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## Research on Artificial Intelligence Ethics Literacy of Medical School Faculty (Postprint)

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### Abstract

The application of artificial intelligence in the medical field has become a crucial driving force for bridging the gap between basic research and clinical practice and reshaping diagnostic and therapeutic paradigms. While reshaping medical decision-making processes and doctor-patient interaction models, it also poses paradigmatic challenges to traditional medical ethics education. Against this backdrop, the systematic construction of AI ethics literacy among medical school faculty has become a key issue in promoting the intelligent transformation of medical education. Through an integrated approach of theoretical construction, mechanism analysis, and practical pathway design, this study systematically addresses the dilemmas in medical AI ethics education. From the interdisciplinary perspective of philosophy of technology and medical ethics, it constructs a literacy framework encompassing cognitive, competency, and value dimensions. It reveals the generative logic of ethics literacy through a three-dimensional mechanism of endogenous drive, exogenous synergy, and dynamic evolution, elucidating the interaction patterns among subject cognitive iteration, institutional context shaping, and risk adaptation. Finally, through the design of an integration framework for ethical cognition and technological practice, innovation in multi-modal training mechanisms driven by clinical scenarios, and institutional empowerment through ecological governance, a closed-loop collaborative cultivation system for AI ethics literacy among medical school faculty is formed.

### Full Text

## Research on Artificial Intelligence Ethics Literacy Among Medical School Teachers

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## Abstract

The application of artificial intelligence in medicine has become a crucial driving force for bridging the gap between basic research and clinical practice and reshaping diagnostic and treatment paradigms. While transforming medical decision-making processes and doctor-patient interaction models, it also poses paradigmatic challenges to traditional medical ethics education. In this context, the systematic construction of AI ethics literacy among medical school teachers has emerged as a key issue in promoting the intelligent transformation of medical education. This study systematically addresses the dilemmas of medical AI ethics education through an integrated approach of theoretical construction, mechanism analysis, and practical pathway design. From the interdisciplinary perspective of philosophy of technology and medical ethics, it constructs a literacy framework encompassing cognitive, competency, and value dimensions; reveals the logic of ethics literacy generation through three-dimensional mechanisms of endogenous drive, exogenous synergy, and dynamic evolution; and elucidates the interaction patterns among subject cognitive iteration, institutional contextual shaping, and risk adaptation. Finally, by designing an integration framework for ethical cognition and technological practice, innovating multi-modal practical training mechanisms driven by clinical scenarios, and enabling institutional empowerment through ecological governance, a closed-loop collaborative cultivation system for AI ethics literacy among medical school teachers is formed.

**Keywords:** artificial intelligence; medical school teachers; ethical literacy; teacher professional development; medical education; teacher quality; collaborative cultivation

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## 1 Framework Construction for AI Ethics Literacy Among Medical School Teachers

From ChatGPT to DeepSeek, generative AI is undergoing a technological leap from general dialogue to deep vertical domain applications, triggering

transformative waves across industries and continuously reshaping development paradigms of production relations and social interaction. As President Xi Jinping pointed out: “We must strengthen the integration of AI with safeguarding and improving people’s livelihoods” [1]. Currently, AI technology is accelerating the reconstruction of medical education models and clinical practice ecosystems. As dual responsible subjects for medical ethics education and technological innovation application, the cultivation of AI ethics literacy among medical school teachers has become a crucial proposition for the innovative development of medical education systems in the era of intelligent healthcare.

Existing research on AI ethics literacy among medical school teachers has yielded numerous achievements. Regarding the connotation of AI ethics literacy, Zhao Yali et al. constructed an evaluation index system for intelligent general practitioners and weighted its indicators [2]. Fan Dingrong et al. developed a five-dimensional literacy framework for “AI + Nursing Education” [3]. Regarding AI ethics risks, Lei Fang et al. [4] explored potential ethical risks in AI-based clinical decision support systems. Li Yiting et al. [5] investigated AI applications in nutrition management, while Yu Ruxia et al. [6] analyzed ethical risks that may arise from AI applications in clinical diagnosis and treatment. Regarding teacher literacy in medical schools, Huang Fumin et al. [7] analyzed the positive impact of digital literacy among medical school teachers on improving teaching quality, personalized learning, and teacher professional development. Yuan Na et al. [8] constructed a teaching efficacy scale for medical school teachers. Although these findings provide important references for cultivating AI ethics literacy among medical teachers, there remains room for further optimization and improvement. In particular, current medical AI ethics governance faces a triple dilemma of ambiguous cognitive frameworks, unclear generation mechanisms, and unfocused practical pathways. Existing studies either emphasize the transplantation of universal AI ethics principles while neglecting medical professional characteristics, or limit themselves to static factor analysis without revealing the dynamic evolution patterns of teacher AI literacy, and lack a complete research chain integrating theoretical construction, mechanism analysis, and pathway design from a systems theory perspective. Therefore, it is essential to bridge the closed loop between theoretical construction and practical transformation of medical AI ethics education, and provide systematic solutions for cultivating medical educators with ethical consciousness and risk response capabilities through mechanism deconstruction and pathway innovation, thereby facilitating the construction of a responsible new medical education ecosystem of human-machine symbiosis.

