IJMS INTERNATIONAL JOURNAL *of*
MEDICAL STUDENTS

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The *International Journal of Medical Students* (IJMS) is an open-access, peer-reviewed scientific journal (ISSN 2076-6327) that publishes original research in all fields of medicine. The Journal was created in 2009 to share the scientific production and experiences of medical students (*i.e.,* MBBS students, MD students, DO students, MD/MSc students, MD/PhD students, etc.) and recently graduated physicians (<3 years into practice) from all over the world. Our objective is to be the primary diffusion platform for early-career scientists, using standards that follow the process of scientific publication.

The *IJMS* receives submissions where there is at least one author enrolled as a medical student in any medical school in the world or a recently graduated physician worldwide. For research articles, early-career scientists must be accompanied by a senior researcher that must be also responsible for the research, guaranteeing the quality of the work. We publish Original Articles, Short Communications, Reviews, Case Reports, Interviews, Experiences, and Letters, which follow an innovative and unique two-step, double-masked peer-review process, in brief:

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The time between submission and final publication in most cases has been two to four months depending on the diligence of Peer-Reviewers and Authors.

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Artificial Intelligence

Artificial intelligence (AI) refers to a technology that mimics human-like thinking through continuous training in perception, reasoning, and learning performance. The rapid development of AI – especially Large Language Models (LLMs) – has far-reaching effects on every facet of life, including medical education. LLM's thought process has been described in studies as a 'Transformer' architecture, a concept which allows models to derive context through simultaneous analysis of different parts of a sentence.[1] It is owing to this that LLMs can respond to diverse queries and tasks through computational analysis of statistical relationships between words and phrases across large datasets, producing 'human-like' language often indistinguishable from that made with real human capabilities.[2]

This editorial aims to review (1) current applications of AI use in medical education and medical research alongside its benefits and risks, (2) output validity, ethical concerns, and consequences of AI overreliance, (3) cover IJMS's stance and recommendation of AI use, and (4) highlights IJMS's activity in 2025.

Artificial Intelligence in Medical Education

Given its ability to process vast amounts of complex data, AI is one of the most valuable tools present to address the high information density naturally found during medical training. Studies have reported the use of AI by medical students for computer-assisted teaching and to alleviate the burden of heavy cognitive tasks.[3] While its use has been gaining traction, usage among medical students varies heavily across regions, varying from 46-89%.[3–5] In general, AI has received a positive reception, with students viewing it as an effective, credible, and efficient learning tool.[4,5] Zhao et al. (2025) reported that effort expectancy (ease of use) and performance expectancy (usefulness) modified by facilitating conditions (available resources) were direct positive predictors of behavioural intention.[6]

Its direct application ranges from exam preparation to free-form simulated patient interactions.[7] Kung et al. (2023) reported that ChatGPT demonstrated knowledge that surpasses the passing level for the USMLE (United States Medical Licensing Examination) without any prior prompting or AI training. It can also provide easy-to-understand explanations and logical reasoning for each answer.[8] Aside from assisting in problem-solving, recent studies demonstrate that LLMs such as Gemini and ChatGPT can generate high-fidelity clinical vignettes and multiple-choice questions equally compelling for learning compared to those made by faculty members.[9] While this improves conceptual understanding and preparedness, overreliance may reduce independent reasoning due to the taking of a more passive stance towards the problem-solving process.[10] Studies have also reported that factual accuracy is limited to questions testing lower-order cognitive skills, therefore hindering its applicability in areas with a very high degree of specialty.[11,12]

In contrast to structured examination, Skryd et al. (2024) reported that using ChatGPT to generate lists of differential diagnoses enables easy interlinking of materials across multiple modules. Students can then easily ask follow-up questions to help recall and refine their understanding of each diagnosis's underlying pathophysiology.[13] This reinforces clinical reasoning and improves integration of basic science into clinical practice. McDuff et al. (2025) reported a significant 50% increase in differential diagnosis quality generated by clinicians assisted with LLMs.[14] However, another study reported that AI by itself performed worse in pinpointing the correct diagnosis than expert physicians.[15] This reinforces that overreliance and blind-trusting without cross-verification might be a pitfall for students with little clinical experience to accept incorrect or oversimplified outputs.[16] AI operates on the probability of words, not the probability of disease; fundamentally generating differential diagnoses based on which medical terms usually appear together in text, not based on clinical intuition and years of experience behind it.

AI has reportedly been used to simulate clinical case scenarios in which medical students perform tasks such as obtaining a patient's history and interpreting the physical examination.[13] ChatGPT can help students develop doctor-patient communication and initial examination skills while also identifying gaps and aid in decision making through personalized

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feedback.[13,17] Holderried et al. (2024) reported that ChatGPT is able to provide effective and structured feedback on history-taking dialogues.[18] Weisman et al. (2025) also reported that ChatGPT can assist medical students in learning how to break bad news with appropriate timing, mode of communication, and conversation protocol in a simulated telephone call discussing abnormal results of a diagnostic mammogram requiring further biopsy. Virtual patients were reported to be able to ask sensible questions and respond to inquiries with appropriate emotional inflections.[19] While this contributes to the development of doctor-patient communication skills, studies argue that AI-based learning should only supplement and never fully replace human interaction.[20] Diagnoses may also come from reading nuances within silence and the atmosphere, stressing that insensitivity to non-verbal cues might result in incomplete diagnoses.[21]

AI may also be used to restructure learning experience by creating personalized schedules and an adaptive learning system. Real-time analysis and personalized learning of prompts inputted into the program can help AI create learning aids tailored to an individual's specific learning style and knowledge gaps.[22] In the absence of AI, medical students largely depend on fixed curricular structures and mentorship/guidance available at their institution. AI offers advantages that address gaps within the conventional settings, such as access to real-time feedback and individualized mentorship.[23] While this increased learning efficiency and shifts learning speed to reflect a more competency-based pace, low discipline might create a study plan that 'overfits' a student's current condition while giving a false sense of security. This creates an illusion of competence, where excessive adaptation fails to force students to engage in progressively complex scenarios, thus encouraging cognitive disengagement and a misleading perception of mastery.[24,25]

Artificial Intelligence in Medical Research

Aside from its use in an educational context, the benefits of using AI can be applied to all steps of the research-writing process. This spans the initial phase (topic selection and research question formulation), the research process (development of research strategies, screening and summarizing sources, and assisting with data interpretation and extraction), and manuscript writing (manuscript outlining, drafting, reference management, and language proofing).[26]

Tangsrivimol et al. (2025) highlighted the use of LLM in hypothesis generation. The paper argues that LLMs' ability to process and synthesize vast amounts of data accelerates research workflow and hypothesis generation.[27] Excellent topic selection and hypothesis generation require an adequate amount of base knowledge. This can be time-consuming for medical students who must juggle their learning capacity between consuming new curriculum-related medical knowledge and off-curriculum knowledge related to their chosen research topic. LLMs aid students in refining research ideas and framing research questions using the limited number of papers medical students

consume, thus lowering the entry barrier to research.[27,28] While this lowers the entry barrier to research for early-career researchers, LLMs have been reported to be able to generate superficial or formulaic questions and fail to provide extensive support in topics requiring critical thinking and novelty.[29]

Table 1. Common Applications of Artificial Intelligence for Medical Students in Education and Research.

Application	Example of use	Primary benefit	Key limitations/risks
Medical Education			
Examination preparation	Generation of practice questions and explanations for every answer	Improves conceptual understanding and examination preparedness	Reduction in independent reasoning
Clinical reasoning	Generation of differential diagnoses and clarification of underlying pathophysiology	Reinforces clinical reasoning and integration of basic sciences	Incorrect or oversimplification of outputs
Simulated clinical encounters	Generation of history-taking, diagnostic pathway, and counselling scenarios	Development of doctor-patient communication skills	AI is not able to replace real patient interaction and build empathy
Personalized learning	Generation of customized study plans, flashcards, learning schedules	Increased efficiency and individualized pacing	Low discipline might create an overfitting study plan
Medical Research			
Topic selection and question formulation	Research ideas refinement, research questions framing	Lowers entry barrier to research	Superficial or formulaic questions
Methodology development	Providing suggestion and pointing out common methodological pitfalls	Improves methodological rigor, accurate real-time feedback	Lack of basic understanding and reasoning behind the methodology
Literature search assistance	Source selection, keyword identification, and abstract summarization	Faster orientation to a topic	Inconsistent, hallucinated, or incomplete summaries
Manuscript structuring and drafting	Sections outlining, language clarity improvement	Improve paper delivery and coherence	Potential plagiarism or similarities from papers within learning dataset

LLMs have also been described as a valuable tool during methodology development, providing suggestions and pointing out methodological pitfalls. Biswas et al. (2023) reported that ChatGPT exhibited 'commendable capability in identifying methodological flaws, articulating insightful feedback on theoretical frameworks, and gauging the overall contribution of the articles to their respective fields.[30] Weerasinghe et al. (2025) also reported a high-performance rating of 8.86/10 from researchers who used AI assistance to ensure compliance with ethical and scientific standards during protocol development.[31] AI has been demonstrated to generate multiple perspectives on a single topic, feedback on the most viable research path, while upholding the highest level of methodological rigor through accurate real-time feedback often unavailable when dealing with busy supervisors.[32] While using AI to spot methodological flaws is beneficial, overreliance without cross verification and critical thinking may cause cognitive offloading and automation bias, leading to a lack of basic understanding and reasoning behind the methodology.[33]

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Figure 1. Conceptual Framework of Artificial Intelligence Across Medical Students Training and Research.[2,8,16,17,22,26,44,45,51,54,58]

Bhattacharyya et al. (2023) reported that across 115 references generated by ChatGPT-3.5 on various biomedical topics, 47% were found to be fabricated, 46% were authentic but inaccurate, and only 7% were authentic and accurate.[38] This highlights the critical importance of oversight against AI-generated outputs, from the content itself to the references from which they are derived.

Another example of LLM use by medical students includes manuscript structuring and drafting.[7] Huang et al. (2025) wrote that LLMs can help scientists better organize a logical outline and provide feedback to improve writing style.[39,40] LLMs are able to perform thematic analysis and generate outlines that resemble common patterns found in impactful papers within specific niches of the medical field. D'Agostino et al. (2024) reported that LLMs are very good at organizing thought processes, often producing text that is indistinguishable from that written by humans.[41] It was also described as excelling in 'drafting initial versions of articles and refining grammar and style in existing documents, thus enhancing their clarity and coherence.[40] This 'levels the playing field' for researchers living in non-English speaking resource-limited countries where linguistic mentorship and guidance are scarce by providing high-level feedbacks on linguistic polishing normally only found by using expensive professional editing services.[42]

While LLMs can help outline sections and improve language clarity, because LLMs are trained on vast repositories of existing text, they may inadvertently reproduce/generate similar content from their training datasets without attribution, leading to unintentional plagiarism.[43] This kind of plagiarism extended from the easier-to-detect verbatim plagiarism to the more subtle paraphrase plagiarism, where ideas instead of exact words became reworded without proper attribution from which they are derived within their learning dataset.[43]

The importance of using AI in research lies not so much in what students create with these tools as in how consistent use alters how students approach research during training. While AI can assist with any part of the research process, it may promote formulaic avenues of inquiry, generate work that appears coherent despite knowledge gaps, or reduce thorough engagement with sources.[44]

For medical students whose scientific judgement is still forming, these impacts are especially pertinent. Kobak et al. (2025) reported that LLM influence is detectable across a substantial proportion of recent biomedical abstracts, indicating that AI-assisted writing is becoming commonplace in scientific communication.[45] Notably, this appears to be occurring without disclosure of AI use. These results imply that research training should take into account that medical students are joining research settings where AI-mediated writing is already common.

Due to how AI was developed, experts believe that its main advantage lies not in idea generation but in its ability to recall and sort through the vast amounts of information in the datasets it was trained on.[29] While medical students are often limited by the amount of knowledge they have (and time limits to acquire new knowledge), LLMs can act as 'semantic filters' by identifying thematic patterns and relevant studies within the literature. Wang et al. (2025) reported a 63.4% reduction in screening time and a 23.5% improvement in accuracy following human-AI collaboration in clinical evidence synthesis.[34] Proestel et al. (2025) reported that LLMs can correctly identify specific FDA guidance documents and answer questions associated with them, significantly reducing the time required to synthesize information from unfamiliar sources for medical students.[35] While the use of LLMs for practices such as source selection, identification, and summarization may help medical students, studies reported that AI may provide outputs with inconsistencies, hallucinations, or incomplete summaries.[36]

Aside from concerns about the validity of content generated by these LLMs, researchers have reported a high prevalence of fabricated references generated by LLMs. Walters and Wilder (2023) reported fabrication rates of 55% and 18% for references generated by ChatGPT-3.5 and ChatGPT-4, respectively.[37]

As AI use becomes increasingly routine in both student work and published writing, it is of utmost importance for the research community to address the ethical and professional consequences

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of AI use for researchers themselves. _Table 1_ describes common AI applications for medical students in education and research. _Figure 1_ presents a conceptual framework for the use of artificial intelligence across medical student training and research.

Output Validity, Ethical Concerns, and Consequences

In a behaviour known as 'stochastic parroting', LLMs are fundamentally trained to not "understand" but instead statistically mimic human language – hence the term, stochastic parrots – through a string of computational analysis.[16] It acts as a sophisticated predictor of sentence and text formatting patterns, not because of its own internal learning, but by repackaging material learned through its training datasets.

Although seemingly innocuous in daily life, outputs – often missing important technical/scientific nuances – taken as accurate with little-to-no cross-verification in fields such as medical research might propagate misinformation.[16] This creates a phenomenon where AI has been described to fall under 'hallucination,' where it outright makes its own data and presents it as accurate, often with convincing phrasings indistinguishable from human-written language.[46] While in most times content-related hallucinations may pass themselves as seemingly real, incorrectly cited/made-up citations are usually easier to recognize. Recent studies have reported that up to half of AI-generated citations are erroneous, leading to misattribution and significant plagiarism.[47–49]

AI is trained on large, existing datasets provided by its creator companies. The lack of equal representation across all demographics in these datasets led to algorithmic bias, in which AI exacerbates prevalent human biases learned from training models to generate outputs based on social prejudices.[50] Ashwin et al. (2025) reported that the use of Whisper (an AI-based speech-to-text transcription software) during clinical practice resulted in violent and racially inflammatory slurs with potential miss/loss of information.[51] Close sourcing and a lack of transparency regarding the sources of their datasets also raised ethical concerns. Most AI tools were built by private, non-medical entities, not subject to the data protection laws that govern healthcare and health data management systems worldwide.[52] As a result, clinical findings may be lifted off without the knowledge or consent of patients, providers, or researchers, leading to the non-consensual ownership, storage, usage, and transfer of sensitive patient and researcher data across companies and jurisdictions. Elimination of the various biological, ethnic, and social nuances that undergird clinical findings may lead to further misdiagnosis and misrepresentation of scientific conclusions.[53]
Aside from concerns about AI-generated outputs, the research community has raised concerns that overreliance on AI tools can erode human capabilities through skill devaluation, reduced self-determination, and loss of accountability.[54] It is therefore critical that AI usage first be accepted as a tool inseparable from human life in the future. The nuances and potential consequences of AI use should be taught to medical students, rather than feigning ignorance of the suspicious attitude toward AI in the medical field.[55]

IJMS's Stance & Recommendation on AI Use

The development of an AI screening tool and measures to flag AI-generated content will be a never-ending race. Therefore, IJMS believes that in the future, AI should not become an enemy of the scientific community, but an assistant towards improving research quality. IJMS urges student-authors to be accountable in their use of AI, both when taking their first steps and throughout their research careers. IJMS agrees with ICMJE (International Committee of Medical Journal Editors) and COPE (Committee on Publication Ethics) that AI is ineligible for authorship due to a lack of accountability, and the authors must disclose any use of AI-assisted technologies in the production of submitted work.[56,57] In the end, it is the author's ultimate responsibility to ensure that all information in the manuscript is factually correct and that no ethical concerns are present. IJMS supports the integration of AI learning into the medical curriculum. We believe that medical students are the future backbone of medical research. Therefore, ethical and rational use of AI must be taught as early as possible.

Highlights of IJMS in 2025

The year 2025 marked a period of consolidation and strategic growth for the International Journal of Medical Students (IJMS), strengthening its role as a global platform for high-quality medical student research, editorial training, and scientific communication.

One of the year's major academic milestones was the 2025 World Conference of Medical Student Research (WCMSR). The conference recognized outstanding student scholarship across original research, case reports, posters, and oral presentations, as well as public engagement through audience-voted awards. Rather than listing all distinctions here, readers are encouraged to explore the full list of awardees, presentations, and recordings at: https://ijms.info/IJMS/Conference/editions/2025

The success of WCMSR 2025 was made possible by strong student leadership, led by Chloe Carrington (University of Queensland–Ochsner, second-year medical student), alongside a dedicated organizing team. Editorial rigor during the abstract evaluation process was reinforced by the exceptional contribution of student editors, with Aditi Saini, Atroba Zaheer, Dhvanit Rajdeep, Lessa Alessandra Méndez Lara, Shrideavi Murugan, and Tyler Hepler standing out for completing the highest number of abstract reviews.

Beyond the conference, IJMS demonstrated significant growth in its digital presence. In 2025, the journal website recorded 156,500 new users and 401,557 page views, reflecting increasing global reach and readership. Additionally, IJMS successfully re-established and strengthened its Social Media and Communications strategy, led by Mihai-Gabriel Zaiț and his team, improving dissemination, visibility, and engagement across platforms.

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Finally, IJMS continued to recognize excellence within its editorial structure, with Drs. Ahmed Nahian and Hamrish Kumar Rajakumar as Student Editor and Associate Editor of the Year, respectively, reaffirming the journal's mission to train the next generation of medical editors and academic leaders. Together, these achievements reflect a focused, impactful year for IJMS—defined by academic quality, editorial development, and sustained global engagement.

This issue of the International Journal of Medical Students features a broad range of original research, reviews, short communications, case reports, and experiential scholarship addressing priority topics in medical education, mental health, workforce well-being, health systems, and emerging technologies. The original articles examine clinical audits in medical training,[59] sleep disorders,[60] empathy in physician–patient interactions,[61] the impact of psychiatric comorbidities on HIV care,[62] pandemic-related educational disruptions,[63] and resident burnout.[64] Complementary short communications and reviews focus on educational interventions,[65] resilience training,[66] women in medicine initiatives,[67] and the expanding role of artificial intelligence in clinical practice.[68,69] The issue is further enriched by clinically relevant case reports,[70,71] and reflective experiences[72] that emphasize complex decision-making and trauma-informed care, reinforcing IJMS's commitment to globally relevant, practice-informed, and student-led medical scholarship.

References

1. Write Vaswani A, Brain G, Shazeer N, Parmar N, Uszkoreit J, Jones L, et al. Attention is all you need. NIPS 2017. Forthcoming 2017.

2. Clusmann J, Kolbinger FR, Muti HS, Carrero ZI, Eckardt JN, Laleh NG, et al. The future landscape of large language models in medicine. Commun Med. 2023;3:141.

3. Wobo KN, Nnamani IO, Alinnor EA, Gabriel-Job N, Paul N. Medical students' perception of the use of artificial intelligence in medical education. Int J Res Med Sci. 2025;13:82–9.

4. Moallem E, Ghavami V, Moghri J, Marvi A, Najafi M, Tabatabaee SS. Medical students' attitudes towards artificial intelligence and educational needs: a cross-sectional study. J Health Adm. 2025;28:40–55.

5. Sami A, Tanveer F, Sajwani K, Kiran N, Javed MA, Ozsahin DU, et al. Medical students' attitudes toward AI in education: perception, effectiveness, and its credibility. BMC Med Educ. 2025;25:82

6. Zhao X, Liu W, Yue S, Chen J, Xia D, Bing K, et al. Factors influencing medical students' adoption of AI educational agents: an extended UTAUT model. BMC Med Educ. 2025;25(1):1678.

7. Elhassan SE, Sajid MR, Syed AM, Fathima SA, Khan BS, Tamim H. Assessing familiarity, usage patterns, and attitudes of medical students toward ChatGPT and other chat-based AI apps in medical education: cross-sectional questionnaire study. JMIR Med Educ. 2025;11:e63065.

8. Kung TH, Cheatham M, Medenilla A, Sillos C, De Leon L, Elepaño C, et al. Performance of ChatGPT on USMLE: potential for AI-assisted medical education using large language models. PLOS Digit Health. 2023;2(2):e0000198.

9. Elzayyat M, Mohammad JN, Zaqout S. Assessing LLM-generated vs. expert-created clinical anatomy MCQs: a student perception-based comparative study in medical education. Med Educ Online. 2025;30(1):2554678.

10. Yavich R. Will the use of AI undermine students independent thinking? Educ Sci. 2025;16(6):669.

11. Feizi S, Hatami F, Mirzaei SK, Shahriari MH, Dolikhani MR, Shirzadeh-Barough S, et al. Applicability of ChatGPT to generate multiple-choice questions for ophthalmology resident exam. Br J Ophthalmol. 2025. Epub 2025 Dec 17.

12. Law AKK, So J, Lui CT, Choi YF, Cheung KH, Kei-ching Hung K, et al. AI versus human-generated multiple-choice questions for medical education: a cohort study in a high-stakes examination. BMC Med Educ. 2025;25(1):208.

13. Skryd A, Lawrence K. ChatGPT as a tool for medical education and clinical decision-making on the wards: Case Study. JMIR Form Res 2024;8:e51346.

14. McDuff D, Schaekermann M, Tu T, Palepu A, Wang A, Garrison J, et al. Towards accurate differential diagnosis with large language models. Nat. 2025;642:451–7.

15. Takita H, Kabata D, Walston SL, Tatekawa H, Saito K, Tsujimoto Y, et al. A systematic review and meta-analysis of diagnostic performance comparison between generative AI and physicians. NPJ Digit Med. 2025;8(1):175.

16. Bender EM, Gebru T, McMillan-Major A, Shmitchell S. On the dangers of stochastic parrots: Can language models be too big? FAccT '21. Forthcoming 2021:610–23.

17. Safranek CW, Sidamon-Eristoff AE, Gilson A, Chartash D. The role of large language models in medical education: applications and implications. JMIR Med Educ 2023;9:e50945.

18. Holderried F, Stegemann-Philipps C, Herrmann-Werner A, Festl-Wietek T, Holderried M, Eickhoff C, et al. A language model-powered simulated patient with automated feedback for history taking: prospective study. JMIR Med Educ 2024;10(1):e59213.

19. Weisman D, Sugarman A, Huang YM, Gelberg L, Ganz PA, Comulada WS. Development of a GPT-4-powered virtual simulated patient and communication training platform for medical students to practice discussing abnormal mammogram results with patients: multiphase study. JMIR Form Res 2025;9:e65670.

20. Cross J, Kayalackakom T, Robinson RE, Vaughans A, Sebastian R, Hood R, et al. Assessing ChatGPT's capability as a new age standardized patient: qualitative study. JMIR Med Educ 2025;11:e63353.

21. Tiwari S. The role of non-verbal communication in biomedical settings: from diagnostics to patient support. Afr J Biomed Res. 2022;25(1):112–6.

22. Abd-Alrazaq A, AlSaad R, Alhuwail D, Ahmed A, Healy PM, Latifi S, et al. Large language models in medical education: opportunities, challenges, and future directions. JMIR Med Educ 2023;9(1):e48291.

23. Zheng L, Xiao Y. Refining AI perspectives: assessing the impact of ai curricular on medical students' attitudes towards artificial intelligence. BMC Med Educ 2025;25(1):1115.

24. Fan L, Deng K, Liu F. Educational impacts of generative artificial intelligence on learning and performance of engineering students in China. Sci Rep. 2025;15(1):26521.

25. Matueny RM, Nyamai JJ. Illusion of competence and skill degradation in artificial intelligence dependency among users. Int J Res Sci Innov. 2025;12(5):1725–38.

26. Lee J, Wu AS, Li D, Kulasegaram KM. Artificial intelligence in undergraduate medical education: a scoping review. Acad Med. 2021;96(11S):S62–70.

27. Tangsrivimol JA, Darzidehkalani E, Virk HUH, Wang Z, Egger J, Wang M, et al. Benefits, limits, and risks of ChatGPT in medicine. Front Artif Intell 2025;8:1518049.

28. Sallam M. ChatGPT utility in healthcare education, research, and practice: systematic review on the promising perspectives and valid concerns. Healthcare. 2023;11(6):887.

Editorial

Suteja R., et al.

MS's Stance on Ethical Artificial Intelligence Usage for Medical Student Education and
Research, and Highlights of IJMS in 2025

29. Lahat A, Shachar E, Avidan B, Shatz Z, Glicksberg BS, Klang E. Evaluating the use of large language model in identifying top research questions in gastroenterology. Sci Rep. 2023;13(1):4164.

30. Biswas S, Dobaria D, Cohen HL. ChatGPT and the future of journal reviews: a feasibility study. Yale J Biol Med 2023;96(3):415.

31. Weerasinghe K, Olawade DB, Teke J, Msiska M, Boussios S. The impact of AI-driven chatbot assistance on protocol development and clinical research engagement: an implementation report. J Pers Med 2025;15(7):269.

32. Biswas SS. ChatGPT for research and publication: a step-by-step guide. J Pediatr Pharmacol Ther. 2023;28(6):576-84.

33. Moore LJ, Gerlich M. AI tools in society: impacts on cognitive offloading and the future of critical thinking. Societies. 2025;15(1):6.

34. Wang Z, Cao L, Danek B, Jin Q, Lu Z, Sun J. Accelerating clinical evidence synthesis with large language models. NPJ Digit Med. 2025;8(1):509.

35. Proestel S, Jeng LJB, Smith C, Deady M, Amer O, Ahmed M, et al. Semantic search of FDA guidance documents using generative AI. Ther Innov Regul Sci. 2025;59:1148–59.

36. Yip R, Sun YJ, Bassuk AG, Mahajan VB. Artificial intelligence's contribution to biomedical literature search: revolutionizing or complicating? PLOS Digit Health. 2025;4(5):e0000849.

37. Walters WH, Wilder EI. Fabrication and errors in the bibliographic citations generated by ChatGPT. Sci Rep. 2023 13:1 2023;13(1):14045.

38. Bhattacharyya M, Miller VM, Bhattacharyya D, Miller LE. High rates of fabricated and inaccurate references in ChatGPT-generated medical content. Cureus 2023;15(5):e39238.

39. Huang J, Tan M. The role of ChatGPT in scientific communication: writing better scientific review articles. Am J Cancer Res 2023;13(4):1148.

40. Meng X, Yan X, Zhang K, Liu D, Cui X, Yang Y, et al. The application of large language models in medicine: A scoping review. iScience. 2024;27(5):109713.

41. Hakam HT, Prill R, Korte L, Lovreković B, Ostojić M, Ramadanov N, et al. Human-written vs AI-generated texts in orthopedic academic literature: comparative qualitative analysis. JMIR Form Res. 2024;8:e5216.4.

42. Ahn S. The transformative impact of large language models on medical writing and publishing: current applications, challenges and future directions. Korean J Physiol Pharmacol 2024;28(5):393-401.

43. Meyer JG, Urbanowicz RJ, Martin PCN, O'Connor K, Li R, Peng PC, et al. ChatGPT and large language models in academia: opportunities and challenges. BioData Min. 2023;16(1):20.

44. Alkaissi H, McFarlane SI. Artificial hallucinations in ChatGPT: implications in scientific writing. Cureus. 2023;15(2):e35179.

45. Kobak D, González-Márquez R, Horvát EÁ, Lause J. Delving into LLM-assisted writing in biomedical publications through excess vocabulary. Sci Adv. 2025;11(27):eadt3813.

46. Özer M. Is artifical intelligence hallucinating? Turk Psikiyatri Derg. 2024;35(4):333.

47. Athaluri SA, Manthena SV, Kesapragada VSRKM, Yarlagadda V, Dave T, Duddumpudi RTS, et al. Exploring the boundaries of reality: investigating the phenomenon of artificial intelligence hallucination in scientific writing through ChatGPT references. Cureus. 2023;15(4):e37432.

48. Linardon J, Jarman HK, McClure Z, Anderson C, Liu C, Messer M. Influence of topic familiarity and prompt specificity on citation fabrication in mental health research using large language models: experimental study. JMIR Ment Health 2025;12:e80371.

49. Kacena MA, Plotkin LI, Fehrenbacher JC. The use of artificial intelligence in writing scientific review articles. Curr Osteoporos Rep. 2024;22(1):115–21.

50. Norori N, Hu Q, Aellen FM, Faraci FD, Tzovara A. Addressing bias in big data and AI for health care: A call for open science. Patterns. 2021;2(10):100347.

51. Ashwin M, Jha S, Prasad G, Kumar S. Fake it till you make it? AI hallucinations and ethical dilemmas in Anesthesia research and practice. J Anaesthesiol Clin Pharmacol 2025;41(3):381-3.

52. Konnoth C. AI and data protection law in health. In: Solaiman B, Cohen IG, editors. Research handbook on health, AI and the law. Cheltenham: Edward Elgar Publishing. 2024;111–29.

53. Roy E, Malafa S, Adwer LM, Tabache H, Sheth T, Mishra V, et al. Artificial intelligence in healthcare: medical students' perspectives on balancing innovation, ethics, and patient-centered care. Int J Med Stud. 2025;13:9–16.

54. Floridi L, Cowls J, Beltrametti M, Chatila R, Chazerand P, Dignum V, et al. AI4People-an ethical framework for a good ai society: opportunities, risks, principles, and recommendations. Mind Mach. 2018;28(4):689–707.

55. Namazi H, Radfar MM. Philosophy of medicine meets AI hallucination and AI drift: moving toward a more gentle medicine. J Med Ethics Hist Med. 2025;18.

56. International Committee of Medical Journal Editors. Defining the role of authors and contributors. Available from: https://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html.. Cited December 18, 2025.

57. Committee on Publication Ethics. Authorship and AI tools. Available from: https://publicationethics.org/guidance/cope-position/authorship-and-ai-tools. Cited December 19, 2025.

58. Clusmann J, Kolbinger FR, Muti HS, Carrero ZI, Eckardt JN, Laleh NG, et al. The future landscape of large language models in medicine. Commun Med. 2023 3:1 2023;3(1):141.

59. Deameh MG, Mansour OS, Abu Rahma H, et al. Clinical audits in medical education: barriers and opportunities among Jordanian medical students. Int J Med Students. 2025;13(3):367–373. https://ijms.info/IJMS/article/view/3042.

60. Rodriguez-Alarcon C, Japon-Cueva D, Viñan-Paucar L, et al. Insomnia prevalence and risk factors among Hispanic university staff in Ecuador: a cross-sectional study. Int J Med Students. 2025;13(3):374–381. https://ijms.info/IJMS/article/view/2814.

61. Thomas E, Shenod S, Madhu B, et al. Empathy in practice: comparing physicians' self-assessment and patient perceptions using the Jefferson Scales. Int J Med Students. 2025;13(3):382–387. https://ijms.info/IJMS/article/view/3247.

62. Guani LE, Murdock A, Arshoun A, et al. A retrospective analysis exploring the impact of psychiatric comorbidities on the time to initiate HIV treatment. Int J Med Students. 2025;13(3):388–398. https://ijms.info/IJMS/article/view/3380.

63. Iqbal H, Foster A, Zhang A, et al. Single center experience of the impact of the COVID-19 pandemic on education and career outlook of radiologists. Int J Med Students. 2025;13(3):399–405. https://ijms.info/IJMS/article/view/2428.

64. Medina-Gaona LA, García Aguirre G, Salcedo Villanueva G, et al. Burnout in ophthalmology residents in a tertiary referral hospital in Mexico City. Int J Med Students. 2025;13(3):406–416. https://ijms.info/IJMS/article/view/2794.

65. Aggarwal A, Radke J, Vakkalanka JP, et al. Using an interactive self-directed module to teach nicotine use disorder management. Int J Med Students. 2025;13(3):417–422. https://ijms.info/IJMS/article/view/3274.

66. McClintock A, Michunovich A, Ference E, et al. The resilient resident: a pilot resiliency curriculum on physical medicine and rehabilitation resident burnout. Int J Med Students. 2025;13(3):423–431. https://ijms.info/IJMS/article/view/3000.

67. Bhagudas S, Crump A, Sansoni GA, et al. A narrative review of women in medicine interest groups at the pre-medical, graduate, and post-graduate medical education levels. Int J Med Students. 2025;13(3):432–438. https://ijms.info/IJMS/article/view/2281.

68. Kosuri SSR, Sunnucks D. Navigating the digital frontier: a review on the clinical applications of convolutional neural networks and emerging AI models in medicine and surgery. Int J Med Students. 2025;13(3):439–449. https://ijms.info/IJMS/article/view/2610.

69. Rivera-Díaz J, Laguna Rocafort S, Bonilla IM, et al. A comprehensive review of hidradenitis suppurativa: from pathogenesis to clinical insights and

INTERNATIONAL JOURNAL of MEDICAL STUDENTS

Editorial

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novel therapeutic advancements. Int J Med Students. 2025;13(3):450–459. https://ijms.info/IJMS/article/view/2809.

70. Saldaña-Ruiz MA, Espinosa-Mora JE, Rendón-Saldívar ML, et al. Surgical management of refractory pulmonary actinomycosis: a case report. Int J Med Students. 2025;13(3):460–462. https://ijms.info/IJMS/article/view/3142.

71. Tepfenhart T, Fort C, Twahirwa M, Jensen B. Port-a-Cath fragmentation causing recurrent chest pressure and dizziness in an elderly man: a case report. Int J Med Students. 2025;13(3):463–466. https://ijms.info/IJMS/article/view/3234.

72. Al-Rubaiy Z. A reflective case study: complex presentation of a veteran patient with cardiomyopathy and a history of facial reconstruction. Int J Med Students. 2025;13(3):467–469. https://ijms.info/IJMS/article/view/3498.

