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Transforming Medical Education: Cultivating Statistical Thinking in the AI Era

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Abstract: Artificial intelligence (AI) is rapidly transforming healthcare and medical education. Strong statistical thinking skills are vital for evaluating and applying AI tools. However, traditional medical statistics education has not adapted to this demand. This paper first analyzes the connotation and importance of statistical thinking, points out the significant challenges currently faced by medical statistics education, and then proposes strategies such as innovative teaching methods combined with evidence-based medicine, utilizing AI platforms for supplemental teaching, multidisciplinary integration, and strengthening the understanding of the statistical foundations of AI to enhance the statistical thinking abilities of medical professionals. This study emphasizes the importance of cultivating medical statistical thinking in the era of AI to improve the quality of medical education and ensure the safety and effectiveness of future medical services.

Keywords: Artificial intelligence; Medical education; Statistical thinking; Cultivation strategies

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1. Introduction

The realm of artificial intelligence (AI) is significantly impacting numerous sectors in modern society. As shown in **Table 1**, its healthcare applications deserve special attention, along with its contribution to global medical education. In the healthcare field, deep learning models (e.g., convolutional neural networks) have demonstrated exceptional skill in analyzing medical images, accurately interpreting data from X-rays, magnetic resonance imaging (MRI), and computed tomography (CT) scans. Research shows it successfully aids in the early identification of multiple conditions, such as lung cancer and diabetic retinopathy, with diagnostic accuracy comparable to or even better than that of human experts [1]. In personalized medicine, AI is essential for developing tailored treatment plans that meet the unique needs of individual patients. By leveraging data points such as genetic profiles, lifestyle choices, and historical treatment records, AI can predict patient medication responses and optimize treatment strategies. This method not only enhances

patient outcomes but also minimizes the dependence on trial-and-error approaches [2]. At the same time, AI accelerates the assessment of potential drug candidates in drug discovery, enhances the accuracy of predicting both drug efficacy and toxicity, refines the design of clinical trials [3], and increases surgical precision in robot-assisted surgeries, aiding minimally invasive procedures [2]. In healthcare management, it has been demonstrated that AI enhances administrative efficiency by automating patient scheduling, billing processes, and insurance claims, allowing healthcare professionals to focus more on patient care [4]. It also uses remote health monitoring platforms to identify potential health issues and facilitates the implementation of interventions through telemedicine services [2].

Regarding medical education, AI has shown considerable promise for wide implementation. Intelligent dialogue systems and virtual assistants serve as efficient teaching aids, capable of instantly answering student questions, summarizing research findings, and recommending relevant learning resources [1]. The utilization of AI in personalized learning platforms and adaptive content systems allows for the analysis of student performance and learning styles, resulting in customized teaching content, precise identification of knowledge gaps, and optimization of the learning experience [5]. AI-powered simulation systems and virtual patients create exceptionally realistic clinical scenarios for students, allowing them to refine their clinical skills, diagnostic reasoning, and medical decision-making in a controlled environment [6]. Additionally, methods like optical mark recognition and automated grading support automated assessment in education, delivering detailed and personalized feedback to students.

Table 1. Applications of AI in different medical fields

Medical field	AI applications	Potential benefits
Radiology	Tumor detection through image analysis	Accelerates diagnosis and promotes early detection
Oncology	Predicting treatment response	Enables individualized treatment plans, enhances treatment effectiveness
Ophthalmology	Diabetic retinopathy screening	Improves screening efficiency and prevents vision loss
Pathology	Cancer cell identification	Enhances diagnostic accuracy and reduces human error
Cardiology	Heart disease risk prediction	Facilitates early intervention and better prognosis
Surgery	Robot-assisted surgery	Improves precision and supports minimally invasive procedures
General medicine	Assisted diagnosis and decision support	Aids in scientific diagnosis and treatment decisions