This study employs a research methodology combining theoretical analysis and systematic construction from an interdisciplinary perspective of medical pedagogy and technology ethics. At the theoretical level, it uses literature research and conceptual analysis to systematically review theoretical frameworks of bioethics and algorithmic ethics, revealing integration pathways between traditional medical ethics principles and AI ethics requirements through comparative studies. At the framework construction level, it adopts Korthagen’s three-

level teacher competency model as the theoretical foundation, combined with the Delphi expert consultation method, to construct a literacy framework encompassing three dimensions: technical cognition, ethical reflection, and educational practice. At the mechanism analysis level, it employs systems theory to analyze the interaction patterns of literacy generation from three dimensions: endogenous drive, exogenous synergy, and dynamic evolution. At the pathway design level, it uses case study and scenario simulation methods, combined with typical scenarios of medical AI applications, to propose clinically adaptable training programs.

The deep integration of AI technology in medicine has given rise to numerous new ethical issues that are both professional and technical, such as human-machine responsibility delineation and patient data privacy. As responsible subjects of medical ethics education, medical school teachers urgently need to construct an ethics literacy framework adapted to intelligent healthcare scenarios. This requires focusing on the theoretical foundation of integrating medical ethics and AI, clarifying the interactive relationship between their value logics and technical boundaries, then analyzing the core elements of AI ethics literacy for medical school teachers, establishing its connotation from the dimensions of cognition, competency, and values, and finally promoting the transformation from theory to practice by constructing a multi-level, operational evaluation index system.

### 1.1 Overview of AI Ethics Literacy for Medical School Teachers

Unlike traditional education, medical education is a social practice activity that purposefully, systematically, and organizationally cultivates medical talents in response to social needs. Medical school teachers are professional groups with dual identities as both medical practitioners and educators, representing composite roles integrating clinical medicine, educational theory, and humanistic literacy. Since medical education encompasses natural sciences, humanities, social sciences, and clinical disciplines, teachers must possess interdisciplinary knowledge integration capabilities. The World Federation for Medical Education (WFME) explicitly requires medical schools to establish faculty development mechanisms in its *WFME Global Standards for Quality Improvement in Basic Medical Education* [9], emphasizing that teachers must possess both medical professional competencies and pedagogical literacy. The subsequent 2015 WFME standards [10] further strengthened this concept, requiring medical schools to “ensure positive interaction between medical research and teaching,” implicitly demanding a dual role design for teachers—requiring both medical professional knowledge to ensure teaching content accuracy and pedagogical skills to optimize teaching processes. Thus, medical school teachers must fulfill dual roles: both disciplinary experts and educators. Oleksandr Boychuk [11] argues that medical school teachers must achieve professional cultivation and personality shaping of students (especially future healthcare workers) through “conscious and purposeful work,” with their work possessing the duality of “organic unity of

medical professionalism and social education.”Based on this perspective, medical school teachers can be defined as professionals engaged in teaching, research, and clinical guidance in higher medical education institutions, with core responsibilities including imparting medical knowledge, cultivating clinical skills, guiding scientific research innovation, and shaping medical students’ professional ethics.

In April 2021, during his inspection of Tsinghua University, President Xi Jinping emphasized the need to “advance the construction of new engineering, new medical science, new agricultural science, and new liberal arts, and accelerate the cultivation of urgently needed talents” [12]. The “Four New Disciplines” construction has become a landmark initiative leading the reform and innovation of China’s higher education. The proposal of “new medical science” aims to revolutionize talent cultivation models, not only training medical professionals but also cultivating medical scientists with research capabilities. Therefore, reform of the medical undergraduate teaching system in the new era is imperative, and teacher team construction is the primary task in this transformation. In this context, our understanding of medical school teachers needs to break through the traditional single role positioning of “knowledge transmitters” and instead view them as leaders of medical education reform, practitioners of interdisciplinary innovation, and promoters of the integration of research, clinical practice, and teaching. New medical science construction requires teachers to not only possess solid medical professional literacy but also master emerging technologies such as AI and big data [13] to meet the teaching demands of “medicine-engineering intersection” and “medicine-science fusion” [14].

