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Perspective

The 5As Framework: Guiding the Integration of Artificial Intelligence in Health Professions Education

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Abstract

Introduction: The rapid evolution of artificial intelligence (AI) technologies, including large language models (LLMs) and virtual simulations, offers transformative opportunities for health professions education (HPE) by enabling personalized learning and enhanced clinical reasoning. However, challenges like resource disparities, ethical concerns, and inequities in low- and middle-income countries (LMICs) such as Iran necessitate a structured framework.

Methods: This perspective proposes the 5As Framework—Availability, Accessibility, Acceptability, Adaptability, and Affordability—as a comprehensive guide for equitable AI integration in HPE. Building on models like the Technology Acceptance Model (TAM), Diffusion of Innovations, and Unified Theory of Acceptance and Use of Technology (UTAUT), it addresses gaps in procurement, usability, ethics, flexibility, and costs, tailoring solutions to LMIC contexts.

Results: Availability ensures procurable tools via open-source platforms like Hugging Face and partnerships, countering proprietary barriers. Accessibility emphasizes intuitive interfaces, natural language processing (NLP) aligned with clinical language, and multimodal interactions compatible with systems like Moodle, reducing learning curves. Acceptability fosters trust through bias audits, co-design, and framing AI as augmentative, as in objective structured clinical examination (OSCE) feedback. Adaptability leverages machine learning for customizable simulations tied to local priorities like Iran's health needs, supporting curricula from preclinical to continuous professional development (CPD). Affordability promotes open-source alternatives, World Health Organization (WHO) grants, and workload automation for long-term savings.

Conclusion: Implications span curriculum design with equitable simulations, faculty development via bias workshops, and assessments like script concordance tests with human oversight. While conceptual, the 5As requires empirical validation through multicentre trials to confirm impacts on outcomes and equity. Ultimately, this equity-oriented roadmap empowers educators and policymakers to harness AI for human-centered HPE, bridging global divides and preparing professionals for AI-augmented practice.

Perspective

The rapid evolution of artificial intelligence (AI) technologies, including large language models (LLMs) and virtual simulations, presents transformative opportunities for health professions education (HPE). These innovations enable highly personalized learning pathways, where adaptive algorithms tailor content to individual learner needs, and immersive simulations enhance clinical reasoning by replicating complex patient scenarios with unprecedented fidelity.[1] For instance, LLMs can generate dynamic case studies that evolve based on student responses, fostering deeper critical thinking, while virtual reality tools simulate rare procedures, bridging gaps in hands-on training. Such advancements promise to revolutionize how future health professionals develop competencies essential for real-world practice. Yet, these opportunities come with significant implementation challenges, including stark resource disparities across institutions and persistent ethical concerns like algorithmic bias and data privacy. In resource-limited settings, unequal access to high-speed internet or computational power risks widening existing inequities, potentially leaving behind educators and learners in underserved regions. Ethical dilemmas further complicate adoption, as opaque AI decision-making could undermine trust in human judgment, central to healthcare. These hurdles demand a structured, equity-focused approach to guide integration, ensuring AI augments rather than supplants human-centered education and prevents the exacerbation of global divides.[2]

This perspective article proposes the 5As Framework—Availability, Accessibility, Acceptability, Adaptability,

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and Affordability—as a comprehensive conceptual guide for embedding AI into HPE. Tailored with particular attention to equity and feasibility in low- and middle-income countries (LMICs) like Iran, the framework offers educators, administrators, and policymakers a practical lens to navigate these complexities. By systematically addressing procurement barriers (*Availability*), user-friendly integration (*Accessibility*), cultural and ethical alignment (*Acceptability*), flexible customization (*Adaptability*), and economic viability (*Affordability*), it promotes sustainable AI adoption across curricula, assessments, and faculty development programs. Ultimately, the 5As prioritizes human-centered outcomes, empowering HPE stakeholders to harness AI's potential while safeguarding inclusivity and professional values in diverse global contexts.

