accumulation of clinical knowledge and diagnosis-and-treatment experience (capacity co-building). Current industrial-sector pain points are reflected in three aspects: the user-participation pain point, where implicit knowledge contributions by medical and nursing staff lack positive incentives; the data-governance pain point marked by fragmented medical data and barriers to cross-institutional data sharing; and the resource-collaboration pain point, where there lacks regular coordination mechanisms for scheduling medical equipment and expert intellectual resources.

B. Value Co-creation Theory

The core viewpoint of value co-creation theory holds that value is not created by a single producer but jointly generated through interactions among platform suppliers, demanders and other multi-party agents. Mature research outcomes have been achieved in commercial-platform contexts. Nevertheless, given the features of strict regulation, high risks and public-service attributes in medical scenarios, models from commercial platforms cannot be directly copied. In healthcare contexts, physicians sharing case reports, grassroots doctors participating in seminars, and patients uploading health-monitoring data all count as value-co-creation behaviors. Implicit contributions need to be made explicit, and value identification, incentive and distribution schemes adapted to the medical industry should be formulated.

C. Action Design Research (ADR)

Action Design Research (ADR) integrates action research and design science. Oriented toward real-world organizational scenarios, it follows the cycle of "problem identification-prototype construction-practical intervention-evaluation and reflection-theory extraction". Different from pure theoretical deduction, ADR emphasizes deploying prototype solutions in business scenarios to obtain feedback for iterative optimization, and ultimately yields both practical tools and theoretical knowledge. It fits well for researching complex information systems such as smart-healthcare platforms where theories and practices are highly intertwined. This study follows the ADR "build-intervene-evaluate" cycle for its overall analytical framework.

D. "Perception-Decision-Execution" Closed-Loop Theory

Ni Mingxuan proposes that smart healthcare forms a closed-loop system centered on "perception-decision-execution": the perception layer of the Internet of Things collects vital-sign and device-operation data; the platform layer completes data storage, analysis and decision-making; and finally outputs service intervention schemes for implementation. This technical path provides theoretical support for the four-tier platform architecture (perception layer-network layer-platform layer-application layer) in this research, realizing a complete closed loop from data collection to business execution.

III. RESEARCH DESIGN

A. Research Ideas

This research is divided into three phases:

Phase One: Theoretical Construction. Sort out policy documents and domestic and foreign literature, identify three major pain points of internet-of-medical-things platforms, build an initial ADR research model based on the four-tier Internet-of-Things architecture, and distinguish two evolution levels: resource sharing and capacity co-building.

Phase Two: Action Intervention. Following the ADR cycle, finish the prototype framework design of the platform covering core modules including intelligent device management, multi-disciplinary consultation and remote surgical teaching. Innovatively introduce the value-contribution-points mechanism, and take practical feedback from medical institutions as intervention input to iteratively optimize platform functions and collaboration rules.

Phase Three: Effectiveness Evaluation. Adopt an improved Wide & Deep multi-modal evaluation approach integrating questionnaire-and-interview data, platform behavior logs and social-network analysis of multi-source data. Develop a lightweight SaaS-enabled maturity-assessment tool and conduct evaluations from the dimensions of user participation, data governance, resource collaboration and knowledge transformation, so as to extract core design principles for platform transformation.

B. Data Sources

1. Secondary public data: Industrial reports released by the National Bureau of Statistics, CNNIC and iResearch; public texts from medical-industry communities to grasp real-world industrial demands.
2. Semi-structured interviews: Select 3-5 medical practitioners for interviews to obtain front-line personnel's pain points and improvement suggestions for telemedicine platforms.
3. Questionnaire surveys: Collect smart-healthcare service demands and user experience from ordinary users.
4. Simulated desensitized business data: Collaborate with community medical institutions to acquire desensitized device logs and business data for prototype simulation and indicator measurement.

C. Analytical Tools

Python is adopted for data cleansing and multi-modal statistical modeling; NVivo is used for coding and thematic analysis of interview texts; Gephi is applied for social-network analysis of physician collaboration to identify knowledge-spreading paths. Basic development of the platform prototype is completed with SpringBoot and Vue.js.