AI ethics literacy for medical school teachers has unique value concerns that differ from other fields. First, the core dimensions of ethical consideration differ. Medical AI applications directly concern life and health, requiring teachers’ethics literacy to transcend general data privacy or algorithmic fairness issues and delve into medical-specific ethical dilemmas. This necessitates ethical considerations beyond conventional technology ethics. Teachers must guide students to deeply contemplate responsibility allocation in AI-assisted diagnosis, particularly the decision-making basis when algorithmic judgments diverge from clinical experience. Second, the integration methods of ethical norms differ. AI ethics in medical education cannot be separated from the existing medical ethics system. Teachers’ primary educational value orientation is to help students understand that AI introduction cannot weaken the fundamental principle of “patient benefit priority,” strengthening informed consent and minimizing harm in the context of new technologies. Finally, the practice orientation of ethics education differs. While AI ethics in other fields may focus on theoretical discussion, medical education must closely integrate with clinical scenarios, requiring teachers to cultivate students’ ethical sensitivity through real cases. Moreover, the goal of medical AI ethics education is not only risk avoidance but also maintaining doctor-patient trust to ensure medical practice does not lose its humanistic essence in pursuit of efficiency.

Relative to clinical physicians, medical school teachers’ AI ethics literacy

demonstrates more distinctive group characteristics through their professional attributes, requiring greater emphasis on educational transmissive ethical decision-making capabilities, whereas clinical physicians focus more on technical application ethics in clinical practice. Medical school teachers' AI ethics literacy manifests in: first, teaching transformation capability—the ability to translate abstract AI ethics principles into teachable cases that guide students to understand ethical conflicts behind technology; second, interdisciplinary critical thinking cultivation—revealing ethical paradoxes of AI in medical imaging diagnosis, gene editing, and other scenarios through curriculum design, such as algorithmic bias discrimination against vulnerable groups that clinical physicians must avoid in specific diagnosis and treatment; third, forward-looking ethics research—medical school teachers must track frontier developments in AI ethics and continuously integrate them into teaching syllabus updates, while clinical physicians' ethical responsibilities focus more on technical usage compliance. This reflects the special mission of medical school teachers as the source of ethics education—their ethics literacy is not merely individual behavioral norms but a leverage point for shaping the overall AI ethics perspective of the future medical community.

## 1.2 Theoretical Interpretation Pathways for AI Ethics Literacy in Medicine

The framework construction for AI ethics literacy in the medical field must be grounded in the cross-fertilization of bioethics and algorithmic ethics, while accommodating both the particularity of medical practice and the universality of technology application. As the core ethical framework in medicine, bioethics systematically explores moral and ethical issues in life sciences through the integration of science, philosophy, and ethics, focusing on interpreting the value, dignity, rights, and responsibilities of life from a medical perspective and emphasizing respect and protection for life itself [15]. The basic framework of bioethics, constituted by the four principles of respect for autonomy, non-maleficence, beneficence, and justice proposed by American scholars Beauchamp and Childress, provides fundamental ethical constraints for AI applications in medical scenarios.

Specifically, the principle of respect for autonomy requires clinicians to inform patients in advance about the risks and uncertainties involved in using intelligent technologies when adopting AI algorithm recommendations, respecting and maintaining patients' right to informed consent. The principle of non-maleficence is realized through risk assessment mechanisms in AI clinical applications, minimizing technical harms such as misdiagnosis and data leakage through algorithm auditing and clinical validation to the greatest extent possible. The principle of beneficence focuses on the foundational “people-oriented” value orientation, where AI application research and development should aim to improve diagnostic accuracy and accessibility, creating optimal health benefits for patients through continuous algorithm optimization. The principle of justice emphasizes

that AI medical resource allocation must avoid algorithmic bias, ensuring that patients of different genders, races, and socioeconomic statuses can fairly access quality medical services. If AI models pursue only efficiency maximization, they may sacrifice the interests of vulnerable groups [16]. Principlism is the dominant methodology in AI ethics, representing the endogenous manifestation of translating AI ethics from moral principles to practice in medical contexts [17].