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Clinical Audits in Medical Education: Barriers and Opportunities Among Jordanian Medical Students

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Abstract

Background: Clinical audits are crucial for enhancing healthcare quality, but various obstacles can restrict their implementation. This study aims to examine barriers to the implementation of clinical audits among medical students and interns. **Methods:** We conducted a cross-sectional online survey involving 727 clinical-year medical students (4th–6th year) and interns in Jordan from six Jordanian universities between August and November 2023. Participants completed a self-administered online questionnaire covering demographics, knowledge of clinical audits, perspectives on clinical audits, and barriers to conducting them. **Results:** Of the 727 participants (58.2% male; 35.5% in their 6th year), only 7.3% had engaged in clinical audits, despite 69.5% identifying personal development and 64.8% recognizing healthcare improvement as motivations. Key barriers included time constraints (78%), academic pressure (79%), and a lack of institutional support (80%), while 59.2% felt their curriculum left them underprepared. Awareness of audit objectives was limited, with 48.4% disagreeing that they understood audit objectives. Fear of criticism was commonly reported, with 70.7% agreeing or strongly agreeing that this discouraged their participation. Multivariable logistic regression adjusted for university, academic year, GPA, and gender showed that prior research involvement strongly predicted audit knowledge (1–2 projects: aOR = 6.30; 3–4 projects: aOR = 4.92; $p < 0.001$). **Conclusions:** Students expressed positive attitudes toward clinical audits but showed limited knowledge and very low participation. These findings highlight the need for structured, hands-on audit training within undergraduate medical curricula and improved institutional support to facilitate student engagement in quality improvement activities.

Introduction

Clinical audit is a crucial process that systematically measures the effectiveness of healthcare services against established standards to improve quality and outcomes.[1] This process involves evaluating various aspects of patient care, identifying areas for improvement, and implementing changes at the individual, team, or service level. This cyclical approach not only helps identify deficiencies but also fosters a culture of continuous improvement in healthcare practices. Also, it forms a core component of clinical governance and supports constant monitoring of quality and safety in healthcare services.

Clinical audit operates within the broader framework of Clinical Governance, a system through which healthcare organizations continuously improve quality and safeguard high standards by integrating audit with six additional pillars, including risk management and education. The audit cycle *(Figure 1)* typically involves setting evidence-based standards, collecting and comparing data against these criteria, implementing changes, and re-auditing to assess whether improvements have been achieved.[2]

patient outcomes, and strengthening health systems overall. LMICs must address data quality and availability issues through investments in data collection systems and by training healthcare providers in audit techniques and quality improvement principles. Overcoming these obstacles unlocks the true potential of clinical audits in LMICs, promoting evidence-based practices and a culture of continuous improvement that ultimately leads to better health outcomes and the success of broader healthcare programs.[4] These system-level limitations also limit medical

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students' opportunities to engage in audit activities, due to limited mentorship, insufficient institutional support, and a lack of structured audit training.

International studies consistently report low levels of formal audit training, limited student participation in audit projects, and uncertainty about audit principles and methods.[5,6] Evaluating medical students' knowledge and attitudes toward clinical audits is crucial. Student involvement in clinical audits is essential in Jordan and similar low- and middle-income countries, where workforce shortages and gaps in quality improvement efforts persist. Early engagement in audit practices can equip future physicians with essential skills to strengthen healthcare delivery and promote a culture of continuous evaluation. Engaging them in audits not only provides valuable research experience but also familiarizes them with the core principles and methods essential for their future roles as specialists and consultants.[7] Identifying the barriers faced by medical students can guide early interventions, enhance their readiness for evidence-based practice, and ultimately improve the quality of patient care. 8. Furthermore, encouraging positive attitudes toward audits can significantly influence future participation. Students involved in audits gain insights into clinical guidelines, develop critical evaluation skills, and understand how audits can improve healthcare delivery.[7] The high satisfaction reported by both students and supervisors highlights the educational value of these audits, ultimately enhancing student confidence and understanding of continuous quality improvement.[9]

Clinical audits have the potential to improve healthcare in resource-limited settings, so integrating audit training into medical education is essential. Sustainable educational frameworks that address leadership, stakeholder engagement, and resource limitations could enhance clinical audit integration within LMIC medical curricula.[10] This study assesses medical students' awareness and comprehension of clinical audit procedures, including their principles, practices, and benefits. It aims to evaluate medical students' attitudes and perspectives toward clinical audits, including their level of involvement, the value of clinical auditing, and any perceived barriers to future use of these techniques. This study, therefore, aimed to assess Jordanian medical students' knowledge, attitudes, and perceived barriers to clinical audits, and to identify predictors of prior audit knowledge and participation.

Methods

Study Design and Population
This cross-sectional study took place in Jordan and involved medical students enrolled in clinical rotations (4th, 5th, and 6th years) and medical interns from six universities: the University of Jordan (JU), Hashemite University (HU), Al-Balqa Applied University (BAU), Jordan University of Science and Technology (JUST), Yarmouk University (YU), and Mutah University (MU). Based on institutional estimates, the six universities collectively include approximately 7,500 clinical-year students; these figures

are approximations intended only to provide context for the sampling frame. As participation was voluntary and recruitment was based on convenience sampling, the sample cannot be assumed to be representative of all Jordanian medical students. We employed a convenience sampling approach to recruit participants over four months, from August to November 2023. We invited participants to complete a self-administered questionnaire created online using Google Forms. Participants completed and submitted the questionnaire anonymously and voluntarily. The survey link was distributed through official student WhatsApp groups and learning management systems coordinated by student representatives at each university. Reminder messages were sent periodically throughout the data collection period to improve participation. No incentives were provided. Because the survey was distributed through student platforms without a fixed invited denominator, an exact response rate could not be calculated.

Questionnaire
We collected data using a 37-item Arabic self-administered questionnaire specifically developed for this study. The questionnaire covered sections on participant demographics, clinical audit knowledge, attitudes, perspectives, participation, and perceived barriers. The structure included five main sections: demographics; clinical audit knowledge; attitudes toward clinical audits; perspectives on the value of audits; and barriers to conducting audits. The questionnaire was reviewed by a panel of five experts, including clinicians with experience in clinical audits and faculty members in medical education, who assessed items for relevance, clarity, and content coverage. The validated questionnaire was then used in a pilot test. During this phase, the questionnaire was administered to 30 individuals who were representative of our target population. The focus was to gather feedback on the clarity and comprehensibility of the questions. Based on the feedback, necessary modifications were made, and the questionnaire was revalidated in its final form. These modifications mainly involved rephrasing ambiguous items and simplifying wording to improve clarity. Results from the pilot test were excluded from the final analysis. To ensure data robustness, the questionnaire included both multiple-choice and Likert-scale items, enabling a comprehensive assessment of participant responses. The Likert-scale responses were converted to a 1–5 numeric scale to facilitate calculations of mean and confidence intervals (CI). Participants could withdraw from the study at any time. The final questionnaire included 10 items assessing knowledge, six assessing perspectives, and 10 assessing perceived barriers. These domains were conceptually defined based on education expert review; no exploratory factor analysis was performed because the aim was descriptive rather than scale development.

Reliability Analysis
Internal consistency was assessed for each multi-item scale in the questionnaire using Cronbach's alpha. The reliability coefficients demonstrated excellent internal consistency for the knowledge

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scale (α = 0.958), and good internal consistency for both the perspectives scale (α = 0.899) and barriers scale (α = 0.883). The mean (±SD) composite scores were 2.64 ± 0.99 for knowledge, 4.18 ± 0.61 for perspectives, and 4.01 ± 0.61 for barriers, confirming satisfactory internal reliability of all measurement domains.

Ethical Consideration

The Faculty of Medicine's Research Ethics Committee and the Institutional Review Board (IRB) approved the study ethically (approval number: 54/2023). To protect participant confidentiality, all responses were collected anonymously, with no identifying information linked to the data. We anonymized participant information by coding it during storage, transfer, and analysis. We stored all data securely with a passcode and shared it only with authorized research team members.

Sample Size Calculation

With a count of approximately 7500 medical students in the clinical years in Jordanian universities, a sample size of 366 is needed to achieve a 5% margin of error and a 95% confidence level, assuming a null response distribution of 50%. The sample size calculation was performed using Raosoft® (an online sampling calculator)[11]. Although the achieved sample size exceeds the minimum requirement and allows for precise estimation of proportions within this sample, the use of convenience sampling limits generalizability beyond the responding students.

Statistical Analysis

All collected data were imported into an Excel sheet for sorting, cleaning, and coding. Statistical analyses were performed with Jamovi (version 2.5).[12] Continuous variables were reported as mean ± standard deviation (SD). Categorical variables were reported as frequencies and percentages. For all variables with more than 0.5% missing data, the exact number of patients with missing data was marked in the relevant table. Chi-square tests were used to assess associations between categorical variables (e.g., previous knowledge vs. academic year, university). Statistical significance was considered when p-values <0.05. To identify independent predictors of prior knowledge of clinical audits, a multivariable logistic regression model was constructed. The dependent variable was previous knowledge of clinical audits (yes/no). Predictors included university, academic year, GPA category, gender, and number of prior research projects. Multicollinearity among predictors was assessed using variance inflation factors (VIF) in Jamovi by entering all predictors into a linear regression model. All VIF values were close to 1.0, indicating no concerning multicollinearity. The choice of reference category does not affect model fit; BAU was selected to facilitate the interpretation of odds ratios. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. University was included as a categorical variable to account for institutional differences. Mixed-effects modeling or weighting adjustments were not applied because the small number of clusters (six universities) could lead to instability. Although clustering by university may

introduce within-group correlation, mixed-effects modelling was not used because the small number of clusters (six universities) can lead to unstable variance estimates. Instead, the university was included as a fixed categorical predictor in the model. This analytic limitation is acknowledged and further addressed in the discussion. We acknowledge that treating individual Likert-scale items as continuous measures is debated; therefore, full category distributions are presented in the tables to support interpretation, and composite means are reported only for multi-item scales.

Results

Participant Demographics

Most participants were male (58.2%) and in their clinical senior years, particularly 6th year (35.5%). GPA distribution was skewed toward the "Very Good" category, and only 17.7% reported prior knowledge of clinical audits, with 7.3% having previously participated. The majority (92.7%) had never completed a clinical audit project *(Table 1).*

Participant Experience and Motivations for Clinical Audits

Among the 727 participants, only 17.7% reported prior knowledge of clinical audits, and just 7.3% had participated in a clinical audit project, leaving 92.7% with no experience in audit activities. When asked about motivations for engaging in clinical audits, the leading reasons were personal improvement and skill development (69.5%), improving healthcare outcomes (64.8%), and supporting evidence-based practice (61.2%). Additionally, residency requirements influenced 45.5% of participants, and 58.2% expressed a general research interest.

Table 1. Demographic Characteristics of Participants.

	Overall (N=727)
Age: Mean (SD)	22.7 (1.2)
Gender	
Female	304 (41.8%)
Male	423 (58.2%)
Year	
Intern	134 (18.4%)
6th year	258 (35.5%)
5th Year	216 (29.7%)
4th Year	119 (16.4%)
GPA	
Excellent	95 (13.1%)
Very Good	476 (65.5%)
Good	148 (20.4%)
Satisfactory	8 (1.1%)
Previous Knowledge	129 (17.7%)
Previous Participation	53 (7.3%)
No. of Projects	
0	674 (92.7%)
1-2	33 (4.5%)
3-4	17 (2.3%)
4-5	2 (0.3%)
>5	1 (0.1%)
>5	1 (0.1%)

Legend: SD: Standard Deviation.

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Association of Previous Knowledge and Participation with University, Academic Year, and GPA

Significant variability in audit knowledge was observed across universities (P < 0.01). Students at MUT and HU reported the highest levels of knowledge, whereas those at JUST and YU reported the lowest. Knowledge and participation also increased with academic seniority: interns demonstrated the highest levels of both prior knowledge (26.9%) and participation (14.9%), while fourth-year students showed the lowest rates. GPA showed only a borderline association with previous knowledge (P = 0.05). (Table 2).

Figure 1. Audit Cycle.
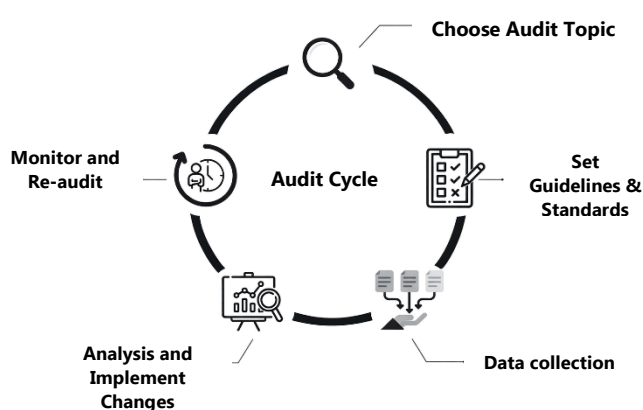
Table 2. Association Between University, Year of Study, and GPA with Previous Knowledge and Participation.

Variable	N	Previous Knowledge: Yes, n (%)	Test Statistic	Previous Participation, n (%)	Test Statistic
University			P < 0.01		P=0.29
JU	128	29 (22.7%)		10 (7.8%)	
HU	152	35 (23.0%)		17 (11.2%)	
BAU	111	22 (19.8%)		5 (4.5%)	
JUST	110	10 (9.1%)		7 (6.4%)	
YU	110	6 (5.5%)		5 (4.5%)	
MU	116	27 (23.3%)		9 (7.8%)	
Year			P = 0.02		P<0.01
Intern	134	36 (26.9%)		20 (14.9%)	
6th Year	258	43 (16.7%)		16 (6.2%)	
5th Year	216	35 (16.2%)		12 (5.6%)	
4th Year	119	15 (12.6%)		5 (4.2%)	
GPA			P = 0.05		P=0.07
Excellent	95	21 (22.1%)		13 (13.7%)	
Very Good	476	71 (14.9%)		29 (6.1%)	
Good	148	35 (23.6%)		10 (6.8%)	
Satisfactory	8	2 (25.0%)		1 (12.5%)	

Legend: Chi-Square Test.

Multivariable Analysis of Predictors of Clinical Audit Knowledge

To identify independent predictors of previous knowledge of clinical audits, a binomial logistic regression model was performed. After adjusting for confounders, university and prior research involvement were the only significant predictors. Compared with students from Al-Balqa Applied University (BAU), those from Jordan University of Science and Technology (JUST) (p = 0.007) and Yarmouk University (YU) (p = 0.001) had significantly lower odds of reporting prior knowledge of clinical audits. Furthermore, students with previous project experience showed markedly higher odds of knowledge, particularly those who had completed 1–2 (aOR = 6.30, p < 0.001) or 3–4 projects (aOR = 4.92, p < 0.001). Academic year, GPA, and gender were not statistically significant predictors.

Knowledge of Clinical Audit

Knowledge scores were generally low across most items, with means ranging from 2.4 to 2.8 on a 1–5 scale, indicating that responses tended to fall between "disagree" and "neutral." The lowest scores were observed for knowledge of different audit types (mean 2.49) and understanding of standard criteria used in audit projects (mean 2.52). The relatively higher—though still below neutral—scores included awareness of evidence-based guidelines (mean 2.77) and confidence in contributing to audits (mean 2.81). Many students reported feeling underprepared by their curriculum, as reflected in the low mean score for curricular preparation (2.44). (Table 3).

Perspectives on Clinical Audit

Participants strongly agreed on the value of clinical audits in healthcare. They agreed that audits improve healthcare quality (Mean: 4.13, 95% CI: 4.08–4.18) and patient satisfaction (Mean: 4.08, 95% CI: 4.03–4.14). They also viewed audits as contributing to greater healthcare efficiency (Mean: 4.24, 95% CI: 4.18–4.29) and supporting effective teamwork (Mean: 4.15, 95% CI: 4.09–4.20). Most participants supported the need for clear institutional policies on audits (Mean: 4.28, 95% CI: 4.23–4.34) and believed that clinical audit training should be part of medical education (Mean: 4.19, 95% CI: 4.13–4.25) (Table 4).

Barriers to Conducting Clinical Audit

Students reported several substantial barriers to engaging in clinical audits. The most prominent were lack of time (Mean: 4.04) and academic pressure (Mean: 4.01). Perceived shortages in faculty support (Mean: 4.18) and the absence of a dedicated clinical audit department (Mean: 4.17) also scored highly. Psychological safety concerns, including fear of criticism due to student status (Mean: 3.88) and perceived resistance from medical staff (Mean: 3.99), further contributed to hesitancy. (Table 5).

Discussion

This study aims to evaluate medical students' level of awareness of clinical audits and to identify the barriers that limit their

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participation. While the majority of students expressed a positive attitude toward clinical audits, with many recognizing their role in enhancing healthcare quality and outcomes, actual participation remains low (7.3%). Low knowledge and low participation appeared to coexist; however, the cross-sectional design does not allow determination of whether limited knowledge leads to lower participation or whether both reflect broader curricular and institutional factors.

Clinical audits play a crucial role in promoting the responsibility of healthcare professionals. By serving as a tool for positive change, clinical audits help decrease medical litigation through regular monitoring and adherence to established care standards.[13] However, the effectiveness of clinical audits relies on a comprehensive understanding of the process, including its

steps, standards, and objectives.[14] These were areas identified as deficient among medical students in our study.[13,14]

The findings of this study align with regional evidence regarding limited clinical audit engagement and understanding among healthcare trainees and professionals. A multi-project clinical audit conducted at Al-Karak Governmental Hospital in Jordan demonstrated improved adherence to clinical guidelines from 34% to 73% following structured audit cycles; however, participation remained primarily limited to residents and junior clinicians.[15] In our sample, 17.7% reported prior knowledge, and 7.3% had participated in an audit, consistent with previous Jordanian findings showing limited undergraduate audit exposure.

Table 3. Participants' Knowledge of Clinical Audits.

Knowledge	Mean (95% CI)	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Know the objectives of clinical audit	2.76 (2.68–2.85)	99 (13.6%)	253 (34.8%)	168 (23.1%)	135 (18.6%)	72 (9.9%)
Understand the Steps for conducting projects	2.58 (2.50–2.66)	98 (13.5%)	313 (43.1%)	160 (22.0%)	108 (14.9%)	48 (6.6%)
Know the standard criteria used in projects	2.52 (2.43–2.60)	135 (18.6%)	267 (36.7%)	191 (26.3%)	82 (11.3%)	52 (7.2%)
Aware of the role of evidence-based guidelines	2.77 (2.69–2.86)	91 (12.5%)	260 (35.8%)	169 (23.2%)	136 (18.7%)	71 (9.8%)
Know the role of data analysis	2.69 (2.60–2.77)	108 (14.9%)	255 (35.1%)	183 (25.2%)	117 (16.1%)	64 (8.8%)
Know the different types of clinical audits and can differentiate between them	2.49 (2.41–2.57)	127 (17.5%)	302 (41.5%)	161 (22.1%)	88 (12.1%)	49 (6.7%)
Know the benefits of participating	2.77 (2.69–2.86)	100 (13.8%)	237 (32.6%)	181 (24.9%)	146 (20.1%)	63 (8.7%)
Feel confident to contribute	2.81 (2.72–2.90)	100 (13.8%)	229 (31.5%)	191 (26.3%)	122 (16.8%)	85 (11.7%)
The curriculum at my university adequately prepares me	2.44 (2.36–2.53)	157 (21.6%)	273 (37.6%)	170 (23.4%)	71 (9.8%)	56 (7.7%)
Learned how to conduct clinical audit projects from an external source	2.53 (2.45–2.62)	146 (20.1%)	269 (37.0%)	155 (21.3%)	92 (12.7%)	65 (8.9%)

Legend: CI: Confidence Interval.

Table 4. Participants' Views on the Impact and Necessity of Clinical Audits.

Perspective	Mean (95% CI)	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Improves the quality of healthcare	4.13 (4.08–4.18)	4 (0.6%)	10 (1.4%)	84 (11.6%)	420 (57.8%)	209 (28.7%)
Increases patient satisfaction	4.08 (4.03–4.14)	4 (0.6%)	10 (1.4%)	103 (14.2%)	414 (56.9%)	196 (27.0%)
Increases the efficiency and quality of healthcare	4.24 (4.18–4.29)	3 (0.4%)	9 (1.2%)	86 (11.8%)	343 (47.2%)	286 (39.3%)
Develops teamwork concept	4.15 (4.09–4.20)	4 (0.6%)	14 (1.9%)	111 (15.3%)	341 (46.9%)	257 (35.4%)
Hospitals should have a clear policy regarding clinical audit	4.28 (4.23–4.34)	4 (0.6%)	6 (0.8%)	85 (11.7%)	316 (43.5%)	316 (43.5%)
Should be a part of medical education	4.19 (4.13–4.25)	6 (0.8%)	12 (1.7%)	97 (13.3%)	335 (46.1%)	277 (38.1%)

Legend: CI: Confidence Interval

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Table 5. Barriers to conducting clinical audits.

Barrier	Mean (95% CI)	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Lack of time	4.04 (3.98–4.11)	6 (0.8%)	30 (4.1%)	124 (17.1%)	333 (45.8%)	234 (32.2%)
Academic pressure	4.01 (3.95–4.07)	6 (0.8%)	27 (3.7%)	122 (16.8%)	371 (51.0%)	201 (27.6%)
Difficulty of the clinical audit	3.86 (3.79–3.93)	6 (0.8%)	44 (6.1%)	212 (29.2%)	249 (34.3%)	216 (29.7%)
Lack of support from teachers	4.18 (4.12–4.24)	4 (0.6%)	14 (1.9%)	126 (17.3%)	288 (39.6%)	295 (40.6%)
Lack of support and assistance from colleagues	3.98 (3.91–4.04)	7 (1.0%)	27 (3.7%)	170 (23.4%)	295 (40.6%)	228 (31.4%)
Absence of a clinical audit department	4.17 (4.11–4.23)	5 (0.7%)	10 (1.4%)	125 (17.2%)	305 (42.0%)	282 (38.8%)
Difficulty accessing patient information	3.85 (3.77–3.92)	17 (2.3%)	60 (8.3%)	164 (22.6%)	263 (36.2%)	223 (30.7%)
Avoiding expressing opinions	3.92 (3.85–3.99)	14 (1.9%)	42 (5.8%)	161 (22.1%)	279 (38.4%)	231 (31.8%)
Resistance of the medical staff to any criticism or change	3.99 (3.92–4.05)	6 (0.8%)	26 (3.6%)	166 (22.8%)	303 (41.7%)	226 (31.1%)
Fear of criticism, as I am still a student	3.88 (3.80–3.96)	32 (4.4%)	44 (6.1%)	137 (18.8%)	280 (38.5%)	234 (32.2%)

Legend: CI: Confidence Interval

Conclusions

Jordanian medical students demonstrate positive attitudes and moderate awareness of clinical audits; however, their participation remains low and may be influenced by factors such as limited institutional support, inadequate curricular preparation, academic workload, and fear of criticism. Structural and educational changes are essential to bridge the gap between positive perceptions and practical engagement. Incorporating mandatory, hands-on clinical audit experiences, supervised by experienced clinicians, and establishing dedicated clinical audit departments could promote a culture of continuous quality improvement, ultimately empowering future healthcare professionals to utilize clinical audits effectively and enhance patient outcomes. These findings may help inform ongoing curricular discussions and institutional planning efforts in Jordan.

Summary – Accelerating Translation

Title

Clinical Audits in Medical Education: Barriers and Opportunities Among Jordanian Medical Students

Main Problem

Clinical audits are an important tool for improving the quality and safety of healthcare. They help healthcare teams compare current practice with agreed standards and make improvements where needed. Despite their importance, medical students often have limited exposure to clinical audits during their training, especially in low- and middle-income countries. In Jordan, little is known about how well medical students understand clinical audits, how often they participate in them, and what barriers prevent their involvement.

Aim of the Study

The aim of this study was to assess Jordanian medical students' and interns' knowledge of clinical audits, their attitudes toward audit activities, their level of participation, and the barriers that limit their engagement. The study also aimed to identify factors associated with prior knowledge of clinical audits.

Methodology

We conducted a national cross-sectional online survey between August and November 2023. The survey included 727 clinical-year medical students (4th–6th year) and medical interns from six Jordanian universities. Participants completed a structured, anonymous questionnaire that assessed demographics, knowledge of clinical audits, perspectives on their value, previous participation, and perceived barriers. Data were analyzed using descriptive statistics and multivariable logistic regression to identify independent predictors of audit knowledge.

Results

Most students recognized the importance of clinical audits and agreed that they improve healthcare quality, efficiency, and patient outcomes. However, actual participation was very low, with only 7.3% reporting previous involvement in a clinical audit. Knowledge of audit principles and processes was generally limited, with many students reporting inadequate curricular preparation. The most commonly reported barriers were lack of time, academic pressure, insufficient institutional and faculty support, and fear of criticism. Students with prior research experience were significantly more likely to report knowledge of clinical audits. University affiliation was also associated with differences in audit knowledge.

Conclusion

Although Jordanian medical students show positive attitudes toward clinical audits, their limited knowledge and very low participation highlight important gaps in undergraduate medical education. Addressing these gaps requires structured, hands-on audit training, supportive mentorship,

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and institutional support that reduces time pressure and promotes psychological safety. These findings may help inform curriculum development and educational planning in Jordan and similar settings, with the goal of preparing future physicians to actively participate in quality improvement initiatives.

References

1. Smith R. Audit and research. BMJ. 1992;305(6859):905–6.

2. Burgess R, Moorhead J. New principles of best practice in clinical audit. Oxford: Radcliffe Publishing; 2011.

3. Kruk ME, Gage AD, Arsenault C, Jordan K, Leslie HH, Roder-DeWan S, et al. High-quality health systems in the Sustainable Development Goals era: time for a revolution. Lancet Glob Health. 2018;6(11):e1196–252.

4. Pirkle CM, Dumont A, Zunzunegui MV. Criterion-based clinical audit to assess quality of obstetrical care in low- and middle-income countries: a systematic review. Int J Qual Health Care. 2011;23(4):456–63.

5. Workumuluye WM, Tadesse S. Improving student participation in group project work: case study. Int J Educ Res. 2020;11(3):8–16. Available from: https://ijer.inased.org/makale/. 1661 Cited 2025 Dec 5.

6. Takada T. Uncertainty in auditing. 2023. Available from: https://doi.org/10.53106/256299802023120501005. Cited 2025 Dec 5.

7. Narwani V, Nalamada K. Clinical audits: a realistic research opportunity for medical students. Med Teach. 2013;35(5):424.

8. Saravanan T, Shanmugapriya S. A study on the effectiveness of teaching the principles and methods of clinical audit to medical postgraduates. Curr Med Res Pract. 2018;8(2):59–63.

9. Davis S, O'Ferrall I, Hoare S, Caroline B, Mak DB. Perceptions of medical graduates and their workplace supervisors towards a medical school clinical audit program. Int J Med Educ. 2017;8:244–51.

10. Merry L, Castiglione SA, Rouleau G, Létourneau D, Larue C, Deschênes MF, et al. Continuing professional development (CPD) system development, implementation, evaluation and sustainability for healthcare professionals in low- and lower-middle-income countries: a rapid scoping review. BMC Med Educ. 2023;23(1):498.

11. Raosoft Inc. Sample size calculator. Available from: http://www.raosoft.com/samplesize.html. Cited 2023 Oct 16.

12. The jamovi project. jamovi (Version 2.6) [computer software]. 2025. Available from: https://www.jamovi.org. Cited 2025 Dec 5.

13. Desalu OO, Adeoti AO, Makusidi MA, Fadare JO, Aremu GO, Amao EA, et al. Family physicians/GP and internist opinions, familiarity and practice behaviour regarding clinical practice guidelines of common medical conditions in Nigeria. J Fam Med Prim Care. 2021;10(1):502–8.

14. Gillam S, Siriwardena AN. Frameworks for improvement: clinical audit, the plan-do-study-act cycle and significant event audit. Qual Prim Care. 2013;21(2):123–30.

15. Abu-Jeyyab M, Al-Jafari M, El Din Moawad MH, Alrosan S, Al Mse'adeen M. The role of clinical audits in advancing quality and safety in healthcare services: a multiproject analysis from a Jordanian hospital. Cureus. 2024.

16. Ravaghi H, Zarnaq RK, Adel A, Badpa M, Adel M, Abolhassani N. A survey on clinical governance awareness among clinical staff: a cross-sectional study. Glob J Health Sci. 2014;6(6):37–42.

17. Drake TM, Bath M, Claireaux H, Mohan M, Fitzgerald JEF, Dynes K, et al. Medical research and audit skills training for undergraduates: an international analysis and student-focused needs assessment. Postgrad Med J. 2018;94(1107):37–42.

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Insomnia Prevalence and Risk Factors Among Hispanic University Staff in Ecuador: A Cross-Sectional Study

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Abstract

Background: Insomnia, characterized by difficulty initiating or maintaining sleep, is a common condition that adversely affects health, productivity, and overall well-being. This study aimed to determine the prevalence and associated risk factors of insomnia among Hispanic university staff at a higher education institution in Ecuador. **Methods:** A cross-sectional study was conducted between August 2023 and February 2024, including 385 university employees. Participants completed an anonymous survey collecting demographic, lifestyle, occupational, and sleep-related data. Sleep quality and insomnia severity were assessed using the Pittsburgh Sleep Quality Index (PSQI) and the Insomnia Severity Index (ISI). Data were analyzed using descriptive statistics, Spearman correlations, logistic regression, and Receiver Operating Characteristic (ROC) curve analysis to identify predictors of clinically significant insomnia (ISI > 14). **Results:** The prevalence of insomnia was 65.2%, with mean PSQI and ISI scores of 8.8 ± 5 and 11.5 ± 7, respectively. Severe insomnia affected 2.9% of participants. Higher insomnia scores were significantly correlated with workplace stress, workload, ethnicity, light exposure during sleep, and use of insomnia medication. Logistic regression identified workplace stress and light exposure as the strongest predictors of insomnia. ROC analysis indicated workplace stress had the greatest discriminative ability (AUC = 0.864), followed by light exposure (AUC = 0.789). **Conclusion:** A high prevalence of clinically significant insomnia was observed among university staff, primarily linked to workplace stress and nighttime light exposure. Targeted interventions addressing these factors could improve sleep health and overall well-being. Further studies in diverse populations are needed to validate these findings.

Introduction

Insomnia is a prevalent sleep disorder characterized by difficulties initiating or maintaining sleep, often resulting in significant distress and impairment in general health. It can be influenced by demographic characteristics, occupational stress, and lifestyle habits. In the university context, staff members are frequently exposed to high levels of work-related stress and varying work schedules, which may increase their risk of insomnia However, research on the prevalence and risk factors of insomnia among Hispanic university staff, particularly in Latin America, remains limited. Understanding these factors is crucial, to address the influence of cultural, economic, and occupational aspects on sleep habits and overall well-being.[1,3]

Quality sleep plays a fundamental role in cognitive functioning, emotional regulation, and productivity. For university employees, the demands of academic responsibilities, administrative duties, and research commitments can often disrupt sleep patterns, and lead to health problems. Exploring sleep quality within this context is particularly important, as cultural factors significantly influence sleep behaviors, perceptions, and coping mechanisms such as substance use. Moreover, recent studies have shown associations between light exposure, particularly from electronic devices, and sleep disturbances, as well as vaping and its potential role in sleep quality due to nicotine's known effects.[4,7] Examining the prevalence of sleep disorders in this population provides a comprehensive understanding of the unique challenges affecting their well-being.[8,9]

While research on sleep health in university settings has predominantly focused on North America and Europe, studies in Latin America and among Hispanic populations are scarce. Several studies have shown that Hispanic individuals often experience disparities in sleep health, including higher prevalence rates of sleep disorders and poorer sleep quality compared to their non-Hispanic counterparts. Grandner et al. highlighted that

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perceived racial discrimination is an independent predictor of sleep disturbance and daytime fatigue among minorities, a factor that could be relevant for university staff in Ecuador, where social and cultural stressors may similarly influence sleep health in academic settings These findings, alongside cultural attitudes towards sleep, access to healthcare, and varying levels of awareness about sleep health, suggest that the Hispanic population may face unique sleep health challenges. [10,14]

This research aims to fill the gap in the literature by investigating the prevalence of insomnia and its associated risk factors among Hispanic university staff in Ecuador. By identifying key risk factors (demographic, lifestyle, and work-related) contributing to insomnia, this study seeks to inform targeted interventions to improve sleep health and overall well-being among university staff.

Methods

Study Desing and Setting

This study adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for observational studies. We conducted a cross-sectional study to assess the prevalence of insomnia and associated risk factors among the university staff of the Catholic University of Santiago de Guayaquil in Guayaquil, Ecuador. All participants were Hispanic individuals from Ecuador, although they self-identified with various ethnic subcategories, including mixed (a term commonly used to describe individuals of combined Indigenous, European, and/or African ancestry), white, Afro-Ecuadorian (an officially recognized ethnic group in Ecuador referring to descendants of African populations historically settled in the country), and others. The study period extended from August 2023 to February 2024.

Participants and Sampling

The inclusion criteria included all university staff members who were willing to participate voluntarily. We employed a quota-based stratified sampling strategy to ensure diverse representation across different departments and job areas, including faculty, administrative staff, and other roles. Faculty accounted for 47% of the total population and included teaching staff such as professors, lecturers, and instructors. Administrative staff, representing 32%, referred to employees involved in administrative and support functions such as secretaries, human resources personnel, and financial officers. Other roles, comprising 21% of the population, encompassed non-academic and non-administrative positions such as custodial staff, security personnel, and cleaning staff. These percentages were provided by the university as the official staff distribution, and they were used as quotas to approximate the proportional representation of each group in the study sample, even though the precise total population size was unavailable.

To determine the sample size, we targeted a 95% confidence level with a 5% margin of error. Given absence of exact population size,

a sample size of 385 was selected, commonly recommended for sufficiently large populations to maintain statistical reliability. This sample size and the voluntary participation ensured alignment with the study's goals and inclusion criteria, achieving a response rate consistent with expectations for online surveys.

Data Collection

Participants were invited to complete an anonymous online survey, which was designed to collect comprehensive data on demographics, lifestyle habits, work-related factors, and sleep-related behaviors. The survey gathered information on several variables: job area, workload, gender, age, ethnicity, current and past use of insomnia medication, assistance received for insomnia, smoking and vaping use, high caffeine intake, physical activity, social level, and light exposure during light exposure during sleep, primarily reflecting the use of electronic devices (e.g., smartphones, tablets, televisions), categorized by the number of lights while sleeping.