IV. MODEL AND MECHANISM INNOVATION OF INTERNET-OF-MEDICAL-THINGS RESOURCE-COLLABORATION PLATFORMS

A. Dynamic Value-Improvement Model for Internet-of-Medical-Things Platforms

Existing studies mostly describe value co-creation in a static manner. This paper constructs a dynamic evolution model and divides platform development into two levels:

Level One: Resource Sharing (Basic Phase). The core objective is to realize interconnection of devices and data, corresponding to the construction goals of traditional telemedicine systems. Typical scenarios cover IoT-enabled medical-asset positioning and basic cross-institutional data intercommunication, solving hardware and information-connectivity problems. Yet knowledge circulation and multi-agent incentives are absent. Most existing telemedicine platforms stay at this level.

Level Two: Capacity Co-building (Resource-Collaboration-Platform Phase). On the basis of resource sharing, promote cross-institutional circulation of clinical knowledge and diagnosis-and-treatment experience to achieve joint capacity improvement of multiple parties. Typical scenarios include remote surgical teaching, multi-center case seminars and multi-disciplinary consultations. At this stage, the platform evolves beyond a mere transmission tool into an ecosystem for knowledge production and capacity cultivation.

This model can judge the development stage of internet-of-medical-things platforms and offer guidance for platform iteration and upgrading, filling gaps in existing research on the hierarchical division of value co-creation.

B. Cross-Agent Incentive-Mechanism Design for "Value-Contribution Points"

The key obstacle restricting medical platforms from advancing to capacity co-building lies in inadequate incentives for implicit-knowledge contributions. Physicians sharing case reports, participating in discussions, and grassroots doctors feeding back local diagnosis-and-treatment experience make contributions that are hard to quantify and barely rewarded, resulting in low willingness to participate. Drawing on point-based systems of commercial platforms and considering features of the medical industry, this paper designs a value-contribution-points mechanism:

1. Points-acquisition scenarios: Points are automatically awarded according to contribution quality for behaviors such as physicians sharing clinical cases, participating in multi-disciplinary consultation seminars, grassroots physicians submitting learning feedback after watching remote-teaching videos, and uploading local diagnosis-and-treatment experience. Smart contracts record the whole process to guarantee transparency and traceability.
2. Rights redeemable by points: Points can be redeemed for online consultations with senior experts, priority access to medical training, and access rights to desensitized scientific-research datasets and other exclusive medical-industry benefits. Cash transactions are excluded to avoid compliance risks in the medical sector.

This mechanism makes implicit knowledge contributions by medical staff explicitly valuable and addresses the practical difficulty of insufficient driving forces for multi-party collaboration.

C. Four-Tier Overall Platform Architecture

Based on the classic layered structure of the Internet of Things and the "perception-decision-execution" closed-loop thinking, the platform consists of four tiers:

1. Perception Layer: Connect intelligent medical devices and wearable terminals to collect device operating status and vital-sign data.
2. Network Layer: Realize secure data transmission among medical institutions with privacy encryption.
3. Platform Layer: Core modules cover the resource-scheduling engine, value-contribution-point system and multi-modal evaluation dashboard.
4. Application Layer: Deliver business functions for diverse users, including intelligent device management, remote surgical teaching, multi-disciplinary consultation and SaaS services for the maturity-assessment tool.

D. Design of the Maturity-Assessment Tool for Social Value Co-creation

To translate complex theories into tools available for front-line managers, this paper designs a lightweight SaaS-mode maturity-assessment tool. After medical institutions input operational indicators such as equipment utilization rate, consultation response time, patient referral-outflow rate and training sessions, the tool automatically generates assessment reports. It judges maturity levels of platforms from four dimensions: user participation, data governance, resource collaboration and knowledge transformation, and outputs targeted improvement suggestions. Oriented toward medical consortia and hospitals at all levels, the tool features low costs and convenient popularization, assisting institutions in transforming from telemedicine systems to resource-collaboration platforms.

V. PLATFORM EFFECTIVENESS-EVALUATION PATH

This study adopts an improved Wide & Deep multi-modal evaluation framework that integrates quantitative behavioral data and qualitative interview texts. Platform effectiveness is assessed from three dimensions:

1. Resource-collaboration efficiency: Medical-equipment utilization rate, cross-hospital consultation response time, patient referral-outflow rate of grassroots institutions.
2. User contribution: Quantity of physicians' case sharing, frequency of seminar participation, distribution of acquired points. Gephi is used to draw physician-collaboration network graphs and trace knowledge-spreading paths.
3. Service quality: Satisfaction questionnaires for medical staff, changes in patients' medical costs, feedback on capacity improvement of grassroots physicians.