Algorithmic ethics, as a branch of technology ethics, focuses on ethical issues triggered by AI and big data technologies, with its core question being how to embed moral norms into the core architecture and operational mechanisms of algorithms, enabling them to follow the value norms of human society during data processing and decision-making to ensure fairness, justice, and security in algorithm usage. In the medical field, algorithmic ethics primarily emphasizes transparency, explainability, fairness, and accountability in technology application. In clinical applications, it is necessary to disclose AI algorithms' training data sources, model architectures, and performance indicators, understand algorithmic decision logic, ensure clinical verifiability of algorithmic decision paths, and thus avoid diagnostic risks caused by algorithmic "black box effects" [18].

The integration of bioethics and algorithmic ethics provides a solid theoretical foundation for interpreting AI applications in medicine and methodological guidance for addressing responsibility issues in ethical situations. First, given the high-risk nature of medical decisions, multi-level robust verification systems must be constructed in AI-empowered clinical diagnosis practice, enhancing the clinical reliability and safety of intelligent technologies through adversarial sample testing and continuous learning mechanisms, continuously improving the anti-interference capability of medical AI systems. Second, addressing the essential attribute of "human care" in medical practice [19] requires further optimization of human-machine collaborative diagnosis and treatment models, fully maintaining emotional connections in doctor-patient relationships by setting emotional interaction modules in intelligent consultation systems. Third, facing the dynamic complexity of medical problems, AI technology applications must be accompanied by adaptive ethical assessment frameworks, preventing diagnostic deviations caused by model hallucinations through multi-modal verification technologies [20].

### **1.3 Component Elements of AI Ethics Literacy for Medical School Teachers**

Teacher literacy is an important research topic in pedagogy, with scholars developing multi-dimensional explanatory pathways such as the four-factor structure and the STEM teacher professional literacy pyramid model. AI ethics literacy for teachers represents a normative interpretation of specific dimensions in particular technology application fields. Fred Korthagen' s three-level teacher competency model from Utrecht University in the Netherlands [21] provides a compatible explanatory pathway for the component elements of AI ethics literacy among medical school teachers. This model divides teacher behavior into

three main levels: first, the basic technical operation level (based on tool usage experience and intuitive reactions); second, the ethical reflection integration level (forming embodied cognition through human-machine collaboration practice); and third, the systematic ethical decision-making level (involving multi-stakeholder interest balancing and value ranking). These three levels form deep mapping with the practical requirements of AI ethics. Based on this, using Korthagen's three-level model as a foundation, we can divide AI ethics literacy for medical school teachers into three dimensions. The technical cognition dimension focuses on teachers' foundational capabilities as technology understanders, including two secondary indicators: AI technology understanding capability and data management capability, the former ensuring teachers master the basic principles and limitations of medical AI, the latter emphasizing the standardization of full-process medical data management. The ethical reflection dimension embodies teachers' professional role as ethics guides, with two secondary indicators: ethical principle application capability and bias identification and elimination capability, requiring teachers to both integrate traditional medical ethics with AI ethics and possess the ability to identify and eliminate algorithmic bias. The educational practice dimension highlights teachers' professional characteristics as education implementers, containing three secondary indicators: ethical teaching design capability, student ethics literacy cultivation capability, and educational reflection and improvement capability, corresponding to three key educational stages: curriculum development, student cultivation, and teaching optimization. This three-dimensional division follows the logical progression from technical cognition to ethical reflection to educational practice, fully reflecting the professional characteristics of medical education and the dual mission of the teaching profession, constructing a competency framework that meets both the common requirements of AI ethics and the distinctive features of medical education. The component framework of AI ethics literacy for medical school teachers is shown in Figure 1 [Figure 1: see original paper].

## 2 Generation Mechanisms of AI Ethics Literacy for Medical School Teachers

The formation of AI ethics literacy among teachers is a multi-dimensional, dynamic, and complex process. From the theoretical perspectives of medical pedagogy and technology ethics, a three-dimensional collaborative evolution analysis framework can be constructed based on the Embedded AI Ethics Education Framework and the Principle-Based Ethics Maturity Model [22]. First, at the individual cognition level, literacy generation stems from teachers' deep integration of medical ethical values and technical ethics requirements, manifesting as a cognitive development trajectory from passive acceptance to active construction. This process relies on the three-dimensional competency structure of AI literacy—knowledge, skills, and attitudes—emphasizing teachers' understanding of AI principles, ability to identify ethical risks, and attitude toward responsible usage [23]. Second, at the professional practice level, literacy development is shaped by the dual attributes of medical scenario particularity and educational