However, the widespread use of AI in healthcare is generating new demands for the skills and roles of medical professionals. This situation presents challenges and opportunities, including identifying significant contradictions within the conventional medical education system. As AI becomes increasingly prevalent in healthcare, it is essential to consider the impact on physician roles and responsibilities. On one hand, as AI gradually takes over data-intensive and repetitive tasks, physicians' work is increasingly focused on interpreting complex cases, delivering healthcare services with a strong emphasis on humanistic care, and fostering nuanced doctor-patient communication [4]. In contrast, the thorough incorporation of AI in medicine requires a comprehensive overhaul of traditional medical education. This restructuring will allow medical graduates to effectively utilize AI tools while ensuring they comprehend the foundational principles and limitations of these technologies. In this initiative, we integrate AI-related knowledge into the curriculum while fostering essential skills for effective human-machine collaboration [7]. As a result, statistical thinking

has become a crucial aspect of medical education and is increasingly important. The absence of these skills can lead to concerns regarding the proper use and interpretation of AI. Seyyed-Kalantari *et al.* [8] argued that inadequate calibration can result in errors, which lead to missed diagnoses and delays in critical treatments or unnecessary procedures.

Medical statistics education is currently confronted with several urgent challenges, including outdated teaching materials, a significant gap between theory and clinical practice, and low levels of student motivation. With the advancements brought by the AI era, these problems notably hinder the adaptability of medical professionals. In this regard, the goal of this paper is to thoroughly explore the standard application scenarios of AI in the medical field, analyze the importance of statistical thinking for medical professionals, and evaluate the challenges faced by contemporary medical statistics education. Moreover, we intend to suggest cultivation strategies that organically integrate statistical thinking into medical education, ensuring it enhances the overall development of medical talent. This approach offers practical and achievable routes for effectively incorporating statistical thinking within medical education in the AI era.

2. Integration of statistical thinking and medical AI

2.1. The meaning and core characteristics of statistical thinking

Statistical thinking involves a systematic and logical reasoning approach based on statistical principles and methods. It allows for data analysis, results interpretation, and evidence-based scientific decisions to tackle real-world issues [9]. According to the American Statistical Association (ASA), the core of statistical thinking involves comprehending variability, randomness, and uncertainty inherent in data, along with the capacity to spot and rectify data bias and errors [10]. In the current age of AI in medicine, medical professionals are empowered to focus on the predictive results of AI algorithms and to understand the statistical mechanisms behind these results thoroughly. This, in turn, guarantees the scientific rigor of clinical decision-making.

Statistical thinking is more than just the application of basic statistical methods. It represents a comprehensive and systematic thinking paradigm that can effectively address random variation and systematic bias in the design, implementation, and analysis processes of scientific research and medical practice [11]. A professional approach to data management involves recognizing and handling variability, assessing and reducing bias, and critically analyzing data and outcomes. **Table 2** illustrates the essential components of statistical thinking and their significance in the context of medical AI.

Table 2. Key elements of statistical thinking

Element	Description	Relevance to medical AI
Understanding variation	Recognizing inherent differences in biological processes	Clarifies uncertainty in AI model predictions
Identifying bias	Detecting systematic errors in data collection and analysis	Helps mitigate biases in AI algorithms
Critical evaluation	Maintaining a skeptical approach to data and conclusions	Evaluates the reliability of AI-generated outcomes
Applying statistical methods	Using appropriate techniques to answer research questions	Enhances understanding of the statistical principles behind AI

Statistical thinking is crucial for the effective interaction between medical professionals and AI technology. **Figure 1** shows the relationship between AI, medical education, and statistical thinking. Physicians skilled in statistical thinking can understand AI model training and evaluation. They can interpret AI-generated probabilities, identify biases in AI algorithms, and validate AI output results scientifically [12]. The case of algorithmic racial bias, as demonstrated by Obermeyer *et al.* [13], illustrates how statistical thinking can assist in identifying hidden systematic biases in AI models.