Through multiple ADR "build-intervene-evaluate" cycles, evaluation outcomes of each round are fed back into the platform to optimize functional modules and adjust point-based rules. Finally, five core design principles for internet-of-medical-things collaboration platforms are extracted.

VI. RESEARCH FINDINGS AND IMPLICATIONS

A. Major Research Findings

First, telemedicine systems are not equivalent to resource-collaboration platforms. Hardware interconnection and video-based consultation constitute only foundational resource sharing. Real collaboration platforms require capacity co-building and the circulation of clinical knowledge. Obvious hierarchical differences exist between the two. A large number of current telemedicine platforms are confined to the first level and fail to tap ecosystem value.

Second, incentive mechanisms serve as the key to realizing multi-party value co-creation. Technological upgrading alone cannot drive physicians to pro-actively contribute implicit knowledge. The adapted value-contribution-points mechanism for the medical industry can effectively boost participation enthusiasm and build sustainable operational momentum for platforms.

Third, the construction of internet-of-medical-things platforms requires dual-driving forces of "technology and management mechanisms". The Internet of Things and big data provide the technological foundation, while value-co-creation rules, evaluation systems and incentive schemes belong to management mechanisms. Only the combination of both can achieve the leap from "tool-oriented systems" to "value-driven ecosystems".

B. Practical Implications

For medical-informatization enterprises: Platform development should not merely focus on realizing business functions. Incentive schemes and assessment toolkits shall be designed simultaneously. The assessment-indicator system and collaboration-mechanism templates (remote-teaching incentive schemes and cross-hospital equipment-scheduling workflows) produced in this research can act as references for enterprise product design.

For health-administrative authorities: The dynamic "build-intervene-evaluate" iterative mode in this research provides ideas for sandbox regulation of platforms. Under the bottom-line guarantee of medical-data security, internet-of-medical-things platforms can be allowed to pilot innovative collaborative-service modes. The maturity-assessment tool can also serve as auxiliary reference for performance appraisal of regional medical-consortium construction.

For medical institutions: The maturity-assessment tool can be adopted for self-diagnosis to identify platform weaknesses, and realize step-by-step transformation from equipment interconnection to knowledge collaboration. It facilitates the implementation of hierarchical diagnosis and treatment, reduces patient referrals from grassroots institutions, and eases the medical-burden of the public.

C. Theoretical Implications

This research expands the application boundary of value co-creation theory to the highly-regulated public-service scenario of internet-of-medical-things. It applies the ADR Action Design Research methodology to the iteration of smart-healthcare platforms and constructs an integrated research framework driven by "technological innovation plus collaborative dynamics". By distinguishing the two levels of resource sharing and capacity co-building, it deepens understanding of the evolution rules for internet-of-medical-things platforms.

LIMITATIONS AND FUTURE PROSPECTS

This research is limited to prototype design and simulation verification. Large-scale long-term real-world pilot applications in medical institutions have not yet been completed. Follow-up work will further cooperate with partner medical institutions to carry out field pilots, collect real business data and continuously optimize point-based rules and assessment indicators. Meanwhile, privacy and security of medical data constitute the lifeline of internet-of-medical-things platforms. Future studies shall further refine security mechanisms for data desensitization, access permission and blockchain-based evidence preservation. With advances in large-model technologies, follow-up research may explore embedding generative AI into platforms to assist case sorting and knowledge extraction and further amplify the value of internet-of-medical-things resource-collaboration platforms.

References

[1] Ding Shuai. New Practical Action Design for Smart-Healthcare Platforms on the Internet of Medical Things: From Telemedicine Systems to Resource-Collaboration Platforms[J]. Journal of Information Systems, 2025.

[2] Huang Dahui. Research on Smart-Healthcare System Application of Internet-of-Things Platforms[J]. Journal of Medical Informatics, 2023.

[3] Ni Mingxuan. Smart Healthcare: From Internet of Things to Cloud Computing[J]. Chinese Journal of Computers, 2013.

[4] National Health Commission of the People's Republic of China. 14th Five-Year Plan for National Health Informatization[Z]. 2022.

[5] Guo Xitong. Research on High-Quality Medical-Resource Sharing Empowered by Digital-Health Technologies[J]. Strategic Study of CAE, 2025.

[6] Wang Kanliang, Li Gaoyong. Action Design Research (ADR): Methodology and Its Application in Information-Systems Research[J]. Journal of Management Science in China.