mission, strengthened through bidirectional feedback between clinical decision-making and teaching practice. This requires deeply integrating ethics education into medical curricula to form an embedded closed loop of curriculum development, teacher-student preparation, ethics integration, and practical feedback [24]. Finally, at the environmental adaptation level, literacy evolution manifests as continuous adaptation to technological transformation and ethics paradigm shifts, including both the identification and response to emerging ethical issues (such as algorithmic bias and data privacy) [25] and the creative transformation of traditional medical ethics principles. The logical structure of the generation mechanism for AI ethics literacy among medical school teachers is shown in Figure 2 [Figure 2: see original paper].

### **2.1 Endogenous Drive Mechanism: Ethical Cognition and Technical Reflection of Medical School Teachers**

The endogenous drive mechanism of AI ethics literacy for medical school teachers is rooted in their dual role positioning as medical educators and industry practitioners, manifesting as systematic construction of ethical cognition systems and conscious enhancement of technical reflection capabilities. In the AI era, medical school teachers must take medical ethics as the foundation, deeply integrate the technical principles of AI with the complexity of medical scenario practice, and systematically construct a cognitive framework guided by clear values, centered on deep risk identification, and aimed at practicing medical responsibility.

At the value orientation dimension, medical school teachers must deeply understand the extended connotations of core medical ethics values such as “life paramountcy,” “patient benefit priority,” and “medical ethics as foundation” in the AI era. The UNESCO Recommendation on the Ethics of Artificial Intelligence passed in 2021 [26] proposes that AI development should always protect human rights, freedom, and dignity as core values. This forms a value compatibility possibility with medical ethics values, while requiring medical school teachers to clearly define the ethical boundaries of intelligent technology tools in diagnosis, treatment, research, and teaching.

At the risk identification dimension, medical school teachers must systematically master the ethical risk mapping of AI applications in medical scenarios [27], understanding the forms and causes of risks such as data privacy leakage, algorithmic bias, and technological dependency. Particularly, they must enhance their “questioning capability” toward algorithms, proactively “anticipating” potential misdiagnoses or “hallucinations” that AI algorithmic models may produce in medical practice through active learning, continuously improving their ability to predict the limitations of algorithmic technology.

At the responsibility practice dimension, medical school teachers must enhance their subjective consciousness as technology leaders and become critical practitioners of AI technology ethics. Specifically, teachers must establish bidirec-

tional reflection mechanisms in clinical teaching and research. On one hand, they must possess the ability to cautiously analyze AI-optimized diagnosis and treatment pathways, achieving precise traceability of every data link and conclusion generation. On the other hand, they must be highly vigilant against the erosion of medical humanistic spirit by technological alienation, avoiding the dissolution of student agency brought about by technological alienation.

## 2.2 Exogenous Synergy Mechanism: Interaction Between Policy Norms and Medical Practice Contexts

The generation of AI ethics literacy among medical school teachers cannot be separated from systematic support from external policies and norms, while also requiring literacy enhancement through deep synergy with medical practice contexts. The exogenous synergy mechanism emphasizes constructing a full-chain teacher cultivation support system of “macro policy guidance—meso institutional design—micro behavioral norms” through institutional constraints, scenario-based adaptation, and interdisciplinary collaboration.

At the macro policy guidance dimension, focusing on the *New Generation AI Ethics Norms* [28] and the *Opinions on Accelerating Educational Digitalization* [29], national-level top-level design for medical AI ethics must be further strengthened, clarifying the AI ethics assessment capabilities teachers must possess, and providing policy basis and directional guidance for cultivating AI ethics literacy among medical school teachers.

At the meso institutional design dimension, teacher cultivation systems must be further implemented based on industry standards such as *Teacher Digital Literacy* [30] and local programs like the *Shanghai Medical AI Work Plan (2025-2027)* [31]. Cross-disciplinary ethics review mechanisms within the industry must be established, integrating AI ethics into teacher evaluation systems, providing institutionalized training and resource support for teachers, and ensuring literacy enhancement is closely integrated with clinical practice.

At the micro behavioral norms dimension, attention must be paid to the particularity of medical school education, especially each institution’s professional strengths and medical talent cultivation directions, promoting the establishment of precise, school-specific implementation plans for teacher AI literacy [32]. School-based resources should be used to develop AI application ethics operation manuals for medical schools, specifying operational standards for data collection, algorithm training, and clinical deployment.