According to Hunter and Holmes [12] in the *New England Journal of Medicine*, statistical thinking lays the groundwork for a comprehensive understanding of the "causal mechanisms" that drive medical AI predictions and recommendations. While AI algorithms have proven effective in various applications, they primarily function as complex pattern recognition tools. Statistical thinking provides healthcare professionals with the tools to comprehensively analyze data and model processes, thereby improving their understanding of the statistical relationships that influence AI outcomes. It is imperative to understand this concept to build trust in AI systems and ensure their effective use [14]. Furthermore, Gazquez-Garcia *et al.* [15] emphasized that statistical thinking is crucial for the careful and scientifically sound integration of AI into clinical practice, thereby reducing the risks associated with overreliance on AI.

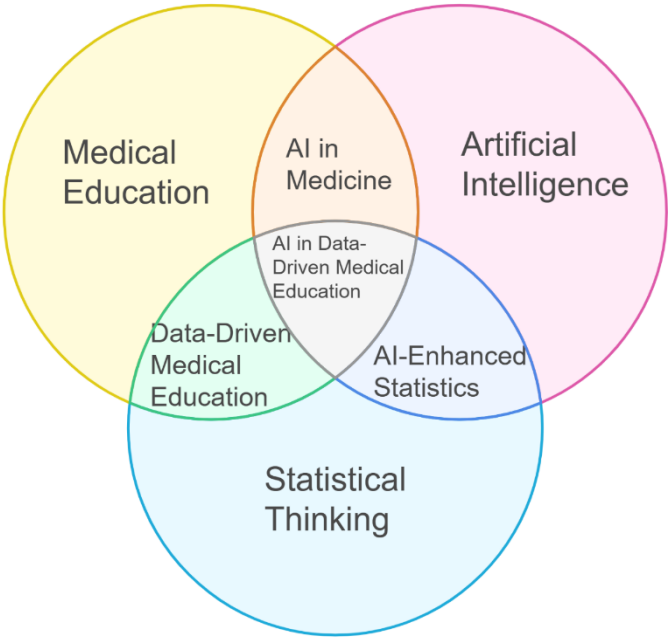

Figure 1. The relationship between artificial intelligence, medical education, and statistical thinking

2.2. The importance of cultivating statistical thinking

Understanding statistical thinking is essential for medical professionals to evaluate the methods and results found in medical literature. Its significance is increasing with the incorporation of AI technologies in diagnostic and treatment practices. Medical practitioners need to critically analyze these technologies, which involve understanding the statistical principles behind AI models like probability estimation and predictive analytics that often impact clinical choices. Statistical thinking allows medical professionals to interpret and apply statistical concepts in medical research accurately and better assess the performance and clinical utility of diagnostic tools and therapeutic interventions. For example, the ability to interpret diagnostic probabilities before and after testing is critical. Research shows that many practitioners tend to overestimate

these probabilities, resulting in overdiagnosis and unnecessary resource consumption [16]. Additionally, incorporating Bayesian inference into medical diagnosis is crucial as it allows for updating probabilities with new evidence. This method highlights the connection between statistical reasoning and AI, assisting in overcoming the "black box" view associated with these technologies [17].

Statistical thinking is an essential skill for medical professionals because it helps them recognize potential pitfalls and risks linked to the use of AI in healthcare. Such risks encompass systematic biases in algorithms, misinterpretation of AI outputs, and excessive reliance on AI recommendations [13,18,19]. For example, using incomplete datasets to train AI models may lower diagnostic accuracy [20]. A solid understanding of statistical principles enables medical professionals to critically assess health-related information in various formats, including AI-generated content, and to effectively recognize and mitigate potential biases that could lead to health disparities [19].

The limited statistical knowledge of medical professionals can hinder their critical evaluation of AI-generated results, potentially leading to serious mistakes in diagnosis, treatment, and patient management. When doctors overlook the limitations of the data used to develop an AI model, they risk misdiagnosing patients, which jeopardizes patient safety [20]. This undue reliance on AI outcomes may perpetuate inaccuracies or biases that could ultimately impact patient results and safety.

3. Current status and challenges of medical statistics education

Medical students encounter significant hurdles in developing statistical thinking due to the fast-paced evolution of AI technology. These obstacles arise from the fundamental flaws within the medical education system and the complex relationship between AI and statistical understanding.

