Executive Summary

Background on AI in Medical Education

- The AAMC has led efforts to develop AI curriculum best practices in medical education, including a 12-part webinar series in 2024.
- Currently, no widely available longitudinal AI curriculum exists for easy adaptation across institutions.
- The use of AI at peer institutions is variable, although NYU serves as a key example of an institution who is advanced in the field.
- Both faculty and students recognize the importance of AI in medical education, but significant gaps exist in **faculty expertise (93% report limited knowledge)** and **student exposure to AI in clinical settings (33% have never encountered AI during rotations)**; key challenges include **lack of faculty training, limited curricular time, and ethical concerns**, highlighting the need for structured AI educational and institutional support.

Key Task Force Recommendations

- **Develop a comprehensive, longitudinal AI curriculum spanning all phases of the PSOM curriculum.**
    - The Task Force recommends that there should be short term, near term, and long term goals, including establishing pilot AI modules in select courses before full curriculum integration.
    - AI content should be embedded into existing courses rather than introduced as a standalone curriculum to prevent curriculum overload.
    - Foundational AI concepts, such as its applications in healthcare, ethical considerations, and bias evaluation, should be introduced early and reinforced through clinical experiences.
    - Consider early engagement with GME and CME programs to extend AI education beyond undergraduate medical training.
- **Create a PSOM AI Policy** to guide ethical use, data security, and responsible implementation.
    - Establish institutional guidelines on ethical AI use and responsible implementation, including data privacy, bias mitigation, and accountability.
    - Ensure compliance with legal and regulatory standards, including HIPAA and FERPA compliant AI tools for student and faculty use.
- **Invest in faculty development** across the educational continuum to ensure educators can confidently teach AI concepts. This should include structured education for faculty on AI tools and best practices.
    - Provide structured faculty development programs including training workshops, AI case studies, and peer learning initiatives to address existing significant faculty knowledge gaps.
    - Develop AI-specific educational resources and best practices to support faculty in effectively teaching AI concepts.

- **Establish an AI curriculum director leadership role** to oversee integration and ensure ongoing curriculum updates.
    - This leader will align AI instruction across all phases of the PSOM curriculum, support faculty-support initiatives, and ensure continuous curriculum updates.
- **Create a robust IT Infrastructure** to ensure HIPAA-compliant AI tools are available to students and faculty.
    - Collaborate with Penn Medicine Academic Computing Services (PMACS) and Corporate Information Systems (IS) to ensure students and faculty have access to HIPAA-compliant AI tools like PennAI Chat.
    - Maintain an ongoing partnership with institutional IT teams to align AI infrastructure with curricular needs.

Background on AI Current State in Med Ed

Review of AAMC Recommendations for Teaching Artificial Intelligence in Medicine

The AAMC has been at the forefront of convening faculty at medical schools across the United States and internationally to form best practices when teaching AI curricula. As of November 2024, the AAMC has released videos of 12 monthly webinars as part of a series starting in January 2024 called the Artificial Intelligence in Academic Medicine Webinar Series. These webinars can be accessed at the following web address: https://www.aamc.org/about-us/mission-areas/medical-education/artificial-intelligence-ai-academic-medicine-webinar-series?utm_source=sfmc&utm_medium=email&utm_campaign=aamcgeneral&utm_content=email.

These resources span discussions of practical uses of AI in medicine, how to train faculty as both learners and educators of AI, and how to implement AI into medical school curricula. Of note, to our knowledge there are no currently accessible resources that contain a full documentation or recordings of a longitudinal AI curriculum in a medical school that would be easily exportable to another institution. As a result, we are focusing on the AAMC's resources as a near consensus on the thoughts of AI curriculum implementation among academic medicine faculty. Across the 12 webinars, the following emerged as important considerations for the implementation of AI tools in medical schools. A full summary of each of the 12 webinars is included in the Appendix.

Case Example of New York University-Langone

New York University (NYU)-Langone Health Grossman School of Medicine's adoption of an AI curriculum was one of the most advanced examples documented in the AAMC series. In this case, the Dean of the medical school also serves as the CEO of the health system, allowing for clinical, research, and teaching missions to use the same infrastructure. The health system agreed to pay all costs of using the Microsoft Azure platform and developed a partnership with Microsoft allowing them to use the Azure (adaptation of ChatGPT) system with HIPAA compliance and privacy intact. NYU-Langone was also able to build a custom front end for their internal community to reflect that this tool was specifically for NYU-Langone users.

The education applications used at NYU-Langone are housed on the same infrastructure as their clinical applications. As a result, data never leaves the NYU firewall, allowing for more fluid use of protected health identifiers (PHI) for research and for teaching learners using live patient charts. Within the medical school, professors imported content from lecture syllabi into ChatGPT to map the lectures to USMLE content area keywords and MeSH terms. They also developed a DxMentor app that sends reminders for ChatGPT generated teaching points using Epic's electronic medical record from the charts of student assigned patients. The reminders are stored in a log that the student can go back to reference later in the day or in the rotation. Finally, NYU is also using AI-generated summary evaluations by inputting all faculty evaluations of a student into ChatGPT.

Data Privacy Concerns

Several of the webinars discussed concerns over privacy both for PHI and for student evaluations and grades. In particular, if data was de-identified, there are reports that AI-based systems have been able to re-associate information with the original patient or student names. Additionally, because most uses of AI require outside vendors, there are concerns as to who owns the data inputs into a Large Language Model (LLM) system (like ChatGPT). It was recommended that software contracts with external vendors address ownership of data inputs. Notably, there were fewer concerns at institutions like NYU, where all programs are housed on NYU-Langone computer systems, reducing the exporting of data (including student evaluations or protected health information) to systems outside of the campus firewall.