Furthermore, medical schools should conduct training that embeds relevant AI technology ethics norms into real medical scenarios, improving teachers’ clinical practice capabilities through contextualized ethics training. Schools may establish ethics workshops for medical scenario applications, where teachers participate in attribution analysis of real cases such as AI misdiagnosis disputes and patient data leakage incidents, extract and summarize ethical risk prevention and control strategies, transform reflection outcomes into teaching resources,

and strengthen the practical transformation of their technical ethics cognition. Schools can also establish development portfolios for teacher AI ethics literacy, recording dynamic data on teachers' participation in technical ethics training, technical review projects, and academic outputs, while introducing peer review and patient feedback mechanisms to form a feedback closed loop from learning to practice to evaluation and improvement, promoting continuous self-assessment and knowledge updating among medical school teachers, and driving teachers to internalize technical ethics norms as professional instincts, enabling them to always adhere to the bottom line of medical ethics in technology applications.

### **2.3 Dynamic Evolution Mechanism: Continuous Adaptation of Technical Risks and Medical Ethics Conflicts**

The generation of AI ethics literacy among medical school teachers is a dynamic evolutionary process that requires constructing a rapid response system adapted to fast technological iteration and upgraded ethical challenges. As AI application scenarios continuously expand and enrich, the ethical dilemmas they trigger also show dynamic change trends. Teachers' ability to grasp evolving ethical focuses from the technological frontier has become an important standard for measuring their literacy and even competency.

First, medical schools must establish dynamic monitoring and graded response mechanisms for technical ethics risks, providing teachers with real-time updated ethical decision-making support tools and dynamic graded training resources for AI ethics literacy. Fully utilizing industry resources, they should collaborate with affiliated hospitals and enterprises to develop ethical risk matrices for medical AI, real-time tracking and analysis of the latest ethical controversies, policy and regulatory changes, and academic research progress in domestic and international medical AI application fields, while conducting risk assessment and hierarchical ranking of medical AI tools from dimensions such as technical maturity, data sensitivity, and clinical impact scope. For example, autonomous surgical robots could be classified as high-risk technology, requiring restricted usage scenarios and strengthened pre-operative ethical review, while AI-assisted imaging diagnosis could be classified as medium-risk, requiring regular verification of algorithmic fairness. This dynamic risk management model can continuously expose teachers to new ethical challenges in practice, continuously update their ethical cognitive frameworks and decision-making capabilities, and thereby transform theoretical norms into practical wisdom in specific contexts, achieving spiral upgrading of ethics literacy.

Second, the systematic enhancement of medical school teachers' AI ethics literacy requires continuous adaptation to medical ethics conflicts. With the emergence of new ethical dilemmas such as conflicts between algorithmic decision-making and clinical experience, and tensions between patient privacy protection and data sharing, higher demands are placed on teachers' ethical judgment capabilities. As a long-term organizational response strategy, cross-disciplinary ethics case seminars can be organized to guide teachers in analyzing ethical dilemmas

in real clinical scenarios, while encouraging teachers to participate in ethics review work for medical AI projects, deepening their understanding of technical ethics conflicts in practice. This continuous adaptation process enables teachers to dynamically grasp ethical changes brought by technological development, transform abstract ethical principles into concrete coping strategies, and thus form clinically adaptable ethics literacy.

### 3 Cultivation Pathways for AI Ethics Literacy Among Medical School Teachers

As AI technology reshapes the knowledge graph and practical fields of medical education, medical school teachers' ethical roles are transitioning from traditional transmitters of ethical principles to value guides for human-machine collaborative decision-making. However, existing teacher cultivation systems in medical schools still suffer from problems such as disconnection between ethical cognition and technical application, insufficient clinical scenario adaptability, and institutional support gaps, making it difficult to address complex ethical risks such as AI diagnosis algorithm bias and data privacy leakage. Based on this, it is necessary to address the structural dilemmas in developing AI ethics literacy among medical school teachers during the intelligent transformation of medical education through framework design, pathway innovation, and institutional optimization, providing systematic solutions for constructing a responsible medical AI education ecosystem.