Study Instruments

The survey also included standardized instruments to measure insomnia severity, sleep quality, alcohol use disorders, and workplace stress. The Pittsburgh Sleep Quality Index (PSQI) was used to assess overall sleep quality and identify sleep problems, categorized as no sleep problem (0-4), deserves medical attention (5-7), deserves medical attention and treatment (8-14), and severe sleep problem (15-21). The Insomnia Severity Index (ISI) measured the severity of insomnia symptoms, categorized as no clinically significant insomnia (0-7), subthreshold insomnia (8-14), clinical insomnia of moderate severity (15-21), and severe clinical insomnia (22-28). The Alcohol Use Disorders Identification Test (AUDIT) evaluated alcohol consumption patterns and potential addiction, categorized as low (0-7), medium (8-15), high (16-19), and possible addiction (20-40). The Workplace Stress Scale (WSS) assessed stress levels related to the work environment, categorized as none (0-15), low (16-20), moderate (21-25), severe (26-30), and highly dangerous (31-40). The cut-off points for all the scales were standardized according to the established norms for each test, which are widely used in various populations and do not vary significantly by cultural context.

Statistical Analysis

Data were analyzed using IBM SPSS software. Descriptive statistics, including counts, percentages, means, and standard deviations, summarized the data. Spearman correlations were computed to examine associations between sleep quality measures and demographic, lifestyle, and environmental factors. Spearman correlation was chosen due to the ordinal nature of some variables, and because it is a non-parametric test that does not require assumptions of normality, making it more suitable for the data distribution in this study

A binary logistic regression analysis was conducted to identify independent predictors of clinically significant insomnia. Variables that were significantly associated with insomnia in the

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univariate analysis (p < 0.05) were included in the multivariate logistic regression model. The enter method was applied to include all selected predictors simultaneously in the model. The dependent variable was binary, with clinically significant insomnia (ISI > 14) coded as 1 and the absence of insomnia (ISI ≤ 14) coded as 0. The results of the logistic regression were presented as adjusted odds ratios (OR) with corresponding 95% confidence intervals (CI) to quantify the strength and direction of associations.

Model performance was evaluated by using the Hosmer-Lemeshow goodness-of-fit test, with a p-value > 0.05 indicating that the model fits the observed data adequately. Additionally, Nagelkerke R^2 was calculated to assess the proportion of variance in insomnia that was explained by the model, providing an indication of the model's explanatory power.

To assess the discriminative ability of the predictors identified in the logistic regression analysis, Receiver Operating Characteristic (ROC) curve analysis was performed. The Area Under the Curve (AUC) was calculated for each predictor, with 95% confidence intervals to estimate the precision of the AUC values. The AUC values were interpreted as follows: 0.5 indicated no discriminative ability, 0.7–0.8 indicated acceptable discriminative ability, and values greater than 0.8 indicated excellent discriminative ability.

Ethical Considerations

Ethical approval was formally reviewed and waived] by the university's ethics committee, in accordance with local regulations, given that the survey was fully anonymous and participation was voluntary. Although written informed consent was not obtained], participants were provided with detailed information about the study's purpose, procedures, and confidentiality measures at the beginning of the survey. Their voluntary completion of the survey was considered implied consent, aligning with internationally accepted ethical guidelinesfor research involving human participants.

Results

Participant Characteristics

A total of 385 university employees participated in the study. Most participants were faculty members (46.8%), followed by administrative staff (31.7%) and other roles (21.6%). Most participants (84.4%) reported working 40 hours or more per week. The gender distribution was relatively balanced, with 45.5% male and 54.5% female participants. The mean age of the participants was 38.8±12 years.

Regarding ethnicity, most of the participants identified as mixed (79.2%), followed by white (14.8%), Afro-Ecuadorian (4.9%), and other ethnicities (1.0%). A small percentage of participants reported currently using insomnia medication (9.9%), while 7.0% had used it before, and 83.1% had never used it. Similarly, 6.0% of participants had received assistance for insomnia, 7.3% had used it before, and 86.8% had never received assistance.

In terms of lifestyle habits, 25.5% of participants were cigarette smokers, while 11.2% used vapes. High caffeine intake was reported by 7.8% of participants. Physical activity levels varied, with 4.9% engaging in more than 10 hours of physical activity per week, 21.3% engaging in 5-10 hours, 43.6% engaging in less than 5 hours, and 30.1% reporting no physical activity. The social level distribution indicated that 33.8% of participants considered themselves to have a low social level, 50.1% regular, and 16.1% high. Regarding sleep environment, 44.7% of participants reported sleeping with no lights on, 20.0% with one light, 16.6% with two lights, 11.7% with three lights, and 7.0% with more than three lights on as shown in **Table 1.**

Sleep Quality and Insomnia Prevalence

The mean PSQI score was 8.8±5, with 15.1% of participants experiencing severe sleep problems, 39.0% deserving medical attention and treatment, 24.7% deserving medical attention, and 21.3% having no sleep problems. The mean ISI score was 11.5±7, with 2.9% of participants experiencing severe insomnia, 26.8% moderate insomnia, 35.6% threshold insomnia, and 34.8% no insomnia.

The mean score for the AUDIT was 8.9±9, with 20.3% of participants possibly addicted, 7.5% scoring high, 9.6% medium, and 62.6% low. The mean score for the Workplace Stress Scale WSS was 21.1±8, with 12.2% of participants experiencing highly dangerous levels of stress, 17.1% severe stress, 25.5% moderate stress, 19.0% low stress, and 26.2% no stress.

Overall, 65.2% of participants reported experiencing insomnia, categorized as those scoring above the threshold on the ISI as shown in **Table 2.**

Correlates of Insomnia

The study revealed several statistically significant correlations between sleep quality measures and various demographic, lifestyle, and environmental factors. Higher PSQI scores showed a significant positive correlation with job area (rho = 0.158, p = 0.002), Work load (rho = 0.167, p = 0.001), Ethnicity (rho = 0.102, p = 0.046), use of Insomnia Medication (rho = 0.245, p < 0.001), Assistance for Insomnia (rho = 0.191, p < 0.001), Cigarette use (rho = 0.320, p < 0.001), and vape use (rho = 0.154, p = 0.002). Likewise, significant moderate positive correlations were found between PSQI scores and light exposure (rho = 0.550, p < 0.001), AUDIT (rho = 0.586, p < 0.001), and WSS (rho = 0.669 p < 0.001).

Furthermore, we identified several statistically significant correlations involving the ISI score and various variables. Specifically, ISI scores demonstrated significant positive correlations with Job Area (rho = 0.119, p = 0.019), Work load (rho = 0.164, p = 0.001), Ethnicity (rho = 0.105, p = 0.039), use of Insomnia Medication (rho = 0.248, p < 0.001), Assistance for Insomnia (rho = 0.234, p < 0.001), Cigarette use (rho = 0.326, p < 0.001), and Vape use (rho = 0.162, p = 0.001). Moreover, significant moderate positive correlations were found between ISI

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scores and AUDIT (rho = 0.606, p < 0.001), light exposure (rho = 0.624, p < 0.001), and WSS (rho = 0.717, p < 0.001) as Shown in table 3 and illustrated in Figure 1-2.

Table 1. Demographic and Lifestyle Characteristics of the Study Population.

Characteristic	Value
Total Participants	385
Occupational role	
Faculty Members	180 (46.8%)
Administrative Staff	122 (31.7%)
Other Roles	83 (21.6%)
Gender Distribution	
Male	175 (45.5%)
Female	210 (54.5%)
Mean Age	38.8 ± 12 years
Ethnicity	
Mixed	305 (79.2%)
White	57 (14.8%)
AfroEcuadorian	19 (4.9%)
Other	4 (1.0%)
Insomnia Medication Use	
Currently Using	38 (9.9%)
Used Before	27 (7.0%)
Never Used	319 (83.1%)
Assistance for Insomnia	
Currently Receiving	23 (6.0%)
Used Before	28 (7.3%)
Never Received	335 (86.8%)
Lifestyle Habits	
Cigarette Smokers	98 (25.5%)
Vape Users	43 (11.2%)
High Caffeine Intake	30 (7.8%)
Physical Activity	
>10 Hours per Week	19 (4.9%)
5-10 Hours per Week	82 (21.3%)
<5 Hours per Week	168 (43.6%)
No Physical Activity	116 (30.1%)
Social Level	
Low	130 (33.8%)
Regular	193 (50.1%)
High	62 (16.1%)
Sleep Environment	
No Lights	171 (44.7%)
One Light	77 (20.0%)
Two Lights	64 (16.6%)
Three Lights	45 (11.7%)
More than Three Lights	27 (7.0%)

Multivariate Analysis

A logistic regression analysis was performed to identify independent predictors of clinically significant insomnia. The model demonstrated good fit (Hosmer and Lemeshow Test: p = 0.837) and explained 66.8% of the variability in insomnia risk

(Nagelkerke R^2 = 0.668). Significant predictors included the use of insomnia medication (OR = 6.734, 95% CI: 2.153–21.057, p = 0.001), the number of lights in the sleeping environment (OR = 1.872, 95% CI: 1.216–2.882, p = 0.004), workplace stress levels (OR = 2.740, 95% CI: 1.999–3.756, p < 0.001), and alcohol consumption (OR = 5.240, 95% CI: 1.702–16.132, p = 0.004). Other variables, such as job area, workload, ethnicity, assistance for insomnia, and smoking or vaping use, did not show statistically significant associations in the multivariate model (p > 0.05). These findings suggest that lifestyle and environmental factors, particularly light exposure, workplace stress, and substance use, play a crucial role in predicting insomnia risk among university staff. The results of the multivariate analysis are summarized in ***Table 4.***

Table 2. Results of Sleep, Insomnia, and Stress Assessments in the Study Population.

Variable	Mean ± SD	Category	Frequency	Percentage
PSQI Score	8.8 ± 5	Severe Sleep Problems	58	15.1%
		Medical Attention and Treatment	150	39.0%
		Medical Attention	95	24.7%
		No Sleep Problems	82	21.3%
ISI Score	11.5 ± 7	Severe Insomnia	11	2.9%
		Moderate Insomnia	103	26.8%
		Threshold Insomnia	137	35.6%
		No Insomnia	134	34.8%
AUDIT Score	8.9 ± 9	Possibly Addicted	78	20.3%
		High Score	29	7.5%
		Medium Score	37	9.6%
		Low Score	241	62.6%
WSS Score	21.1 ± 8	Highly Dangerous Stress	47	12.2%
		Severe Stress	66	17.1%
		Moderate Stress	98	25.5%
		Low Stress	73	19.0%
		No Stress	101	26.2%
Insomnia Prevalence		Insomnia (Above Threshold on ISI)	251	65.2%

Legend: PSQI Score: Pittsburgh Sleep Quality Index. ISI Score: Insomnia Severity Index. AUDIT Score: Alcohol Use Disorders Identification Test. WSS Score: Workplace Stress Scale.

ROC Curve Analysis

Receiver Operating Characteristic (ROC) curve analysis was conducted to evaluate the diagnostic performance of variables in predicting clinically significant insomnia. The Area Under the Curve (AUC) was calculated for each predictor to determine its discriminative ability. Variables with an AUC > 0.7 were considered to have acceptable discriminative power, while those with an AUC > 0.8 demonstrated excellent predictive ability. The

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results showed that workplace stress had the highest AUC (0.864, 95% CI: 0.826–0.902, p < 0.001), indicating excellent discriminative performance. Other variables with strong predictive power included: Number of lights in the sleeping environment (AUC = 0.789, 95% CI: 0.745–0.833, p < 0.001) and Alcohol consumption (AUC = 0.770, 95% CI: 0.725–0.816, p < 0.001). Variables with moderate predictive power included cigarette use (AUC = 0.615, 95% CI: 0.559–0.672, p < 0.001) and use of insomnia medication (AUC = 0.599, 95% CI: 0.542–0.655, p = 0.001). Other factors, such as job area, workload, ethnicity, assistance for insomnia, and vape use, had AUC values closer to 0.5, indicating limited discriminative ability for predicting insomnia. These findings confirm that workplace stress and environmental factors, particularly light exposure, are critical predictors of insomnia among university staff. The strong discriminative performance of these variables underscores their importance in identifying individuals at high risk for clinically significant insomnia.

The ROC curves for these variables are presented in Figure 3, and the corresponding AUC values, along with 95% confidence intervals and p-values, are summarized in **Table 5.**

Figure 1. Scatter plot between Insomnia Severity Index (ISI) Scores and Workplace Stress Scale (WSS) Scores.

R^2 LINEAR= 0,490
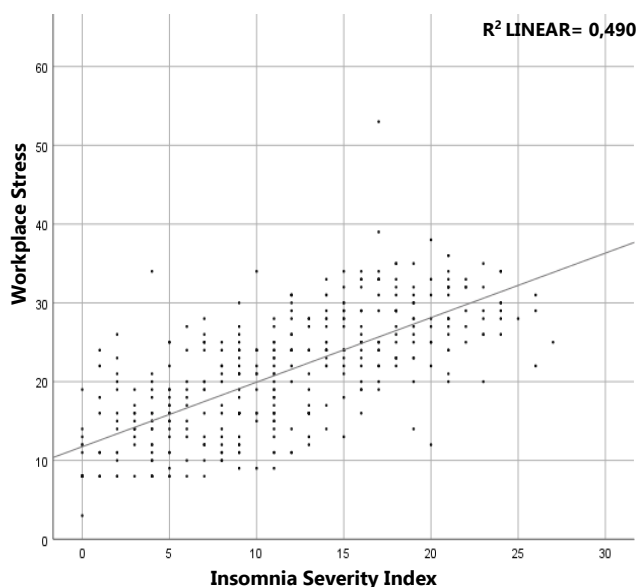
Discussion

This study aimed to evaluate insomnia prevalence and associated risk factors among Hispanic university staff. A substantial proportion of participants reported clinically significant insomnia, with higher severity correlated with job role, workload, and ethnic background. Lifestyle factors, including tobacco use, and excessive light exposure during sleep, were significantly associated with impaired sleep quality. Furthermore, elevated workplace stress levels demonstrated a strong correlation with increased insomnia severity.

Figure 2. Scatter plot between Insomnia Severity Index (ISI) Scores and Alcohol Consumption (AUDIT) Scores.

R^2 LINEAR= 0,430
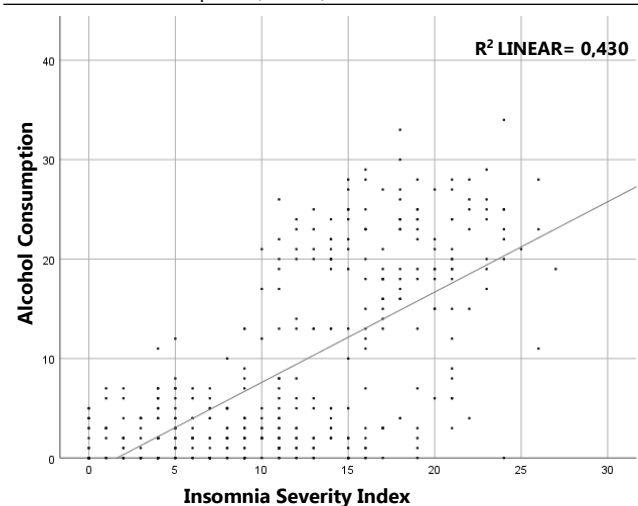
In this study, we employed the ISI to measure insomnia severity due to its greater specificity in assessing clinically significant insomnia compared to the PSQI. While both scales assess sleep disturbances, the ISI is considered a more precise tool for categorizing insomnia severity, as it is specifically designed to evaluate the frequency and intensity of insomnia symptoms, providing a clearer delineation between different levels of severity. The ISI categorizes insomnia as subthreshold insomnia, moderate insomnia, and severe insomnia, offering a detailed understanding of insomnia symptoms that is more aligned with clinical practice. In contrast, the PSQI, while useful for evaluating overall sleep quality, has broader categorizations that may not fully capture the nuanced differences between varying levels of insomnia severity. For instance, a PSQI score of 5 or higher indicates the need for medical attention, but it does not differentiate between moderate and severe insomnia as effectively as the ISI. Given the focus of this study on identifying clinically significant insomnia, the ISI was the preferred measure due to its more targeted approach, allowing for a better understanding of insomnia severity and its relationship with lifestyle and environmental factors. This distinction in operationalizing insomnia severity between the ISI and PSQI helps to clarify the findings in this study, particularly regarding the prevalence and impact of insomnia among university staff.

While the study did not directly assess cultural factors, some environmental and lifestyle characteristics observed in the results may reflect cultural influences on sleep. In the Hispanic population of this study, which belongs to Western culture, factors such as alcohol consumption, smoking, and environmental conditions (e.g., the number of lights in the room) may be shaped by cultural perceptions and social norms. Recent meta-analyses have found that the association between electronic media use and sleep quality was significantly stronger in Eastern cultures.[4,5] This difference has been speculated to arise from cultural variations in social media use patterns, perceptions of social norms and expectations, bedtime routines, and coping mechanisms for stress. These findings highlight the potential role

of cultural factors in shaping sleep behaviors. However, as our study did not include populations from Eastern cultures, we are unable to draw direct comparisons. Nonetheless, it is important to speculate on the possible factors that may influence sleep quality within the Hispanic population studied. Cultural norms related to social activities, stress management, and bedtime habits, as well as exposure to environmental conditions such as artificial light, may interact to mediate the relationship between lifestyle behaviors and insomnia. These speculations warrant further investigation to better understand the cultural underpinnings of sleep disturbances and their implications in diverse populations.

Figure 3. ROC Curve for Variables in Predicting Clinically Significant Insomnia.
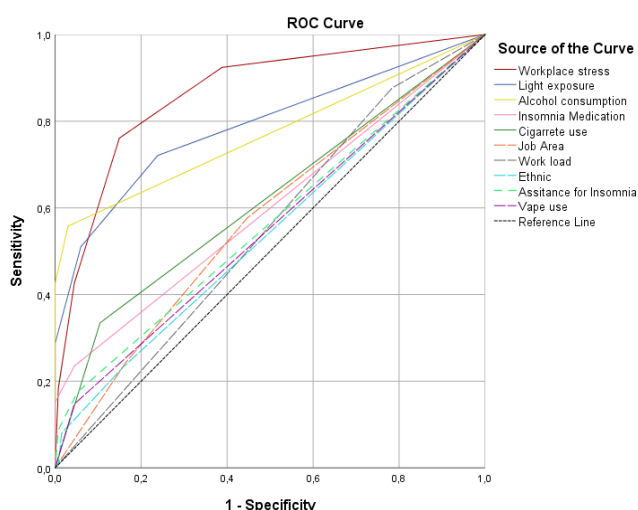
There are several studies on the prevalence of insomnia in different populations; however, this study, conducted within a university community, encompasses various populations with different work areas. A study conducted in Portugal among schoolteachers found a prevalence of insomnia symptoms at 40.6%, compared to the 60.6% prevalence found in our study. [15] The difference in prevalence may be attributed to the fact that our study included not only teaching staff. Furthermore, the categorization methods differed; our study utilized standardized scales, whereas the Portuguese study applied diagnostic criteria. These variations underscore the need for future research to establish a consistent diagnostic approach for insomnia.

Regarding the analysis of risk factors, a study among Indian corporate employees investigated personal habits like those in our study and found comparable results for alcohol consumption and cigarette use.[16] However, this study did not include vaping as a variable and assessed alcohol use through a simple count of drinks rather than using the standardized AUDIT scale, which we employed. The use of the AUDIT scale in our study adds robustness to our findings regarding the significant relationship between alcohol consumption and sleep quality. Additionally, other studies conducted in other countries have demonstrated

that higher alcohol intake correlates with decreased sleep quality, and these studies also utilized the AUDIT scale, which supports the validity of our methodological approach.[17,19] Furthermore, our study uniquely analyzed the relationship between workplace stress and insomnia, identifying a significant correlation that aligns with international research identifying workplace stress as a factor associated with insomnia.[20,21]

Table 3. Correlations Between Variables and Sleep Quality (PSQI) and Insomnia (ISI).

Variable	Sleep Quality		Insomnia	
	Correlation (Rho)	p-Value	Correlation (Rho)	p-Value
Job Area	0.158	0.002	0.119	0.019
Workload	0.167	0.001	0.164	0.001
Ethnicity	0.102	0.046	0.105	0.039
Insomnia Medication Use	0.245	< 0.001	0.248	< 0.001
Assistance for Insomnia	0.191	< 0.001	0.234	< 0.001
Cigarette Use	0.320	< 0.001	0.326	< 0.001
Vape Use	0.154	0.002	0.162	0.001
Lights in Sleeping Environment	0.550	< 0.001	0.624	< 0.001
Alcohol Consumption	0.586	< 0.001	0.606	< 0.001
Workplace Stress	0.669	< 0.001	0.717	< 0.001

Legend: p-values considered significant at <0.05

A particularly novel aspect of our study is the analysis of the relationship between workplace stress and insomnia. While several studies have established a link between workplace stress and poor sleep quality, most of these studies focus on corporate or healthcare settings. Our study specifically explores this relationship in university staff, an occupational group that has not been as widely studied in this context. International research has shown that workplace stress is significantly correlated with sleep disturbances, with studies in diverse settings reporting consistent associations. However, few have specifically examined how the unique stressors in academic environments—such as workload, job role, and institutional pressures—interact with insomnia symptoms in university staff.[15,20,21] Our findings reveal a strong and significant correlation between elevated workplace stress levels and increased insomnia severity (rho = 0.669, p < 0.001 for PSQI; rho = 0.717, p < 0.001 for ISI), indicating a robust relationship between these variables. These findings underscore the need for further longitudinal studies to better understand the temporal and causal dynamics between workplace stress and insomnia in academic settings.

Moreover, our study identifies a novel and relatively underexplored risk factor: the impact of the number of lights in the sleeping environment on sleep quality. Specifically, we investigated how the presence of lights, which often reflects the use of electronic devices, correlates with worsened sleep quality and increased insomnia symptoms. Our findings reveal a significant association between light exposure before sleep and

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deterioration in sleep quality, which aligns with the known pathophysiological mechanism where light exposure suppresses melatonin production, thereby disrupting sleep. Although our study's population differs from those in previous research, such as studies in younger cohorts, the observed relationship between light exposure and sleep disturbances is consistent with existing literature.[22] Interventions aimed at reducing light exposure before sleep could be particularly beneficial. These may include promoting awareness of the negative effects of electronic devices before bedtime and encouraging environmental changes such as dimming lights or using blackout curtains to improve sleep quality. Such practical strategies could be more effective when tailored to the specific habits and preferences of the target population, fostering better acceptance and adherence to sleep improvement recommendations.

Table 4. Multivariate Analysis of Predictors of Clinically Significant Insomnia.

Variable	Exp(B)	95% CI for Exp(B)	p-value
Insomnia Medication	6.734	2.153 – 21.057	0.001
Workplace Stress	2.740	1.999 – 3.756	0.000
Alcohol Consumption	5.240	1.702 – 16.132	0.004
Number of Lights	1.872	1.216 – 2.882	0.004
Cigarette Use	1.623	0.591 – 4.461	0.348
Job Area	1.451	0.950 – 2.216	0.085
Workload	2.178	0.854 – 5.554	0.103
Assistance for Insomnia	0.880	0.289 – 2.679	0.822
Ethnicity	1.129	0.610 – 2.092	0.699
Vape Use	0.923	0.157 – 5.439	0.929

Legend: p-values considered significant at <0.05

Despite efforts to minimize methodological biases, several limitations persist. The cross-sectional design of the study prevents establishing causality between insomnia and the identified risk factors. The reliance on self-reported data, particularly for variables like alcohol and caffeine intake, may introduce biases such as recall bias and social desirability bias, potentially affecting the accuracy of reported sleep behaviors and lifestyle factors. In addition, unmeasured stressors and health comorbidities, such as depression, anxiety disorders, or undiagnosed sleep disorders (e.g., sleep apnea), could contribute to residual confounding. Furthermore, environmental factors like noise, temperature, and housing conditions may also play a role in mediating sleep disturbances, but were not assessed in this study, which could partially explain the observed relationships. The study was conducted at a single university in Ecuador, which may limit the generalizability of the findings to other Hispanic university staff, especially those in different geographical regions or cultural contexts. The sample predominantly consisted of individuals with mixed ethnicity, which, while reflective of many Hispanic populations, may not fully represent the diversity within broader Hispanic communities, such as indigenous or Afro-Hispanic groups. These subgroups may experience unique cultural, socioeconomic, and environmental influences on sleep behaviors. Moreover, Hispanic populations in different regions may have varying work environments, health behaviors, and

access to resources, all of which could influence the prevalence and risk factors for insomnia. Future research should consider longitudinal designs and include more diverse university settings, incorporating Hispanic populations from different ethnic, socioeconomic, and geographic contexts. It should also aim to incorporate a broader range of health-related and environmental factors to provide a more comprehensive understanding of the determinants of insomnia in this population.

Table 5. Receiver Operating Characteristic Curve (ROC) Analysis for Predicting Clinically Significant Insomnia.

Variable	Area Under the Curve (AUC)	95% CI	p-value
Workplace Stress	0.864	0.826–0.902	<0.001
Light Exposure	0.789	0.745–0.833	<0.001
Alcohol Consumption	0.770	0.725–0.816	<0.001
Insomnia Medication	0.599	0.542–0.655	0.001
Cigarette Use	0.615	0.559–0.672	<0.001
Job Area	0.572	0.512–0.632	0.020
Workload	0.546	0.485–0.608	0.133
Ethnicity	0.541	0.482–0.601	0.180
Assistance for Insomnia	0.563	0.505–0.621	0.041
Vape Use	0.551	0.493–0.610	0.097

Legend: The association is significant at the level 0.05.

In conclusion, this study provides valuable insights into the prevalence of insomnia and its associated risk factors among Hispanic university staff. Our findings highlight the multifaceted nature of insomnia in this population, underscoring the need for targeted interventions that address both lifestyle factors and work-related stressors. Given the significant impact of insomnia on staff well-being, it is crucial for university administrations to consider implementing workplace policies that promote better sleep health. This could include stress management programs, flexible work hours, and educational initiatives on sleep hygiene. By improving sleep health, universities can not only enhance the quality of life for their staff but also improve productivity and job satisfaction. These findings contribute to a growing body of evidence and provide a basis for informing public health policies aimed at addressing insomnia-related issues within academic settings.

Summary – Accelerating Translation

Insomnia Prevalence and Risk Factors Among Hispanic University Staff: A Cross-Sectional Study

This study aimed to determine how common insomnia is among Hispanic university staff at the Catholic University of Santiago de Guayaquil in Ecuador and identify its risk factors. From August 2023 to February 2024, 385 university employees took part in an anonymous online survey. The survey asked about their personal details, lifestyle, work-related factors, and sleep habits. We used two tools, the Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI), to measure sleep quality and insomnia severity.

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We found that 65.2% of participants had insomnia. On average, their PSQI score was 8.8, with 15.1% experiencing severe sleep problems, and their ISI score was 11.5, with 2.9% having severe insomnia. Higher PSQI scores were linked to job area, workload, ethnicity, use of insomnia medication, smoking, and light exposure in the sleeping environment. ISI scores were related to workload, and ethnicity. Increased workplace stress was strongly associated with more severe insomnia.

Overall, a significant number of Hispanic university staff reported significant insomnia. Key factors included job role, workload, lifestyle habits, and environmental conditions. Addressing these factors through targeted interventions is important for improving sleep health and well-being among university staff.

References

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). 5th ed. Arlington, TX: American Psychiatric Association Publishing; 2013.

2. Vargas PA, Flores M, Robles E. Sleep quality and body mass index in college students: the role of sleep disturbances. J Am Coll Health. 2014;62(8):534–41.

3. Ford DE. Epidemiologic study of sleep disturbances and psychiatric disorders. JAMA. 1989;262(11):1479.

4. Han X, Zhou E, Liu D. Electronic media use and sleep quality: updated systematic review and meta-analysis. J Med Internet Res. 2024;26:e48356.

5. Lund L, Sølvhøj IN, Danielsen D, Andersen S. Electronic media use and sleep in children and adolescents in Western countries: a systematic review. BMC Public Health. 2021;21:1598.

6. Riehm KE, Rojo-Wissar DM, Feder KA, et al. E-cigarette use and sleep-related complaints among youth. J Adolesc. 2019;76:48–54.

7. Wang S, Nandy RR, Rossheim ME. Associations between e-cigarette use and sleep health among adults in the United States, NHANES 2015–2018. Sleep Med. 2024;114:220–8.

8. Walker M. Why We Sleep: Unlocking the Power of Sleep and Dreams. New York: Scribner; 2017.

9. Rana A, Soodan V. Effect of occupational and personal stress on job satisfaction, burnout, and health: a cross-sectional analysis of college teachers in Punjab, India. Indian J Occup Environ Med. 2019;23(3):133.

10. Grandner MA, Hale L, Jackson N, Patel NP, Gooneratne NS, Troxel WM. Perceived racial discrimination as an independent predictor of sleep disturbance and daytime fatigue. Behav Sleep Med. 2012;10(4):235–49.

11. Sateia MJ. International classification of sleep disorders-third edition: highlights and modifications. Chest. 2014;146(5):1387–94.

12. Sivertsen B, Hysing M, Harvey AG, Petrie KJ. The epidemiology of insomnia and sleep duration across mental and physical health: the SHoT study. Front Psychol. 2021;12:662572

13. Yip T, Cheon YM. Sleep, psychopathology and cultural diversity. Curr Opin Psychol. 2020;34:123–7.

14. Jackson CL, Powell-Wiley TM, Gaston SA, Andrews MR, Tamura K, Ramos A. Racial/ethnic disparities in sleep health and potential interventions among women in the United States. J Womens Health (Larchmt). 2020;29(3):435–42.

15. Pereira C, Almeida C, Veiga N, Amaral O. Prevalence and determinants of insomnia symptoms among schoolteachers. Aten Primaria. 2014;46:118–22.

16. Yardi N, Adsule S. A cross-sectional observational study to determine the prevalence of insomnia amongst Indian corporate employees. J Assoc Physicians India. 2015;63(10):20–5.

17. Guan YQ, Zhang M, Zhang X, Zhao ZP, Huang ZJ, Li C, et al. Association between alcohol consumption and insomnia in employed floating population in China. Zhonghua Yu Fang Yi Xue Za Zhi. 2021;55(9):1114–22.

18. Zheng D, Yuan X, Ma C, Liu Y, VanEvery H, Sun Y, et al. Alcohol consumption and sleep quality: a community-based study. Public Health Nutr. 2021;24(15):4851–8.

19. Hipson WE, Fisher DJ. The association between acute stress-related insomnia and alcohol use. Sleep Health. 2016;2(3):246–52.

20. Li XM, Cui SY, Song Y, Wu JH, Wang YB, Wang LH, Yuan JX. Association between occupational stress and insomnia among steel workers. J Environ Occup Med. 2019;36(8):710–7.

21. Kim H, Kim B, Min K, Min J, Hwang S, Park S. Association between job stress and insomnia in Korean workers. J Occup Health. 2011;53(3):164–74.

22. Cabral LGL, Queiroz TN, Pol-Fachin L, Santos ARL. Digital technology and its impacts on sleep quality and academic performance during the pandemic. Arq Neuropsiquiatr. 2022;80(10):1052–6.

Empathy In Practice: Comparing Physicians' Self-Assessment and Patient Perceptions Using the Jefferson Scales

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Abstract

Background: Empathy is essential for effective patient care, improving communication, satisfaction, and compliance. This study was done to assess empathy levels in a tertiary care center in South India. **Methods:** A cross-sectional study among 40 physicians from various specialties assessed physician empathy using the Jefferson Scale of Physician Empathy–Health Professionals version (JSE-HP) and patient perceptions using the Jefferson Scale of Patient Perceptions of Physician Empathy (JSPPPE). Five patients per physician participated. Data were collected from January to June 2024, and was analyzed by a t-paired and ANOVA tests and a multilevel linear mixed-effects model. **Results:** A total of 200 patient–physician encounters were analyzed. Most physicians were under 50 years (90%), and patients were aged 19–85 years. Mean physician self-empathy (JSE) was 74.5 ± 8.6, and mean patient-perceived empathy (JSPPPE) was 31.0 ± 4.6. No correlation was observed between self- and patient-rated empathy ($\rho = -0.06$, p = 0.71). In multilevel analysis, self-empathy was not associated with patient-perceived empathy ($\beta = -0.05$, 95% CI [-0.15, 0.06], p = 0.37). Physician age, gender, and specialty were not significant predictors. The intraclass correlation coefficient (ICC = 0.066) indicated 7% of variance in patient empathy scores was due to physician-level differences. **Conclusion:** A disparity exists between physicians' self-perceived and patient-rated empathy. Experienced physicians and those in patient-centered specialties are rated higher. Regular empathy training and feedback can align self-perceptions with patient expectations, improving communication and care quality.

Introduction

Empathy is the ability to recognize, understand, and respond to others by cognitively perceiving their feelings and physical state. It is the ability to gain understanding into others' physical and emotional experiences either by interpreting their behavioral cues or by mentally recreating those experiences and moving through them as if they were one's own.[1]

Empathy can be classified into cognitive, affective, behavioral, social and ecological elements, though the predominance of one or the other differs amongst scholars.[2–6] Empathy has to be distinguished from the similar concept of sympathy, which is the recognition of another's affective experience without re-experiencing it, either through interpretation or mental simulation.

With regards to patient care, empathy is believed to be a cognitive skill that helps to develop a relationship between health professionals and their healthcare users which reinforces their cooperation towards a tailor-made therapeutic plan, enhancing the patient's satisfaction from the therapeutic process. This way, quality of care is enhanced, errors are eliminated, and an increased percentage of health care recipients positively experience therapy with better compliance.[7] Such an approach

might enhance the sense of usefulness among healthcare providers, ensuring better job satisfaction and preventing burnout.[8]

Various studies have shown that empathy varies depending on the country, gender of the healthcare worker, the specialty, the evaluation instrument used and the evaluator.[9–12] Literature supports the need of incorporating empathy during the training and practice years of practitioners.[13]

Owing to the critical role of empathy in physician–patient relation and clinical outcomes, the purpose of this study is to evaluate empathy status in physicians and correlation of empathy scores by patients, with demographic features in a tertiary care center in South India.