Examples of AI Use in Medical Schools

Across the webinars, there were many examples of ways that artificial intelligence could benefit students, faculty, and administrators. These included:

- Using AI to create OSCE cases and to generate formative feedback from the encounter.
- Facilitated adaptive learning where students were given different content on strokes based on their initial knowledge level.
- Creation of the Medical Student Performance Evaluation (MSPE) using AI to summarize all evaluations.
- Using AI to turn meeting transcripts into meeting minutes.
- Chat bots for Q&As after a lecture.
- Decision support tools and procedural guidance for trainees.
- Personalized learning platforms (intelligent tutoring systems).
- Virtual patient simulators for clinical reasoning.
- Content generation of educational materials.
- Data analytics in the admissions process such as application review, performance analytics of evaluations, sentiment analysis, and bias evaluation such as determining emotional tone from text.
- Predicting students who may struggle in future courses.

The six competencies outlined by Russell et al. 2023 include:

1. Explain what artificial intelligence is and describe its healthcare applications.
2. Explain how social, economic, and political systems influence AI-based tools and how these relationships impact justice, equity, and ethics.
3. Carry out AI-enhanced clinical encounters that integrate diverse sources of information in creating patient-centered care plans.
4. Evaluate the quality, accuracy, safety, contextual appropriateness, and biases of AI-based tools and their underlying datasets in providing care to patients and populations.
5. Analyze and adapt to changes in teams, roles, responsibilities, and workflows resulting from implementation of AI-based tools.
6. Participate in continuing professional development and practice-based improvement activities related to the use of AI tools in health care.

Each subcommittee put together plans for their respective core, considering appropriate division of content as well as desired overlap and repetition of critical content. In the subsequent sections of this report, we describe: 1) background on current state of AI in medical education, 2) a needs assessment summary, 3) longitudinal integration, and 4) the necessary resources to implement AI/ML into our UME curriculum.

Current Use of AI at Peer Institutions

The following sections describe the findings from web searches conducted of each listed each institution to identify and characterize efforts related to integrating AI into the UME curriculum.

The guiding questions for these searches included:

- Have new courses, workshops, or tutorials been created for the students to learn AI?
- Have new institutes or centers been created that are focused on AI for medical education?

The Task Force reviewed the footprint of AI at our peer institutions **(Table 1**). Additional information regarding their findings is available in the Appendix.

- Case Western Reserve
- Columbia
- Johns Hopkins
- New York University
- University of Chicago
- University of Rochester
- Yale
- Cornell
- Duke
- Harvard
- Stanford
- University of Pittsburgh
- Washington University

Institution	New courses, workshops, or tutorials specifically for AI in UME	New institutes or centers specifically for AI in UME
Case Western	❌	❌
Columbia University	❌	❌
Cornell University	❌	❌
Duke University	❌	❌
Harvard University	✅	❌
Johns Hopkins University	❌	❌
New York University	❌	❌
Stanford University	✅	✅
University of Chicago	❌	❌
University of Pittsburgh	✅	✅
University of Rochester	❌	❌
Washington University	❌	❌
Yale University	❌	❌

Table 1: Tabular summary of key questions for each institution. ✅ indicates evidence was found for that initiative. ❌ indicates no evidence was found for that initiative.

Longitudinal Integration

The Task Force recommends that in the first year of AI integration there may be to be an onboarding process, wherein all cores of the curriculum receive the same baseline content on AI prior to targeted integration within the pre-clerkship, clerkship, and post-clerkship framework. There will need to be an initial ramp up period during which all students and faculty can receive basic knowledge in key AI concepts. Subsequent curricular integration can focus on the specific needs of various learner levels once this baseline shared knowledge is achieved.

A summary curricular map of the AI competencies from Russell et al. 2023 and current plans for integration into the PSOM IMPaCT curriculum is shown in **Table 2** below. Green indicates that the committee has a specific recommendation for integration and yellow indicates that the committee recommends that the AI competency be integrated into the core but does not yet have a specific plan. Red denotes that the competency is not felt to be relevant to that part of the curriculum at this time.

	Competency	**Core 1**	**Core 2**	**Core 3**
Explain what artificial intelligence is and describe its healthcare applications.	Define basic definitional terms of AI.	Biomedical Sciences		
	Identify the range of health-related AI applications.	Anatomy, Integrative Systems & Diseases	Clerkship Practicum	Measey STeP
	Describe contributions from the disciplines of data science, computer science, and informatics to the development of health care AI tools. Summarize the factors that influence the quality of data and explain how they impact the outputs of AI-based applications.	Ultrasound Diagnostics		
	Explain how different approaches to data visualization can affect interpretation of the outputs of AI-based tools and the subsequent actions that might be taken.			
	Describe the statistical properties of AI-based tools and explain how they should be used in interpreting outputs.			
Explain how social, economic, and political systems influence AI-based tools and how these relationships impact justice, equity, and ethics.	Acknowledge personal responsibility for fairness and equity in the use of AI-based tools in health care.	Doctoring I	Core Clerkships	Bioethics
	Describe how system-level factors and regulatory structures influence the implementation of AI-based tools in health care.			
	Identify and evaluate how personal and structural biases can impact health data and the outputs of AI-based tools.	Health System Sciences		
	Recognize the potential for use of AI-based tools to reduce or exacerbate health disparities and participate in debiasing activities to mitigate negative impacts.		Doctoring II	
	Appraise the ethical issues for clinicians, patients, and populations raised by various design, implementation, and use scenarios involving AI.	Doctoring I		