(1) Student cognitive and motivational challenges

A primary challenge in medical statistics education is the widespread lack of intrinsic motivation among students. Medical students frequently view statistics as more complex and less relevant than clinical sciences, hindering their learning [21]. Research indicates that biostatistics is particularly daunting for medical students, who often feel anxious while studying statistics [22]. According to a survey by Li *et al.* [22], this anxiety arises not only from the intricate nature of statistics but also due to the vague link between statistical concepts and their future clinical applications, which ultimately diminishes student engagement.

Although there is increasing acknowledgment of the role that statistics play in evidence-based medical practices and AI applications, ongoing issues within statistics education for medical students suggest that current teaching strategies and curriculum frameworks have not effectively met the evolving demands of medical professionals. Research indicates that students frequently encounter anxiety, low motivation, and a deficiency in statistical comprehension. These findings draw attention to a notable discrepancy between conventional statistics education methods and the educational requirements of modern medical students [22–24].

(2) Diversity of student backgrounds

Medical students exhibit significant differences in their mathematical foundations, prior statistical knowledge, and quantitative reasoning skills at the beginning of their statistical education [25]. The concept of diversity extends beyond mathematical preparation to include differences in learning styles, approaches to understanding quantitative concepts, and levels of prior exposure to statistical inference. Educators must be able to address a wide range of backgrounds to design effective curricula that meet the diverse learning needs of all students.

While competency-based medical education (CBME) shows promise in addressing background differences, its implementation has yielded mixed results. A recent survey of CBME implementation found that only 50% of faculty felt that undergraduate courses adequately met the goals of the educational specification [26]. Assessments of key competencies revealed significant gaps, with half of the faculty reporting significant challenges in adequately assessing student "skills" and 34% reporting similar difficulties in assessing "attitude-communication" competencies [26]. The findings suggest that even well-structured educational frameworks cannot effectively address the ongoing challenge of student diversity in medical statistics education.

(3) Time constraints in the medical curriculum

Time spent on statistical education within the medical curriculum is typically restricted. This leads to a superficial understanding of fundamental concepts and an insufficient examination of advanced statistical methods crucial for modern medical research and AI applications [21,27]. As statistical techniques in medical research grow more sophisticated, particularly with the integration of AI technologies for analysis, the demand for improved time management is becoming more pressing.

Surveys among faculty reveal that around 60% feel the existing curriculum fails to merge subjects effectively [26]. This shortcoming restricts statistical learning and hampers educators' ability to illustrate essential links between statistics and medical fields. As a result, existing teaching strategies fall short in equipping medical professionals to critically assess medical literature and comprehend AI-driven clinical decision support systems.

(4) Integration with core medical disciplines

In medical education, the teaching of statistics often fails to effectively connect with vital disciplines such as anatomy, physiology, pharmacology, and clinical medicine [21]. Unfortunately, this disjointed method perpetuates the perception that statistics is just an isolated, theoretical subject lacking significant clinical relevance. A study on CBME implementation revealed that 60% of faculty felt the curriculum lacked sufficient integration, whereas 40% indicated they had never taken part in an integrated teaching session [26].

The "insular" teaching model is at odds with the inherently interdisciplinary nature of modern medical practice, where statistical thinking is essential for clinical decision-making, research interpretation, and evidence-based medicine. As AI becomes more integrated into healthcare, the necessity for interdisciplinary education is increasingly evident. Medical AI applications typically merge statistical techniques with specialized clinical knowledge, indicating that statistical education should be deeply intertwined with essential medical fields to develop students' interdisciplinary skills.

(5) Assessment challenges in statistics education

A comprehensive examination of standard assessment techniques in statistics education reveals significant weaknesses in measuring students' profound grasp of statistical concepts and their ability to apply this knowledge in complex medical scenarios, particularly concerning AI applications [28]. While multiple-choice questions and computation tasks are typically seen as effective assessment methods, they often fail to assess students' statistical reasoning skills in real clinical environments, especially those involving AI.