#### 3.1 Integration of Ethical Cognition Construction and Technical Practice: Framework Design for Cultivating AI Ethics Literacy

The cultivation of AI ethics literacy among medical school teachers must center on systematic knowledge construction and integration of technical practice capabilities, building a progressive cultivation framework of theoretical foundation, skill enhancement, and value internalization. At the theoretical foundation level, teacher cultivation should focus on constructing interdisciplinary knowledge systems, integrating knowledge from medical ethics, data governance, and AI technology principles. The medical ethics module focuses on analyzing programmatic documents such as the *Declaration of Geneva* [33] and the *New Generation AI Ethics Norms* [25], strengthening teachers' deep understanding of "respect for patient autonomy," "non-maleficence principle," and "fairness," and explaining the reshaping logic of AI technology on doctor-patient trust relationships by comparing differences in rights and responsibilities between traditional medical ethics and the AI era. The data governance module focuses on the specific application of regulations such as the *Personal Information Protection Law of the People's Republic of China* [34] and the *Biosecurity Law of the People's Republic of China* [35] in medical scenarios, requiring teachers to master operational norms such as de-identification, encrypted transmission, and compliant sharing of patient biometric data, and enhancing teachers' risk prediction capabilities through case analysis of ethical controversies such as cross-border use of

genetic data. The AI technology module emphasizes the correlation between AI technology principles and ethical risks, such as explaining how the “black box” characteristics of deep learning models lead to non-traceable diagnostic results, or how “hallucination” phenomena in generative AI may trigger misdiagnosis risks.

Innovation in methods and approaches for cultivating AI ethics literacy among medical school teachers should also be pursued, constructing a three-dimensional training model of blended learning, immersive practical training, and reflective seminars. Blended learning relies on platforms such as MOOCs and Xuexitong to provide foundational theoretical courses, allowing teachers to independently complete knowledge accumulation. Immersive practical training conducts ethics review simulations through medical simulation centers—for example, regarding deployment applications for AI-assisted diagnosis systems, teachers must simulate the role of ethics committees, reviewing data source compliance, algorithm transparency reports, and emergency plans, and writing evaluation opinions. The reflective seminar segment introduces an “ethics roundtable” mechanism, inviting clinicians, legal consultants, and patient representatives to jointly discuss boundaries of AI technology application, prompting teachers to deepen ethical cognition through multi-perspective collisions.

### **3.2 Clinical Scenario Embedding and Multimodal Practical Training Synergy: Competency Advancement Pathways**

The competency advancement pathway for AI ethics literacy among medical school teachers must be based on the national new medical science development strategy, conform to the trend of medical intelligent transformation, and construct a clinically embedded cultivation system with Chinese characteristics. This cultivation system must promote general medical model reforms, strengthen the integration of basic and clinical medical education, integrate research training with medical practice, and combine professional humanistic literacy with medical education [36], achieving systematic improvement of teachers’ AI ethics literacy through coordinated advancement of multimodal practical training.

At the basic competency cultivation stage, the policy requirements in the *New Generation AI Ethics Norms* [25] should be implemented by integrating medical education characteristics, organically combining ethics awareness cultivation with teaching competency enhancement. Teachers should be organized to participate in the full-process management of outpatient AI-assisted diagnosis systems in rotation, including data collection, algorithm application, and result verification, cultivating their cognitive abilities regarding fundamental ethical issues such as medical data privacy protection and algorithmic fairness. Simultaneously, standardized simulation training based on real cases should be conducted, enabling teachers to continuously encounter real doctor-patient communication scenarios in AI consultation, helping teachers deepen their understanding of technical ethics in clinical practice. This stage primarily cultivates teachers’

general understanding of AI medical scenarios, ensuring teacher competency development keeps pace with cutting-edge industry development.

At the professional competency deepening stage, the exemplary leading role of regional high-level hospitals should be fully leveraged, utilizing platform resources of top-tier affiliated hospitals to hierarchically establish demonstration bases for medical AI ethics practical training. Through hospital-school joint construction of high-fidelity clinical training environments such as surgical robots and intelligent imaging diagnosis, immersive and interactive multimodal practical training should be conducted. This stage focuses on cultivating teachers' ethical decision-making capabilities in complex medical scenarios, helping teachers transform clinical participation experiences into classroom teaching cases through typical situations such as intelligent monitoring system early warning disposal in intensive care units and resource allocation in AI-assisted emergency triage, forming teaching case reserves based on practical resources. Simultaneously, cross-disciplinary and cross-institutional collaborative cultivation mechanisms should be further promoted, integrating multi-domain expert resources from clinical medicine, AI, and ethics to provide comprehensive professional support for teacher development.