Conceptual Grounding

The 5As Framework builds upon and extends well-established theoretical models, strategically addressing their specific limitations when applied to the integration of AI in HPE. At its core, Davis's Technology Acceptance Model (TAM) serves as a foundational predictor of user adoption for new technologies, focusing on key perceptual factors that drive behavioral intent. Developed by Fred Davis in his 1986 doctoral dissertation and formally published in 1989, TAM draws directly from the Theory of Reasoned Action, originally formulated to explain voluntary behaviors in social psychology, and adapts it to technology acceptance within information systems contexts.[3] In the realm of medical education, TAM has proven particularly valuable for evaluating tools related to clinical competence assessment and AI integration, as it systematically measures perceptions among faculty and students regarding a technology's practical utility.[4] Central to TAM are two primary constructs—perceived usefulness, which assesses how much a tool enhances performance, and perceived ease of use, which evaluates the effort required for adoption.[4] These elements strongly underpin the Accessibility pillar of the 5As by highlighting user-friendly design as a gateway to engagement. However, TAM falls short in resource-scarce environments, such as those prevalent in LMICs, where it overlooks critical procurement barriers like licensing costs and infrastructural availability that can halt adoption before perceptions even come into play.

Similarly, Rogers' Diffusion of Innovations theory complements TAM by emphasizing how innovations spread through social systems, spotlighting attributes like relative advantage, compatibility with existing practices, and observability of results.[5] These align closely with the 5As' Acceptability and Adaptability dimensions, as they stress the need for AI tools to fit seamlessly into HPE workflows and demonstrate tangible benefits in real-time educational settings. Yet, this model neglects affordability as a standalone driver, especially in LMICs where economic constraints often determine whether an innovation ever reaches the diffusion stage.

Digital equity frameworks further enrich this foundation, with Van Dijk's model of successive access gaps—encompassing material (e.g., hardware), skills (e.g., digital literacy), and usage (e.g., motivational) divides—illuminating the infrastructural inequities that AI deployment can amplify.[6] While powerful for diagnosing broad societal divides, these frameworks lack tailored applications to HPE specifics, such as embedding AI into competency-based curricula or mitigating biases in clinical simulations. Recent advancements, like the Unified Theory of Acceptance and Use of Technology (UTAUT), extend these ideas by incorporating performance expectancy, effort expectancy, social influence, and facilitating conditions, with adaptations for medical students that explicitly address trust and perceived risk in AI contexts.[7] This reinforces the ethical dimensions woven into the 5As' Acceptability pillar.

What truly distinguishes the 5As Framework is its comprehensive synthesis, which holistically applies all five dimensions across core HPE domains—curricula design, assessment strategies, and faculty development initiatives. It foregrounds Affordability amid the rising costs of proprietary AI platforms, while tailoring Adaptability to the competency-based education shifts that dominate contemporary HPE, such as personalized learning trajectories and lifelong professional development. By selectively drawing from high-impact HPE literature, the 5As delivers a pragmatic, equity-oriented roadmap that transcends the tech-centric focus or generalized adoption theories of its predecessors, offering a cohesive guide for sustainable AI integration in diverse global settings.

Availability

Availability stands as the foundational pillar of the 5As Framework, ensuring that AI tools are readily procurable for educational use without imposing undue institutional hurdles that could derail integration efforts from the outset. In LMICs, proprietary restrictions on advanced platforms—such as GPT variants or sophisticated diagnostic simulators—severely limit access, stemming from underdeveloped technological ecosystems, stringent licensing requirements, and exorbitant fees that strain already limited budgets. These barriers not only hinder procurement but also perpetuate a cycle of exclusion, where cutting-edge AI remains confined to well-resourced institutions, leaving the majority of medical schools unable to experiment or scale applications.

Illustrative solutions emerge through open-source repositories like Hugging Face, which democratize access by offering pre-trained models tailored for anatomy visualization, case-based reasoning, and interactive simulations—empowering resource-constrained medical schools to prototype AI-driven educational tools affordably and swiftly.[8] Institutional partnerships with tech developers and national AI repositories further amplify this availability, as evidenced by collaborative initiatives that bridge academia and industry to share resources and expertise.[9] Policymakers play a pivotal role by prioritizing subsidized licensing agreements and infrastructure investments, effectively countering the digital divide where LMICs consistently lag in AI readiness and computational capacity.[10]

This dimension sets the essential stage for the subsequent pillars, as unprocurable tools render all further integration impossible—particularly in multilingual contexts like Iran, where localized models are indispensable for cultural and linguistic relevance. By securing Availability first, the framework lays a robust groundwork for equitable AI adoption across HPE.[11]