Recent studies regarding AI performance in medical examinations underscore the challenge of these assessments. A recent evaluation revealed that ChatGPT-4 scored 74.57% on a radiation oncology board exam, excelling especially in statistics-related questions [29]. It is important to raise concerns about current assessment practices. Suppose AI can successfully pass traditional statistical assessments without real understanding. In that case, there is a risk that these methods may not adequately measure the critical

cognitive abilities that distinguish human expert reasoning from algorithm-driven pattern recognition.

The integration of AI tools such as ChatGPT into medical education presents significant opportunities and unique challenges. A recent study exploring medical students' perceptions of ChatGPT showed that most respondents accepted the tool. Specifically, 86.9% of students agreed that ChatGPT could offer substantial benefits to medical students, while 83.2% indicated that it would aid in the quick and precise summarization of complex topics [30]. However, concerns remain about the accuracy, reliability, and proper use of these tools. The successful integration of AI-driven technologies with strict standards in statistics education represents a new and exciting frontier in medical education, research, and practice.

4. Strategies for cultivating statistical thinking in medical professionals

4.1. Integration of evidence-based medicine and innovative teaching methods

Medical educators should explore different evidence-based strategies and innovative teaching methods to tackle the ongoing challenges in statistical education. These strategies can enhance the statistical thinking skills of medical students significantly. They include authentic medical cases, case studies, and published research findings. They demonstrate the direct relevance of statistical concepts to clinical practice [21]. For instance, when presenting hypothesis testing, educators can use a case study of a clinical trial to guide students in analyzing how statistical methods are used to determine the effectiveness of a drug.

Educators can utilize various active learning techniques to boost student engagement and foster a more profound understanding. A prominent example is case-based learning (CBL), where students collect clinical data from patients, use statistical techniques for analysis, and develop diagnostic and treatment recommendations [31,32]. Another approach is problem-based learning (PBL), which presents students with inquiries regarding disease prognosis. This method encourages group discussions, allowing students to apply their statistical knowledge to examine factors that impact prognosis [33]. Conversely, team-based learning (TBL) requires students to engage in individual study before participating in group discussions and assessments, which promotes a deeper grasp of statistical concepts through collaborative efforts [34].

Education should shift away from rote memorization of formulas and computational methods, moving towards a stronger focus on developing a solid conceptual grasp of essential statistical principles and their interpretation in medical scenarios [35]. By integrating accessible statistical software and data visualization tools into the curriculum, students can actively engage with and analyze authentic medical datasets, deepening their comprehension of statistical concepts and lessening their dependence on manual calculations [36].

It is imperative to seamlessly integrate statistical concepts into the teaching of core clinical disciplines throughout the undergraduate curriculum [21]. To achieve this integration, there is a need for collaborative teaching between statisticians and clinicians. Studies have shown that introducing fundamental statistical concepts, such as probability and sampling distributions, at the outset of medical training and progressively advancing to more advanced topics, such as multivariate statistical analysis and survival analysis, in subsequent stages, can facilitate comprehension and skill development [21]. During various clinical rotations, students apply statistical methods to analyze patient medical record data, reinforcing statistical principles and improving knowledge retention and application abilities. It is also important to employ varied teaching methods, offer optional remedial or advanced support courses, and consider the diverse mathematical backgrounds and levels of statistical anxiety among medical students [25].

The integration of clinically pertinent examples, active learning methodologies, an emphasis on conceptual comprehension, the utilization of technology, and the encouragement of interdisciplinary collaboration significantly enhances student engagement and understanding. These strategies render statistics more applicable to medical students and assist in mitigating related learning anxiety. The adoption of active learning methods fosters critical thinking and practical application skills, representing a significant advancement over conventional passive learning approaches. When statistical concepts are integrated into medical problem-solving and research scenarios, students can recognize their practical importance, fostering a deeper understanding of the subject matter.