	Competency	Core 1	Core 2	Core 3
Carry out AI-enhanced clinical encounters that integrate diverse sources of information in creating patient-centered care plans.	Recognize that clinicians are responsible for all patient care decisions, including those that involve support from AI-based tools, and exercise judgment in applying AI-generated recommendations.	Pre-Clerkship Week	Core Clerkships	Core 3 Electives; Capstone Simulations
	Discern a patient's information needs, preferences, numeracy, and health literacy levels regarding the use of AI-based tools in their care.			
	Explain to patients the concepts of risk and uncertainty as they relate to the outputs of AI-based tools and describe practical implications for their care.			Core 3 Electives; Capstone Simulations
	Integrate information derived from multiple AI and non-AI sources in patient-centered decision-making processes that result in personalized care plans.			
	Demonstrate comfort and humility in caring for data-empowered patients and incorporate patient-reported data and outcomes in developing care plans.			
	Apply methods of data visualization to facilitate patient understanding of AI-derived data, with sensitivity to possible differential impacts related to race, ethnicity, sex, gender, and social determinants of health.			
	Describe how AI-based tools can be used to enhance access and quality of care in remote and underserved settings.			
Evaluate the quality, accuracy, safety, contextual appropriateness, and biases of AI-based tools . . . in providing care to patients and populations.	Access critical information about specific AI-based tools before applying them to patient care, including sources and representativeness of training data, algorithm performance for the question being asked, and how they were validated.			Measey STeP
	Describe how the scope and quality of data sets used in development of AI tools influence their applicability to specific patients and populations.			
	Identify potential biases in the design of an AI-based tool, and the implications of those biases for patient care and population health.			
	Collaborate with patients, caregivers, informaticians, and others in the ongoing monitoring of AI-based applications and communicate feedback through established organizational channels.			
Analyze and adapt to changes in teams, roles, responsibilities, and workflows resulting from implementation of AI-based tools.	Participate collaboratively in team-based discussions that analyze changing roles, responsibilities, and workflows associated with the adoption of novel AI-based tools and help implement necessary changes.			
	Effectively use AI-based tools to facilitate critical communications between all members of health care teams.			
	Recognize data and informatics professionals as valuable members of healthcare teams and collaborate with them in the design of AI tools that address clinical problems.			
	Contribute to micro- and macro-system decision-making processes regarding which AI-based tools should augment and which should replace parts of current healthcare practices.			

Table 2. Six competencies annotated by Core

Core 1

Overview

In evaluating the current PSOM IMPaCT Core 1 curriculum, we recognized and respected that any additional course content must be balanced against the large volume of content to which incoming medical students are already exposed. However, given the ubiquity of AI technologies, an early introduction to and education on AI principles and considerations would provide students with a framework on which to build their understanding of AI over the course of their medical education. Thus, we propose integrating AI education into existing courses in Core 1 to enhance the AI education delivered during Cores 2 and 3. This can include weaving in lessons and concepts within existing lectures and small group discussions or modifying some existing lessons to incorporate examples or teaching points that include AI concepts.

Recommendations

Course(s)	**Program Objective**	**Recommendation**
Fall Biomedical Sciences (Genetics, Biochemistry, Cell &Tissue Biology)	MK1	Begin education on basic definitional terms on AI concepts as early as the August summer primer.
	MK1	Incorporate touchpoints on AI concepts and applications throughout Core 1
Anatomy		Introduce clinical applications of AI in relevant portions of course modules, e.g., examples of AI use in radiology can be introduced in the Anatomy & Imaging course.
Integrative Systems and Disease		Introduce clinical applications of AI in relevant portions of course modules.
Doctoring	P2, SBP1	Incorporate introductions to AI fairness, equity, and bias in Doctoring lessons. This includes specific lessons in clinicians' responsibility in the fair and equitable use of AI tools, and understanding of how personal and structural biases may impact healthcare data and the output of AI tools, and the recognition of how AI tools may reduce or exacerbate health disparities and inequities.
	PBLI2	Students should be preliminarily taught how to appraise the ethical issues that clinicians, patients, and populations may face in the design, implementation, and use of AI tools.
Ultrasound Diagnostics	PBLI2, P2	Introduce important concepts in interpretation of AI outputs. Important lessons include recognition of clinicians' responsibility in all care decisions, including those involving AI-generated recommendations or diagnoses.
Health System Sciences	SBP1	Introduce applications of AI in health systems and population health. Include context on how AI tools may enhance or reduce access to care for populations.
Pre-Clerkship Week	P2	Provide instruction on how AI can or cannot be safely used in their clinical rotations, including a clear list of "Do's and Don'ts" relating to use of commercially available AI software, including software that is not officially offered through PSOM.

Considerations

Facilitators: In reviewing existing course offerings during Core 1, we identified several courses that either already incorporate the teaching of AI concepts or are ripe for including such lessons. For example, some concepts are covered in the Genetics course, given the utilization of AI techniques in the field. Thus, incorporating AI concepts may be easier in some courses than others. While a preliminary review of Core 1 identified courses such as Genetics, Ultrasound, and Anatomy that provide natural areas where AI education can be incorporated, more specific mapping of each course within Core 1 will likely yield clearer areas into which AI education can be seamlessly introduced into existing lessons. Many students will likely have personal experience using commercially available AI tools such as LLMs (e.g., ChatGPT, Gemini, Claude), which may facilitate incorporating certain elements of these tools into lesson plans as appropriate. Small group discussions that already include review of primary literature could swap out currently assigned papers to instead include papers that also include AI elements to further weave AI education into Core 1.

Barriers: Given the novelty of incorporating AI into the existing medical curriculum, many lectures and small group discussions have been designed without including AI concepts. Faculty who lead these lessons may have variable expertise in AI concepts and experience using AI tools. Some faculty may require partnership with faculty with the requisite knowledge to help incorporate such elements into existing lesson plans. Alternatively, or additionally, workshops and training sessions to educate faculty on basic AI concepts, applications in healthcare, and best practices for teaching AI may be of benefit. Therefore, while some basic concepts, such as terminology, can be readily incorporated into existing courses, more complex AI concepts or courses with less flexibility in modifying content to include AI examples may require a longer-term plan to fit AI education within the existing curricular structure appropriately.