Methods

Study design and setting

This is a cross-sectional study conducted at a tertiary care teaching hospital with outpatient and inpatient capacity.

Participants

In order to obtain a widespread idea of empathy among physicians, data was collected from   physicians from the

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departments of Medicine, Surgery, Ophthalmology, ENT, Obstetrics and Gynecology, Orthopedics, Dermatology and Medical Gastroenterology of the institute. Physicians were selected as per convenience and these specific departments were chosen due to their varying levels of patient complexity.[14]

Sample Size and Study Period
A total of 40 physicians and their respective patients (200) were assessed. The research data was collected on a weekly basis per department from January 2024 to June 2024.

Data Collection and Study Tool
Physicians were asked to analyze their empathy using the questionnaire 'The Jefferson Scale of Empathy (JSE)-HP version'. Patients treated by the same primary physician and his/her team on an inpatient or outpatient basis at PSGIMS&R were asked to give their perception of their treating physicians' empathy by using questionnaire 'Jefferson Scale of Patient Perceptions of Physician Empathy (JSPPPE)'. Informed consent was obtained from each individual physician and patient.

The Jefferson Scale of Empathy
The Jefferson Scale of Empathy (JSE) is a validated instrument to measure clinical empathy in physicians and practicing health professionals (HP-version), medical students (S-version), and health professions students other than medical students (HPS-version).[15] These versions have been developed with minor alterations in them to make them relevant for each target population.[16] It is a 20-item answered on 7 point Likert-type scale (1- Strongly Disagree, 7- Strongly Agree) which takes up to 5 minutes to fill.[17] A global score is calculated with higher scores (ranging from 20 to 140 for the total scale) reflecting a higher empathetic approach.

The JSE-HP is a tool used by health professionals to assess their own level of empathy in patient care.

The Jefferson Scale of Patient Perceptions of Physician Empathy (JSPPPE) is a brief, 5 item survey developed for measuring patient perceptions of their physician's empathy. Each item of the survey is answered on a 7-point Likert scale (1-Strongly Disagree, 7-Strongly Agree).

Satisfactory evidence of the Jefferson Scales, in support of its validity and reliability properties, amongst various healthcare workers has been reported.

JSE-HP, JSE-S, and JSE-HPS focus on self-assessment of empathy. JSPPPE shifts the perspective to patients evaluating their physician's empathy.Using both JSE-HP and JSPPPE together, as in this study, helps identify gaps between physician self-perception and patient experience.

Ethics Statement
The study was approved by the institutional human ethics committee (IHEC Project 23/266) in accordance with the institutional guidelines and regulations.

Inclusion and Exclusion Criteria
40 physicians in total, from four (n=19) 'people-oriented' and four (n=21)'technology-oriented', specialties were included (Internal Medicine, Medical Gastroenterology and Obstetrics & Gynecology and Dermatology, Surgery, Orthopedics, Ophthalmology and Otolaryngology, respectively) The selection of participants was by convenience sampling.

Adult patients coming to outpatient clinics or inpatient care of the respective departments during the study period were included. Consenting patients were added in a consecutive manner till required sample size was attained. The departments of Psychiatry and Pediatrics and their patients were excluded as it was felt that a level of discrepancy may arise. The department of emergency medicine was excluded due to the nature of urgent care.

Procedure
Physicians completed the questionnaires before approval was obtained to include their patients. Outpatients received questionnaires immediately after their consultation, while inpatients were approached on the second day of admission. English was the primary medium of communication in this private tertiary care hospital; any language barriers were addressed by bilingual volunteers. Non–English-speaking participants, primarily Tamil- or Malayalam-speaking, received verbal translations from a bilingual interviewer, as validated translated versions were unavailable. To ensure double blinding, patient responses were anonymized, and no identifying information was collected.

Sample Size
Enrollment was capped at five consecutive patients per physician as both physician and patient interviews added approximately 25 minutes to each clinic session. With 40 consenting physicians across eight departments, this produced a patient sample (n) of 200. An effective sample size (neff) was calculated to ensure whether 200 patients were a representative sample. As 5 patients were nested within physicians (m=5) and observations could be co-related, a design effect (DE) was calculated to understand the effect of clustering on variance on precision.

$$neff = n/DE$$
$$DE = 1 + ICC(m − 1)$$

The effective sample size under clustering is n = 200 / 1.60 ≈ 125; assuming ICC = 0.15 from comparable outpatient empathy scores.[18,19] With SD of mean JSPPPE (σ) ≈ 8 points,[15] the 95% confidence interval (CI) for JSPPPE mean scores.

$$95\% \text{ CI} = 1.96 \times \sigma/(n_{eff})^{1/2}$$
$$= 1.96 \times 8/(125)^{1/2}$$
$$= +1.4$$

This proved that the design would achieve a +1.4 precision around previously reported mean JSPPPE scores while staying within practical extensions of clinic and physician times.

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 23 (SPSS Inc., Chicago, IL, USA) and RStudio version 2025.05.01 +513 (R Foundation for Statistical Computing, Vienna, Austria). Descriptive statistics (mean, standard deviation, and range) were computed for physicians' self-rated empathy scores on the JSE-HP (range 20–140) and patients' perceived empathy on the JSPPPE (range 5–35). Independent t-tests were used to compare means between pairs of groups, and one-way ANOVA was applied when comparing more than two groups.

A multilevel linear mixed-effects model was employed to account for clustering of patients within physicians. The primary outcome was patient-perceived empathy (JSPPPE), and the primary predictor was physician self-empathy (JSE-HP). Physician age group, specialty, and gender were included as covariates. The model was specified as: $JSPPPE_{ij} = \beta 0 + \beta 1(JSE\text{-}HPc) + \beta 2(Age) + \beta 3(Specialty) + \beta 4(Gender) + u_{0j} + \varepsilon_{ij}$ where i represents individual patients, j represents physicians, u_{0j} is the random intercept for physician, and ε_{ij} is the patient-level residual error. A random intercept was included to account for between-physician variance. The JSE-HP was grand-mean centered for interpretability. Model parameters were estimated using restricted maximum likelihood (REML), and p-values were derived using Satterthwaite's degrees of freedom approximation.

Effect sizes are reported as unstandardized regression coefficients (β) with 95% confidence intervals (CI). The intraclass correlation coefficient (ICC) was calculated to quantify the proportion of total variance in patient-perceived empathy attributable to physician-level differences. Additionally, an unadjusted Spearman rank correlation was performed between mean physician JSE-HP and mean patient JSPPPE scores aggregated per physician. All statistical tests were two-tailed, with a significance threshold of $\alpha = 0.05$.

Results

The analysis included 200 patient–physician encounters involving 40 physicians. Of these, 18 (45%) were aged <35 years, 18 (45%) were between 35 and 50 years, and 4 (10%) were older than 50 years. Patient ages ranged from 19 to 85 years. The mean (SD) score for physicians' self-rated empathy (JSE-HP) was 74.5 ± 8.6, while the mean (SD) for patients' perceived empathy (JSPPPE) was 31.0 ± 4.6.

At the physician level, there was no significant correlation between self- and patient-rated empathy (Spearman's $\rho = -0.06$, p = 0.71). In pairwise comparisons, male physicians had marginally higher but statistically insignificant JSE-HP scores than female physicians (p > 0.05).

Physician self-empathy was not significantly associated with patient-perceived empathy ($\beta = -0.05$, SE = 0.05, 95% CI = −0.15 to 0.06, p = 0.37; *Figure 1*). After standardization (mean = 0, SD = 1), this relationship remained non-significant ($\beta = -0.08$, SE = 0.10, 95% CI = −0.28 to 0.11, p = 0.37).

Physicians aged 35–50 years reported the highest self-empathy scores [mean = 76.2 (SD = 7.3); 95% CI = 74.6–77.7], followed by those <35 years [mean = 73.8 (SD = 9.5); 95% CI = 71.7–75.7], and physicians >50 years [mean = 70.5 (SD = 7.8); 95% CI = 66.8–74.2]. Interestingly, patients rated physicians aged >50 years significantly higher on empathy [mean = 32.1 (SD = 2.8); p = 0.033]. This is depicted in *Figure 1.*

Figure 1. Relationship Between Physician Self-Empathy (JSPE) and Patient-Perceived Empathy (JSPPPE).
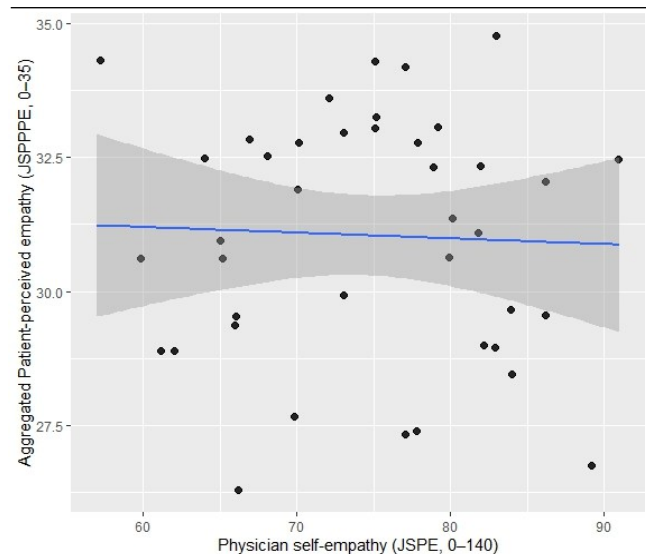
Legend: Scatterplot showing the relationship between physicians' self-rated empathy (JSE-HP, 0–140) and aggregated patient-perceived empathy (JSPPPE, 0–35) for each physician (N = 40). Each point represents one physician and their corresponding aggregated patient-score. The blue line represents the fitted linear regression line, and gray-shaded band indicates the 95% confidence interval. The relationship between JSE-HP and JSPPP was not significant (Spearman's $\rho = -0.06$, p = 0.71).

Physicians from technically oriented specialties (Dermatology, Otolaryngology, Surgery, Ophthalmology, and Orthopaedics) had lower mean JSPPPE scores [mean = 30.9 (SD = 4.0)] than those from person-oriented specialties (General Medicine, Obstetrics and Gynecology, and Medical Gastroenterology) [mean = 31.0 (SD = 5.0)].

In the multilevel model, none of the covariates (physician age group, specialty, or gender) were significantly associated with patient-perceived empathy (all p > 0.05). The variance of the physician-level intercept was 1.42 (SD = 1.19), and the patient-level variance was 20.08 (SD = 4.48). Approximately 7% of the variance in patient empathy scores was attributable to between-physician differences (ICC = 0.066).

Discussion

Empathy, compassion, and communication skills are strongly linked to physician traits that have been demonstrated to enhance patient-centered outcomes. This study was undertaken to identify the current perception of empathy amongst the clinicians and their respective patients.

Our hospital-based cross-sectional study involving 200 patients and 40 physicians found a negative correlation between physicians' self-assessed empathy and patients' perceptions of physician empathy during clinical encounters.

Previous studies using various scales, such as the Consultation and Relational Empathy (CARE) questionnaire, have similarly reported a lack of correlation between physician and patient ratings of empathy.[20,21] Although most physicians considered themselves empathetic, there was an insignificant inverse correlation between their self-rated and patient-rated empathy scores (ρ = –0.06, p = 0.71). This finding indicates that higher self-assessed empathy does not necessarily translate into higher empathy ratings from patients. One possible explanation is that physicians may possess an inherent sense of empathy but fail to address patients' unmet emotional or supportive needs during consultations.

Interestingly, patients rated physicians aged >50 years higher for empathy, despite these physicians assigning themselves lower self-empathy scores. Effective communication with patients is an art refined through years of experience and practice. Older physicians may have established longer relationships with their patients and developed greater skill in managing clinical workloads efficiently. Prior studies have shown that older, more experienced physicians tend to rate themselves higher in empathy than younger physicians.[22,23] Over time, clinical experience and exposure to diverse patient populations may enable a more holistic approach to care, with seasoned clinicians focusing more on the human aspects of medicine.

Our study population comprised individuals from similar ethnic and linguistic backgrounds, which may explain the absence of significant associations between patient–physician demographic factors and empathy ratings.

In this study, physicians' self-rated empathy (JSE-HP) did not correlate with patient-perceived empathy (JSPPPE), even after adjusting for physician age, gender, and specialty in a multilevel model. The intraclass correlation coefficient (ICC) indicated that approximately 90% of the variability in empathy perception lay at the patient–encounter level. This discrepancy suggests that physicians' self-perceptions of empathy may not accurately reflect the empathic behaviors perceived by patients during real clinical interactions. The absence of significant effects for physician age, gender, or specialty further implies that empathy, as perceived by patients, is likely more situational and relational than trait-based.

Contrary to earlier reports, our study found no significant association between physician gender or specialty and patient-perceived empathy.[24,25] However, specialties requiring greater patient interaction and communication (e.g., general medicine, obstetrics and gynecology) showed slightly higher empathy scores in the preliminary analysis compared to more technique-oriented fields (e.g., surgery, dermatology, orthopedics). This may be because physicians in patient-centered specialties spend more time on history taking and discussion, allowing for richer empathic communication, whereas procedural specialists may focus more on technical skills, leading to briefer and less emotionally engaged interactions.

This study contributes to the existing literature by providing a regionally grounded perspective from the Indian healthcare context, where physician–patient interactions often reflect unique cultural expectations and communication styles.

Conclusion

This study suggests a disparity between physicians' self-assessed empathy and patients' perceptions of their empathy, as measured by the Jefferson Scales. There are lacunae globally, in the medical curricula, typically lacking substantial emphasis on empathy training. Empathy plays a significant role in successful clinical encounter, patient satisfaction and treatment outcomes.

Experienced physicians, particularly those over the age of 50, tend to receive higher empathy scores from patients, despite giving themselves lower self-assessment scores. This may indicate that while self-perception of empathy may diminish with age and experience, patients may appreciate the depth of care and communication skills developed over years of practice. Conversely, younger physicians may rate themselves higher, possibly reflecting an idealized view of their empathetic capabilities that does not always align with patient feedback. This variation could also be influenced by individual differences in attitudes toward humility. We also observed that specialties demanding greater patient interaction and communication scored higher on empathy compared to more technique-focused specialties. This suggests that the nature of the specialty has an influence on the practice and perception of empathy, with specialties that prioritize patient communication and relational skills inherently fostering higher empathy. However, there cannot be a 'one size fits all' approach, and definitely the patients' needs and demands differ according to the specialty they are consulting.

Continuous training and self-reflection is pivotal to bridge the gap between physicians' self-assessments and patient perceptions of empathy. Setting up regular feedback systems and improving communication skills training can aid physicians in better understanding and addressing patient expectations, thereby enhancing patient satisfaction and care outcomes. Future research should evaluate the factors behind the discrepancies and propose interventions aimed at aligning physicians' self-perceptions with patient assessment to promote a more empathetic healthcare environment.

Limitations

This study has several limitations. The use of convenience sampling from a single tertiary care hospital and a small, unevenly distributed physician sample limits generalizability and statistical power for subgroup analyses. Validated translations of the

questionnaires were unavailable, necessitating verbal interpretation by bilingual volunteers, which may have affected the reliability of patient responses.

Response bias is possible, as participating physicians may have been more self-aware or confident in their empathy, and patients might have provided favorable ratings due to social desirability. Important confounding factors, including physician workload, patient volume, consultation length, and case complexity, were not controlled for and may have influenced empathy ratings. Cultural factors may also have affected perceptions, as older physicians received higher patient-rated empathy scores, potentially reflecting societal norms rather than true differences in empathic behavior.

Future studies should use larger, representative samples, validated multilingual instruments, objective assessments, and control for workload-related confounders to improve validity and generalizability.

Summary – Accelerating Translation

Title: Empathy in Practice: Comparing Physicians' Self-Assessment and Patient Perceptions Using the Jefferson Scales.

Main problem to solve: Empathy forms the foundation of effective physician–patient relationships and directly influences communication, satisfaction, and therapeutic outcomes. Despite its recognized importance, there remains a gap between how physicians perceive their own empathy and how patients experience it during clinical encounters. Understanding this discrepancy is vital for translating empathy from an internalized professional value into a consistently observable clinical behavior.

Aim: The present study aimed to assess empathy among physicians using the Jefferson Scale of Empathy – Health Professional version (JSE-HP) and compare it with patient perceptions of their physicians' empathy using the Jefferson Scale of Patient Perceptions of Physician Empathy (JSPPPE). The study also explored the association of empathy scores with physician demographic characteristics such as age, gender, and specialty.

Methodology: A cross-sectional study was conducted at a tertiary care teaching hospital in South India between January and June 2024. Forty physicians across eight departments and their respective 200 patients participated. Physicians completed the JSE-HP, while their patients evaluated them using the JSPPPE. Statistical analyses were performed using SPSS and RStudio. Descriptive statistics, independent t-tests, ANOVA, and multilevel linear mixed-effects modeling were used to analyze relationships between self- and patient-rated empathy, accounting for clustering of patients within physicians.

Results: The mean physician self-empathy score (JSE-HP) was 74.5 ± 8.6, and the mean patient-perceived empathy score (JSPPPE) was 31.0 ± 4.6. There was no significant correlation between physicians' self-assessed empathy and patients' perceptions (Spearman's ρ = −0.06, p = 0.71). Older physicians (>50 years) received higher empathy ratings from patients despite lower self-scores, suggesting that experiential factors and communication style may enhance perceived empathy. No significant associations were found between empathy scores and physician gender or specialty, although person-oriented specialties showed slightly higher mean values. Approximately 7% of the variance in empathy perception was attributable to physician-level differences.

Conclusion: This study reveals a clear disparity between physicians' self-perception of empathy and how patients actually experience it. Self-assessed empathy may not reliably reflect empathic communication in clinical settings. The findings highlight the need for continuous empathy training, reflective practice, and structured patient feedback to bridge this perception gap. Incorporating empathy assessment into medical education and clinical audits can accelerate the translation of empathy from theoretical understanding to measurable, patient-centered practice—enhancing care quality, trust, and therapeutic outcomes..

References

1. Riess H. The science of empathy. J Patient Exp. 2017;4(2):74–7.

2. Perry A, Shamay-Tsoory S. Understanding emotional and cognitive empathy: a neuropsychological perspective. In: Baron-Cohen S, Tager-Flusberg H, Lombardo MV, editors. Understanding other minds. 3rd ed. Oxford: Oxford Univ Press; 2013. p. 178–94.

3. Klöckner CC, Gerbase MW, Nendaz M, Baroffio A, Junod NP. Relationship between self-reported cognitive and behavioural empathy among medical students. Patient Educ Couns. 2022;105(4):895–901.

4. Segal EA. Social empathy: a model built on empathy, contextual understanding, and social responsibility that promotes social justice. J Soc Serv Res. 2011;37(3):266–77.

5. Figueredo AJ, Steklis NG, Peñaherrera-Aguirre M, Fernandes HBF, de Baca TC, Salmon C, et al. The influence of individual differences and local ecological conditions on emotional empathy, cognitive empathy, and harm avoidance towards nonhuman animals. Hum Anim Interact. 2022;2022:0021.

6. Gerace A, Day A, Casey S, Mohr P. An exploratory investigation of the process of perspective taking in interpersonal situations. J Relatsh Res. 2013;4:e6.

7. Moudatsou M, Stavropoulou A, Philalithis A, Koukouli S. The role of empathy in health and social care professionals. Healthcare (Basel). 2020;8(1):26.

8. Sturzu L, Lala A, Bisch M, Guitter M, Dobre D, Schwan R. Empathy and burnout: a cross-sectional study among mental healthcare providers in France. J Med Life. 2019;12(1):21–9.

9. Moya-Salazar J, Goicochea-Palomino EA, Porras-Guillermo J, Cañari B, Jaime-Quispe A, Zuñiga N, et al. Assessing empathy in healthcare services: a systematic review of South American healthcare workers' and patients' perceptions. Front Psychiatry. 2023;14:1249620.

10. He S, Sultana R, Anantham D, Loh HP, Zhou JX, Tang JY, et al. Empathy levels among healthcare professionals: an Asian multi-professional cross-sectional study. Cureus. 2024;16(2):e53750.

11. Howick J, Steinkopf L, Ulyte A, Roberts N, Meissner K. How empathic is your healthcare practitioner? A systematic review and meta-analysis of patient surveys. BMC Med Educ. 2017;17(1):136.

12. Hermans L, Olde Hartman TC, Dielissen PW. Differences between GP perception of delivered empathy and patient-perceived empathy: a cross-sectional study in primary care. Br J Gen Pract. 2018;68(674):e621–6.

13. Nasiri M, Amini M, Mani A, Delavari S, Kiani M, Sagheb MM, et al. Assessing empathy in final-year medical students using the Persian

version of the Jefferson Scale of Physician Empathy. J Educ Health Promot. 2021;10:310.

14. Tonelli M, Wiebe N, Manns BJ, Klarenbach SW, James MT, Ravani P, et al. Comparison of the complexity of patients seen by different medical subspecialists in a universal health care system. JAMA Netw Open. 2018;1(7):e184852.

15. Hojat M. Empathy in health professions education and patient care. New York: Springer Int Publ; 2016.

16. Hojat M, Gonnella JS, Nasca TJ, Mangione S, Veloski JJ, Magee M, et al. The Jefferson Scale of Physician Empathy: further psychometric data and differences by gender and specialty at item level. Acad Med. 2002;77(10 Suppl):S58–60.

17. Hojat M, Maio V, Pohl CA, et al. Clinical empathy: definition, measurement, correlates, group differences, erosion, enhancement, and healthcare outcomes. Discov Health Syst. 2023;2:8.

18. Gathara D, English M, van Hensbroek MB, et al. Exploring sources of variability in adherence to guidelines across hospitals in low-income settings: a multi-level analysis of a cross-sectional survey of 22 hospitals. Implement Sci. 2015;10:60.

19. Krol MW, de Boer D, Rademakers JJ, et al. Overall scores as an alternative to global ratings in patient experience surveys: a comparison of four methods. BMC Health Serv Res. 2013;13:479.

20. Bernardo MO, Cecílio-Fernandes D, Costa P, Quince TA, Costa MJ, Carvalho-Filho MA. Physicians' self-assessed empathy levels do not correlate with patients' assessments. PLoS One. 2018;13(5):e0198488.

21. Akham N, Goutam S, Rajkumari J, Singh TA, Singh TA. Physicians' empathy toward patients at a private medical college, Manipur: a cross-sectional study. Int J Community Med Public Health. 2025;12(4):1742–7.

22. Wang H, Kline JA, Jackson BE, Laureano-Phillips J, Robinson RD, Cowden CD, et al. Association between emergency physician self-reported empathy and patient satisfaction. PLoS One. 2018;13(9):e0204113.

23. Park C, Lee YJ, Hong M, Jung CH, Synn Y, Kwack YS, et al. A multicenter study investigating empathy and burnout characteristics in medical residents with various specialties. J Korean Med Sci. 2016;31(4):590–7.

24. Walocha E, Tomaszewska IM, Mizia E. Empathy level differences between Polish surgeons and physicians. Folia Med Cracov. 2013;53(1):47–54.

25. Abdulkader RS, Venugopal D, Jeyashree K, Al Zayer Z, Senthamarai Kannan K, Jebitha R, et al. The intricate relationship between client perceptions of physician empathy and physician self-assessment: lessons for reforming clinical practice. J Patient Exp. 2022;9:23743735221077537.

A Retrospective Analysis Exploring the Impact of Psychiatric Comorbidities on the Time to Initiate HIV Treatment

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Abstract

Background: Timely initiation of antiretroviral therapy (ART) is critical for optimal HIV management. However, psychiatric comorbidities may influence treatment adherence, healthcare engagement, and overall outcomes. This retrospective cohort study explored the impact of major depressive disorder (MDD), generalized anxiety disorder (GAD), and schizophrenia on the time to initiation of ART for HIV management. **Methods:** Using TriNetX, a de-identified database encompassing 66 U.S. healthcare organizations, adults aged 18 and older with an HIV diagnosis were identified through insurance billing codes. Participants were categorized into four groups based on psychiatric history: MDD, GAD, schizophrenia, or no psychiatric diagnosis. Each psychiatric group was propensity score–matched to a control group without a prior psychiatric history to minimize bias. Measures of association and Kaplan-Meier survival analyses were conducted to assess time to ART initiation. **Results:** There was an observed association between having a psychiatric diagnosis prior to acquiring HIV and a higher likelihood of initiating ART, compared to controls. Additionally, those with a psychiatric diagnosis were observed to have initiated ART sooner. The median time to ART initiation was 136 days for MDD, 129 days for GAD, and 163 days for schizophrenia, compared to 312, 229, and 302 days in their respective control groups. **Conclusion:** Individuals with psychiatric comorbidities were more likely to begin ART earlier than those without a psychiatric condition. This may reflect increased healthcare engagement among patients with established psychiatric care, highlighting the importance of integrated behavioral and medical health services for improving HIV treatment outcomes.

Introduction

In the United States, it is estimated that over 1.2 million individuals over the age of 13 are currently living with HIV. Yearly, over 30,000 individuals acquire HIV in this country.[1] The timely initiation of antiretroviral therapy (ART) is of paramount importance to clinicians and public health practitioners. Current guidelines recommend initiation of ART on the same day or within 72 hours among those who have a confirmed HIV diagnosis, a pending reactive HIV screening, a positive confirmatory HIV test, or an acute HIV infection.[2] Rapid initiation of ART amongst people living with HIV (PLWH) has been shown to reduce the time to viral suppression, increase retention in medical care, and greatly reduce the transmission of HIV.[2] Additionally, asymptomatic patients are shown to experience a myriad of benefits with early ART initiation. Timely prescription of ART has been shown to reduce HIV-related morbidity and mortality, delay or prevent immunocompromise, and potentially lower the risk of viral resistance.[3-5]

Despite these benefits, barriers such as lack of access to affordable care, stigma of HIV and mental health disorders can limit an individual's ability to safely access and maintain ART.[6]

Various psychiatric comorbidities can adversely impact the management of HIV, particularly in patients who have conditions such as major depressive disorder (MDD), generalized anxiety disorder (GAD), or schizophrenia. For instance, one study found that those with a psychiatric disorder were more likely to be non-adherent to ART.[7] These conditions can complicate treatment adherence, healthcare engagement, and overall patient outcomes, creating a critical need for targeted research in this area. Thus, the interplay between mental health and HIV care is critical yet remains understudied in the context of ART initiation. While research has highlighted the negative effects of psychiatric conditions on ART adherence and retention in care, there is limited exploration of how mental health disorders specifically affect the timing of ART initiation in the United States. Studies conducted in other regions, such as South Africa, suggest that conditions like depression and anxiety can delay ART initiation. For example, one study found that individuals with depression were less likely to start ART within 90 days of diagnosis and had overall lower odds of long-term retention in care.[8] Similar trends were observed in individuals with anxiety, pointing to a broader pattern of psychiatric disorders impacting timely ART initiation.[8] However, findings from these studies may not generalize to the

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U.S., where structural, cultural, and healthcare system differences, including greater access to mental health services, different models of HIV care delivery, and distinct patterns of stigma and social support, could influence both psychiatric diagnoses and ART initiation. As such, there is a need for U.S.-based research to understand how these mental health conditions intersect with ART initiation in this context.

Given the well-documented consequences of delayed ART initiation, such as increased morbidity, mortality, and transmission rates, understanding how psychiatric comorbidities influence this crucial aspect of HIV care is essential.[9] Further investigation of this topic can inform targeted interventions and policies aimed at improving treatment adherence and overall health outcomes for PLWH. Furthermore, the evolving social, economic, and healthcare landscapes in the U.S. may present distinct challenges and opportunities for addressing these barriers.[9]

This study seeks to address this gap by examining the impact of psychiatric comorbidities, specifically MDD, GAD, and schizophrenia, on the time to initiate ART for HIV. This initial study focuses on individuals with these conditions. Through a retrospective cohort study design, we aim to better understand the relationship between mental health conditions and ART initiation, with the goal of elucidating the experience of PLWH in the U.S. who may be affected by psychiatric conditions. Based on previous literature, we hypothesize that individuals with these psychiatric comorbidities may initiate HIV treatment at a later date compared to those without a psychiatric comorbidity.

Methods

The current study used the US Collaborative Network in TriNetX to assess the presence of comorbid psychiatric conditions in patients with HIV. This database contains electronic medical records including diagnosis and procedure billing codes across various large US healthcare organizations (HCOs). This network contained 66 HCOs and all data was downloaded on January 11, 2025, 18:18:53 UTC.

Patient cohorts were defined based on select ICD-10-CM billing codes which are outlined in **_Table 1._** Patients across all cohorts were 18 years of age and older and had a diagnosis of HIV. After satisfying these criteria, patients were then divided into groups based on a concomitant psychiatric condition–MDD, GAD, and schizophrenia–or lack thereof. Patients were excluded from the study if they were diagnosed with more than one of the psychiatric conditions of interest or if their diagnosis with HIV infection occurred more than 20 years ago. Patients with missing data were still included in the study.

The total number of patients in each group prior to balancing cohorts was as follows: 12,011 in the MDD group, 11,248 in the GAD group, 6,388 in the schizophrenia group, and 238,073 in the control groups. Propensity score matching across all cohorts was performed based on age, sex, race, and ethnicity before each

head-to-head analysis. Each experimental group was propensity-matched to a control group **_(Supplemental Tables 1A-1C)._** Each experimental group was also propensity-matched to other experimental groups **_(Supplemental Tables 2A-2C)._** After propensity matching, there were 11,349 individuals each in the MDD group and its control, 11,168 individuals each in the GAD group and its control, and 6,622 individuals each in the schizophrenia group and its control.

Table 1. Cohort Definitions for Control, Major Depressive Disorder (MDD), Generalized Anxiety (GAD), and Schizophrenia Groups.

	Must Have		Cannot Have	
	ICD-10-CM Code	**Diagnosis**	**ICD-10-CM Code**	**Diagnosis**
Control	B20-B20	HIV disease	F41.1	Generalized Anxiety Disorder
			F33.0, F33.1, F33.2	Major depressive disorder, recurrent, mild, moderate, or severe without psychotic features
			F20	Schizophrenia
MDD	B20-B20	HIV disease	F41.1	Generalized Anxiety Disorder
	F33.0, F33.1, F33.2	Major depressive disorder, recurrent, mild, moderate, or severe without psychotic features	F20	Schizophrenia
GAD	B20-B20	HIV disease	F33.0, F33.1, F33.2	Major depressive disorder, recurrent, mild, moderate, or severe without psychotic features
	F41.1	Generalized Anxiety Disorder	F20	Schizophrenia
Schizophrenia	B20-B20	HIV disease	F41.1	Generalized Anxiety Disorder
	F20	Schizophrenia	F33.0, F33.1, F33.2	Major depressive disorder, recurrent, mild, moderate, and severe without psychotic features

Table 2. Risk Analysis of Psychiatric Comorbidity Groups to Controls. Table Name.

Risk of starting ART			Risk Value	95% CI	z	p
Major Depressive Disorder (MDD)						
No MDD, GAD, or Schizophrenia	0.605	**Risk Difference**	-0.140	(-0.152, -0.128)	-22.504	<0.001
MDD	0.745	**Risk Ratio**	0.812	(0.797, 0.827)		
Generalized Anxiety Disorder (GAD)						
No MDD, GAD, or Schizophrenia	0.598	**Risk Difference**	-0.124	(-0.137, -0.112)	-19.364	<0.001
GAD	0.722	**Risk Ratio**	0.828	(0.812, 0.844)		
Schizophrenia						
No MDD, GAD, or Schizophrenia	0.609	**Risk Difference**	-0.028	(-0.045, -0.011)	-3.161	0.002
Schizophrenia	0.636	**Risk Ratio**	0.957	(0.931, 0.983)		

Legend: Comparing the risk of starting antiretroviral therapy (ART) in those with major depressive disorder, generalized anxiety, and schizophrenia compared to those without any psychiatric diagnoses.

Table 3. Risk Analysis Between Psychiatric Comorbidity Groups.

Risk of Prescribing ART			Risk Value	95% CI	z	p
MDD vs. GAD						
MDD	0.737	**Risk Difference**	0.010	(-0.003, 0.023)	1.571	0.116
GAD	0.727	**Risk Ratio**	1.014	(0.997, 1.032)		
MDD vs. Schizophrenia						
MDD	0.749	**Risk Difference**	0.114	(0.097, 0.130)	13.547	<0.001
Schizophrenia	0.635	**Risk Ratio**	1.179	(1.151, 1.208)		
GAD vs. Schizophrenia						
GAD	72.47	**Risk Difference**	0.093	(0.076, 0.111)	10.283	<0.001
Schizophrenia	63.15	**Risk Ratio**	1.148	(1.118, 1.178)		

Legend: Comparing the risk of starting antiretroviral therapy (ART) between groups with HIV and comorbid major depressive disorder (MDD), generalized anxiety (GAD), or schizophrenia.

Table 4. Analysis of the Time to ART Initiation in Patients with a Psychiatric Comorbidity Compared to Controls.

	Median Time to ART (days)	Probability of no ART (%)	Kaplan Meier Log-Rank Test		Hazard Analysis		Proportionality Testing	
			χ2	p	Hazard Ratio	95% CI	χ2	p
Major Depressive Disorder (MDD)								
MDD Control	312	6.48						
MDD	136	6.71	165.471	<0.001	0.816	(0.790, 0.843)	1.660	0.198
Generalized Anxiety Disorder (GAD)								
GAD Control	299	10.43						
GAD	129	9.23	138.723	<0.001	0.826	(0.799, 0.854)	1.840	0.175
Schizophrenia								
Schizophrenia Control	302	0.00						
Schizophrenia	163	10.91	17.949	<0.001	0.910	(0.870, 0.951)	12.453	<0.001

Legend: Comparing Kaplan-Meier analysis, log rank tests, and hazard ratios for patients with major depressive disorder, generalized anxiety disorder, or schizophrenia compared to those without these diagnoses to assess time to starting ART. *Degrees of freedom for all analyses = 1

Table 5. Kaplan-Meier Analysis of the Time Until ART Initiation Between Patients with Different Psychiatric Comorbidities.