4.2. AI-powered platforms empowering medical statistics education

AI-driven tools can effectively customize the statistical learning journey for medical students, enhancing engagement and efficacy. Adaptive learning platforms modify the difficulty of educational content according to student performance, allowing them to grasp statistical concepts at their own speed [37]. Moreover, AI chatbots offer immediate responses to students' inquiries and provide comprehensive explanations, aiding in swiftly clearing up confusion. Research indicates that AI-powered flashcards and quizzes can improve student learning by enabling repeated practice, which further reinforces knowledge [37].

Educators can utilize AI to evaluate student performance data, effectively identifying widespread challenges related to grasping statistical concepts. Consequently, faculty can provide personalized tutoring and support, improving students' capabilities to tackle learning obstacles. Our practice questions are designed to meet the standards of the United States Medical Licensing Examination (USMLE). We provide in-depth solution strategies and explanations to aid students in mastering essential statistical concepts [38]. AI-driven virtual patients and simulation systems allow us to craft realistic clinical scenarios where students must apply statistical reasoning to analyze patient data, assess diagnostic tests, and make treatment choices in uncertain situations [6]. Our immersive program improves students' skills in applying statistics and making clinical decisions by integrating AI tools within the statistics curriculum. This approach provides students with hands-on experience analyzing extensive medical datasets, enhancing their capacity to interpret statistical results pertinent to clinical research and practice [39]. Additionally, AI aids medical students in performing literature reviews and pinpointing relevant statistical approaches [40]. By reviewing extensive literature, AI tools help students swiftly identify essential research and statistical methods, enhancing learning efficiency and broadening their perspectives.

Despite the increasing prevalence of AI in medical education, there is still an opportunity to apply it to enhance statistical thinking skills specifically. Contemporary tools provide substantial advantages in personalizing educational experiences, furnishing immediate feedback, and adeptly simulating complex scenarios. Nevertheless, enhancements are requisite to meet the demands of statistical education comprehensively. We contend that the development of AI-driven tools specifically designed for this aim holds considerable potential. Subsequent research and development should focus on utilizing AI technology to rectify the deficiencies associated with traditional statistics education and enhance medical students' statistical thinking abilities.

4.3. Multidisciplinary integration driving the cultivation of statistical thinking

With the rapid advancements in AI technology, there is an urgent need for a paradigm shift in medical education towards interdisciplinary collaboration. We aim to break down traditional disciplinary silos to

make sure that statistics education is not only theoretically rigorous but also directly relevant to the clinical challenges and technological advancements that medical professionals will encounter throughout their careers [41].

Research shows that interdisciplinary teams can work together to pinpoint opportunities for incorporating statistical concepts and reasoning skills into diverse preclinical and clinical areas of the medical curriculum [42]. Integrating statistics into the curriculum ensures that students grasp the significance of statistics in addressing and resolving medical challenges. Collaboration among medical educators, statisticians, data scientists, computer scientists, ethicists, and clinicians is crucial for designing curricula that effectively blend statistical and medical knowledge. This teamwork will improve students' understanding and hands-on application of statistics. Sedlakova *et al.* [41] emphasized that interdisciplinary cooperation is key to crafting realistic, clinically relevant, and engaging case studies and research initiatives. We incorporate insights from various fields to develop educational materials that tackle real-world medical challenges. This approach allows students to utilize their medical knowledge and statistical skills to analyze data and derive valuable insights. According to a recent study [34], a collaborative teaching model for statistics, co-led by clinicians and statisticians, offers students a thorough blend of academic rigor and practical clinical insight. As experts in the field, we fully support this method, which successfully combines statistical theory with practical application in healthcare environments. This approach enables students to engage with theoretical concepts and real-life scenarios, improving their understanding of statistics and their diverse applications.

We recognize the vital role of interdisciplinary collaboration in designing, developing, and implementing medical statistics curricula. Medical schools could provide students with a comprehensive and practical statistics education by integrating statistics with medical courses, developing authentic and clinically relevant learning materials, and adopting collaborative teaching models.