Core 2

Overview

The Core 2 AI curriculum should highlight and probe the uses of AI in current clinical practice, across clerkships and settings, to reinforce and expand upon the foundational concepts covered in Core 1. As the uses of AI that students encounter on clerkships will at times evolve rapidly, it is paramount that the curriculum is likewise dynamic. We recommend achieving this through a combination of regular didactics and experiences embedded in existing clinical activities. Critical to teaching students in their day-to-day clinical activities will be ensuring that faculty and house staff themselves learn how to use newly deployed AI tools safely and effectively, and that the health system provides clear documentation and educational materials for approved uses of AI tools.

Recommendations

Course(s)	**Program Objective**	**Recommendation**
Clerkship Practicum	MK1	Review the breadth of current Penn AI applications so that students can appreciate the scope and recognize new AI applications as they interact with them.
	PBLI2	Introduce students to best practices for using AI in contexts for which the risks (e.g., misinterpretation, overreliance) are non-trivial, by deeply diving into a small set of specific AI applications in case examples.
	P2	Review the UME AI policy regarding the use of AI software that is not officially offered through PSOM.
Clerkships	PC4, PC5	Showcase and explain relevant AI tools within each clerkship. This could include dedicated didactic time, depending on the risk of the AI tools used and the need for education in order to use them safely and effectively.
	SBP1	Lead case-based explorations in didactics on the role of specific AI applications to reinforce concepts of fairness, equity, and bias. This should include a risk assessment of current and likely future AI tools. Students should be taught specific approaches to recognize the risks of AI to exacerbate health disparities and encourage students to take personal responsibility for fairness and equity.
	PBL2, SBP3	Create didactic opportunities for students to deeply investigate, synthesize, and teach others about the value and limitations of an AI tool that has impacted a patient's care. This could be in the context of an evidence-based medicine project or a similar but separate project. Assessments should consider sources and representativeness of training data, alignment between training data and clinical use, validation, monitoring, and risks.
	PBLI2	Facilitate self-directed evaluation of AI tools. Create embedded opportunities for students to briefly research and briefly teach others about an AI tool impacting a patient's care. This would be best embedded in daily activities, where appropriate.
	ICS2, P1	Create opportunities in the ambulatory setting to learn best practices regarding discerning patient's information needs and demonstrating comfort and humility in caring for AI-empowered patients. Discerning patient's information needs, numeracy, and preferences related to AI-based tools and uncertainty in decision making. This would be best embedded in daily activities, where appropriate.
Doctoring II	SBP1, SBP3	Encourage students to reflect on when AI has or could have contributed to beneficial, harmful, or discriminatory care.

Considerations

Facilitators: As has been recently demonstrated, many AI tools will be initially evaluated as pilots. The evaluations of these pilots could be leveraged to generate teaching materials. Students will continue to be exposed to AI in many forms outside of clinical practice.

Barriers: There are substantial differences in the frequency, maturity, methods, models of delivery, and risks of AI tools across practice settings and specialties. Some of these settings and specialties are underrepresented in Core 2. It could be beneficial to incorporate more ambulatory care experiences in Core 2, which would enable exposure to associated AI tools. It could also be beneficial to incorporate exposure to AI applications in specialties with considerable AI use that are underrepresented in Core 2, such as Radiology and Pathology & Laboratory Medicine.

As discussed above, the effectiveness of embedded educations depends on the education of the faculty and housestaff. Furthermore, as technologies and tools may change rapidly, the curriculum may need to be frequently revised substantially.

Core 3

Overview

In Core 3, students take electives and have unique individual experiences, unlike the prescribed content in Cores 1 and 2. The AI component of this core should be able to build on students' AI experiences in Cores 1 and 2, and integrate a more practical, hands-on view of AI in medicine that will build on students core clinical experiences and complement their growing subspecialty-based knowledge.

Recommendations

Course(s)	**Program Objective**	**Recommendation**
Bioethics	SBP1, SBP3, P1, P2	Dedicate a session to explaining how social, economic, and political systems influence AI-based tools, and how these relationships impact justice, equity, and ethics, ideally within the next year. The emphasis to students would be on their personal responsibility for fairness and equity in the use of AI in healthcare, and sensitivity to various sources of bias when using AI. The session would ideally have a combination of didactic and interactive components.
Measey STeP and/or Core 3 Electives	PC4, PC5	Incorporate a simulation experience that would compare the use of AI vs usual care in a particular clinical scenario, reflect on how AI modified decision-making, and the impact on patients and populations as a result.
		Design one comprehensive simulation that presents how AI at different points during a comprehensive patient care journey would offer students the opportunity to appreciate the significant potential impact of AI on care delivery.
		Design additional simulations to complement specific electives. For example: Imaging-based AI in radiology, pathology, dermatology, ophthalmology; EMR-based AI in internal medicine and surgical subspecialties; Triage-based AI in emergency medicine.

Considerations

Facilitators: The recommendation is to incorporate this content during Measey STeP and Bioethics given that this is the only content in the existing curricular structure that is delivered to all students. The longitudinal format of Measey STeP can facilitate multiple touchpoints with the AI concepts. Incorporating AI into the sub-I is not ideal due to the high-stakes nature of the rotation and the level of responsibility expected. Acknowledging that students will ultimately be using AI in patient care, the technology is also still rapidly evolving. By introducing it in a specialty-focused manner during Core 3, it is possible to acknowledge the pace at which AI is developing while still emphasizing the aspects that are mature and ready for clinical use and acknowledging future uses. This approach should be revisited as AI becomes more commonly integrated into patient care.