	Kaplan Meier Analysis		Log-Rank Test		Hazard Analysis		Proportionality Testing	
	Median time to ART (days)	Probability of no ART (%)	$\chi2$	p	Hazard Ratio	95% CI	$\chi2$	p
MDD vs. GAD								
MDD	136	7.17						
GAD	126	9.42	0.075	0.784	0.995	(0.962, 1.028)	16.394	<0.001
MDD vs. Schizophrenia								
MDD	124	6.96						
Schizophrenia	165	10.90	29.293	<0.001	1.121	(1.074, 1.170)	31.512	<0.001
GAD vs. Schizophrenia								
GAD	119	10.19						
Schizophrenia	159	11.52	17.935	<0.001	1.101	(1.051, 1.153)	9.953	0.002

Legend: The Kaplan-Meier analysis, log rank tests, and hazard ratios between groups with major depressive disorder (MDD), generalized anxiety disorder (GAD), or schizophrenia were compared to assess time to starting ART.

Results

Propensity score matching largely showed no significant differences in the demographic breakdown between groups, with few exceptions *(Tables 1A-1C and 2A-2C).* For all control versus experimental analyses, the American Indian or Native Alaskan population was significantly different between groups (MDD: p=0.004, GAD p=0.012, Schizophrenia p=0.048, *Supplemental Table 1A-1C).* For the MDD-to-control and Schizophrenia-to-control Native Hawaiian or Pacific Islander was also significantly different (MDD: p=0.009, Schizophrenia p=0.011, Supplemental Figure 1A and 1C).

Our findings demonstrate an association between comorbid MDD, GAD, or schizophrenia and higher rates of ART initiation among patients with HIV, relative to those without these psychiatric conditions *(Table 2).* Risk analysis showed the control group had a statistically significant decreased risk of starting ART compared to balanced patient cohorts with either MDD (Risk difference = -0.140, CI 95% = -0.4152, -0.128, p < 0.001; Risk ratio = 0.821, 95% CI = 0.797, 0.827), GAD (Risk difference = -0.124 CI 95% = -0.137, -0.112, p < 0.001; Risk ratio = 0.828, CI = 0.812, 0.844), and schizophrenia (Risk difference = -0.028, CI 95% = -0.045, -0.011, p = 0.002; Risk ratio = 0.957, CI = 0.931, 0.983).).

When assessing risk across groups with psychiatric comorbidities, those with schizophrenia had a significantly lower risk of initiating ART treatment compared to the other experimental groups *(Table 3).* Those with MDD were significantly more likely to start ART compared to those with schizophrenia (Risk difference = 0.114, CI 95% = - 0.097, 0.130, p < 0.001; Risk ratio = 1.014, CI 95% = 0.997, 1.032). The same occurred when comparing patients with GAD to those with schizophrenia (Risk difference= 0.093, CI 95% = 0.076, 0.111, p < 0.001; Risk ratio = 1.148, CI 95% = 1.118,

1.178). No significant change in risk was observed when comparing the MDD and GAD groups (Risk difference = 0.010, 95% CI = -0.003, 0.023, p=0.116; Risk ratio = 1.014, 955 CI = 0.997, 1.032).

Kaplan-Meier analysis indicates that those with comorbid MDD, GAD, or schizophrenia received ART treatment in significantly less time than their respective control groups after cohort balancing *(Table 4).* The median times to initiate ART for those in MDD, GAD, and schizophrenia groups were 174, 134, and 139 days less than their balanced control groups, respectively (MDD: Log Rank Test: $\chi2$ = 165.471, df = 1, p<0.001; GAD: Log Rank Test: $\chi2$ = 138.723, df = 1, p<0.001; Schizophrenia: Log Rank Test: $\chi2$ = 17.949, df = 1, p<0.001 = 1, p<0.001). Hazard ratios showed a significantly reduced rate of starting ART in control groups compared to those with a diagnosis of MDD (HR=0.816, CI 95% = 0.790, 0.843), GAD (HR = 0.826, CI 95% = 0.799,0.854) and schizophrenia (HR=0.910, CI 95% =0.870, 0.951). Proportionality tests indicate that the only analysis which had significantly different variance between groups was the comparison between schizophrenia and its control group ($\chi2$ = 12.453, df = 1, p <0.001). This was not seen in the MDD ($\chi2$ = 1.660, df = 1, p = 0.198) or GAD analyses ($\chi2$ = 1.840, df = 1, p = 0.175). When evaluating the percentage of patients who did not start ART, the only significant difference existed between schizophrenia and its control group: 10.91% of the schizophrenia group did not receive ART by the end of the interval time, whereas all of those in the matched control group had received ART *(Table 4).*

Kaplan-Meier analyses between groups with comorbid MDD, GAD, or schizophrenia indicate that those with schizophrenia had a significantly longer time to start ART treatment compared to the other groups *(Table 5).* Our data shows that patients in the schizophrenia group took roughly 40 days longer than the MDD

and GAD groups to initiate ART (MDD vs Schizophrenia: Log Rank Test: $\chi 2$ = 29.293, df = 1, p<0.001; GAD vs Schizophrenia: Log Rank Test: $\chi 2$ = 17.935, df = 1, p<0.001). Furthermore, hazard ratios showed that those with schizophrenia had a significantly reduced rate of getting ART prescribed compared to groups with MDD and GAD (MDD: HR = 1.121, CI 95% = 1.074-1.170; GAD: HR = 1.101, CI 95% =1.051-1.153). Kaplan Meier Analysis and hazard ratios showed no significant differences between the MDD and GAD groups (Log Rank Test: $\chi 2$ = 0.075, df = 1, p=0.784; HR = 0.995, CI 95% = 0.962-1.028). For all the combinations assessed, proportionality tests suggest that none of the hazard ratios had significant variance over time (MDD vs GAD: $\chi 2$ = 16.394, df = 1, p <0.001; MDD vs Schizophrenia: $\chi 2$ = 31.512, df = 1, p < 0.001; GAD vs Schizophrenia: $\chi 2$ = 9.953, df = 1, p = 0.002). A larger number of patients in the schizophrenia group also never started ART therapy when compared to MDD and GAD groups **_(Table 5)._**

Discussion

In contrast to the South African study by Truong et al., our data showed that patients in the U.S. diagnosed with MDD, GAD, or schizophrenia were more likely to initiate ART than those without these diagnoses and were also more likely to initiate it earlier. Initiation of ART for all patients with HIV holds the highest ratings for recommendation and evidence at A and I, respectively, underscoring the importance of prompt treatment.[10] In this respect, it is important to recognize these diagnoses as a possible factor when it comes to initiating the recommended treatment of HIV. However, further research is needed to clarify whether this association reflects access patterns, diagnostic practices, or other underlying mechanisms.

These findings are somewhat unexpected, given the extensive literature that people suffering from psychiatric conditions typically experience worse health outcomes and higher rates of premature mortality compared to the general population.[11] Compared to the study by Truong et al., the present study included a much larger sample size, providing greater statistical power. However, it is important to acknowledge that a multitude of other factors may be related to the incongruence between the results presented here and previously published articles. Differences in sociocultural norms, perceptions of mental illness and HIV, healthcare infrastructure, and access between countries may all contribute to the discrepancies in these findings. It may also be possible that receiving a diagnosis of MDD, GAD, or schizophrenia has different implications for the different populations being studied. The National Institute of Mental Health published a study showing that 50.6% of adults in the US with mental illness received treatment in 2022,[12] while a 2023 study published in the SSM Mental Health Journal estimates that up to 75% of South Africans living with common mental illnesses do not receive treatment.[13] Understanding the implications that lead to these differences may be key to identifying necessary change for facilitating earlier initiation of ART.

Though there is a consensus among the medical community that early initiation of ART results in reduced overall morbidity and mortality for patients diagnosed with HIV, the mean time for initiation of ART was well beyond official recommendations for all groups involved in this study.[10] For example, the average time to initiation of ART in the MDD group was 136 days compared to 312 days for the MDD control group, and limited information exists on whether starting at 136 days provides a clear clinical benefit versus 312 days post diagnosis. While this represents a statistically significant difference, both values fall well beyond the recommended 72-hour window, and there is limited literature assessing the clinical impact of ART initiation at these extended time points. Therefore, while the earlier initiation observed in psychiatric cohorts is statistically significant, its clinical significance remains uncertain and warrants further study.

Importantly, our results show that psychiatric comorbidities evaluated in this study were associated with a statistically significant decrease in the median time to initiation of ART, though causality cannot be inferred. One possible explanation of these findings is that patients with diagnosed psychiatric conditions may have more frequent interactions with the healthcare system, increasing opportunities for earlier intervention. There have been studies supporting this notion, including research published by the American Heart Association in 2013, which showed that a diagnosis of depression independently predicted greater utilization of healthcare resources in patients with heart failure.[14]

Our data showed that people who have been diagnosed with schizophrenia were less likely to start ART. If ART was initiated, they were more likely to start later than those who were diagnosed with MDD or GAD. Given that the schizophrenia, MDD, and GAD groups were propensity score matched, schizophrenia may represent an independent risk factor for lower rates and delayed initiation of ART. It has already been made clear that both factors contribute significantly to morbidity and mortality in those with an HIV diagnosis. Therefore, patients with schizophrenia diagnosed with HIV should be considered at greater risk of poor outcomes than patients with MDD or GAD diagnosed with HIV. Because many regions in the US are limited when it comes to community resources such as screening and early intervention programs, it is important for healthcare providers and public health officials to know how to direct these resources. Prior studies have shown that patients with schizophrenia are less likely to receive routine healthcare, such as blood pressure or cholesterol screening in primary care settings.[15] These findings highlight the importance of funding for programs such as Assertive Community Treatment (ACT), which aim to provide integrated care to people suffering from chronic psychotic disorders.[16] One extensive systematic review including studies over a 17-year period showed that patients with severe mental illness such as schizophrenia who were enrolled in ACT were significantly more likely to remain in contact with services than those receiving standard community care.[17] Another study exploring integrated primary care within an ACT service showed that screening for chronic illness substantially increased with this healthcare model versus the general population of those

diagnosed with severe mental illness.[18] Although this healthcare model can present its own distinct challenges and the literature on such programs remains limited, the utilization of intensive community outreach programs for managing chronic illness should continue to be explored.

This study was limited to information available in the TriNetX database, which relies on comprehensive and proper entry of insurance billing codes to classify what patients are being treated for, meaning that the accuracy of our patient classifications is subject to human error during documentation. Additionally, entry of insurance billing codes, as well as a diagnosis of mental illness and/or HIV, implies adequate access to healthcare. People struggling with mental illness have been shown to have several barriers to healthcare, which can affect the identification and treatment of physical and mental illness.[19] Consequently, it is possible that our data underestimates the rate and timeliness in which people struggling with MDD, GAD and schizophrenia begin ART therapy, especially those who are "silently" struggling with mental illness without a formal diagnosis. There also exists a well-documented, longstanding and complex racial disparity regarding mental health care utilization in the US. One study analyzing data from 12,241 respondents found that individuals identified as either Latino or African American were less likely to have received any mental health care services in the last year than their White counterparts.[20] Accordingly, as our data requires a mental health diagnosis, it is possible that it is not racially representative of the general population living with HIV. Additionally, due to our use of insurance billing codes within the US, the data presented may not be generalizable to populations outside of the US.

As an initial study, our data was limited to patients with MDD, GAD or schizophrenia, as well as their propensity score matched control groups. To further understand the association between mental illness and beginning ART once diagnosed with HIV, as well as the average time until ART is initiated, future research could include patients who have been diagnosed with other mental illnesses, such as the bipolar affective disorders, post-traumatic stress disorder, obsessive compulsive disorder, or other conditions. Because different mental illnesses have varying demographic associations and differing likelihoods of healthcare utilization, this may help identify traits contributing to earlier and more frequent initiation of ART.[21] Similarly, comparing individuals with psychiatric conditions to those with other chronic conditions that require routine care, such as diabetes, congestive heart failure, or chronic obstructive pulmonary disease, may yield additional insights. Additional studies could also evaluate the impact of morbidity and mortality in patients who start ART at different time intervals after the recommended 72-hour timeframe.

Conclusion

Our study showed that those with psychiatric comorbidities were more likely to initiate ART sooner than those without psychiatric comorbidities. While the psychiatric comorbidities evaluated in this study may be associated with earlier initiation of ART, patients with schizophrenia did not benefit from this association as much as the other comorbid groups. Furthermore, the findings may indicate that consistent interactions with the healthcare system increase a patient's likelihood of starting HIV treatment. Future studies could further explore other psychiatric comorbidities with ART initiation or the impact delayed HIV treatment at different time points after the 72-hour recommendation.

Summary – Accelerating Translation

Main Problem to Solve.
In the United States, more than 1.2 million people live with HIV, and over 30,000 new cases are diagnosed each year. For people living with HIV, starting antiretroviral therapy (ART) as soon as possible is essential. ART helps control the virus, improves quality of life, and reduces the chance of transmitting HIV to others. Current medical guidelines recommend starting treatment on the same day as diagnosis or within 72 hours.

However, many people face barriers to starting treatment quickly. These can include the high cost of care, limited access to healthcare, and the stigma that still surrounds both HIV and mental illness. Mental health conditions like depression, anxiety, and schizophrenia can make it even harder for people to stay engaged in care or to follow through with their treatment plans.

Previous research has mostly focused on how mental illness affects whether people stay on HIV medication, but not on how it affects when they start treatment. Studies from other countries, like South Africa, suggest that depression and anxiety can delay starting ART. But because healthcare systems and access to mental health services differ greatly between countries, it's not clear if the same is true in the United States. Understanding how mental health affects the timing of HIV treatment in the U.S. can help improve care and guide public health efforts.

Aim of the Study

This study explored how having certain mental health conditions—major depressive disorder (MDD), generalized anxiety disorder (GAD), or schizophrenia—affects how soon people with HIV begin ART in the United States. The researchers expected that people with these mental health conditions might start ART later than people without them.

Methodology

To investigate this, researchers used data from TriNetX, a large national database that includes de-identified health records from 66 healthcare organizations across the U.S.

The study included adults aged 18 and older who had been diagnosed with HIV. Participants were divided into four groups: those with major depressive disorder (MDD), those with generalized anxiety disorder (GAD), those with schizophrenia, and those with no psychiatric diagnosis. To make fair comparisons, the research team matched each mental health group with a control group that had similar characteristics, such as age, sex, race, and ethnicity.

Researchers then measured how long it took each person to start ART after being diagnosed with HIV. They also compared the overall likelihood of starting treatment between those with and without mental health conditions. Because this study used existing, de-identified data, no personal information was used, and no participants were contacted directly.

Results:

Contrary to what the researchers expected, people with mental health conditions started HIV treatment earlier than those without. Participants with psychiatric diagnoses initiated ART significantly sooner than controls. The median time to ART initiation was 136 days for people with major depressive disorder, 129 days for those with generalized anxiety disorder, and 163 days for those with schizophrenia. In contrast, the control groups for these conditions started treatment after 312, 299, and 302 days, respectively.

This means that across all three psychiatric groups, people with mental health diagnoses began treatment several months earlier than those without. However, there were still meaningful differences within the psychiatric groups. Those with schizophrenia were slower to start treatment than those with depression or anxiety and were less likely overall to receive ART than individuals with other psychiatric diagnoses. While these differences were statistically significant, the study also found that all groups—regardless of mental health status—began treatment much later than the national recommendation of starting within 72 hours.

Conclusion

These findings were surprising because many studies have shown that people with mental health conditions often face more challenges in accessing and maintaining medical care. However, the results of this study suggest that people with diagnosed psychiatric conditions may actually have more frequent contact with the healthcare system, giving them more opportunities to receive HIV treatment earlier.

In the United States, mental health services are often integrated into hospitals or clinics, meaning patients with ongoing psychiatric care may be more closely monitored and referred to other medical services, including HIV care. This could explain why those with depression or anxiety started treatment sooner.

Still, people with schizophrenia seemed to face unique challenges. They started treatment later and were less likely to start at all compared to people with depression or anxiety. This finding highlights the need for targeted outreach and support for people living with both schizophrenia and HIV, who may experience higher barriers to care.

This study found that people living with HIV who also had depression, anxiety, or schizophrenia started antiretroviral therapy sooner than those without a psychiatric diagnosis. However, among the three groups, people with schizophrenia faced more delays and were less likely to receive treatment at all.

These results suggest that regular contact with healthcare services, often part of mental health care, may increase the likelihood of starting HIV treatment. At the same time, they highlight the ongoing need to support people with severe mental illnesses, who may struggle the most with accessing consistent medical care.

Future research should include more psychiatric conditions and explore whether earlier treatment among these groups leads to better long-term outcomes. It should also investigate how to bring all patients closer to the recommended goal of starting HIV treatment within 72 hours of diagnosis..
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References

1. Centers for Disease Control and Prevention (CDC). Fast facts: HIV in the US by age [Internet]. 2024 Nov 14 [cited 2025 Dec 5]. Available from: https://www.cdc.gov/hiv/data-research/facts-stats/age.html.

2. Radix AE, Fine SM, Vail RM, et al. Rapid ART initiation [Internet]. Johns Hopkins University; 2023 [cited 2025 Dec 5]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK557123/.

3. Lundgren JD, Babiker AG, Sharma S, et al. Long-term benefits from early antiretroviral therapy initiation in HIV infection. NEJM Evid. 2023;2(3):evidoa2200302.

4. Lewden C, Chêne G, Morlat P, et al. HIV-infected adults with a CD4 cell count greater than 500 cells/mm³ on long-term combination antiretroviral therapy reach the same mortality rates as the general population. J Acquir Immune Defic Syndr. 2007;46(1):72–7.

5. Uy J, Armon C, Buchacz K, Wood K, Brooks JT, HIV Outpatient Study Investigators. Initiation of HAART at higher CD4 cell counts is associated with a lower frequency of antiretroviral drug resistance mutations at virologic failure. J Acquir Immune Defic Syndr. 2009;51(4):450–7.

6. Bouabida K, Chaves BG, Anane E. Challenges and barriers to HIV care engagement and care cascade: viewpoint. Front Reprod Health. 2023;5:1201087.

7. Mandlate FM, Greene MC, Pereira LF, et al. Association between mental disorders and adherence to antiretroviral treatment in health facilities in two Mozambican provinces in 2018: a cross-sectional study. BMC Psychiatry. 2023;23(1):274.

8. Truong M, Rane MS, Govere S, et al. Depression and anxiety as barriers to ART initiation, retention in care, and treatment outcomes in KwaZulu-Natal, South Africa. EClinicalMedicine. 2021;31:100621.

9. Grinsztejn B, Hosseinipour MC, Ribaudo HJ, et al. Effects of early versus delayed initiation of antiretroviral treatment on clinical outcomes of HIV-1 infection: results from the phase 3 HPTN 052 randomised controlled trial. Lancet Infect Dis. 2014;14(4):281–90.

10. Panel on Antiretroviral Guidelines for Adults and Adolescents. Guidelines for the use of antiretroviral agents in adults and adolescents with HIV [Internet]. Washington (DC): Department of Health and Human Services; 2024 [cited 2025 Dec 5]. Available from: https://clinicalinfo.hiv.gov/en/guidelines/adult-and-adolescent-arv.

11. Molloy R, Brand G, Munro I, Pope N. Seeing the complete picture: a systematic review of mental health consumer and health professional experiences of diagnostic overshadowing. J Clin Nurs. 2023;32(9–10):1662–73.

12. National Institute of Mental Health. Mental illness [Internet]. 2024 Sep [cited 2025 Dec 5]. Available from: https://www.nimh.nih.gov/health/statistics/mental-illness.

13. Sorsdahl K, Petersen I, Myers B, Zingela Z, Lund C, van der Westhuizen C. A reflection of the current status of the mental healthcare system in South Africa. SSM Ment Health. 2023;4:100247.

14. Moraska AR, Chamberlain AM, Shah ND, et al. Depression, healthcare utilization, and death in heart failure. Circ Heart Fail. 2013;6(3):387–94.

15. Roberts L, Roalfe A, Wilson S, Lester H. Physical health care of patients with schizophrenia in primary care: a comparative study. Fam Pract. 2007;24(1):34–40.

16. Bond GR, Drake RE. The critical ingredients of assertive community treatment. World Psychiatry. 2015;14(2):240–2.

17. Marshall M, Lockwood A. Assertive community treatment for people with severe mental disorders. Cochrane Database Syst Rev. 2000;(2):CD001089. Update in: Cochrane Database Syst Rev. 2011;(4):CD001089.

18. Henwood BF, Siantz E, Hrouda DR, Innes-Gomberg D, Gilmer TP. Integrated primary care in assertive community treatment. Psychiatr Serv. 2018;69(2):133–5.

19. Viron MJ, Stern TA. The impact of serious mental illness on health and healthcare. Psychosomatics. 2010;51(6):458–65.

20. Cook BL, Doksum T, Chen CN, Carle A, Alegría M. The role of provider supply and organization in reducing racial/ethnic disparities in mental health care in the US. Soc Sci Med. 2013;84:102–9.

21. Fleury MJ, Grenier G, Bamvita JM, Perreault M, Jean-Caron L. Typology of adults diagnosed with mental disorders based on socio-demographics and clinical and service use characteristics. BMC Psychiatry. 2011;11:67.

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Supplementary Material

Table 1A. Demographics for Major Depressive Disorder Analysis Post-Propensity Score Matching with Control.

Demographics	Control		MDD		Statistics	
	N	%	N	%	P-value	SD
	11,349	100%	11,349	100%		
Sex						
Female	3,721	32.8	3,733	32.9	0.865	0.002
Male	7,403	65.2	7,374	65.0%	0.686	0.005
Unknown						
Race						
White	4,728	41.7	4,685	41.3	0.562	0.008
Black	4,749	42.0	4,723	41.6	0.0536	0.008
Native	30	0.3	57	0.5	**0.004**	0.039
Other	393	3.5	417	3.7	0.371	0.012
Unknown	1,356	11.9	1,360	12.0	0.935	0.001
Asian	62	0.5	79	0.7	0.151	0.019
Hawiian	11	0.1	27	0.2	**0.009**	0.034
Ethnicity						
Hispanic or Latino	1,396	12.3	1,481	13.0	0.090	0.023
Non-Hispanic or Latino	7,889	69.5	7,816	68.9	0.294	0.014
Unknown Ethnicity	2,064	18.2	2,052	18.1	0.836	0.003
Age	**Mean Age**	**SD**	**Mean Age**	**SD**	**P-Value**	**SD**
Current Age	53.0	13.4	52.9	13.3	0.684	0.005
Age at Index	46.2	13.0	46.1	13.0	0.698	0.005

Table 1B: Demographics for Generalized Anxiety Disorder (GAD) Analysis Post-Propensity Score Matching with Control.

Demographics	Control		GAD		Statistics	
	N	%	N	%	P-value	SD
	11,168	100%	11,168	100%		
Sex						
Female	3090	27.7%	3132	28.0%	0.531	0.008
Male	7741	69.3%	7664	68.6%	0.265	0.015
Unknown						
Race						
White	6165	55.2%	6073	54.4%	0.216	0.017
Black	2668	23.9%	2667	23.9%	0.987	<0.001
American Indian or Alaskan Native	37	0.3%	62	0.6%	**0.012**	0.034
Native Hawaiian or Other Pacific Islander	30	0.3%	67	0.6%	0.012	0.034
Unknown	2799	25.1%	2771	24.8%	0.665	0.006
Asian	99	0.9%	114	1.0%	0.302	0.014
Other	416	3.7%	430	3.9%	0.624	0.007
Ethnicity						
Hispanic or Latino	1354	12.1%	1420	12.7%	0.181	0.018
Non-Hispanic or Latino	7015	62.8%	6977	62.5%	0.599	0.007
Unknown Ethnicity	2799	25.1%	2771	24.8%	0.665	0.006
Age	**Mean Age**	**SD**	**Mean Age**	**SD**	**P-Value**	**SD**
Current Age	52.0	13.6	52.0	13.6	0.778	0.004
Age at Index	45.4	13.3	45.4	13.3	0.961	0.001

Table 1C. Demographics for Schizophrenia Analysis Post-Propensity Score Matching with Control.

Demographics	Control		Schizophrenia		Statistics	
	N	%	N	%	P-value	SD
	6,622	100%	6,622	100%		
Sex						
Female	2,107	31.8	2,119	32.0	0.823	0.004
Male	4,473	67.5	4,454	67.3	0.725	0.006
Unknown						
Race						
White	1,517	22.9	1,511	22.8	0.901	0.002
Black	3,644	55.0	3,624	54.7	0.727	0.006
Native	10	0.2	21	0.3	**0.048**	0.034
Other	203	3.1	206	3.1	0.880	0.003
Unknown	1,204	18.2	1,194	18.0	0.821	0.004
Asian	39	0.6	41	0.6	0.823	0.004
Hawiian	10	0.2	25	0.4	**0.011**	0.044
Ethnicity						
Hispanic or Latino	528	8.0	521	7.9	0.822	0.004
Non-Hispanic or Latino	4,206	63.5	4,203	63.5	0.957	0.001
Unknown Ethnicity	1,888	28.5	1898	28.7	0.847	0.003
Age	**Mean Age**	**SD**	**Mean Age**	**SD**	**P-Value**	**SD**
Current Age	52.1	13.2	52.2	13.2	0.691	0.007
Age at Index	45.0	12.5	45.1	12.4	0.672	0.007

Table 2A. Demographics for Propensity-Matched Major Depressive Disorder (MDD) vs. Schizophrenia Analysis.

Demographics	MDD		Schizophrenia		P-value	SD
	N	%	N	%		
	6036	100%	6036	100%		
Sex						
Female	1904	31.5	1916	31.7	0.814	0.0400
Male	4087	67.7	4083	67.6	0.938	0.00100
Unknown	0	0	0	0	-	-
Race						
White	1468	24.3	1468	24.3	1	<0.001
Black	3687	61.1	3643	60.4	0.412	0.0150
American Indian	13	0.2	20	0.3	0.222	0.0222
Other	213	3.5	200	3.3	0.515	0.0120
Unknown	593	9.8	642	10.6	0.141	0.0270
Asian	44	0.7	39	0.6	0.582	0.0100
Hawiian	18	0.3	24	0.4	0.354	0.017
Ethnicity						
Hispanic or Latino	466	7.7	486	8.1	0.499	0.0120
Non-Hispanic or Latino	4386	72.4	4316	71.5	0.292	0.0190
Unknown Ethnicity	1202	19.9	1234	20.4	0.468	0.0130
Age	**Mean Age**	**SD**	**Mean Age**	**SD**	**P-Value**	**SD**
Current Age	51.5	13.1	51.8	13.2	0.217	0.0220
Age at Index	44.8	12.6	44.9	12.5	0.621	0.00900

Table 2B. Demographics for Propensity-Matched Major Depressive Disorder (MDD) vs. Generalized Anxiety Disorder (GAD) Analysis.

	MDD		GAD			
Demographics	**N**	**%**	**N**	**%**	**P-value**	**SD**
	9330	100%	9330	100%		
Sex						
Female	2770	29.7	2770	29.8	0.923	0.00100
Male	6375	68.3	6372	68.3	0.962	0.00100
Unknown	0	0	0	0	-	-
Race						
White	4665	50.0	4715	50.5	0.464	0.0110
Black	2969	31.8	2958	31.7	0.863	0.00300
American Indian	54	0.6	54	0.6	1	<0.001
Other	409	4.4	383	4.1	0.345	0.0140
Unknown	1129	12.1	1111	11.9	0.685	0.00600
Asian	78	0.8	84	0.9	0.636	0.00700
Hawiian	26	0.3	25	0.3	0.888	0.00200
Ethnicity						
Hispanic or Latino	1376	14.7	1280	13.7	0.044	0.0290
Non-Hispanic or Latino	6289	67.4	6403	68.6	0.0740	0.0260
Unknown Ethnicity	1665	17.8	1647	17.7	0.0740	0.00500
Age	**Mean Age**	**SD**	**Mean Age**	**SD**	**P-Value**	**SD**
Current Age	52.5	13.7	52.9	13.7	0.0710	0.0260
Age at Index	45.7	13.2	46.0	13.3	0.0710	0.0260

Table 2C. Demographics for Propensity-Matched Generalized Anxiety Disorder (GAD) vs Schizophrenia Analysis.

	GAD		Schizophrenia			
Demographics	**N**	**%**	**N**	**%**	**P-value**	**SD**
	5308	100%	5308	100%		
Sex						
Female	1752	33.0	1764	33.2	0.805	0.00500
Male	3519	66.3	3506	66.1	0.790	0.00500
Unknown	0	0	0	0	-	-
Race						
White	1474	27.8	1468	27.7	0.896	0.00300
Black	2921	55.0	2922	55.0	0.984	<0.001
American Indian	21	0.4	21	0.4	1	<0.001
Other	199	3.7	199	3.7	1	<0.001
Unknown	637	12.0	635	12.0	0.952	0.00100
Asian	33	0.6	39	0.7	0.478	0.014
Hawiian	23	0.4	24	0.5	0.884	0.00300
Ethnicity						
Hispanic or Latino	478	9.0	481	9.1	0.919	0.00200
Non-Hispanic or Latino	3651	68.8	1695	69.6	0.355	0.0180
Unknown Ethnicity	1179	22.2	1132	21.3	0.269	0.0210
Age	**Mean Age**	**SD**	**Mean Age**	**SD**	**P-Value**	**SD**
Current Age	51.0	13.6	51.4	13.2	0.091	0.0330
Age at Index	44.6	13.0	44.7	12.4	0.508	0.0130

Single Center Experience of the Impact of the COVID-19 Pandemic on Education and Career Outlook of Radiologists

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Abstract

Background: The COVID-19 pandemic mandated social distancing and contact isolation. There is limited data on the impact of such changes on the clinical and educational experience of radiologists. This study aims to understand how the pandemic affected the education, careers, and mental well-being of resident and attending radiologists. **Methods:** A 17-item questionnaire was distributed to resident and attending radiologists at a single academic center. Responses were collected from October 2020 to January 2021 and a follow-up survey was distributed in December 2021. Outcome measures were analyzed using measures of central tendency in Microsoft Excel. **Results:** There were 26 responses, 20 from attending physicians and 6 from residents. Of these, 70% of attendings and 66.7% of residents perceived a negative impact on educational experiences. Among those who completed the depression questionnaire, 85% denied symptoms in themselves or colleagues. In the follow-up survey, all participants reported increased imaging volume, and 57% were working remotely. While 57% saw no impact on mentorship from remote interactions, 29% reported a negative effect. A sense of being overworked was noted by 86%, and 43% reported reduced job satisfaction. Depressive symptoms related to the pandemic were endorsed by 71%. **Discussion:** While schedule flexibility was a notable benefit to remote work, a significant negative impact on educational experiences was reported. Career dissatisfaction was also significant in the follow-up questionnaire, likely due to sustained increased volume and remote education. Future studies should explore workload, mental health, and career satisfaction to improve structuring of radiology workflows.

Introduction

The coronavirus disease of 2019 (COVID-19) pandemic forced rapid adaptation of the healthcare industry to a new environment to mitigate spread of the virus. Social distancing and contact isolation measures have impacted the clinical, educational, and patient care goals of medical institutions.[1,3] Particularly, emergency departments and intensive care units were met with increasing volumes of critically ill patients and resource shortages.[4-6] While workflow changes on medical floors due to the pandemic are well-documented, there is limited data on the adaptations individual health care centers implemented and the consequences of such changes on radiology teams.[6,7] Radiologists continue to have a crucial role in multidisciplinary patient management as they consult physicians of various specialties on diagnoses and management. However, their physical interaction with patients and consulting physicians has been limited with the inception of the picture archiving and communication system (PACS), increasing study volumes, and improved communication systems.[8,9] Notably, many radiologists can work remotely with relatively high proportions of radiology practices offering teleradiology services in the early 2000s.[10]

Therefore, it is appropriate to determine if, and how, the COVID-19 pandemic impacted the field of radiology.

A 2020 study analyzed the use of radiological resources before (2019), during (January-March 2020), and after (April-June 2020) the pandemic.[11] The researchers found a decrease in the number of examinations during the peak of the pandemic but a return to normal pre-pandemic levels after the peak. Moreover, although the volume decreased during the peak, there was greater turnaround time due to PPE and safety precautions necessary to use the resources. This supports the tendency of the public to refrain from seeking care during the pandemic, but the longer turnaround time for assessments may not have relieved the burden on healthcare providers. Similarly, a 2021 study found a 60% decrease in radiology report volume per day overall.[12] Within subspecialties, musculoskeletal, breast, and cardiovascular imaging experienced reductions of >75%. Consequently, 22% of radiologists at this institution were reassigned to other hospital duties.

Among subspecialties with a higher proportion of patient contact, such reductions in patient volume may have implications on

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compensation, burnout, and overall career satisfaction. A cross-section survey distributed to members of the Society of Breast Imaging (SBI) to assess the impact of the pandemic demonstrated significant psychological distress and anxiety in 2020, with slight reductions in 2022.[13] Such distress was correlated with financial strain, childcare responsibilities, decreased research collaboration, and less time with patients. Meanwhile, a similar survey eliciting perspectives of SBI members on remote and in-person work found that hybrid work was preferred over solely in-person or virtual work.[14] This finding was largely driven by feelings of increased efficiency and reduced burnout from remote work; career growth or communication with colleagues and patients were also perceived to not be negatively impacted by this work modality. Importantly, a minority of the respondents were engaged in or had the option of remote work at the time of the survey. Such a difference between the perception of remote work and the experience of remote work highlights the need for more qualitative inquiries on the impact of COVID-19 on radiologists' work.

In addition to imaging volume and work modalities, the impact of the pandemic on the educational environment within radiology residency programs has been studied. Chong et al. provided guidelines, including a list of resources for distance learning and well-being, for programs, offering specific examples from three programs.[15] On a national level, Robbins et al. administered a 22-question survey analyzing the impact of COVID-19 on radiology residencies; 70% of the participants reported a negative impact and 45% perceived a decrease in resident morale.[16] Alhasan et al. report similar perceptions among radiology trainees in Saudi Arabia, noting a severe or moderate negative impact on educational activities felt by a majority of trainees.[17] Regarding changes to clinical workflows, Matalon et al. reported movement of an academic radiology service from 14 traditional reading rooms to 36 spaces across the hospital system.[18] The practice developed a system of "remote readouts" between trainees and attendings, which included video conferencing and screen sharing, as well as an in-house peer learning platform. A survey administered 3 weeks following implementation of this workflow found that social distancing and autonomy/competency was favorable while efficiency was debatable among respondents.[18]

The purpose of this study is to expand on the impact of the COVID-19 pandemic and better understand its effect on lifestyle, education, careers, and mental well-being of resident and attending radiologists at a single academic tertiary care center in the United States. As radiologists continue to work through the COVID-19 pandemic and within a field undergoing rapid technological innovation, the data presented in this study addresses the knowledge gap on the pandemic's impact on radiologists' education and provides insight into important considerations regarding radiologist career outlook.