At the comprehensive competency enhancement stage, the focus should be on cultivating medical education leaders with international perspectives. Outstanding frontline teachers should be selected to participate in national medical AI ethics standard formulation and industry norm revision, bringing medical education realities into policy formulation frameworks. Simultaneously, a transformation mechanism from clinical practice to teaching innovation should be established, converting frontier technical scenarios such as surgical robot applications and gene editing therapy into teaching cases and curriculum resources. A "industry-academia-research-application" collaborative innovation platform should be built to promote deep cooperation among medical institutions, universities, and enterprises, jointly exploring new models of medical AI ethics education. This stage's cultivation should be based on the needs of modern medical education development, cultivating high-quality medical education talents for building a global health community. Through this hierarchical, multi-measure cultivation pathway, the strategic transformation of teachers from technology users to ethics leaders can ultimately be achieved, providing strong talent support for Healthy China construction.

### **3.3 Institutional Empowerment and Ecological Governance: Long-term Guarantee Mechanism**

The sustainable development of AI ethics literacy among medical school teachers requires constructing a systematic, multi-level institutional guarantee system. At the policy guidance level, medical industry management departments, education management departments, and science and technology management departments should collaboratively formulate cultivation guidelines for AI ethics literacy among medical school teachers as soon as possible, explicitly incorporat-

ing AI ethics literacy into the core indicators of teacher professional development. At the practical implementation level, first, a mandatory continuing education credit system can be established, requiring medical school teachers to complete fixed credits of AI ethics thematic training annually. Additionally, an evaluation dimension of “AI ethics application capability” can be added to the professional title review system, incorporating participation in medical AI ethics review and development of relevant teaching cases into review indicators. Furthermore, special development channels can be established to provide key cultivation support for teachers with outstanding performance in AI ethics research and teaching.

In terms of evaluation and incentives, a complete, multi-dimensional evaluation system for AI ethics indicators should be further improved to intervene in the entire process of medical school teacher development. First, standardized evaluation tools should be scientifically developed, including AI ethics knowledge question banks (covering core knowledge points such as data privacy and algorithmic bias) and scenario simulation assessment systems (such as AI-assisted diagnosis dispute handling simulations). Second, clinical practice capability assessment can be gradually promoted, giving frontline teachers more opportunities to participate in real cases and incorporating this into relevant evaluation criteria. Additionally, a contribution point system can be established, providing quantitative evaluation for achievements such as participating in industry standard formulation, publishing teaching cases, and exploring teaching method optimization empowered by AI. Finally, evaluation results can be directly linked to teacher development, serving as references for position appointment and professional title promotion.

In terms of resource synergy, a “government-industry-academia-research-application” integrated support network for medical school teachers should be further developed. At the government level, a national medical AI ethics data platform should be expanded to integrate typical ethics cases, policies and regulations, and other resources, providing authoritative references for teachers. At the industry level, several regional teacher development bases should be established relying on national medical centers, equipped with facilities such as intelligent consultation simulation systems and surgical robot training platforms, providing rotation training for medical school teachers nationwide. At the enterprise level, leading medical AI enterprises and medical schools should be promoted to jointly build joint laboratories to develop specialized ethics practical training systems. At the academic level, a medical AI ethics education alliance should be established to regularly hold teaching competitions and conduct international exchanges. Through this three-dimensional guarantee mechanism, the normalization, standardization, and sustainable development of AI ethics literacy cultivation for medical school teachers can ultimately be achieved.

## Conclusion

This study systematically constructs a theoretical framework and practical pathways for AI ethics literacy among medical school teachers, revealing its unique value as a key element in the fusion of medical education and technological innovation. The findings indicate that the development of medical school teachers' ethics literacy exhibits a competency advancement characteristic from technical cognition to ethical judgment to educational practice. This process requires both teachers' deepening understanding of technical ethics in medical scenarios and systematic support from the institutional environment. The clinical scenario embedding and multimodal practical training synergy cultivation pathway proposed in this study effectively promotes the transformation from theoretical cognition to practical capability by converting typical medical cases into teaching resources. However, with the rapid development of new technologies such as generative AI, medical education faces new challenges such as algorithmic transparency and data privacy protection, requiring teacher ethics literacy cultivation to maintain dynamic adaptability. Future research should, based on the existing theoretical framework, further explore differentiated cultivation strategies across various medical scenarios, improve evaluation index systems, and strengthen international comparative studies to construct a more inclusive and forward-looking medical AI ethics education system, providing continuous support for cultivating medical education talents in the new era.

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