Over time, the Core 3 AI experience should be updated to incorporate the additional competencies listed in the overview. The facilitators for each of the Core 3 AI experiences should ideally be hands-on AI users themselves and be able to speak to the real-world capabilities and limitations of the systems. For maximum impact, the content should be

delivered in as practical a fashion as possible, and not in a theoretical way by someone who has not used AI to care for patients.

Barriers: Incorporating additional content and experiences into already short and content-rich portions of the curriculum may be challenging. Furthermore, simulation-based learning, while hands-on, is still not real-world experience.

In addition, AI continues to evolve rapidly. This creates a natural barrier to preparing students to practice medicine with it in the future. It also requires the AI curriculum director to be able to keep up with the field and identify the components that are relevant to teach students now. As such, the AI curriculum director should be given sufficient resources to effectively design and maintain the curriculum.

APPENDIX

Full Review of 2024 AAMC Artificial Intelligence in Academic Medicine Webinar Series

Webinar 1: "AI in Medical Education: Using the Missions of Medical Education as a Guide"

- This webinar focused on the use of AI-based applications to assist students in their studying and learning at New York University (NYU)-Langone Health Grossman School of Medicine.
- Reasons for success identified:
  - The dean of the medical school also serves as the CEO of the health system allowing for clinical, research, and teaching missions to use the same infrastructure. The health system agreed to pay all of the costs of using the Microsoft Azure platform given the dean oversees the school and the health system.
  - NYU Langone as a health system developed a partnership with Microsoft allowing them to use the Azure (adaptation of ChatGPT) system with HIPAA compliance and privacy intact. NYU Langone was also able to build a custom front end for their internal community to reflect that this tool was specifically for NYU Langone users.
  - The education applications used at NYU Langone are housed on the same infrastructure that the clinical applications are. This means that data never has to leave NYU servers, allowing for more fluid use of protected health identifiers for research and for teaching learners using live patient charts.
- Practical uses of AI in the medical school curriculum at NYU
  - Entering a lecture's written outline into ChatGPT to map the lecture to USMLE content area keywords and MeSH terms.
  - The DxMentor app uses Epic EMR data to send AI-generated nudges of learning points (including full explanations of topics) to students at 8:30am based on the patients they are following on rotations. The system maintains a log of all prior nudges so students can refer back to this. However, the presenters noted high interest but low adoption.
  - NYU enters all evaluations for a student within a clerkship to develop a 1-2 paragraph AI-generated summary evaluation.

Webinar 2: "Building Trust and Transparency in the Age of AI: Behind the Data Curtain"

- This webinar focused on the perceptions of appropriate or inappropriate use of AI by students in generating essays and applications and on the importance of clarifying how data will be used by third-party vendors.
- At SUNY-Upstate, the Graduate Council has implemented screening all qualification exams and dissertations for the use of AI and "originality reports" are submitted to the chair of the committee.
- Regarding data protection, quotations from those surveyed noted concerns over AI's ability in prior studies to re-identify de-identified protected health information.

- Questions encouraged by a privacy lawyer presenter:
    - Can de-identified data be used for training AI models rather than PHI? What protections are in place to prevent the re-identification of the de-identified data in the AI model?
    - Do you know how, when, or where your third-party vendors share data, and have legal representatives reviewed the contracts for privacy concerns?
    - Have you clarified who owns the data (the health system, the school, the vendor, the patient), who can access it, who can use it, and for what purposes?

Webinar 3: "AI & Healthcare Delivery: Navigating the Clinical Reality and Expectations"

- This webinar discussed multiple clinical applications of AI that could be taught within a medical school curriculum.
- Potential AI applications in clinical medicine:
    - Facilitating diagnoses, predicting pathology (such as through watching videos of colonoscopies to predict polyp types), risk stratifying patients (such as VA patients most at risk of suicide), enhancing practice management, building prosthetics, surgical planning, disease predicting, radiology diagnosis, scribing clinical notes through listening to verbal conversations, integration of records for a patient within noncompatible electronic medical record systems, and writing work notes or patient education materials for patients.

Webinar 4: "Utilization AI for the Medical Education Classroom"

- This webinar showcased ways that the University of Miami is using AI to enhance its medical school curriculum. Examples include:
    - Using AI to create OSCE cases and to generate formative feedback from the encounter
    - Facilitated adaptive learning where students were given different content on strokes based on their initial knowledge level
    - Creation of the MSPE using AI to summarize all evaluations
    - Using AI to turn meeting transcripts into meeting minutes
- Future uses
    - Predicting students at risk of not performing well in courses
    - Analysis of communication skills including body language
    - Ability to rate performance of competencies

Webinar 5: "AI in Medical Education: Faculty as Learners and Educators"

- No specific takeaways relevant for this mission.

Webinar 6: "A Disruptive Connector: Learning & Experimenting with Generative AI Together"

- This webinar discussed the ways in which components should be entered into a generative AI program:
    - Task: refers to the general type of output that the prompt should achieve (ex: write a lesson plan)
    - Role: refers to the title or persona of the person who will present the response

    - Audience: refers to the title or persona of the person who the response is designed to reach
    - Create: provides clear instructions about the desired format of the response
    - Intent: indicates the overall intention or purpose of the prompt
- You can perform iterations using generative AI such as creating a patient case, then creating questions, then creating a learning theory for the activity, then creating learning objectives, etc.

Webinar 7: "Leveraging AI to Support Operational Functions"

- No specific takeaways relevant for this mission.