Methods

Study Design and Setting
This study utilized a cross-sectional survey design to assess the impact of COVID-19 on various aspects of radiologists' careers and professional work. The survey was conducted at a single academic tertiary care center and included both resident and attending radiologists. Two surveys were distributed: the initial survey was distributed via email in October 2020 and voluntarily completed by January 2021, while a follow-up survey was distributed in December 2021 to participants of the initial survey. As this study is a cross-sectional study, it adheres to the STROBE checklist and follows the SQUIRE 2.0 guidelines for reporting healthcare improvement research as described in the subsequent sections.

Participants and Study Size
The target population comprised radiologists at the institution, including residents and attending physicians. Inclusion criteria required participants to be employed at the center during the survey period and willing to voluntarily complete the survey. Exclusion criteria included individuals who were no longer affiliated with the institution or declined to provide informed consent for the follow-up survey. The study size was determined by the total number of radiologists employed at the institution during the survey period. All eligible individuals were invited to participate, with no formal sample size calculation performed due to the descriptive and exploratory nature of the study.

Variables and Data Sources
The primary outcome variables included changes in the volume of imaging, remote work and its duration, effects on relationships between attendings and residents, effects on relationships among colleagues, effects on relationships between physicians and other healthcare providers, effects on relationships with patients, overall job satisfaction, and depressive symptoms among radiologists secondary to the pandemic. Outcome measures were collected as non-binary qualitative data, with categorical and ordinal variables analyzed to assess relationships and trends.

The survey consisted of 17 items with both closed-ended multiple-choice questions and open-ended free-text fields. The survey items were designed to capture qualitative and quantitative data regarding the aforementioned variables. No formal pre-testing of the survey instrument was conducted due to the small target population size, which could have limited the availability of respondents.

To minimize bias, the survey was distributed to all eligible participants at the institution. Responses were anonymized during data collection for the initial survey to encourage honest reporting. For the follow-up survey, participants provided an identifier to enable longitudinal analysis while ensuring confidentiality.

Statistical Methods
Descriptive statistics, including measures of central tendency (e.g., mean, median), were used for exploratory data analysis. Data were analyzed separately for the initial and follow-up surveys using Microsoft Excel (version 16.0.18512.42303). No inferential statistical analyses were performed due to the small sample size and the primarily qualitative nature of the data.

Ethical Considerations

The study was exempt from institutional review board (IRB) approval due to the use of de-identified data in the initial survey. Informed consent was implied through voluntary participation. For the follow-up survey, identifiers were collected solely for linking responses over time and were kept confidential.

Results

Initial Survey:

A total of 26 responses from faculty physicians (n=20) and residents (n=6) were collected on the initial survey **(Table 1).** 84.6% (22/26) of the participants reported decreased imaging volume at the start of the pandemic and 46.2% (12/26) reported that the volume was currently increased. 69.2% (18/26) initially worked remotely; 53.8% (14/26) are not currently working remotely. 70% of attending physicians (14/20) and 66.7% of residents (4/6) perceived a negative impact of the pandemic on educational relationships. 50.0% (13/26) reported decreased communication with other radiologists. 38.4% (10/26) reported a decrease or no change in communication with other healthcare workers. 30.8% (8/26) endorsed feeling overworked compared to before the pandemic while 34.6% (9/26) felt less overworked. 50.0% (13/26) reported no change in job satisfaction. Summary of select data from the Initial Survey is shown in **Figure 1.** Only 20 participants completed a questionnaire concerning depression, and 85% (17/20) denied depressive symptoms in self or colleagues. Free text responses favored remote work due to increased efficiency and accessibility through web-based interactions, but recognized negative effects on teaching, burnout, isolation, and personal stress

Follow-Up Survey Results:

The follow-up survey received responses from 7 faculty physicians **(Table 1).** 100% (7/7) reported that imaging volume increased over the one year timeframe and increased compared to pre-pandemic volume. 57% (4/7) are working 1-2 days per week remotely. Regarding resident mentorship, 57% (4/7) reported no impact on these relationships by remote interactions and 29% (2/7) reported a negative impact. 86% (6/7) stated the department is continuing to use virtual platforms for meetings, conferences, and other peer discussions. Notably, 86% (6/7) reported feeling overworked and 43% (3/7) reported decreased job satisfaction compared to one year ago. Summary of select data from the Follow-Up survey is shown in **Figure 2.** 71% (5/7) endorsed depressive symptoms related to the pandemic in self or colleagues. Free text responses stated there are less one-on-one teaching, decreased awareness of strengths and weaknesses in trainees, and overall higher stress levels. Particularly, one response stated that increasing volume and ongoing pandemic are contributing to depressive moods.

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Figure 1. Summary of Select Data Regarding Changes in Workload, Interpersonal Communication, and Job Satisfaction Among Radiologists at the Start of the COVID-19 Pandemic to the Initial Survey Period.
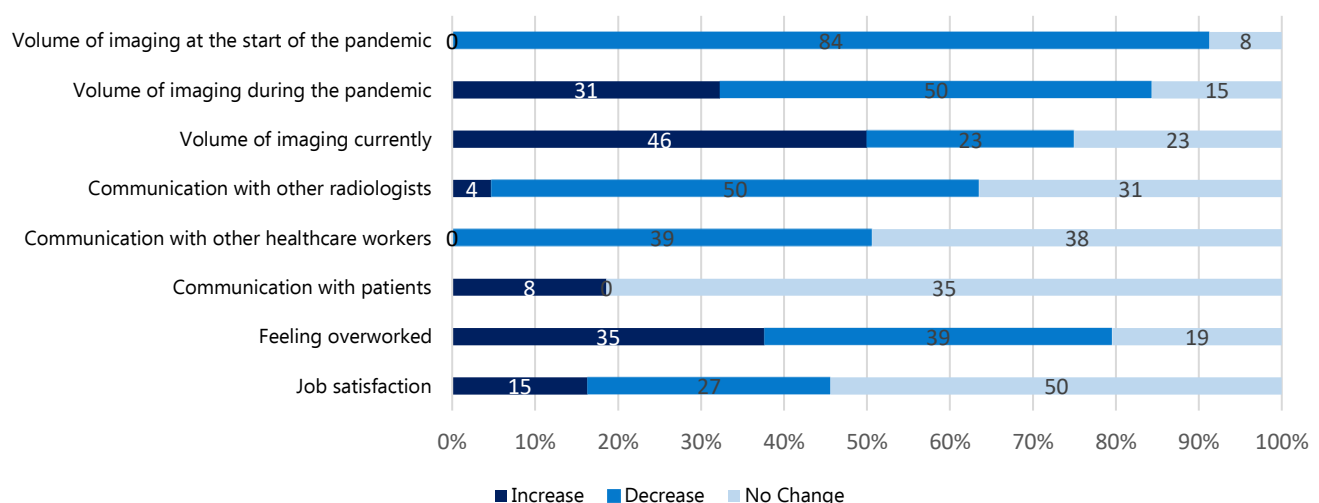
Figure 2. Summary of Select Data from the Regarding Changes in Workload, Interpersonal Communication, and Job Satisfaction Among Radiologists at the Start of the Initial Survey Period to the Follow-Up Survey Period.
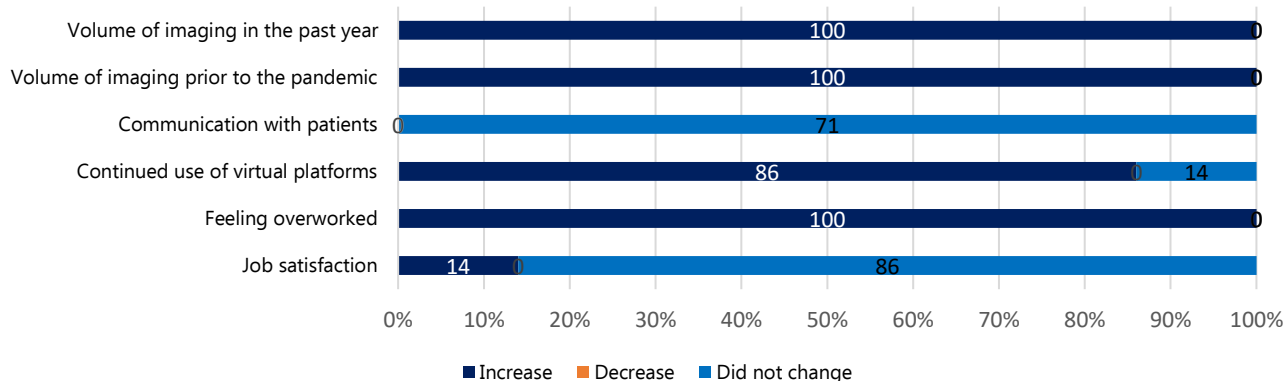
Figure 3. Comparison of Responses Between the Initial Survey and Follow-Up Survey Regarding Remote Work, Professional Relationships, and Depressive Symptoms.
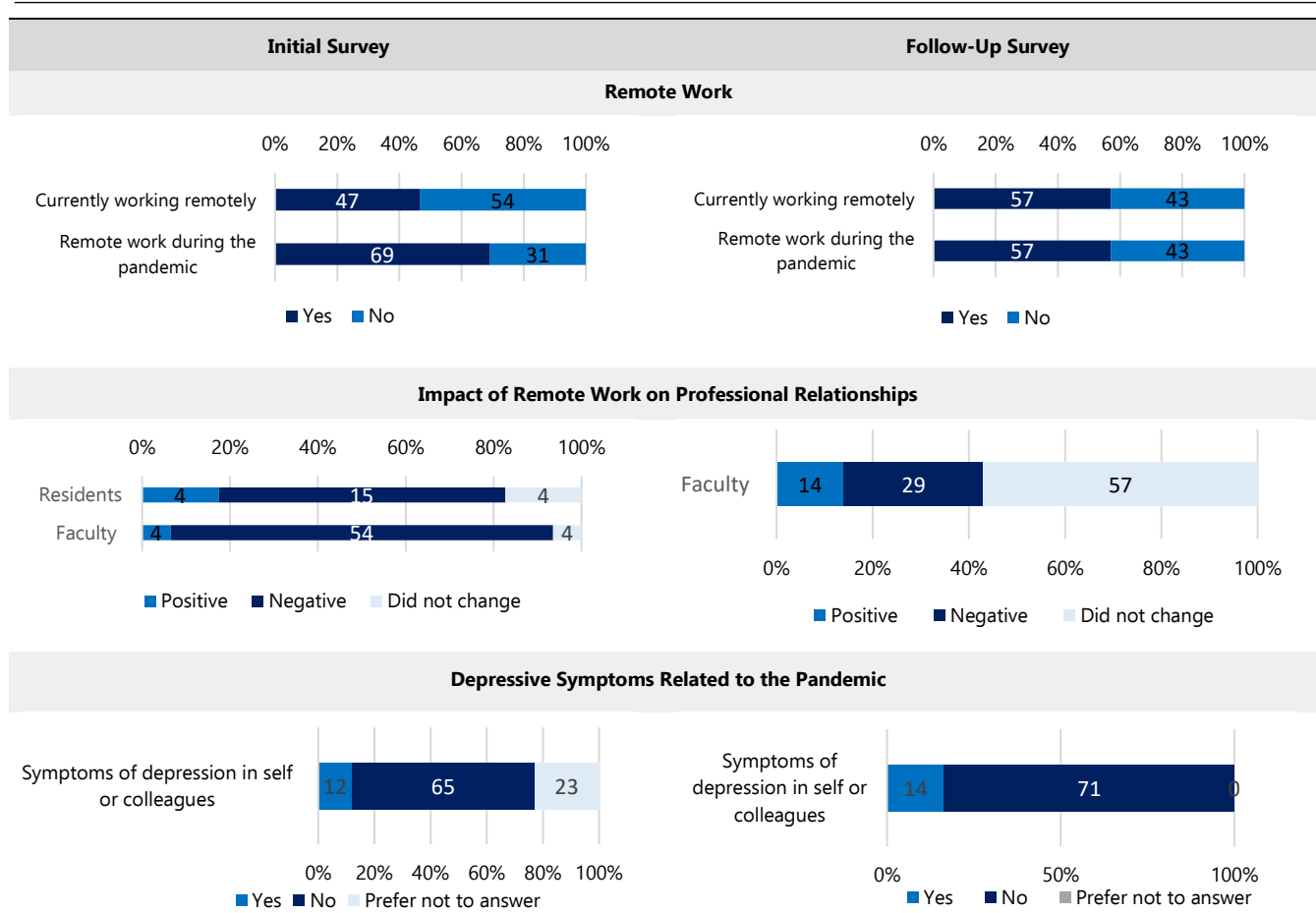
Discussion

The purpose of this survey was to better understand how administrative and clinical changes secondary to the COVID-19 pandemic affected the lifestyle, education, careers, and mental well-being of resident and attending radiologists at an academic medical center on the east coast.

Data from the questionnaire suggest the COVID-19 pandemic had a negative impact on communication and educational relationships within the radiology department. Unlike other medical specialties, patient contact and a requirement for in-office work is minimal, especially if one has resources for home office space. The benefits to working remotely include decreased commuting time and increased schedule flexibility. Furthermore,

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with the continuous proliferation and improvement of online learning tools, such as Radiopaedia.org, and telecommunication channels, the overall educational experience among trainees may not be compromised.[19] However, there may be significant disadvantages with respect to the professional environment of radiology programs. Comradery amongst trainees may be lost with limited in-person interactions and establishing personal relationships with fellow residents and faculty mentors may be more difficult.

Table 1. Number of Survey Responses by Professional Level.

Current Professional Level	Initial Survey	Follow-Up Survey
Intern	0	0
R1	3	0
R2	2	0
R3	1	0
R4	0	0
R5	0	0
Junior Faculty	3	1
Middle Career Faculty	12	4
Senior Faculty	5	2
Total	**26**	**7**

Moreover, while initial evidence for job dissatisfaction and depressive symptoms was unremarkable, the follow-up data highlights feelings of overworking and job dissatisfaction in the past year, likely due to the increased imaging volume and continued remote work and education *(Figure 3).* Factors such as isolation, poor teaching tools, and decreased efficiency during rounds or sign-out may contribute to the negative effects of such remote delivery. Nonetheless, radiologists working in-house may encounter less opportunity for safe lunches because of N95 requirements and limited social distancing opportunities, leading to dissatisfaction. Importantly, these sentiments were reported by attending radiologists and may not be reflective of the experience of residents over the course of the pandemic. It may be hypothesized that residents continued to have appropriate in-person training and education, both procedural and non-procedural, and limits on work volume in accordance with graduate medical education requirements. Accordingly, a risk-benefit analysis would be necessary to determine how best to structure radiology workflows such that precautions for health safety and personal comfort do not significantly limit professional and interpersonal development among resident and attending physicians. Notably, 23% of participants did not answer questions regarding depression in the first questionnaire. This may suggest there is a pervasive stigma or fear of retribution for experiencing mental health issues within the medical field. In addition to highlighting the effect of the COVID-19 pandemic on the mental health of radiologists, it is critical to recognize long-standing learning and working environments that provoke mental health issues and deter radiologists from seeking resources. As some pre-pandemic studies have demonstrated lower job dissatisfaction among radiology residents compared to attending radiologists, added negative experiences due to the COVID-19

pandemic warrant special consideration of the educational environment within radiology departments.[20,21]

As such, radiology residency programs may benefit from adopting a balanced hybrid model that combines the flexibility of remote work for non-procedural activities with in-person training for hands-on experiences and mentorship. Structured socialization opportunities, such as team-building and wellness retreats, alongside formalized mentorship programs, can help foster camaraderie and meaningful connections among residents and faculty. Moreover, investing in high-quality virtual learning platforms and collaboration tools will ensure remote education remains engaging and effective. Importantly, programs must prioritize mental health throughout these experiences by destigmatizing discussions around burnout and depression, along with offering anonymous feedback mechanisms

Limitations of this study include a small sample size and limited participation. The initial survey had 26 respondents, with both attending and resident participation, and the follow-up survey had 7 respondents, with no resident participation. Moreover, such nonresponse bias limits the ability to assess sentiment changes between the initial and follow up survey among individual respondents. Furthermore, there is limited generalizability as the data was collected from a single tertiary care center; future studies in a multicenter cohort are needed to further expand upon the findings of this study. Similarly, the generalizability of the study may be impacted by self-selection bias whereby radiologists most impacted by COVID-19 are more represented in the data compared to radiologists who were less impacted. This impact may describe the relative lack of "No Change" responses in the follow up survey. Future studies should explore methods of improving response rate, such as disseminating surveys through multiple channels or offering incentives for study completion. A larger sample size would also allow for additional statistical analysis that may correlate between the initial and follow up surveys and account for identification of potential predictors, confounders, and effect modifiers among the primary outcomes. As described, the COVID-19 pandemic had variable effects on radiologist education, work, and well-being; thus, future projects should consider more focused surveys delineating the potential causal relationships between workload, professional environment, mental health, and career satisfaction. Special considerations may include highlighting methods for maintaining beneficial educational experiences and peer support through remote work, as well as promoting mental well-being.

Summary – Accelerating Translation

Title: Understanding the Impact of COVID-19 on Radiologists' Work and Education at a Tertiary Academic Center

Main Problem:
The COVID-19 pandemic forced the healthcare system to rapidly adapt to new safety protocols and changes in workflow, significantly impacting various medical specialties, including radiology. Radiologists, who play a crucial role in diagnosing and consulting on patient care, experienced

shifts in their work environment, communication with colleagues, and educational experiences. Despite being able to work remotely, the long-term implications of these changes on radiologists' mental well-being, career satisfaction, and training remain poorly understood.

Aim of the Study:
The purpose of this study was to explore how the COVID-19 pandemic affected the professional work, educational experiences, mental well-being, and career satisfaction of radiologists at a tertiary academic medical center in the United States. By examining changes in imaging volume, communication dynamics, and work modalities, the study aimed to highlight areas for improvement and adaptation in radiology practice during and beyond pandemic conditions.

Methodology:
This study used a cross-sectional survey design to gather information from radiologists, including both residents and attending physicians, at an academic medical center. Two surveys were distributed: the first in October 2020, and a follow-up survey in December 2021. Both surveys collected qualitative and quantitative data on imaging volume, remote work, educational relationships, job satisfaction, and mental health. The responses were anonymized to ensure confidentiality, and participation was voluntary.

Results:
The initial survey, completed by 26 radiologists, showed a significant decrease in imaging volume during the early stages of the pandemic, with 84.6% of participants reporting reductions. Many radiologists (69.2%) transitioned to remote work. Despite the flexibility of working from home, 70% of attending physicians and 66.7% of residents felt that educational relationships were negatively impacted. Communication with colleagues also declined for 50% of respondents. Notably, while many appreciated the benefits of remote work, concerns emerged regarding reduced hands-on training, isolation, and burnout.

In the follow-up survey, which included 7 respondents, all reported that imaging volume had not only recovered but increased compared to pre-pandemic levels. Over half (57%) continued to work remotely part-time. While some educational relationships stabilized, others deteriorated due to virtual limitations. A striking 86% of respondents expressed feeling overworked, and 43% reported decreased job satisfaction. Symptoms of depression were more commonly reported in the follow-up survey compared to the initial one, highlighting growing concerns about mental health among radiologists.

Conclusion:
The COVID-19 pandemic substantially altered the work environment for radiologists, with lasting effects on education, mental health, and career satisfaction. While remote work provided flexibility, it also introduced barriers to communication and mentorship. The increased imaging volume following the pandemic's peak further contributed to feelings of overwork and burnout. Moving forward, hybrid work models that combine in-person training with virtual flexibility, alongside enhanced mental health support, may help radiologists adapt to evolving demands while maintaining professional growth and well-being.

References

1. Alshdaifat E; Sindiani A; Khasawneh W; Abu-Azzam O; Qarqash A; Abushukair O; et al. The impact of COVID-19 pandemic on training and mental health of residents: a cross-sectional study. BMC Med Educ. 2021;21(1):208

2. Abati E; Nelva Stellio L; Manini A; Moroni F; Azzalini L; Vilca LM. A cross-sectional survey study of the impact of COVID-19 pandemic on the training and quality of life of Italian medical residents in the Lombardy region. Ann Med. 2022;54(1):2326–2339

3. Rhodes JH; Santos T; Young GJ. Hospitals' uneven recovery from the COVID-19 pandemic. Health Aff Sch. 2023;1(3):qxad034

4. Font-Cabrera C; Juvé-Udina ME; Adamuz J; Diaz Membrives M; Fabrellas N; Guix-Comellas EM. Activity, triage levels and impact of the pandemic on hospital emergency departments: a multicentre cross-sectional study. J Adv Nurs. 2023;3003.R1:0309–2402

5. Vahidi A; Bahari Z; Behzadnia MJ. Correlation of the COVID-19 infection and outcomes with workload among emergency healthcare workers in an Iranian referral hospital. Arch Razi Inst. 2023;78(6):1804–1810

6. Rietdijk WJR; van der Kuy PHM; den Uil CA. Human resource management at the intensive care unit: a pragmatic review and future research agenda for building a learning health system. Learn Health Syst. 2023;8(2):e10395

7. Ling T; Basic D; Tcharkhedian E; Campisi J; Pringle B; Khoo A. Care in the community: a COVID-19 initiative to reduce hospital re-presentations among community-dwelling people. Australas J Ageing. 2024;43(3):474–481

8. Carlin L; Smith H; Henwood F; et al. Double vision: an exploration of radiologists' and general practitioners' views on using picture archiving and communication systems (PACS). Health Inform J. 2010;16(2):75–86

9. Filice R. Who you gonna call? Automatically connecting radiologists to the right clinician. J Digit Imaging. 2017;30(5):595–601

10. Bashshur RL; Krupinski EA; Thrall JH; Bashshur N. The empirical foundations of teleradiology and related applications: a review of the evidence. Telemed J E Health. 2016;22(11):868–898

11. Cho J; Lee S; Gu BS; Jung SH; Kim HY. The impact of COVID-19 on the use of radiology resources in a tertiary hospital. J Korean Med Sci. 2020;35(40):e368

12. Shi J; Giess CS; Martin T; Lemaire KA; Curley PJ; Bay C; et al. Radiology workload changes during the COVID-19 pandemic: implications for staff redeployment. Acad Radiol. 2021;28(1):1–7

13. Dodelzon K; Grimm LJ; Plimpton SR; Markovic D; Milch HS. Ongoing impact of COVID-19 on breast radiologists' wellness. J Breast Imaging. 2023;5(3):287–29

14. Zhang Z. Opinions on remote and in-person breast imaging work: survey results from the Society of Breast Imaging. J Breast Imaging. 2024;6(1):23–32

15. Chong A; Kagetsu NJ; Yen A; Cooke EA. Radiology residency preparedness and response to the COVID-19 pandemic. Acad Radiol. 2020;27(6):856–861

16. Robbins JB; England E; Patel MD; DeBenedectis CM; Sarkany DS; Heitkamp DE; et al. COVID-19 impact on well-being and education in radiology residencies: a survey of the Association of Program Directors in Radiology. Acad Radiol. 2020;27(8):1162–1172

17. Alhasan AS; Alahmadi SM; Altayeb YA; Daqqaq TS. Impact of COVID-19 pandemic on training and well-being in radiology residency: a national survey of diagnostic radiology trainees in Saudi Arabia. Acad Radiol. 2021;28(7):1002–1009

18. Matalon SA; Souza DAT; Gaviola GC; Silverman SG; Mayo-Smith WW; Lee LK. Trainee and attending perspectives on remote radiology readouts in the era of the COVID-19 pandemic. Acad Radiol. 2020;27(8):1147–1153

19. Taylor A; Williams C. COVID-19: impact on radiology departments and implications for future service design, service delivery, and radiology education. Br J Radiol. 2021;94(1127):20210632

20. Zha N; Patlas MN; Neuheimer N; Duszak R Jr. Prevalence of burnout among Canadian radiologists and radiology trainees. Can Assoc Radiol J. 2018;69(4):367–372

21. McNeeley MF; Perez FA; Chew FS. The emotional wellness of radiology trainees: prevalence and predictors of burnout. Acad Radiol. 2013;20(5):647–655

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Burnout in Ophthalmology Residents in a Tertiary Referral Hospital in Mexico City

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Abstract

Background: Burnout is a syndrome conceptualized as a consequence of chronic workplace stress and is characterized by three dimensions: emotional exhaustion, depersonalization, and reduced personal accomplishment. The Maslach Burnout Inventory (MBI) is the most widely used instrument to assess burnout. Due to cultural, political, and sociocultural factors, burnout rates are reported to be higher in Mexico. This study aimed to determine the prevalence of burnout and the factors associated with its development among residents in general ophthalmology and subspecialties at the Asociación Para Evitar la Ceguera (APEC) in Mexico using the MBI. **Methods:** A cross-sectional survey was conducted using Google Forms and distributed via social networks and email between January and March 2023 to residents training at APEC. The survey consisted of five sections, including the MBI. Data analysis was performed using the SPSS statistical package. **Results:** A total of 55 responses were obtained from 122 residents, yielding a response rate of 45%. The prevalence of burnout was 76% (95% CI: 0.65–0.88). Factors significantly associated with burnout included lack of sleep, self-perception of an unhealthy diet, and the number of days per week spent providing consultations. Additionally, burnout was associated with residents' self-perception of having made medical errors. **Conclusion:** Burnout is highly prevalent among ophthalmology residents. Several factors may contribute to its development, particularly sleep deprivation and increased workload. Conducting studies of this nature is essential to identify risk factors and to design effective interventions aimed at improving the well-being and performance of this population.

Introduction

Burnout can occur in any professional, nevertheless its prevalence has become particularly high among health workers. This has become a global health problem that affects the economy. Its consequences include but are not limited to the increased risk of medical errors, depression, and adverse effects on patient safety 1,2. There is a high prevalence in residents, and doctors who are doing their specialty. In a meta-analysis, a prevalence of 35.1% was reported without dividing by specialties, where a higher prevalence was also seen in surgical residencies/emergency departments than in clinical specialties.[1,29] Few data can be found concerning ophthalmology residents.

Burnout is a syndrome that is included in the eleventh revision of the international classification of diseases (ICD-11) as an occupational phenomenon. It is not classified as a medical condition. This is defined as a conceptualized syndrome resulting from chronic stress in the workplace that has not been managed correctly and is characterized by three dimensions.[3]

- Emotional exhaustion: feeling of lack of energy or tiredness

- Depersonalization: increased mental distance from work or feelings of work-related negativity or cynicism
- Personal achievement: decreased personal satisfaction

One of the medical specialties conceived as having a better quality of life is ophthalmology, however, it has also reported high burnout rates among residents. In a national survey carried out in the United States in 2018, 63.3% of doctors in training presented at least one criterion for burnout.[4] Another study in Saudi Arabia reported a prevalence of 41%.[5] In Mexico, the state of Durango reported a prevalence of up to 89.6% in residents of various specialties.[8] In another study in a family medicine unit in the City of Obregon in Sonora, a prevalence of 45.2% was obtained.[9] To our knowledge, no burnout studies have been done on ophthalmology residents in Mexico. As seen in the other studies mentioned, burnout in other residents in our country is higher than in other countries, variables like cultural, socioeconomic, and political differences establish different challenges that influence burnout prevalence. Our hypothesis was that more than 50% of ophthalmology residents would present burnout syndrome as Mexico presents a healthcare system characterized by an increasing amount of work, long working hours and higher levels of burnout.

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Original Article

Medina L., et al.   Burnout in Ophthalmology Residents in a Tertiary Referral Hospital in Mexico City

The objective of this research is to determine the prevalence of burnout and factors associated with it in general and highly specialized ophthalmology residents at the Hospital for Blindness in Mexico City using the Maslach Burnout Inventory (MBI).

Methods

A survey was carried out in Google Forms sent through social networks (WhatsApp), institutional email, and notice in the general sessions from January 2023 to March 2023 for the collection of data in general and highly specialized ophthalmology residents who are in the Association To Prevent Blindness (APEC) in Mexico. This protocol was approved by the Hospital Ethics Committee under the name BURNOUT2022. Google Forms was the format used in this study as it is a new tool that provides a practical way to do this kind of research. The population studied was in a young age range, must of the users of WhatsApp as it is a mechanism of communication between residents and also from the medical directors of our institution.

The inclusion criteria were general and/or highly specialized ophthalmology residents at APEC and residents who agreed to answer the survey. The exclusion criterion was the failure to complete the survey. The survey is divided into 5 sections. The first section consists of informed consent approved by the Hospital Ethics Committee. The second consists of demographic data and questions about healthy habits such as hours of sleep, hours of living with the family, and healthy eating, the third about the environment and work in the hospital (hours on call, number of patients seen in a day), The fourth section consists of the Maslach Burnout Inventory (MBI).

The Maslach Burnout Inventory (MBI) Scale was created in 1982 by psychologist Cristina Maslach and Michael P. Leiter, it is currently the most used to evaluate this pathology, evaluating the three dimensions mentioned above 10. National surveys in Saudi Arabia and the United States used this tool to evaluate the prevalence of burnout in ophthalmology residents.[4,5] Likewise, other studies carried out in Mexico by gastroenterologists at the National Institute of Medical Sciences and Nutrition Salvador Zubirán[6] used this tool to measure burnout. This tool has been validated in Spanish for use in Spanish-speaking countries.[7]

This survey consists of 22 questions, each one evaluating one of the three spectrums of burnout: emotional exhaustion, personal fulfillment, and depersonalization. The possible ones range from 1-6 where 0 is never and 6 is something that happens every day. The score is added according to which category the question belongs to. It is considered a probable burnout if it tests positive in any of the three categories. The fifth section asks questions about depression and anxiety *(Supplementary Material).*

Data was organized in an Excel file. Statistical analysis was done in SPSS Statistical Package V25.0. Chi squared test was used for categoric variables and for continuous variables ANOVA test was performed. STROBE checklist was reviewed for this study:

Results

A total of 55 responses were obtained from a total of 122 residents (45% rate response). where 25 were men and 30 were women. The average age was 29 years (SD ± 2.22). Only 4 (7.3%) of them are married. 52% of the participants are doing residency for general ophthalmology while 47% are doing some high specialty such as cornea, glaucoma, and retina, among others. Thirty-two residents mentioned whether they engaged in physical activity for an average of 2 hours. 78% consider that they do not eat healthly and eat an average of two and a half meals a day. The average number of hours spent with his family was 5 hours per week. Regarding sleep, on average residents sleep 5.9 hours, while on on-call days this is reduced to an average of 4.7 hours.

Regarding the work environment, residents on average spend 1 day a week in the operating room and the rest in the consultation. A median of 45 hours of resident time spent in the hospital was reported, with an average of 25 patients seen per day. It is important to emphasize that 80% consider that paperwork causes them emotional exhaustion and 72% do not believe that their social life is balanced with their work life. Despite this, 83% feel supported by their colleagues. In the last section of the questionnaire, about anxiety and depression questions, 63% have gone to a psychologist or psychiatrist and 56% reported having been diagnosed with one of these two pathologies. 10% reported having had suicidal ideas. Despite these numbers, only 34% currently receive some type of therapy and 21% take some medication for one of these two entities *(Table 1).*

Regarding the MBI in their respective categories, 63% of the residents presented a high level of emotional exhaustion. 58% presented high levels of depersonalization and 20% obtained a low level of personal accomplishment. A probable burnout is considered when at least one of the categories scores with a high score in the case of emotional exhaustion and depersonalization and a low score in the case of achievement. According to the information mentioned before it was found that 76% (IC 95% 0.65-0.88). of the residents have scores suggestive of burnout *(Figure 1).* 69% commented that due to fatigue they have made mistakes with patients.

The factors associated with the various categories of burnout are shown in *Tables 2* and *3*. The only variable significantly associated with burnout was the self-perception of eating a balanced diet (p 0.01). Likewise, the hours of sleep of residents who obtained a positive burnout score versus those who did not (5.88 ± 0.96 vs 6.23 ± 1.53 p = 0.04). Another variable to highlight is the hours of living with the family per week where doctors with burnout obtained an average of 4.60 ± 7.18 hours versus those without an average of 7.69 ± 11.11 hours with a p = 0.013. Regarding the hospital setting, the significant variable was the days a week spent in the consultation; people with burnout averaged 4.24 ± 0.9 days, and those without burnout averaged 3.54 ± 1.4, obtaining a p = 0.05. As a consequence of burnout, it was significantly associated with a self-perception of a greater risk of committing medical errors (p= 0.04).

Table 1. Demographic and Lifestyle Data of Ophthalmology Residents.

Demographic and behavioral variables of residents		Total	Percentage n= 55
Sex	Men	25	45%
	Women	30	54%
Civil status	Single	51	92%
	Married	4	8%
Grade of study	General Ophthalmology	29	52%
	High specialty (glaucoma, retina, cornea etc)	26	47%
Year of residency	R1	8	14%
	R2	12	21%
	R3	9	16%
	R4	13	23%
	R5	13	23%
Does physical activity	No	23	41%
	Yes	32	58%
Considers he/she its healthy	No	43	78%
	Yes	12	21%
Do you feel that paperwork is emotionally draining?	No	11	20%
	Yes	44	80%
Are you satisfied with your work and social life?	No	40	72%
	Yes	15	27%
Do you feel supported by your colleagues?	No	8	14%
	Yes	46	83%
Have you sought professional support for mental health?	No	20	36%
	Yes	35	63%
Do you take any medication to regulate your mood (fluoxetine, paroxetine, etc.)?	No	43	78%
	Yes	12	21%
Currently receiving therapy	No	36	65%
	Yes	19	34%
Has had suicidal thoughts	No	49	89%
	Yes	6	10%
Have been diagnosed with depression or anxiety	No	24	43%
	Yes	31	56%
Due to fatigue he/she has made mistakes with patients	No	17	30%
	Yes	38	69%

Table 2. Quantitative Variables Associated with Burnout.