Accessibility

Accessibility builds directly on Availability within the 5As Framework, emphasizing user-friendly interfaces and seamless workflow integration to mitigate steep learning curves that often result in underutilization among both students and faculty. By prioritizing intuitive designs, such as natural language processing (NLP) finely aligned with clinical vernacular, AI tools become approachable entry points for adoption, reducing the intimidation factor that plagues complex technologies.[12] Compatibility with widely used learning management systems like Moodle or Blackboard exemplifies this practical embedding, allowing AI functionalities to integrate effortlessly into existing curricula without requiring disruptive overhauls.[13] In Persian-speaking regions like Iran, culturally attuned translations and advanced voice recognition features effectively address entrenched language barriers, broadening reach across diverse HPE settings and ensuring that non-English dominant learners are not sidelined.

Pilot applications, such as AI tutors dedicated to clinical reasoning, vividly demonstrate this potential when interfaces emphasize simplicity and responsiveness, though successful broader rollout hinges on rigorous, inclusive design principles that anticipate varied user profiles.[13] Accessibility extends beyond basic usability to encompass multimodal interactions—combining text, voice commands, and visual elements—to accommodate diverse learner needs, from visual impairments to varying digital literacies, thereby reducing exclusion in competency-based programs that demand equitable participation.[14]

Acceptability

Acceptability forms a critical pillar in the 5As Framework, centering on ethical and cultural alignment to foster genuine stakeholder buy-in through deliberate strategies like transparency measures, systematic bias audits, and inclusive co-design processes. This dimension ensures that AI integration resonates with the values and norms of HPE communities, building confidence rather than resistance.[11] By consistently framing AI as an augmentative tool—explicitly not a replacement for human expertise—it preserves irreplaceable core professional values such as empathy, patient-centered care, and nuanced clinical judgment. For instance, AI-assisted feedback in Objective Structured Clinical Examinations (OSCEs) delivers enhanced precision in performance evaluation while maintaining essential human oversight to interpret contextual subtleties.[15] Rigorous algorithmic transparency further mitigates inherent risks of opaque decision-making, a concern that intensifies in diverse cultural contexts where misaligned outputs could erode trust or perpetuate stereotypes.[13]

Co-design processes, actively involving end-users like faculty, students, and clinicians from the outset, cultivate enduring trust and relevance, directly echoing extensions of the UTAUT that incorporate AI-specific factors such as perceived trustworthiness and reliability.[16] In LMICs, acceptability becomes paramount, as it hinges on proactively addressing biases embedded in predominantly Western-centric training data—necessitating localized audits and dataset refinements to achieve true cultural resonance and fairness in educational applications.

Adaptability

Adaptability constitutes a pivotal pillar in the 5As Framework, ensuring that AI tools dynamically evolve to meet the ever-changing pedagogical demands of competency-based HPE. By leveraging machine learning capabilities, these tools enable profound customization, allowing educators to fine-tune parameters with precision—such as tailoring interactive case scenarios to individual learner proficiency levels or generating simulations of rare pathologies enriched with real-time, contextually relevant data streams.[2] Local adaptations exemplify this flexibility in action; for instance, integrating Iran's national health priorities—such as prevalent regional diseases or public health challenges—into simulation modules creates highly relevant training experiences that resonate with local clinical realities and policy imperatives.

Unlike rigid, static tools that quickly become obsolete, adaptable AI seamlessly supports curricula transitions across educational stages—from foundational preclinical training through to advanced postgraduate continuous professional development (CPD)—powered by self-updating algorithms that incorporate emerging evidence and learner feedback in real time.[17] This robust design aligns closely with core principles of Rogers' Diffusion of Innovations theory, where compatibility with existing practices drives sustained adoption and long-term use[4]. However, the 5As extends these concepts further by addressing HPE's unique evolving needs, such as interprofessional training collaborations and lifelong learning pathways that demand ongoing relevance amid rapid medical advancements.