4.4. Enhancing comprehension and implementation of AI's statistical foundations

The potential for bias in AI algorithms poses a significant threat. Training data must be unbiased to ensure accurate, fair, and non-discriminatory predictions and recommendations, particularly for vulnerable patient populations [18,19]. It is crucial to recognize that AI models built primarily on specific demographic data may not perform well for other populations. This could lead to misdiagnoses or delays in treatment. Furthermore, there are concerns about overreliance on AI technologies without comprehensive assessments of their statistical validity, which might undermine healthcare providers' statistical reasoning and clinical judgment [43]. A deficiency in statistical knowledge needed to interpret the probabilities and risk evaluations generated by AI can lead to poor clinical decisions or insufficient communication of health risks to patients [44].

Calibration (how well predicted probabilities correspond with actual outcomes) and validation (the ability of a model to apply to new data) are essential statistical concepts for assessing the reliability of AI models. Using AI models that are not properly calibrated or validated in clinical settings can pose significant risks [43,45]. The "black box" characteristic of certain advanced AI algorithms can hinder trust-building and restrict the practical clinical application of these tools. Healthcare professionals might find it difficult to grasp the statistical reasoning and the elements that affect predictions and recommendations [46].

To effectively engage in AI-driven healthcare practices, medical professionals need to develop a range of core competencies (see **Table 3**). They include an understanding of the fundamental principles of AI, the ability to critically evaluate AI tools, AI-assisted medical decision-making, the use of AI technology, patient communication skills, ethical considerations, bias awareness, and statistical interpretation skills [1,15,47].

Medical education needs to focus on developing essential competencies, especially statistical knowledge, through well-crafted curricula and assessment strategies. By adopting these methods, we can equip future medical professionals to navigate the AI-driven healthcare landscape with responsibility and effectiveness. Medical schools can establish learning objectives and develop curriculum frameworks specifically tailored to the skills and knowledge required of medical professionals in the age of AI (see **Figure 2**) with clearly defined competencies. It is essential to recognize the fundamental importance of statistical interpretation by explicitly listing it as a key competency.

Table 3. Core competencies in AI-enhanced medical practice

Competency area	Specific skills and knowledge
AI fundamentals	Understanding basic AI principles and their role in healthcare
Critical evaluation of AI tools	Assessing the evidence and statistical performance behind AI applications
Medical decision-making with AI	Integrating AI outputs into clinical decisions while retaining human oversight
Technical proficiency	Operated various AI tools used in clinical practice and research
Patient communication	Explaining AI applications in patient care with clarity and empathy
Ethical and bias considerations	Recognizing and mitigating ethical issues and potential biases in AI
Statistical interpretation	Analyzing statistical outputs from AI, including probability and confidence intervals