Webinar 8: "Artificial Intelligence and Medical School Admissions and Selection"

- This webinar discusses a few case examples of using AI in the medical school admissions process.
- Lessons learned:
    - Using a language learning model for admission requires significant IT funding and technical support and continuous training of the model rather than a one-time cost and effort
    - Challenges included risk management of possible data breaches
    - Bias was a concern
    - Medical school applications could be screened for personal characteristics that matched priorities of the school
    - Schools felt that they needed to inform applicants that AI is being used and how it would affect the assessments of their applications.

Webinar 9: "Leveraging AI for Research & Innovation"

- No specific takeaways relevant for this mission.

Webinar 10: "The Use of AI Tools in the Scholarly Publishing Process"

- No specific takeaways relevant for this mission.

Webinar 11: "Building AI Partnerships Across Medicine, Industry, and Government"

- No specific takeaways relevant for this mission.

Webinar 12: "Artificial Intelligence In and For Medical Education"

- This webinar lists multiple use cases for AI in medical education:
    - Chat bots for Q&As after a lecture, decision support tools for trainees, procedural guidance for trainees, personalized learning platforms (intelligent tutoring systems), virtual patient simulators for clinical reasoning, content generation of educational materials, data analytics such as application review, performance analytics of evaluations, sentiment analysis and bias evaluation such as determining emotional tone from text, predictive models of competence.

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[34]https://md.wustl.edu/items/ai-in-medicine/
[35]Tamara Schneider, "WashU Medicine, BJC Health System Launch Center for Health AI," WashU Medicine, November 13, 2024, https://medicine.washu.edu/news/washu-medicine-bjc-health-system-launch-center-for-health-ai/
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Relevant Publications

- Columbia school of nursing AI project for nursing documentation: Dos Santos FC, Johnson LG, Madandola OO, et al. An example of leveraging AI for documentation: ChatGPT-generated nursing care plan for an older adult with lung cancer. *Journal of the American Medical Informatics Association* 2024;31:2089-2096. https://academic.oup.com/jamia/article/31/9/2089/7676022

  [37]https://medicine.yale.edu/news-article/artificial-intelligence-medical-education-research-patient-care/

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  [39]https://www.yalemedicine.org/events/inaugural-ai-in-medicine-symposium-at-ysm
- Publication of an AI UME effort at Emory University: Abid A, Murugan A, Banerjee et al. AI Education for Fourth-Year Medical Students: Two-Year Experience of a Web-Based, Self-Guided Curriculum and Mixed Methods Study. *JMIR Med Educ* 2024;10:e46500. https://mededu.jmir.org/ 2024/1/e46500/

Peer Institution AI Programming Details

Case Western Reserve

- No apparent new AI curriculum specific to UME
- AI in Medicine in Partnership with Microsoft:[1] HoloAnatomy Software Suite, a holographic learning platform that uses mixed reality to teach anatomy to medical students.
- Have a published policy on Use of Generative AI Tools for Medical School[2]
- CWRU SOM's Center for AI in Drug Discovery, Center for AI Enabling Discovery in Disease Biology (don't seem to explicitly be involved in curriculum)
- General university website mentions "increasing AI-integrated courses across numerous departments", including medicine
- Cleveland Clinic has a new Center for Clinical Artificial Intelligence which has involved med students in research; presumably poses opportunities with CWRU SOM given it's a partner hospital
- Center for AI Enabling Discovery in Disease Biology (AID2B): This recently created center addresses the lack of exposure to computational imaging and precision medicine in traditional medical education. It focuses on incorporating AI methods into understanding disease biology and therapeutic discovery
- Cleveland Clinic's med school (which is connected to but distinct from CWRU SOM) has a new course teaching students how to code and how to explore integrating AI into clinic
- Researchers at Case Western Reserve University have received a four-year, $1.1 million grant from the National Science Foundation (NSF) to develop an artificial intelligence (AI) approach to make medical imaging more safe and efficient.[3]

Cornell University

- No apparent new AI curriculum specific to UME
- Courses offered at undergraduate/graduate level
  1. HINF 5012: Introduces students to a variety of analytic methods for health data using computational tools. The course covers topics in data mining, machine learning, classification, clustering and prediction. Students engage in hands-on exercises using a popular collection of data mining algorithms.
- No apparent new institutes or centers specific to UME
- Institute of Artificial Intelligence for Digital Health (AIDH)[4] has seminar series[5] and sample courses: e.g., AI in Medicine 2024[6] and ML4H 2024.[7] Courses look like they're for non-medical students although might have some relevant curricula to poll. Looks like this is run from the Population Health Sciences department of WCM.
- AI in Healthcare Cornell Certificate Program[8] – online course, 5-7 hrs. per week for 2 months. Not really geared towards med students.

Columbia University

- No apparent new AI curriculum specific to UME
- No apparent new institutes or centers specific to UME
- Despina Kontos used to be radiology researcher at Penn, currently leading some efforts to use AI + biomarkers for patient care (Center for Innovation in Imaging Biomarkers and Integrated Diagnostics, CIMBID). Not really medical education related.
- Online certificate program for AI in healthcare,[9] but this is offered by the school of engineering, not affiliated with the med school
- School of Nursing has an Office of Artificial Intelligence.[10]
- Certificate program for business leaders:
  1. Columbia Engineering Artificial Intelligence certificate program: Designed to help business leaders create a vision for how AI can be used to transform services, build new products, optimize operational efficiency, and disrupt all industries—health care and beyond.