Affordability

Affordability emerges as a crucial pillar in the 5As Framework, directly confronting the economic realities that often impede AI integration by advocating proactive, cost-effective strategies to surmount the prohibitive expenses of proprietary platforms. In LMICs, where budget constraints are acute, open-source alternatives[18] provide immediate relief, offering robust AI capabilities without licensing fees, while grants from authoritative bodies like the World Health Organization (WHO) unlock scalability for nationwide educational initiatives. These resources enable institutions to deploy AI at scale without financial strain, transforming potential barriers into opportunities for widespread adoption. Moreover, automation of faculty workloads—through efficient content generation, automated grading, and personalized feedback systems—delivers substantial long-term savings, effectively balancing modest upfront investments against measurable improvements in educational outcomes and efficiency.[2]

Collaborative funding models, uniting governments, industry partners, and international organizations, strategically address persistent infrastructural gaps such as server capacity and bandwidth limitations, ensuring that affordability never compromises the quality or reliability of AI tools in HPE settings.[19]

Implications for Medical Education

Curriculum Design

Embedding the 5As Framework in AI modules fosters competency-based curricula through adaptable, accessible simulations that ensure equity across diverse educational settings. For instance, the availability of open-source tools supports the creation of preclinical virtual patients, enabling hands-on practice without high costs, while Affordability through grants and automation guarantees broad rollout to all institutions. Accessibility integrates these tools seamlessly into existing platforms, minimizing learning curves for faculty and students. Acceptability builds trust via culturally aligned content that respects local clinical norms, and Adaptability allows real-time customization to learner proficiency, evolving scenarios based on performance feedback. This holistic infusion addresses AI literacy gaps via problem-based learning, preparing learners for AI-augmented practice by cultivating critical thinking, ethical decision-making, and interprofessional skills essential for future healthcare delivery. Ultimately, the 5As transforms curricula into dynamic, inclusive pathways that bridge theory and real-world application.

Faculty Development

Leverage affordable open-source platforms through acceptability-focused workshops that prioritize bias mitigation and augmentation strategies, ensuring AI aligns with ethical standards and cultural values in health professions education. These sessions equip faculty with practical skills to address algorithmic flaws, fostering trust and ethical oversight. Training emphasizes Adaptability, enabling customization of AI tools for local needs—such as integrating regional disease patterns or Persian-language interfaces—particularly in CPD programs that monitor generative AI trends. Multidisciplinary partnerships with clinicians, ethicists, and technologists enhance pedagogical expertise, bridging critical shortages common in LMICs. This approach empowers educators to lead AI integration confidently, promoting sustainable faculty growth and equitable knowledge dissemination across diverse settings.

Assessment

Deploy accessible AI tools for OSCE feedback and script concordance tests, ensuring adaptability to diverse proficiency levels through real-time adjustments that match learner needs and clinical scenarios. Affordability via scalable, open-source models enables widespread deployment without straining institutional budgets, particularly in resource-limited settings. Acceptability safeguards ethical scoring by embedding transparency features and mandatory human oversight, which prevents algorithmic bias and preserves the nuanced judgment essential to clinical competence evaluation. This integration refines global assessments by providing precise, data-driven insights while upholding professional standards, fostering equitable skill development from novice to expert levels. Ultimately, the 5As ensures AI enhances rather than undermines the reliability and fairness of competency-based evaluations across HPE contexts.

Limitations

As a conceptual framework, the 5As requires rigorous empirical validation through multicentre trials, such as Kirkpatrick's four-level evaluations, to comprehensively assess implementation fidelity, learner outcomes, equity impacts, and long-term sustainability across diverse health professions education (HPE) contexts. While it draws from selective high-impact literature rather than a systematic review, this approach prioritizes pragmatic applicability over exhaustive synthesis, though it assumes evolving AI capabilities that may necessitate future adaptations to incorporate emerging risks like data privacy breaches or over-reliance on automation. Generalizability to high-income settings warrants targeted testing, alongside development of precise metrics for each "A"—such as procurement success rates for Availability or user satisfaction scores for Acceptability—to enable quantifiable progress tracking and iterative refinement.

Conclusion

The 5As Framework—Availability, Accessibility, Acceptability, Adaptability, and Affordability—provides a pragmatic roadmap for integrating AI across HPE, from preclinical virtual simulations to lifelong CPD. Health professions educators, administrators, and policymakers must adopt and refine this equity-focused guide to ensure human-centered AI augmentation, preventing resource-driven inequities that disproportionately affect LMICs like Iran. Future multicentre trials will validate its impact, while influencing policies to prioritize open-source tools and ethical safeguards, ultimately fostering inclusive, competency-driven training that equips global healthcare professionals for an AI-enhanced future.

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