Variable	Burnout Yes	Burnout No	p*
Hours of exercise in the week	2.05 ± 2.65	3.46 ± 2.72	0.46
Hours of the sleep in the day	5.88 ± 0.96	6.23 ± 1.53	**0.04**
Hours spent with family per week	4.60 ± 7.18	7.69 ± 11.11	**0.013**
Days of the week giving consult	4.24 ± 0.9	3.54 ± 1.4	**0.05**
Average of patients seen in consult	26.43 ± 12.58	22.08 ± 8.87	0.79
Average hours in the hospital during the week	36.88 ± 24.54	27.08 ± 21.89	0.84

Legend: * p value calculated with T-student test.

Table 3. Qualitative Variables Associated with Burnout.

Variable	OR (IC 95%)	p*
Gender	1.03 (0.29-3.61)	0.95
Civil status	0.27 (0.03-2.18)	0.19
Grade of Residency	1.06 (0.30-3.69)	0.93
Does physical activity	0.33 (0.07-1.37)	0.11
Self-perception of balanced eating	0.19 (0.04-0.78)	**0.01**
Self-perception of performing administrative tasks is exhausting	1.27 (0.28-5.72)	0.75
Self-perception of balance between work and social life	0.31 (0.08-1.18)	0.08
Self-perception of feeling supported by colleagues	2.22 (0.45-10.91)	0.32

Legend: * p value calculated chi Chi squared - test

Discussion

Burnout has become a pandemic in the medical world. Although the specialty of ophthalmology is considered "kind" in residency, studies have proven that this residency can present high levels of burnout. In our study, 76% had data suggestive of burnout, while in the United States in a national survey, it was obtained 63.3%[4,30] while Saudi Arabia obtained 41%.[5] The number of residents with burnout is higher in our study, it could be due to the social, political, and economic conditions different from the countries where the previously mentioned studies were carried out.[28]

Figure 1. Residents with a Category Affected Indicating BurnOut.
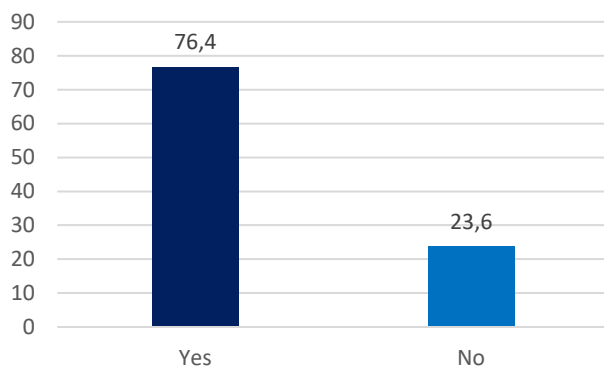
Sleep is one of the habits that allows us to maintain good health and is essential for our well-being according to the Centers for Disease Control and Prevention (CDC).[11] Lack of sleep has physical, cognitive, and mental health effects. The American Academy of Sleep Medicine (AASM) recommends that healthy adults sleep from seven to more hours.[12,31] The residents averaged 5.36 hours of sleep per day, which is already less than recommended. When analyzing the residents with burnout, it was observed that they slept significantly less. In a review that analyzed the impact of lack of sleep and alterations in the circadian cycle in doctors with burnout, a model is described that explains the relationship between burnout and poor sleep, where the mechanisms are: energy depletion and activation of the hypothalamus-pituitary-adrenal axis increasing stress levels in the body. This stress is related to failure in learning, difficulty in memory consolidation, emotional regulation, and cardiovascular health.[13,14] The AASM stated in 2020 that sleep deprivation in doctors is related to higher rates of burnout, so the problem must be visualized and addressed.[15]

One of the factors associated with burnout in our study was the self-perception of eating balanced. The National Health Service of the United Kingdom defines this as eating foods from various food groups in the correct portions, eating the right amount of food, and drinking enough liquid to maintain a healthy body.[16] It has been found that diet is affected by burnout syndrome. The stress that people with this syndrome have influenced the diet that these individuals have, contributing to excess or lack of intake, which causes the release of stress hormones that have been related to central obesity.[17] However, other studies have reported that calorie intake does not seem to have an impact on the development of burnout, but rather is a consequence of it. Although more studies are necessary regarding diet and burnout in residents, it is important to emphasize that an association has been observed between this syndrome and increased cardiovascular risk.[18]

In our study, residents with burnout worked 1 more day of consultation per week, this being statistically significant, however, the number of patients per workday did not show a significant association. A study carried out in the Netherlands conducted a survey on doctors from 2017 to 2018 on the experience questionnaire, work evaluation, and survey of the doctor's work-life related to patient-associated burnout, where it was seen that doctors with high workloads and little opportunity of professional development were more likely to have burnout.[19] A systematic review of interventions to reduce burnout in doctors found that reducing the number of working hours reduces the burnout score, mainly in the emotional exhaustion section.[20]

Finally, it is important to emphasize that in our study a statistically significant correlation was found between the self-perception of making medical errors and residents with burnout. Various studies have evaluated the impact of this syndrome when dealing with patients. In a study carried out in the United States from 2018 to 2019 where doctors from various parts of the country were recruited, a correlation was observed with burnout and the probability of self-reporting a medical error, increasing by 27%.[21] Likewise, a meta-analysis looked for the impact of burnout on patient safety and professionalism, finding that the higher the burnout index, the greater the probability of committing a medical error.[22] Due to the repercussions it has on the health of medical personnel, the health of patients, and the economic cost that this entails[23] this problem must be more analyzed and studied.

One of the factors that should be taken into account is the background of the COVID-19 pandemic, which these residents have suffered. This disease presented a challenge to health workers. Studies were made in intensive care units and emergency departments during the COVID-19 pandemic, and analysis of several studies showed a prevalence of 49.3 to 58%.[23] In another study, all health workers who took care of COVID-19 patients presented a prevalence of 53%.[24] A study made in Israel compared burnout before and during pandemics where a significant correlation was found in having higher levels during pandemics.[25] It could be possible that the COVID-19 pandemic affected the levels of burnout, nevertheless, further studies of BurnOut post-pandemic must be conducted to determine a possible effect.

Various interventions have been carried out to address this public health problem, among the most effective were: improving communication skills, teamwork, participation programs, self-care workshops and psychological interventions.[26] With the findings of our study, it is likely that reducing working hours may reduce burnout scores.[20,27,29] As working hours reduce more hours could be gained for sleep and other activities that the resident need to have a lower sensation of stress.

Our study has several limitations, including a small sample size, this could create a nonresponse bias. Participation in this study was low, more studies should be done to increase the sample. In addition, our study, due to its design, could not determine the causality of the various factors analyzed. Other bias in our study was the method of application through Google Forms, nevertheless we believe do to the characteristics of our population, the majority of residents have an email or WhatsApp account as it is the way hospital gives new information.

Conclusion

Burnout is a public health problem, which has reached very high levels of prevalence, mainly in health personnel. This is related to

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the impact on the person's health, both mental and physical, and an increase in medical errors that lead to increased costs in health systems. Various factors can influence the appearance of this burnout, including little sleep and increased working hours. Likewise, this ends up influencing physical health, promoting an increase in cardiovascular risk and the self-perception of making mistakes when treating patients. It is necessary to carry out more studies to determine the prevalence and associated factors in Ophthalmology residents in Mexico, which would help clarify the panorama and contribute to being able to carry out actions aimed at this population in the various hospitals that teach this discipline. Several interventions have been studied to be effective such as reducing working hours, improving communication skills, psychological interventions, self-care workshop, among others. Mental health should be addressed in medical residents in order to give the best care possible to our patients.

Summary – Accelerating Translation

Burnout en Residentes de Oftalmología en un Hospital de Tercer Nivel de la Ciudad de México

El síndrome de burnout se ha convertido en un problema de salud pública, existiendo pocos datos sobre su prevalecia en residentes de oftalmología en México. El objetivo de esta investigación es determinar la prevalencia de burnout elevado mediante el MBI así como determinar los factores asociados al mismo en los residentes de oftalmología general y de alta especialidad en la Asociación Para Evitar la Ceguera (APEC), el cual es un hospital de alta especialidad en la Ciudad de México.

Metodología

Se realizó una encuesta en Google Forms enviada mediante redes sociales (Whatsapp) y correo electrónico en Enero 2023 a Marzo del 2023 para la recolección de datos en Residentes de oftalmología general y de alta especialidad que se encuentren el APEC. La encuesta consta de 5 secciones incluyendo el MBI. Se utilizó el programa SPSS para el análisis de datos y se consideró significativa a una $p < 0.05$. El estudio fue aprobado por el comité de Ética e Investigación de la Institución.

Resultados

Se obtuvieron un total de 55 respuestas de un total de 122 residentes en el hospital. La prevalencia de burnout fue de 76%. Los factores asociados en forma significativa con el desarrollo de burnout fueron la falta de sueño, la autopercepción de no comer balanceado, los días consulta a la semana; por otra parte, la presencia de burnout se asoció con la autopercepción de cometer errores médicos.

Conclusión

El burnout es un problema con mayor relevancia en los profesionales de la salud. Diversos son los factores que pueden influir en la aparición de este desgaste laboral entre ellos el poco sueño y el aumento de horas laborales. Es importante realizar este tipo de estudios con la finalidad de aclarar el panorama y poder realizar intervenciones efectivas que atiendan a las necesidades de esta población..

References

1. Rodrigues H, Cobucci R, Oliveira A, et al. Burnout syndrome among medical residents: a systematic review and meta-analysis. PLoS One. 2018;13(11):e0206840.

2. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. Ann Surg. 2010;251(6):995–1000.

3. World Health Organization. Burn-out an occupational phenomenon: International Classification of Diseases. 2019 May. Available from: World Health Organization website. Cited Nov 2, 2023.

4. Feng S, Taravati P, Ding L, Menda S. Burnout in ophthalmology residency: a national survey. J Acad Ophthalmol. 2018;10(1):e98–e107.

5. Alotaibi AK, Alsalim A, Alruwaili F, et al. Burnout during ophthalmology residency training: a national survey in Saudi Arabia. Saudi J Ophthalmol. 2019;33(2):130–4.

6. Aguilar-Nájera O, Zamora-Nava LE, Grajales-Figueroa G, Valdovinos-Díaz MÁ, Téllez-Ávila FI. Prevalence of burnout syndrome in gastroenterologists and endoscopists: results of a national survey in Mexico. Postgrad Med. 2020;132(3):275–81.

7. Gil-Monte PR. Validez factorial de la adaptación al español del Maslach Burnout Inventory-General Survey. Salud Publica Mex. 2002;44(1):33–40.

8. Terrone J, et al. Síndrome de burnout en médicos residentes del Hospital General de Durango, México. Rev Med Inst Mex Seguro Soc. 2016;54(2):242–8.

9. Cerpa B, et al. Correlación entre factores sociofamiliares y el síndrome de burnout en residentes y médicos de una unidad de medicina familiar. Arch Med Fam. 2020;24(1):31–6.

10. Saborío L, Hidalgo L. Síndrome de burnout. Med Leg Costa Rica. 2015;32(1):119–24.

11. Centers for Disease Control and Prevention. Are you getting enough sleep? 2022. Available from: CDC website. Cited Nov 2, 2023.

12. Watson NF, et al. Recommended amount of sleep for a healthy adult: a joint consensus statement. Sleep. 2015;38(6):843–4.

13. Stewart NH, Arora VM. The impact of sleep and circadian disorders on physician burnout. Chest. 2019;156(5):1022–30.

14. Trockel MT, Menon NK, Rowe SG, et al. Assessment of physician sleep and wellness, burnout, and clinically significant medical errors. JAMA Netw Open. 2020;3(12):e2028111.

15. Kancherla BS, et al. Sleep, fatigue and burnout among physicians: an American Academy of Sleep Medicine position statement. J Clin Sleep Med. 2020;16(5):803–5.

16. National Health Service. Eating a balanced diet. 2022. Available from: NHS website. Cited Nov 2, 2023.

17. Esquivel MK. Nutrition strategies for reducing risk of burnout among physicians and health care professionals. Am J Lifestyle Med. 2021;15(2):126–9.

18. Melamed S, Shirom A, Toker S, Berliner S, Shapira I. Burnout and risk of cardiovascular disease. Psychol Bull. 2006;132(3):327–53.

19. Scheepers R, Silkens M, van den Berg J, Lombarts K. Associations between job demands, job resources and patient-related burnout among physicians. BMJ Open. 2020;10(9):e038466.

20. Busireddy KR, et al. Efficacy of interventions to reduce resident physician burnout: a systematic review. J Grad Med Educ. 2017;9(3):294–301.

21. Menon NK, Shanafelt TD, Sinsky CA, et al. Association of physician burnout with suicidal ideation and medical errors. JAMA Netw Open. 2020;3(12):e2028780.

22. Al-Ghunaim TA, Johnson J, Biyani CS, Alshahrani KM, Dunning A, O'Connor DB. Surgeon burnout, impact on patient safety and professionalism. Am J Surg. 2022;224(1 Pt A):228–38.

23. Gualano MR, Sinigaglia T, Lo Moro G, et al. The burden of burnout among healthcare professionals during the COVID-19 pandemic. Int J Environ Res Public Health. 2021;18:8172.

24. Jalili M, Niroomand M, Hadavand F, Zeinali K, Fotouhi A. Burnout among healthcare professionals during COVID-19 pandemic. Int Arch Occup Environ Health. 2021;94(6):1345–52.

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25. Shopen N, Schneider A, Mordechai RA, et al. Emergency medicine physician burnout before and during the COVID-19 pandemic. Isr J Health Policy Res. 2022;11(1):30.

26. Aryankhesal A, Mohammadibakhsh R, Hamidi Y, et al. Interventions on reducing burnout in physicians and nurses. Med J Islam Repub Iran. 2019;33:77.

27. Galaiya R, Kinross J, Arulampalam T. Factors associated with burnout syndrome in surgeons. Ann R Coll Surg Engl. 2020;102(6):401–7.

28. Chan MK, Chew QH, Sim K. Burnout and associated factors in psychiatry residents. Int J Med Educ. 2019;10:149–60.

29. Yates SW. Physician stress and burnout. Am J Med. 2019;133(2):160–4.

30. Low ZX, Yeo KA, Sharma VK, et al. Prevalence of burnout in medical and surgical residents. Int J Environ Res Public Health. 2019;16(9):1479.

31. Shah HP, Salehi PP, Ihnat J, et al. Resident burnout and well-being in otolaryngology and other surgical specialties. Otolaryngol Head Neck Surg. 2023;168(2):165–79.

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Supplementary Material

Work Eviroment Evaluation
FIrst Section
Informed Consent

Institution: Association to Prevent Blindness I.A.P
Address: Vicente García Torres 46, Barrio San Lucas, Coyoacán, Delegación B. Juárez, CDMX
What is the objective?

The following questionnaire aims to learn about the ophthalmology residents of the Asoación para Evitar la Ceguera and their work environment. After analyzing the responses obtained, there will be a greater understanding of the status of the residents, which will help us generate strategies for the continuous improvement of the work environment.
What are the possible benefits of participating?

You will not obtain any direct benefit for participating, nor any type of remuneration. However, your participation is valuable to improve the work environment of this hospital.

What consequences are there if I do not wish to participate?
Your decision not to participate will not change or affect your employment status in any way and is not mandatory. You can leave the survey at any time you wish.

How long will my participation last?
The approximate time to complete the questionnaire is 10-15 minutes.

Personal data management
Ensuring good clinical practices, the information you provide us is confidential and will only be used for research purposes. At no time will data such as name, telephone number or employee number be requested. All responses will be anonymous and confidential.

● I have read the consent provided and agree to participate
● I do not wish to participate in this survey

Second Section
1. Age
2. Sex. F, M, I prefer not to say
3. Marital status
   - ● Single
   - ● Married
   - ● Divorced
   - ● Other
4. Which of the following corresponds to the academic period you are in?
   - ● General ophthalmology
   - ● Subspecialty (Retina, Cornea, Glaucoma, etc.)
5. What year of residence are you in?
   - ● R1
   - ● R2
   - ● R3
   - ● R4 (high specialty)
   - ● R5 (high specialty)
6. Do you do physical activity? Yes or no
7. If yes, how many hours do you work out per week? If you do not do physical activity enter 0
8. How many meals do you eat per day? Put the number
9. Do you consider having a balanced diet?
   - ● Yes
   - ● No
10. Per week, how many hours do you spend with your family? Enter the number
11. How many hours do you sleep a day? Enter the number

12. How many hours do you sleep on average when you are on duty? Put the number

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Third Section
1. How many days a week do you go into surgery? Enter the number
2. How many days a week do you consult? Enter the number
3. How many hours on average per week do you spend in the hospital? Enter the number
4. How many patients do you see on average on consultation days? Enter the number
5. How many calls per month on average do you receive due to patient care? Enter the number
6. Do you feel that paperwork wears you down emotionally?
   - ● Yes
   - ● No
7. Currently, are you satisfied with the balance between your work and social life?
   - ● Yes
   - ● No
8. Would you study medicine again?
   - ● Yes
   - ● No
9. Would you choose ophthalmology as a specialty again?
   - ● Yes
   - ● No
10. Do you feel supported by your colleges?
    - ● Yes
    - ● No

Fourth Section - MBI
Answer according to how often it happens to you.
1. I feel emotionally exhausted by my job

0 Never
2. A few times a year or less
3. Once a month or less
4. A few times a month
5. Once a week
6. Few times a week
7. every day
   1. When I finish my workday, I feel empty
   2. When I get up in the morning and face another day of work, I feel fatigued
   3. I feel that I can easily understand patients
   4. I feel like I am treating some patients as if they were impersonal objects.
   5. I feel like working with people all day tires me out.
   6. I feel that I deal with my patients' problems very effectively.
   7. I feel like my job is wearing me down.
   8. I feel like I am positively influencing other people's lives through my work.
   9. I feel I have become harder / rude with people
   10. I worry that this job is hardening me emotionally.
   11. I feel very energetic at work
   12. I feel frustrated at my job
   13. I feel like I spend too much time at my job.
   14. I feel like I don't really care what happens to my patients.
   15. I feel that working in direct contact with people tires me out.
   16. I feel that I can easily create a pleasant atmosphere in my patients.
   17. I feel stimulated after working closely with my patients.
   18. I think I achieve many valuable things in this job
   19. I feel like I'm at the end of my rope.
   20. I feel that emotional problems are treated appropriately in my work.
   21. It seems to me that patients blame me for some of their problems.

Fifth Section
1. I have reached or gone with support from a health professional who cares for my mental health (psychologist or psychiatrist)
   - Yes
   - No

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2. I take some medication to regulate my mood (fluoxetine, paroxetine, etc.)
   - Yes
   - No
3. Are you currently receiving therapy?
   - Yes
   - No
4. I have had suicidal thoughts
   - Yes
   - No
5. I have been diagnosed with depression or anxiety
   - Yes
   - No
6. Due to fatigue I have made mistakes with my patients
   - Yes
   - No

ANNEX 2
Evaluación de Ambiente Laboral

Primera Sección
Consentimiento Informado
Autor Principal: Dr. José Gerardo García Aguirre
Autor Responsable: Dra. Lourdes A. Medina Gaona
Institución: Asociación Para Evitar la Ceguera I.A.P
Dirección: Vicente García Torres 46, Barrio San Lucas, Coyoacán, Delegación B. Juárez, CDMX
¿Cuál es el objetivo?
El siguiente cuestionario tiene como objetivo conocer a los residentes de oftalmología de la Asociación Para Evitar la Ceguera y su ambiente laboral. Posterior al análisis de las respuestas obtenidas, se tendrá mayor comprensión del estado de los residentes, lo que nos ayudará a generar estrategias para la mejora continua del ambiente laboral.
¿Cuáles son los posibles beneficios de participar?
Usted no obtendrá ningún beneficio directo por participar, ni algún tipo de remuneración. Sin embargo, su participación es valiosa para poder mejorar el ambiente laboral de este hospital.
¿Qué consecuencias hay si no deseo participar?
Su decisión de no participar no cambiará ni afectará de ninguna manera su situación laboral, no es de carácter obligatorio. Usted podrá abandonar la encuesta en el momento que lo desee.
¿Cuánto durará mi participación?
El tiempo aproximado para completar el cuestionario es de 10-15 minutos.
Manejo de datos personales
Asegurando las buenas prácticas clínicas, la información que usted nos brinde es confidencial y será únicamente utilizada con fines de investigación. En ningún momento se solicitarán datos como nombre, número telefónico o número de empleado. Todas las respuestas serán anónimas y confidenciales.
   - He leído el consentimiento proporcionado y acepto participar
   - No deseo participar en esta encuesta

Segunda Sección
1. Edad
2. Sexo. F, M , prefiero no decir
3. Estado civil
   - Soltero
   - Casado
   - Divorciado
   - Otro
4. ¿Cuál de las siguientes corresponde al periodo académico en el que te encuentras?
   - Oftalmología general
   - Subespecialidad (Retina, Córnea, Glaucoma etc)
5. En qué año de residencia se encuentra
   - R1
   - R2

- R3
- R4 (alta especialidad)
- R5 (alta especialidad)
6. Realizas actividad física. Si o no
7. En caso de que sí, cuántas horas realizas a la semana. En caso de no coloca 0
8. ¿Cuántas comidas realizas al día? Coloque el número
9. Consideras que comes balanceado.
   - Si
   - No
10. A la semana, cuántas horas convives con tu familia Coloque el número
11. ¿Cuántas horas duermes al día? Coloque el número
12. ¿Cuántas horas duermes cuando tienes guardia en promedio? Coloque el número

Tercera Sección
1. ¿Cuántos días a la semana entras a cirugía? Coloque el número
2. ¿Cuántos días a la semana das consulta? Coloque el número
3. ¿Cuántas horas en promedio a la semana te encuentras en el hospital? Coloque el número
4. ¿Cuántos pacientes revisas en promedio los días de consulta? Coloque el número
5. ¿Cuántas llamadas al mes en promedio recibes debido a la atención a un paciente? Coloque el número
6. Sientes que el papeleo te desgasta emocionalmente
   - Si
   - No
7. Actualmente, estás satisfecho con el equilibrio entre tu trabajo y vida social
   - Si
   - No
8. Volverías a estudiar medicina
   - Si
   - No
9. Volverías a elegir oftalmología como especialidad
   - Si
   - No
10. Te sientes apoyado por tus colegas
    - Si
    - No

Cuarta Sección - MBI
Conteste de acuerdo a la frecuencia con la que le sucede
23. Me siento emocionalmente agotado por mi trabajo
0 Nunca
1. Pocas veces al año o menos
2. Una vez al mes o menos
3. Unas pocas veces al mes
4. Una vez al semana
5. Pocas veces a la semana
6. todos los días
   24. Cuando termino mi jornada de trabajo me siento vacío
   25. Cuando me levanto por la mañana y me enfrento a otra jornada de trabajo me siento fatigado
   26. Siento que puedo entender fácilmente a los pacientes
   27. Siento que estoy tratando a algunos pacientes como si fueran objetos impersonales
   28. Siento que trabajar todo el día con la gente me cansa
   29. Siento que trato con mucha eficacia los problemas de mis pacientes
   30. Siento que mi trabajo me está desgastando
   31. Siento que estoy influyendo positivamente en la vida de otras personas a través de mi trabajo
   32. Siento que me he hecho más duro con la gente
   33. Me preocupa que este trabajo me esté endureciendo emocionalmente
   34. Me siento con mucha energía en mi trabajo
   35. Me siento frustrado en mi trabajo
   36. Siento que estoy demasiado tiempo en mi trabajo

37. Siento que realmente no me importa lo que les ocurra a mis pacientes
38. Siento que trabajar en contacto directo con la gente me cansa
39. Siento que puedo crear con facilidad un clima agradable en mis pacientes
40. Me siento estimulado después de haber trabajado íntimamente con mis pacientes
41. Creo que consigo muchas cosas valiosas en este trabajo
42. Me siento como si estuviera al límite de mis posibilidades
43. Siento que en mi trabajo los problemas emocionales son tratados de forma adecuada
44. Me parece que los pacientes me culpan de alguno de sus problemas

Quinta Sección

1. He llegado o acudir con apoyo algún profesional de la salud que atienda mi salud mental (psicólogo o psiquiatra)
   - Si
   - No
2. Tomo algun medicamento para regular mi estado de ánimo (fluoxetina, paroxetina etc)
   - Si
   - No
3. Actualmente recibe terapia.
   - Si
   - No
4. He llegado a tener pensamientos suicidas
   - Si
   - No
5. Me han llegado a diagnosticar depresión o ansiedad
   - Si
   - No
6. Debido a la fatiga he cometido errores con mis pacientes
   - Si
   - No

Using an Interactive Self-Directed Module to Teach Nicotine Use Disorder Management

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Abstract

Background: Tobacco use is the largest and most preventable cause of morbidity and mortality. Though cessation counseling is an effective treatment, its priority is lowered in overcrowded medical curricula, reducing students' confidence in clinical counseling. Self-directed e-modules help with didactic lectures and could be used to teach nicotine cessation practices. This study evaluated an interactive self-directed module on students' knowledge acquisition and confidence in nicotine use disorder management. **Methods:** This pre-post interventional study had 155 medical students complete the module between January and December 2022. Students were given knowledge-based pre- and post-module tests, and later a post-module survey to evaluate their learning experience and comfort with nicotine use disorder management. Paired differences between pre- and post-module tests were assessed for the overall- and question-specific scores. The survey data was qualitatively analyzed. **Results:** The module significantly improved students' overall test scores with a mean difference of 13.4 (95% CI: 10.5-16.3) between the pre- and post-module tests. There was a significant increase in understanding of electronic nicotine devices' role in smoking cessation (difference: 29.7; CI: 21.2-38.2), evidence-based pharmacology therapy (difference:15.5; CI: 9.2-21.8), and combination treatment plans (difference: 16.1; CI: 8.8-16.1). Topics related to nicotine use disorder diagnosis and the harms of electronic nicotine devices showed no significant change. Additionally, students self-reported a significant improvement in comfort with nicotine use disorder management (difference: 0.75; CI: 0.58-0.93). **Conclusion:** Medical students developed knowledge of and confidence in nicotine use disorder management with this interactive self-directed e-module.

Introduction

Tobacco use is a leading preventable cause of mortality, with more than 8 million deaths worldwide annually.[1] Smoking cessation is an effective intervention to reduce nicotine use disorder (NUD) and its complications, like myocardial infarction.[2] However, surveys show that the pathophysiology and treatment for NUD are not adequately covered in the medical curricula, with a national survey in Germany showing that less than 10% of graduating students feel comfortable counseling patients willing to quit smoking.[2] Students are even less confident with electronic nicotine delivery systems (ENDS) counseling given its rising prevalence since the turn of the century.3 Some reported barriers to implementing smoking cessation teaching include curriculum crowding, insufficient funding, and the low priority placed on smoking cessation counseling.[2,4] Given the burden of disease and the clinical effectiveness of smoking cessation interventions, medical curricula need to teach practical skills in managing NUD.[5]

In response to the 2019 pandemic, most learning transitioned online. Studies showed that electronic learning (e-learning) was comparable to in-person didactic lectures regarding knowledge acquisition.[6-9] Therefore, a self-directed interactive PowerPoint® module may be a solution to teaching the knowledge needed for NUD diagnosis and management in a crowded curriculum due to its immediate feedback and self-paced tempo. The objective of this study was to evaluate the impact of a self-directed interactive teaching module on medical students' knowledge and comfort with managing NUD.

Methods

Participants

This pre-post interventional study had one-hundred fifty-five medical students at a large, academic, tertiary care center complete the self-directed interactive e-module on NUD management as a rotation requirement during their Internal Medicine clerkship between January - December 2022. Students

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were in their clinical year of medical training (year 2 or year 3 of medical school) and had no prior formal teaching on NUD management. The project was determined to be a non-human subjects research by the local Human Subjects Office/Institutional Review Board in October 2021 (IRB ID: 202110118).

Module Design

The module used PowerPoint®, an accessible software, to address: the presentation and diagnosis of nicotine withdrawal, the impact of ENDS and their role in smoking cessation, and evidence-based NUD treatments. The research team made a 30-minute module that follows a patient who presents with nicotine withdrawal symptoms. Students are asked to diagnose the patient, explore if ENDs can be a treatment as a response to the patient's request, and then explore alternative evidence-based NUD treatments. Each slide provided information related to the case and asked for the "next best step" in management. If the best answer was selected, students would progress through the case; otherwise, they would be re-directed to slides clarifying that topic. Each slide included a voice recording summarizing the slide to diversify methods of receiving information. At the end of the module, a summary slide reviewed the key points of the diagnostic tools and treatments for NUD.

Study Protocol

On Day 1, students completed an online 5-question multiple-choice pre-module test, which was untimed and unsupervised, to assess their baseline knowledge of NUD management *(Supplementary Material A).* Both pre- and post-module tests were graded only on timely completion, rather than percent correct. Given the test's low-stakes nature, students likely went through the module at their own learning pace and were unlikely to use supplementary materials during the tests, though their use was not expressly prohibited. Pre-test responses were recorded, but the correct answers were not provided. On Day 3, students were given access to the module. They had 11 days to complete the module ad libitum, immediately after which, students did the same online 5-question test, untimed and unsupervised. Upon completing the post-module test, students were given the answers to the questions with detailed explanations for each distractor answer. They were also given the professor's email for further questions. Students were encouraged to complete an end-of-module survey that had 2 Likert questions comparing their pre- and post-module knowledge, and two free-text questions asking about their experience with the module *(Supplementary Material B).* The data was collected by the Internal Medicine clerkship, who anonymized the year-worth of data. They only provided the researchers with the overall test scores, the score breakdown for each question, and survey responses.

Outcomes

The primary outcome measure was the difference between the overall and question-specific pre-and post-module test scores. The secondary outcomes were students' opinions on learning from the module, and the change in students' confidence using NUD evidence-based practices.

Statistical Analysis

The test questions' ability to accurately assess the mastery of the content was evaluated using a point-biserial correlation; which checks how well each question distinguishes between students who understand the topic and those who do not. The differences in overall and question-specific pre- and post-module test scores were measured using paired t-tests (alpha = 0.05) and a 95% confidence interval (CI). CI is a range of values in which the true difference would likely occur 95% of the time; and is significant if it does not cross zero as a non-zero value means that some difference exists. Students' confidence in cessation counseling was measured with a weighted average of their responses on the Likert scale. Pre- and post-module averages were compared using a paired t-test. Additionally, common themes (mentioned >5% of the time) on the two free-response items (primary takeaway points and module feedback) were qualitatively analyzed. All statistical analyses were completed using SAS software v9.5 (Cary, NC).[10]

Results

Knowledge acquisition questions were deemed to be effective measures to discriminate between students who mastered the content and those who did not, as the point biserial of correct answers for all questions was > 0.25 [11], indicating that students who performed well overall, did so with consistency. Students' knowledge acquisition following the module significantly improved as suggested by the overall pre- and post-module scores (difference: 13.4; 95% CI: 10.5-16.3). Additionally, there was a significant improvement in the understanding of ENDS use in smoking cessation (Q2 - difference: 29.7; CI: 21.2-38.2), evidence-based medications (Q4 - difference: 15.5; IQR: 9.2-21.8), and combined treatment options (Q5 - difference: 16.1; IQR: 8.8-16.1). Q1 (nicotine withdrawal symptoms) and Q3 (risks of ENDS) had high pre- and post-test scores; therefore, there was no significant change in students' understanding before and after the module *(Table 1).*

Table 1. Mean Paired Difference in Test Scores Before and After the Nicotine Use Disorder Management Module (n = 155).

	Pre-Test Score (%)	Post-Test Score (%)	Mean Paired Difference	Standard Deviation	95% CI for Mean Paired Difference
Overall	78.6	92.0	13.4[a]	18.4	10.5 – 16.3
Q1	94.2	95.1	3.9	27.6	[-8.3] – 0.5
Q2	45.8	75.5	29.7[a]	53.7	21.2-38.2
Q3	96.1	98.1	1.9	21.2	[-5.3]-1.4
Q4	81.9	97.4	15.5[a]	39.7	9.2-21.8
Q5	74.8	91.0	16.1[a]	46.3	8.8-16.1

Legend: a statistically significant mean difference with an α = 0.05. Q1: NUD Diagnosis | Q2: ENDS role in smoking cessation | Q3: Harms of ENDS | Q4: Pharmacologic Therapy | Q5: Combination treatment plans

The post-module survey was completed by 96 (61.9%) students. Ninety-four (97.9%) students agreed or strongly agreed that medications and counseling are effective in smoking cessation, an increase from 87 (90.6%) prior to the module. Eighty-three students (86.5%) agreed or strongly agreed that they were comfortable using medications for NUD, an increase from only 43 (44.8%) prior to the module. After the module, students noted a statistically significant increase in both knowledge acquisition of (difference: 0.30; CI 0.20-0.40) and confidence in (difference: 0.75; CI 0.58-0.93) NUD management *(Table 2).*

With regards to the clinical pearl question, 29 (30.2%) students learned about the pros and cons of evidence-based pharmacological treatments, 26 (27.1%) students learned about practices related to prescribing and following-up, 16 (16.7%) students took away the importance of combination management with pharmacologic and non-pharmacologic options, 9 (9.4%) learned about the use of ENDS in NUD management, and 8 (8.3%) students noted improved understanding of NUD evaluation.

Finally, with respect to module feedback, 51 students (53.1%) provided no additional comments, 14 students (14.6%) requested more information on counseling treatments, and 13 students (13.5%) commented on the audio. Students had concerns about not being able to speed up the audio, the audio not adding to what was on the slide, or suggested video-recorded lectures as an alternative.

Table 2. Weighted Average of Likert Scale Scores Before and After Nicotine Educational Modulea (n = 96).

	Before	After	Mean Paired Difference	Standard Deviation	95% CI
Q1: Knowledge Acquisition	4.26	4.56	0.30	0.48	0.20-0.40
Q2: Comfort with NUD management	3.26	4.01	0.75	0.89	0.58-0.93

Legend: a Mean Likert scale scores: Strongly Disagree (1) – Strongly Agree (5).