Duke University

- No specific course curriculum found about AI for UME
- Duke School of Nursing has an AI Educational Hub for nursing students here: https://nursing.duke. edu/ai-hub
- Sample 5-day summer school curricula[11] here offered by Duke AI Health, although not affiliated with the medical school
- AI Health seminar series here.[12] Optional, doesn't really seem to be geared towards students
- Sounds like they're using AI to give students feedback on academic writing per this article from 2023: https://medschool.duke.edu/news/artificial-intelligence-health-care-promise-and-pitfalls
- Description of "Longitudinal Curricular Experiences" here:[13] Specifically has a focus on "Innovation Sciences." Description copied verbatim: *This thread seeks to integrate topics that prepare medical students to lead transformations in health care. These concept areas will augment the biomedical and clinical sciences and introduce medical students to skills and ideas equipping them to become leaders in design health, evidence-based clinical medicine, clinical research, basic science research, population health, health systems science,* ***data science*** *as their careers progress.*
- Duke AI Health:[14] a multidisciplinary, campus-wide initiative to connect and streamline research and application of AI in medicine in an equitable and safe manner . This initiative consolidates fellowships, research, and regulatory groups.
    - **Algorithm-Based Clinical Decision Support (ABCDS)**[15]: A committee-driven regulatory pipeline in which any new clinical algorithm workflows must be registered and approved
    - **Collaborative to Advance Clinical Health Equity (CACHE)**[16]: Community-driven initiative to identify and minimize racial disparities in healthcare

Johns Hopkins University

- Deploying ambient AI for clinical documentation across the health system.[17] Not necessarily medical education, although medical students will likely be seeing this in their rotations.
- No AI educational initiatives listed on medical school curricula online
- AI in Medicine Focus Area[18] for medical students if they choose to pursue a Masters in Biomedical Engineering, Focus Area Courses include Biomedical Data Science (+Lab), Data Design, and Precision Care Medicine

Harvard University

- New month-long introductory course on AI in healthcare required for first-year students on Health Sciences and Technology (HST) track (a program for 30 students out of 165 total in one year). Second part of it will be delivered in January; taught by director of HST program on the MIT side. Whole course is meant to cover ways AI will be emerging in healthcare; project-based class to make it interactive.
  - HMS is piloting the course in 2 parts: "Artificial Intelligence in Healthcare I" for the Fall term, and the second part for the Spring term. The course is guided by 2 goals: 1) "To [help students] understand new tools and methods at the frontier of medicine", and 2) "Arm students with the knowledge needed to conduct involving AI". The course emphasizes practicums (skill-based learning) over solely didactic learning through project-based models. HMS is also aiming to rollout an AI "tutor bot" software in 2025, aimed to aid students' learning.[19]
- HMS established the Dean Innovation Awards for the Use of Artificial Intelligence in Education, Research, and Administration. These awards provide up to $100,000 grants for select projects that research A.I. in relation to diversity, equity, and education[20]
- Medical school Dean pointed towards flipped classroom model as a style benefitting from AI
- Medical school trying to develop an AI tutor bot, to be released potentially in 2025
- Dept. of Biomedical Informatics (DBMI) at HMS has launched an AI in Medicine (AIM) PhD track program. This program included medical AI coursework, AI research collaborations, and clinical rotations[21]
- Faculty are involved in AI in healthcare certificate, but it's not a program oriented towards med students (it's corporate)
- The HMS Office of Extern Education offers a continuing education course, "AI in Clinical Medicine" (exp 2025). This live virtual course is intended for licensed physicians[22]

New York University

- No apparent new AI curriculum specific to UME
- Offers dual degree MD/MS in Biomedical Informatics
- School of medicine offers concentration in data-driven medicine and technology

Stanford University

- Scholarly Concentration available in "Informatics & Data-Driven Medicine" and some electives/ courses to complete this scholarly concentration are related to AI.
- Dual degree Master's program: Biomedical Informatics
- University offers many online classes[23] related to AI though not geared specifically toward medical students
- School of Medicine offers online CME related to AI, including a "AI in healthcare Capstone Project"[24]
- Several cross-departmental courses exploring application of AI in healthcare (open to med students)
- Collaboration between Stanford Institute for Human-Centered Artificial intelligence and the School of Medicine to "guide the responsible use of AI across biomedical research, education, and patient care"
- Courses offered at undergraduate/graduate level:
  1. BIODS 220: Artificial Intelligence in Healthcare: Developed to fill the gap in AI literacy among healthcare professionals, this course teaches the application of deep learning to patient data, diagnostics, and treatment planning
  2. BIOMEDIN 260: Computational Methods for Biomedical Image Analysis and Interpretation: Focused on medical imaging, this course teaches computational techniques for analyzing clinical imaging data
  3. CS 523: Research Seminar in Computer Vision and Healthcare: A seminar that explores the intersection of computer vision and healthcare, emphasizing interpretability and human-centered AI methods
- Other training courses:
  1. AI in Medicine Bootcamps at the AIMI Center: These intensive sessions train medical students to integrate AI tools into clinical workflows, providing hands-on experience with machine learning algorithms
  2. Artificial Intelligence in Healthcare: Online course to learn about the current and future applications of AI in healthcare with the goal of learning to bring AI technologies into the clinic safely and ethically.
- Stanford Center for Artificial Intelligence in Medicine and Imaging (AIMI): Created to address the lack of accessible medical datasets and educational resources, AIMI fosters a collaborative environment for developing AI-driven healthcare solutions. It also supports symposia and conferences tailored for medical students.[25]
  - **Leadership: Curtis Langlotz (Radiology)**: See Director's Welcome[26]
  - Significant number of affiliated faculty[27]

This website is full of content and highly informative. Includes affiliated people, education, research, resources (including datasets), industry affiliates/opportunities, events, etc.