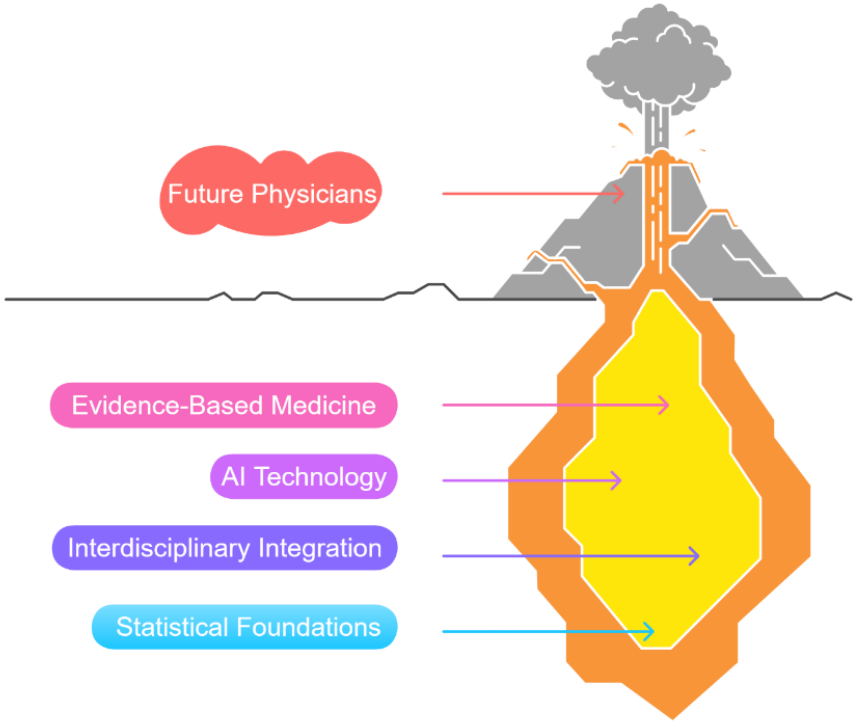

Figure 2. Future physicians' cornerstone

5. Conclusion and recommendations

This paper highlights the importance of developing statistical thinking skills in medical education, especially regarding AI's growing integration into healthcare. The swift evolution of AI technologies in medicine presents distinct opportunities to enhance diagnostic precision, refine treatment protocols, and improve patient care quality. Nonetheless, to fully leverage these advantages, medical practitioners must possess the ability to critically assess and utilize AI tools—abilities that fundamentally depend on a solid statistical background.

To address the current challenges facing medical statistics on education and to ensure that future healthcare professionals are equipped with an AI-driven medical environment, we propose the following recommendations:

(1) Enhancing the statistics curriculum: Medical schools must implement a comprehensive and vertically integrated statistics curriculum that emphasizes clinical relevance and practical application scenarios. The curriculum should encompass fundamental statistical concepts, research design techniques, data analysis approaches, and frameworks for interpreting results. Furthermore, it needs to tightly integrate theoretical instruction with clinical medical practice to establish a seamless combination of theory and application.

(2) Adopting active learning methodologies: Statistics education ought to include diverse active learning approaches such as CBL, PBL, and TBL. Our techniques have demonstrated effectiveness in boosting student engagement, fostering deeper conceptual understanding, and nurturing students' capacity to utilize statistical thinking in addressing real-world medical issues.

(3) Strategically integrating AI technologies: Incorporating AI-driven tools and platforms into curriculum design is essential for improving student learning experiences. We accomplish this through adaptive learning platforms, intelligent tutoring systems, virtual patient simulations, and sophisticated data analysis tools. This approach enables us to customize educational experience, provide prompt feedback, and efficiently replicate clinical decision-making situations.

(4) Innovating assessment systems: Our initiative aims to discover creative assessment methods to help us effectively evaluate how students apply statistical thinking in real-world medical scenarios and situations with AI-generated data. These assessments may encompass thorough examinations using real clinical cases, extensive research projects, and organized critical analyses of AI-generated results.

(5) Establishing interdisciplinary collaboration platforms: We believe that medical schools ought to actively promote robust interdisciplinary collaboration among experts in medical education, statisticians, data scientists, and clinicians to develop and implement medical statistics curricula jointly. By collaborating, we can maintain the statistical integrity of course content and ensure its relevance to clinical practice and technological advancements.

(6) Promoting faculty development: Medical schools should create structured professional development programs to enhance educators' abilities and understanding of teaching statistics amidst the evolving AI landscape. Participants will acquire innovative teaching methods and proficiency in utilizing AI-driven educational tools effectively.

Future research should explore practical methods for cultivating statistical thinking skills in medical education within the context of AI. Specifically, it includes systematically evaluating the effectiveness of different teaching strategies, examining the impact of AI-enhanced educational tools on student statistical learning outcomes, and tracking the long-term development of statistical competencies among healthcare professionals trained through AI-integrated programs.

In conclusion, it is critical to improve the statistical thinking of healthcare professionals to harness the transformative capabilities of AI in healthcare. Indeed, by emphasizing statistical thinking skills in medical education, we can ensure that future physicians are well prepared to use AI technologies responsibly and effectively. This, in turn, will help improve patient outcomes and build a more robust healthcare system.

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Disclosure statement

The authors declare no conflict of interest.

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