University of Chicago

- Have awards encouraging research projects with AI in medical education
- Most of the AI initiatives do not seem to be localized at the med school
- "The University of Chicago Medicine recently piloted the use of a generative AI-powered clinical documentation tool among 200 providers. The tool, used only with patient consent, has already led to significant reductions in physician burnout, as well as higher patient satisfaction"28
- **The Medical Imaging and Data Resource Center (MIDRC)**, hosted at UChicago, has been selected to participate in a new pilot program from the NSF to democratize AI research[29]

University of Pittsburgh

- The AI Task Force was established in 2021 which led to UME Curriculum updated to incorporate AI: *"Artificial Intelligence added to EBM-Applied: The committee today approved a content change request for MS1 course Evidence-Based Medicine (Applied) to add AI/machine learning sessions to their schedule, helping to fulfill recommendations from a recent AI/ML Task Force. EBM-A will add three hours of introductory content (2 hours of large group time, and one hour of asynchronous videos), replacing unused/extra independent study hours. The new content will tie to the eight overall AI/ML competencies for medical students, focusing on clinical application as much as possible, with a pre-test/post-test methodology to evaluate the innovation."*
- AI in Medicine Curricula: Led by the Associate Dean for AI in Medicine, these programs were developed specifically to address gaps in understanding AI applications in clinical decision-making and medical research. The curriculum incorporates machine learning and data analytics into core medical education.
- Artificial intelligence and machine learning in medicine mini-elective for MS1 and MS2[30]
- Is rolling out changes to med school curriculum: 1) several AI "must know" lectures in 2024, 2) a self-paced elective in 2025 without requirement for previous coding experience, and 3) a more advanced, specialized elective for students with computational experience, to be released in 2026.
- Computational Pathology and AI Center of Excellence (CPACE): This new center was designed to address the lack of AI-driven education in pathology by providing hands-on tools and case studies for medical students.
- Center for AI Innovation in Medical Imaging (CAIIMI): Focuses on bridging the gap between AI research and its practical applications in radiology and medical imaging.
- A research team is currently putting together 'Pitt GPT' to try out generative AI in the medical space
- Pitt and NVIDIA just agreed to collaborate to make Pittsburgh site of NVIDIA's inaugural AI Tech Community (meant to bring together academia, industry, and public sector partners). Will allow acceleration of medical research going on at Pitt as well as exploration of new

ways to merge AI and healthcare. Aimed at advancing AI in clinical medicine and biomanufacturing, this partnership brings cutting-edge AI tools and collaborative opportunities to the medical curriculum.

- General guidance for teach with AI but not specific to UME: https://teaching.pitt.edu/resources/ teaching-with-generative-ai/
- **Key people: Hooman Rashidi**, previously at Cleveland Clinic where he built the Center for Artificial Intelligence and Data Science, "which is not only a cutting-edge AI research facility but also focused on AI
  - "*Rashidi is rolling out an AI curriculum in three phases for MD students: He's delivering several*
    AI "must know" lectures in 2024; introducing a self-paced elective in 2025, which requires absolutely no programming or machine learning experience; and launching a more specialized elective in 2026—one that does involve coding and other computational skills." Pitt AI Website[31]

Rashidi envisions eventually offering similar workshops and other educational opportunities to already practicing physicians and scientists and to students and professionals in other health sciences fields.

  - "In demand: Humans who are AI savvy: The most important skills for the future will be adaptability and flexible thinking paired with curiosity; this applies to the teacher and the learner."

- 2021 Curriculum Committee Report:[32]
  - **Artificial Intelligence added to EBM-Applied:** The committee today approved a content change request for MS1 course Evidence-Based Medicine (Applied) to add AI/machine learning sessions to their schedule, helping to fulfill recommendations from a recent AI/ML Task Force. EBM-A will add three hours of introductory content (2 hours of large group time, and one hour of asynchronous videos), replacing unused/extra independent study hours. The new content will tie to the eight overall AI/ML competencies for medical students, focusing on clinical application as much as possible, with a pre-test/post-test methodology to evaluate the innovation.

University of Rochester

- No AI in medicine curricula listed on the medical school education website
- Some work on genAI for patient message triage although this is research, not really education: https://www.hcinnovationgroup.com/analytics-ai/article/53078074/at-the-university-of-rochester- medical-center-a-breakthrough-with-generative-ai
- Rochester's 2030 Strategic Plan articulates investment and cross-disciplinary collaboration to advance knowledge and safety regarding AI use[33]

Washington University

- No apparent new AI curriculum specific to UME
- AI in Medicine Student Interest Group[34]
- Center for Health AI is a collaboration WashU School of Medicine and BJC Health System to support clinical applications and practical training of AI. The Center has briefly described that this initiative will include training for medical students and residents through "immersive, practical training in AI-driven care delivery", yet the details remain unclear.[35]
- "Precision Education" tool kit - an initiative using AI to tailor curriculum and study aids.
- University-wide AI for Health Institute[36] consolidates research, grant opportunities, and symposiums

Yale

- No apparent new AI curriculum specific to UME, but active adjacent activities
- Using AI to augment educational initiatives on health equity: *"At the suggestion of one of their team members, Haleigh Larson, a third-year medical student at Yale, they started using Humata.ai to help cull through the medical curriculum. The research team, which also includes Aeka Guru, an undergraduate fellow, developed a question list for input into Humata.ai so it could assess sex and gender content in the curriculum and generate a course report. Questions included: 'Is there any discussion of sex and/or gender in the document?' 'What areas could benefit from discussion of sex and gender topics?' 'What journals have papers with information on these topics?' among others. The Humata.ai tool then performed an initial content analysis to assess sex and gender content in the curriculum and develop suggestions for incorporating new information."* Copied from article here[37]
- GutGPT[38]: educational tool for medical students from the Yale Center for Healthcare Simulation. Not a "formal" educational initiative, but an educational study exposing students and residents to genAI tools
- New *2024 AI in Medicine Symposium at Yale School of Medicine*[39]
- AI in Medicine Student Interest Group that holds monthly seminars
- Yale offers this course but not specifically for medical students: - https://online.yale.edu/medical-software-ai-program