Discussion

This study found that an interactive self-directed module significantly improved students' overall understanding of NUD management. Specifically, it improved their understanding of: the role of ENDS in smoking cessation, the evidence-based medications available for NUD, and the combined pharmacologic and non-pharmacologic NUD management. There was no significant change in identifying nicotine withdrawal or the harms of ENDS, topics taught in preclinical curriculums.[2, 4] This finding is also supported by students' reporting a better understanding of NUD management. Based on qualitative analyses, the module improved students' confidence in prescribing evidence-based medications and following up on patients with NUD.

This study highlights the knowledge gap in ENDS use. Unlike prior studies, this study showed that students were aware of the negative consequences of ENDS (Q3 96.1%); however, similar to those studies, students did not know ENDS' role in smoking cessation (Q2 45.8%).3 ENDS role in NUD management had the lowest average test scores before and after the module, though there was a significant improvement following learning from the module. Since all the questions had appropriate point biserial values, the low score suggests that students are uncertain about the use of ENDS in NUD management.

Limitations of this study include its single-site population and short-term follow-up evaluation. This limits the study's generalizability and assessment of long-term knowledge retention. Although students reported confidence in NUD management, this study did not evaluate for skill acquisition. Incorporating NUD management as an observed clinical skilled assessment could be considered. Finally, though this module improved students' clinical knowledge and comfort with NUD management, how this medium compares to an in-person lecture or an alternate medium like a video lecture is unknown and could be further investigated.

Conclusion

Given the rising prevalence of ENDS and the clinical effectiveness of nicotine cessation interventions, this study demonstrated that an interactive self-directed module can improve students' knowledge of and comfort with managing NUD. Though further studies are needed to evaluate long-term knowledge retention and clinical skill acquisition, an online interactive module may be a solution to developing clinical knowledge related to NUD management in a crowded curriculum that places a lower priority on nicotine cessation counseling.[2,4]

Summary – Accelerating Translation

Using an Interactive Self-Directed Module to Teach Nicotine Use Disorder Management

Tobacco use is the largest and most preventable cause of morbidity and mortality. Though cessation counseling is an effective treatment, its priority is lowered in overcrowded medical curricula, reducing students' confidence in clinical counseling. Self-directed e-modules can help teach nicotine cessation while not burdening the medical syllabus. The objective of this study was to evaluate the impact of a self-directed interactive teaching module on medical students' knowledge and comfort with managing nicotine use disorder (NUD).

The research team developed a self-directed interactive e-module that taught the current diagnostic guidelines and evidence-based treatment options for NUD, including the role of electronic nicotine delivery systems (i.e. e-cigarettes). One hundred fifty-five 2nd and 3rd year medical students, without prior formal training in NUD management, completed the module at their own pace. There were mandatory knowledge-based pre- and post-module tests. They were then encouraged to complete an optional post-module survey to evaluate their learning experience and comfort with nicotine use disorder management.

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Data analysis showed that the module significantly improved students' overall test scores with a significant increase in: (1) understanding of electronic nicotine devices' role in smoking, (2) evidence-based pharmacology therapy, and (3) combination treatment plans. Topics related to nicotine use disorder diagnosis and the harms of electronic nicotine devices showed no significant change. Additionally, students self-reported a significant improvement in comfort with nicotine use disorder management following learning from the module. Though further studies are needed to evaluate long-term knowledge retention and clinical skill acquisition, an online interactive module may be a solution to developing clinical knowledge and confidence related to NUD management in a crowded curriculum that places a lower priority on nicotine cessation counseling.

References

1. World Health Organization. Tobacco. Available from: https://www.who.int/news-room/fact-sheets/detail/tobacco. Updated 21 Jul 2023; cited 2025 Mar 9.

2. Herold R, Schiekirka S, Brown J, Bobak A, McEwen A, Raupach T. Structured smoking cessation training for medical students: a prospective study. Nicotine Tob. Res. 2016;18(12):2209–15.

3. Zhou S, Van Devanter N, Fenstermaker M, Cawkwell P, Sherman S, Weitzman M. A study of the use, knowledge, and beliefs about cigarettes and alternative tobacco products among students at one US medical school. Acad. Med. 2015;90(12):1713–9.

4. Elfandi S, Poudyal H. Tobacco cessation curriculum in medical schools: a scoping review. J. Clin. Exp. 2023;38(5):1614–23.

5. Raupach T, Al-Harbi G, McNeill A, Bobak A, McEwen A. Smoking cessation education and training in UK medical schools: a national survey. Nicotine Tob. Res. 2015;17(3):372–5.

6. Cook DA, Levinson AJ, Garside S, Dupras DM, Erwin PJ, Montori VM. Internet-based learning in the health professions: a meta-analysis. JAMA. 2008;300(10):1181–96.

7. Ayoub F, Moussa M, Papatsoris AG, Abou Chakra M, Chahine NB, Fares Y. The online learning in medical education: a novel challenge in the era of COVID-19 pandemic. Hell. Urol. 2020;32(2):89–96

8. Moriates C, Valencia V, Stamets S, Joo J, MacClements J, Wilkerson L, Cox SM. Using interactive learning modules to teach value-based health care to health professions trainees across the United States. Acad. Med. 2019;94(9):1332–6.

9. Esquela-Kerscher A, Krishna NK, Catalano JB, Lundberg PS, Kerry JA. Design and effectiveness of self-directed interactive learning modules based on PowerPoint™. Med. Sci. Educ. 2016;26:69–76.

10. SAS Institute Inc. SAS 9.5. Cary, NC: SAS Institute Inc.; 2024.

11. Varma S. Preliminary item statistics using point-biserial correlation and p-values. Educ. Data Stat. Insights. 2016;16(07):1–7.

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Supplementary Material

Supplementary Material A

Pre- and Post-Test Questions

1) Leif is a 50-year-old male who comes to you after quitting smoking three weeks ago. He reports he has not been sleeping well and has noticed problems focusing at work. His spouse notes he has seemed more irritable, too. He also has been feeling down and notes weight loss.

Which of the following is NOT a symptom of nicotine withdrawal?

    A.   Difficulty concentrating
    B.   Sleep problems
    C.   Depression
    D.   Weight loss

2) Toby is a 24 yo who presents for his annual physical. He tells you that he would like to stop smoking due to financial reasons. However, cigarettes help him relax during his work-related stress and long days where he is barely able to get enough sleep. In the past, he has tried patches, gums, and some medication that he does not remember, but none of them worked. Therefore, he decided to step down and use a vape pen. He has been using it for 6 months, without touching a cigarette. He currently swears by it. What is your next step?

    A.   Suggest trying a nicotine nasal spray
    B.   Refer him to a smoking cessation group
    C.   Discuss setting a stop date for the vape pen
    D.   Provide reassurance that vaping is shown to help with smoking cessation

3) Nico is a 16yo who vapes with his friends. When discussing the risk of vaping, he says that it is safer than cigarettes and will not lead to cancer, so he is not interested in stopping it. Which of the following counseling points is the most accurate?

    A.   Vaping has the same amount carcinogens as cigarettes.
    B.   Vaping has more nicotine exposure than cigarettes.
    C.   Vapes were developed to help with smoking cessation
    D.   Vapes produce free radicals that can lead to lung damage, like cigarettes.

4) Alex is a 36-year-old who has expressed interest in smoking cessation. He decides that he would like to try a medication for smoking cessation. Which of the following is TRUE about pharmacotherapy for smoking cessation?

    A.   Buprenorphine is a first-line agent for smoking cessation
    B.   Bupropion, varenicline, and nicotine replacement are each more effective for smoking cessation than placebo
    C.   Varenicline is contraindicated in patients with bulimia
    D.   All forms of nicotine replacement therapy are rapid acting and require frequent redosing
    E.   Due to seizure risk, bupropion should not be used in conjunction with varenicline

5) Trixie is a 30-year-old with a history of epilepsy, who currently smokes 1 pack of cigarettes per day. She is interested in smoking cessation. She tried to quit cold turkey 3 years ago, and it worked for 5 months, however, she returned to smoking due to poor sleep and irritability. She again stopped smoking using nicotine gum but returned use having morning nicotine cravings while experiencing an increase in interpersonal stress. She presents today, interested in trying a nicotine replacement. Which of the following treatment plans includes the most evidence-based interventions?

    A.   Have her use a patch while smoking ½ a pack and slowly have her wean off smoking
    B.   Prescribe the nicotine patch only as it may have better success than the gum
    C.   Provide the nicotine patch and refer her to a local therapist.
    D.   Prescribe the nicotine patch with bupropion.

Answers

1) D: Weight loss. Weight gain, not weight loss, can be a symptom of nicotine withdrawal. People may gain 10-15 pounds on average. This may be due to loss of the appetite-suppressing effects of nicotine. People who quit smoking may also eat more to keep their hands and mouth busy to replace the behavior of smoking. Difficulty concentrating, sleep problems, and depression can all be symptoms of nicotine withdrawal. Other symptoms of nicotine withdrawal include irritability, anxiety, restlessness, and cravings.

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2) C: Given that Toby found a method that works for him, we should try to use that to work towards smoking cessation. He has tried many different NRTs, so trying another one may not be helpful (Choice A). He barely has enough time in a day for himself, so he probably won't follow through with a group (Choice B). Though vaping may help with smoking reduction and move individuals away from cigarettes, it is not found to help with cessation (Choice D). Therefore, we need to discuss a plan to slowly wean of vaping.

3) D: Vaping does have fewer carcinogens than cigarettes (Choice A), and can have reduced nicotine exposure depending on use (Choice B), however, they still produce radicals via combustion (Choice D). There is no conclusive evidence that vaping helps with smoking cessation.(Choice C)

4) B: While varenicline has the highest quality evidence to support its use, either nicotine replacement therapy, varenicline, or bupropion may be considered based on individual patient factors. Generally, varenicline or NRT are recommended as first line treatment. However, bupropion may be suited to patients who previously had success with bupropion, have comorbid untreated depression, or have financial concerns.

A) is Incorrect – buprenorphine is a medication for opioid use disorder and does not currently have a role in smoking cessation
C) is incorrect – bupropion is contraindicated in patients at risk for seizure, such as those with potential electrolyte derangements due to purging behaviors
D) is incorrect – many forms of nicotine replacement are long acting, such as a patch. Optimal therapy often includes a combination of long acting and short acting forms.
E) is incorrect – bupropion carries an increased risk of seizure, but varenicline does not amplify this risk. Combination bupropion + varenicline may in fact be more effective than varenicline alone.

5) C: Trixie has epilepsy so she should avoid bupropion (Choice D). Her journey to smoking cessation is interrupted by stressors. Therefore some form of counseling may help her in addition to the patch. (Choice C not Choice B) There is a risk of nicotine toxicity with using a patch and smoking simultaneously and titrating become difficult (Choice A not the best answer).

Supplementary Material B
Post-Module Survey

Q1. Medications and counseling are effective in helping people stop smoking.
Prior to Module:
(Strongly Disagree)1   2   3   4   5   (Strongly Agree)
After the Module:
(Strongly Disagree)1   2   3   4   5   (Strongly Agree)

Q2. I am comfortable using medications for nicotine use disorder.
Prior to Module:
(Strongly Disagree)1   2   3   4   5   (Strongly Agree)
After the Module:
(Strongly Disagree)1   2   3   4   5   (Strongly Agree)

Q3. List at least 1 clinical pearl you plan to implement into the care of people with NUD.

Q4. List at least 1 way this module could be improved and any other feedback you wish to share.

The Resilient Resident: A Pilot Resiliency Curriculum on Physical Medicine and Rehabilitation Resident Burnout

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Abstract

Background: Physical Medicine and Rehabilitation (PM&R) physicians are among those most affected by burnout. Following the 2017 Revision of ACGME (Accreditation Council for Graduate Medical Education) Requirements, programs and institutions were encouraged to emphasize physician well-being and recognition and strategies to mitigate burnout. As an at-risk specialty, we desired to develop and implement a facilitated resilience curriculum for Resident Physicians (RPs). **Methods:** We performed a clinical audit to develop and implement a resilience curriculum (RC) during the 2018-2019 academic year at a tertiary accredited acute care rehabilitation facility. The leader of each workshop previously underwent formal resilience training in integrative health coaching and organizational leadership. In part with all RP's, a four-part workshop series was conducted using four guiding questions: (1) "Who am I and who are we?", (2) "What contributes to resilience?", (3) "What challenges our resilience?", and (4) "How can we combat challenges to resilience?". We report PM&R RP responses to an End of Curriculum Assessment (ECA). **Results:** Key ECA themes highlighted that RPs were highly engaged in the process, all reported the RC was helpful, and strategies learned in times of stress were firmly adopted. By the end of the academic year, 93.3% RPs reported that they used strategies learned from the curriculum in times of stress during the academic year. Of these, 85.7% RPs reported using these strategies multiple times a month), (4) endorsed increased comfort discussing personal struggles with peers and more control over work schedules. 100% of RPS were able to make and sustain new positive lifestyle changes throughout the academic year. **Conclusions:** Our pilot resilience curriculum provides preliminary data in support of a curriculum to address PM&R RPs burnout in the workplace and can be used to meet ACGME residency program requirements.

Introduction

Burnout has been defined as a syndrome of emotional exhaustion, depersonalization, and reduced sense of personal accomplishment.[1] Burnout rates vary by medical specialty among United States (U.S.) physicians. Physiatrists reported significant burnout,[2] as confirmed by subsequent physical medicine and rehabilitation (PM&R) studies.[3-6] Accreditation Council for Graduate Medical Education (ACGME) sought to address this issue for RPs, among whom burnout rates have been reported as high as 63%,[7] by instituting work hour limitations and ongoing revisions to the Common Program Requirements, including the addition of a well-being commitment.

A key challenge to addressing burnout among PM&R RPs is that examples in this population are sparse. Kao and colleagues found physiatry RPs and fellow burnout rates range from 22.2%-83.3%.8 Bean and colleagues report that the combination of lack of adequate time for personal life and greater than 50-hour work weeks correlated with RPs burnout.[9] Scholars suggest the following interventions for PM&R RPs burnout ought to include mental health services, mindfulness classes, planned social activities, and mentorship programs.[10] Aggarwal and colleagues administered a 12-week peer-led wellness curriculum to a mixed sample of five RP programs, including 21 physiatry RPs; however, results of the intervention on physiatry RPs were not discussed.[11] Due to the paucity of literature, we piloted a novel resilience curriculum (RC) and obtained preliminary usability data from PM&R RPs. We focused our pilot efforts on the depersonalizing effects of burnout and developed our RC to guide RPs on a path to self-discovery. The curriculum was designed to fulfill the ACGME's program requirement to prevent and minimize RP burnout. The coursework was also meant to be an independent curriculum that could be incorporated into an existing resilience series.

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Table 1. Results of the End of Curriculum Assessment Administered to RPs.

Resident physicians who…	RP Respondents N	%
Felt the curriculum was helpful	15	100
Successfully made positive lifestyle changes**	15	100
At years' end, used strategies learned from the curriculum during stressful times	14	93
Felt loss of meaning and purpose during the previous academic year	12	80
Used strategies multiple times a month	12*	80
Experienced 1 or more major life stressors this academic year	11	73
Felt greater control over work schedules at the end of the curriculum	9	60
Felt more open to discussions regarding wellness at the end of the curriculum	6	40
Felt loss of meaning and purpose at the end of the curriculum	5	36
Felt more comfortable discussing personal struggles with peers at the end of the curriculum	5	33
Felt more connected to peers at the end of the curriculum	4	29
Used strategies once a month or less	2*	13

Legend: Table note: %: Percentage of positive respondents / total respondents. N: number of positive resident physician End of Curriculum Assessment respondents of 15 respondents. *: Of total 14 respondents. **: Including increasing physical activity, regular meditation, strengthening support systems, focusing on self-acceptance, and re-establishing priorities.

Figure 1. Timeline of Resiliency Curriculum Design and Implementation.

ACGME Guidelines Update
Common Program Requirements Section VI.C Well-Being

Workshop #1
"Who am I and who are we?"
Featuring the Gallup Clifton Strengths Assessmen

Workshop #3
"What challenges our resilience?"
Via role-playing exercises and feedback strategies

2017   2018   2019

2017   2018   2019

Curriculum Design
Resilience Series discussions during monthly GME meetings

Workshop #2
"What contributes to resilience?"
Emphasizing the importance of self-reflectionare we?"
Featuring the Gallup Clifton Strengths Assessmen

Workshop #4
"How can we combat other challenges to our resilience?"
By sharing personal stories and coping strategies

Methods

Design

Exempt status was obtained from the institutional review board. RP participation was voluntary. We performed a clinical audit of our existing curriculum which was found to lack resiliency training. Based on the 2017 ACGME burnout reduction standards, our department developed a set of competency-based educational objectives. "Resilience Series" was added to the recurring agenda of monthly Program Evaluation meetings to discuss and promote the RC with departmental leadership. The focus of the RC was on the depersonalizing effects burnout can have on individuals and how to guide RPs on a path to self-discovery.

Participants and procedures

Our pilot RC was initiated during the 2018-2019 academic year. RPs attended four 60-minute workshops July 2018 to March 2019, facilitated by our resident wellness advocate and lead faculty physician, with formal resilience training in integrative health coaching and organizational leadership. There were no prerequisites for learners to begin the curriculum and all 15 RPs were invited to each workshop. The variables we aimed to address are the described below for each workshop and the End of Curriculum Assessment (ECA) is how we measured those variables. Further details regarding characteristics of the workshop, see **_Supplemental material 1_**.[12] For the complete timeline of events, see **_Figure 1._**

Workshop intervention

Workshop 1 "Who am I and who are we?" aimed to change the culture of self-doubt and criticism often found in medicine by identifying and fostering individual and group strengths. The theme was selected to create a unified residency vision and mission statement, as Silver and Bhatnagar proposed that physiatrists may be able to utilize mission statements for combating burnout.13 RPs suggestions and common recurring themes from the team building exercise were used to create unified vision and mission statements. The statements were displayed in the RPs workroom at the discretion of each RP throughout the academic year to serve as a source of inspiration during times of stress.

The Gallup Clifton Strengths Assessment was purchased by the residency program and completed by all RPs prior to the workshop start.14 Alternative assessments such as Myers-Briggs Type Indicator or the Kolbe Index were also available.15,16 For each RP, the assessment produced a list of top five strengths, which were further divided into four domains (executing, influencing, relationship building, strategic thinking). The results of this workshop were discussed with each RP during mid-year evaluations and were utilized by during the academic year to better understand and assist RPs in times of stress.

Workshop 2 "What contributes to resilience?" aimed to educate RPs on the modifiable dimensions of well-being, such as vitality, emotion, relationship, purpose, and growth, noting how each dimension could be modified to meet individuals' wants and needs. Differences in common terms used to describe one's health and how to assess personal health states through reflection and self-discovery were discussed.

Workshop 3 "What challenges our resilience?" aimed to address the most voiced RPs struggles at that time. Prior to the session, an email was sent to RPs asking for suggested topics for which "Giving and receiving constructive feedback" was selected from their responses. A presentation was given to discuss various feedback models and the importance of facilitating in-person bi-directional feedback. Attendees consisted of RPs and attendings, who were divided into groups of three, consisting of a feedback giver, receiver, and observer. Groups were given a fictional scenario and instructed to facilitate proper bi-directional feedback based on tools gained from a sample exercise, such as "feedback sandwich" (positive feedback given before and after negative verbal feedback). The workshop concluded with a debrief and strategizing discussion. To continue healthy feedback interactions between RPs and attending physicians, this workshop was also utilized to improve existing rotational RP observation assessments, competency assessments, and end-of-rotation evaluation forms.

Workshop 4 "How can we combat other challenges to resilience?" aimed to discuss current RPs struggles and revisit coping strategies in times of stress. All fifteen RPs, five from each post graduate year (PGY), were asked to contemplate how they manage burnout and stay resilient before the session. Current RPs struggles were discussed in small group settings. Next, the group suggested coping strategies that may be useful for each real-world situation. We revisited personal and group strengths, modifying dimensions of well-being, and connecting to sources of power such as peers, friends, and family.

Outcomes

We retrospectively monitored curriculum usability with a face-validated posttest designed ECA with multiple-choice and open-ended questions *(Supplemental material 2).* Each workshop had a 1-minute free-text evaluation to provide any feedback to help with future workshops and assessments. This anonymous

data was collected and reviewed by the lead faculty advisor and the residency program director. Subjective analysis of the RC for the following academic year was performed to justify future expansion of more sessions. Of the 15 ECAs collected, the percentages of each chosen answer choice per question were calculated to subjectively review. To ensure accuracy of data collection, RPs were informed their responses were anonymous and would have no impact on ACGME evaluations.

Results

Results of the ECA are provided in *Table 1.* 73.3% of RPs reported experiencing one or more major life stressors during the academic year. 80% of RPs reported feeling loss of meaning/purpose at one or more points during the previous academic year, and 33.3% reported feeling this less frequently at the end of the year. 100% of RPs reported that the curriculum was helpful. By the end of the academic year, 93.3% RPs reported that they used strategies learned from the curriculum in times of stress. Of these, 85.7% RPs reported using these strategies multiple times a month and 14.3% RPs reported using the strategies once a month or less. 33.3% RPs reported feeling more comfortable discussing personal struggles with peers and 26.6% felt more connected to their peers in general. 60% of RPs felt a greater sense of control over their work schedules. 40% of RPs felt more open to discussions regarding wellness. 100% of RPs were able to make and sustain new positive lifestyle changes throughout the year. These included being more physically active, engaging in regular meditation, expanding and/or further strengthening their support systems, focusing less on obtaining perfection, getting out of their comfort zone more often, and re-establishing priorities. Additional subjective feedback received from RPs included "the desire for more frequent sessions", "unstructured discussion time", "a focus on systemic issues", and "more faculty involvement in these workshops". Regarding the ECA, all RPs reported the RC was helpful. RPs endorsed increased comfort discussing personal struggles with peers and more control over work schedules. We observed an increased ability to successfully make and sustain positive lifestyle changes and a decreased personal sense of loss of meaning

Discussion

We aimed to pilot a RC for PM&R RPs and obtain preliminary usability data. Results are in *Table 1.* All RPs reported the program was helpful and reported making positive changes to their lifestyle. The curriculum describes strategies that residency programs can immediately implement to address key organizational drivers of burnout; and RPs were highly engaged in the process as demonstrated by attendance at workshops. All sessions were attended by 12-15 RPs. Most RPs (80%) experienced loss of meaning/purpose during the previous year. At RC series completion, 29% of RPs expressed greater connection to their peers. Feeling isolated and loss contribute to stress and burnout; future programs need to consider ways of decreasing isolation, perhaps by increasing activities which promote a greater social connectedness among RPs. More

research is necessary before it can be concluded that the number of people attending workshops contributed to an effect.[17]

We observed an effect on department leadership. Leadership embraced the RC as a platform to promote connection and meaning in the workplace. Our department chairman shared RPs mission and vision statement with hospital administrators and system wide GME leadership. Attendings and RPs noted increased camaraderie, focus on self-care, and change in supportive dialogue since curriculum implementation.

It should be noted that our RC was designed to support all RPs beginning in 2018. Shortly before, there were revisions that were made to the Common Program Requirements (Section VI.C Well-Being)18 in 2017. A 2020 Cochrane Systematic Review suggests very-low certainty evidence supporting the effectiveness of resilience training on resilience, anxiety, and stress or stress perception in healthcare students.[19] A recent meta-analytic review found interventions to improve teamwork, communication, and stress management have small but positive effects on burnout;[20] however, no intervention studies on RC have included PM&R RPs, highlighting the need for more research. Our institution is committed to providing a community that promotes well-being.[21] For the 2025-2026 academic year, the Liaison Committee on Medical Education does not mandate resiliency or a well-being curriculum.[22]

Key limitations of this pilot are that well-being is dynamic and not every dimension can be addressed by our curriculum. We acknowledge that different curriculum interventions resonated at varying strengths with each RP. We chose RPs to administer the curriculum because they were highly motivated. We recognize the small sample size and, while not all invited residents attended all workshops, there were no dropouts. Future workshops ought to involve attending physicians and other disciplines. A clinical psychologist could also be involved in co-administering future workshop curricula. We surveyed RPs at one academic site, limiting generalizability to academic programs of different sizes, or to other specialties. There is possibility of selection bias. Additionally, the ECA was administered at the end of the year; including pre-assessment data would allow for more robust analysis. This clinical audit did not include hypothesis testing because the purpose was to generate preliminary data for a larger study. Descriptive statistics are provided in **_Table 1_** to gain insight into the RC to improve burnout in the PM&R context. We were not powered to conduct hypothesis testing. RPs responses may have been affected by social desirability bias as well as confounding factors including program, organization, institutional factors, or resident factors. Validated burnout scales should be employed during pre and post assessments. Multiple factors influence RPs burnout including time of year, rotation demand, work hours, control over schedule, transitional life changes, differences between PGY years, and specific stressors including increased leadership roles and navigating future career opportunities. It is plausible this curriculum could be beneficial for categorical PM&R programs as well; however, more research

is warranted. A strength is that our curriculum is actively in use today.

Conclusions

Our findings support the notion that a PM&R RC to address to address burnout in the workplace is feasible with RPs. This pilot supports further development of the RC to decrease burnout in PM&R RPs. If effective, this curriculum could provide an option for RPs nationally.

Summary – Accelerating Translation

Title: The Resilient Resident: A Pilot Resiliency Curriculum on Physical Medicine and Rehabilitation Resident Burnout.

Main Problem

Burnout among resident physicians (RPs) is a significant issue, characterized by emotional exhaustion, depersonalization, and a diminished sense of personal accomplishment. In the U.S., burnout rates vary by specialty, and physiatry has shown notably high levels of burnout. The Accreditation Council for Graduate Medical Education (ACGME) has responded with regulations such as work hour limits and a focus on well-being.

Aim of Study

To address this, the Carolinas Department of Physical Medicine and Rehabilitation (PM&R) piloted a resilience curriculum aimed at reducing burnout among their residents. This curriculum was designed to meet ACGME requirements and was created based on literature and departmental needs, focusing on the negative impacts of burnout and guiding residents toward self-discovery.

Methodology

Four workshops were held throughout the 2018-2019 academic year at a tertiary accredited acute care rehabilitation facility in the Southeast U.S. These were hosted by the resident wellness advocate and lead faculty physician, who had completed formal resilience training and specialized training in leadership. Attendance was voluntary and all residents were encouraged to attend.

Details of the Curriculum:
1. Workshop 1: "Who am I and who are we?"
   - **Objective:** The workshop goal was to change the culture of self-doubt and criticism often found in medicine by identifying and fostering individual and group strengths. It helped residents identify their personal strengths and those of their peers.
   - **Activities:** Residents took the Gallup Clifton Strengths Assessment to discover their top strengths. They then used this information to create a unified vision and mission statement for their residency program. This statement was displayed in their work area to inspire and motivate them throughout the year.
2. Workshop 2: "What contributes to resilience?"
   - **Objective:** This workshop focused on educating RPs on the modifiable dimensions of well-being, such as vitality, emotion, relationship, meaning/purpose, and growth, noting how each dimension could be modified to meet individuals' wants and needs.
   - **Activities:** Residents learned how to reflect on their personal health and make changes to improve their overall well-being.
3. Workshop 3: "What challenges our resilience?"

- **Objective:** The goal was to address the most voiced RP struggle at that time, which was identified as how to give and receive constructive feedback effectively.
- **Activities:** Residents participated in role-playing exercises where they practiced giving and receiving feedback in a constructive way. They also discussed how to improve feedback processes between residents and attending physicians.
4. Workshop 4: "How can we combat other challenges to our resilience?"
   - **Objective:** This workshop aimed to discuss the current RP struggles and revisit coping strategies in times of stress.
   - **Activities:** Residents shared their personal struggles and brainstormed coping strategies in small groups. They revisited their strengths and discussed how to connect with supportive people like peers and family.

Results

Assessment: Preliminary data were collected using a face validated survey at the end of the program. The data from ECU indicates that the curriculum was well-received and effective in promoting positive changes and coping strategies, although there were varying degrees of impact on feelings of connection and openness.

Survey Results:

Below is a summary of the results of the End of Curriculum Assessment for the RPs:

- **Helpfulness of Curriculum:** All 15 RPs (100%) found the curriculum helpful.
- **Lifestyle Changes:** All 15 RPs (100%) successfully made positive lifestyle changes, such as increasing physical activity, meditating regularly, and strengthening support systems.
- **Use of Strategies in Stressful Times**: 14 RPs (93%) used the strategies learned from the curriculum during stressful periods.

- **Loss of Meaning and Purpose:** 12 RP (80%) felt a loss of meaning and purpose during the previous academic year.
- **Frequency of Using Strategies:** 12 RPs (80%) used the strategies multiple times a month.
- **Major Life Stressors:** 11 RPs (73%) experienced one or more major life stressors during the year.
- **Control Over Work Schedules**: 9 RPs (60%) felt they had greater control over their work schedules by the end of the curriculum.
- **Openness to Wellness Discussions:** 6 RPs (40%) felt more open to discussing wellness topics by the end of the curriculum.
- **Ongoing Loss of Meaning and Purpose:** 5 RPs (36%) still felt a loss of meaning and purpose at the end of the curriculum.
- **Comfort in Discussing Struggles:** 5 RPs (33%) felt more comfortable discussing personal struggles with peers by the end of the curriculum.
- **Connection with Peers:** 4 RPs (29%) felt more connected to their peers by the end of the curriculum.
- **Infrequent Use of Strategies:** 2 RPs (13%) used the strategies once a month or less.

These positive preliminary data support the notion that the RC was well-received and promoted positive changes and coping strategies, although there were varying degrees of impact on feelings of connection and openness.

Conclusion

The PM&R RC has shown promise in helping RPs deal with burnout and stress. This pilot could be a useful model to improve physician well-being for other residency programs. Future improvements could involve including more faculty, mental health professionals, and expanding research to see how well the program works in different settings..

References

1. Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory. 3rd ed. Consulting Psychology Press; 1986.
2. Shanafelt TD, Boone S, Litjen T, Dyrbye LN, Sotile W, Satele D, et al. Burnout and satisfaction with work–life balance among US physicians relative to the general US population. Arch. Intern. Med. 2012;172(18):1377–85.
3. Shanafelt TD, Hasan O, Dyrbye LN, Sinsky C, Satele D, Sloan J, et al. Changes in burnout and satisfaction with work–life balance in physicians and the general US working population between 2011 and 2014. Mayo Clin. Proc. 2015;90(12):1600–13.
4. Medscape. Medscape National Physician Burnout and Suicide Report 2020. Available from: https://www.medscape.com/slideshow/2020-lifestyle-burnout-6012460. Updated Jan 15, 2020; cited 2024 May 15.
5. Medscape. "Death by 1000 Cuts": Medscape National Physician Burnout and Suicide Report 2021. Available from: https://www.medscape.com/slideshow/2021-lifestyle-burnout-6013456. Updated Jan 22, 2021; cited 2024 May 15.
6. Shanafelt TD, West CP, Sinsky C, Trockel M, Tutty M, Satele DV, et al. Changes in burnout and satisfaction with work–life integration in physicians and the general US working population between 2011 and 2017. Mayo Clin. Proc. 2019;94(9):1681–94.
7. Dyrbye LN, Burke SE, Hardeman RR, Herrin J, Wittlin NM, Yeazel M, et al. Association of clinical specialty with symptoms of burnout and career choice regret among US resident physicians. JAMA. 2018;320(11):1114–30.
8. Kao DJ, Franzese K, Seo YI, Mandalaywala NV, Oak K, Moroz A, et al. Evaluating burnout in physical medicine and rehabilitation residents. PM&R. 2016;8(Suppl):S326.
9. Bean AC, Schroeder AN, McKernan GP, Mesoros M, Silver JK, Verduzco-Gutierrez M, et al. Factors associated with burnout in physical medicine and rehabilitation residents in the United States. Am. J. Phys. Med. Rehabil. 2022;101(7):674–84.
10. Francio V, Ha C, Barndt B, Schappell J, Smith S, Weider KI, et al. Wellness in physical medicine & rehabilitation (PM&R) residency programs. PM&R. 2018;10(Suppl):S50.
11. Aggarwal R, Deutsch JK, Medina J, Kothari N. Resident wellness: an intervention to decrease burnout and increase resiliency and happiness. MedEdPORTAL. 2017;13:10651.
12. Duke Health. Duke Health and Well-Being Coach Training. Available from: https://dhwprograms.dukehealth.org/health-wellbeing-coach-training/. Updated 2024; cited 2024 Jun 3.
13. Silver JK, Bhatnagar S. Physician burnout in physical medicine and rehabilitation (PM&R): should we focus more on physiatrists' mission? Am. J. Phys. Med. Rehabil. 2017;96(8):e159–61.
14. Rath T. Strengths Finder 2.0. New York, NY: Gallup Press; 2007.
15. Briggs KC. Myers-Briggs Type Indicator. Form G. Palo Alto, CA: Consulting Psychologists Press; 1987.
16. Kolbe Corp. Kolbe A™ Index. Available from: https://secure.kolbe.com/k2/show_takeIndex/indexType_A. Updated 2021; cited 2024 Jun 3.

17. LaFontaine TP, DiLorenzo TM, Frensch PA, Stucky-Ropp RC, Bargman EP, McDonald DG. Aerobic exercise and mood. Sports Med. 1992;13(3):160–70.

18. Accreditation Council for Graduate Medical Education. ACGME Common Program Requirements Section VI with Background and Intent. Updated Feb 2017; cited 2024 Jun 3.

19. Kunzler AM, Helmreich I, König J, Chmitorz A, Wessa M, Binder H, Lieb K. Psychological interventions to foster resilience in healthcare students. Cochrane Database Syst. Rev. 2020;7:CD013684.

20. Kiratipaisarl W, Surawattanasakul V, Sirikul W. Individual and organizational interventions to reduce burnout in resident physicians: a systematic review and meta-analysis. BMC Med. Educ. 2024;24(1):1234.

21. Atrium Health. Department of Physical Medicine and Rehabilitation. Well-Being Policy. Updated Jun 2024.

22. Liaison Committee on Medical Education. Functions and Structure of a Medical School: Standards for Accreditation of Medical Education Programs Leading to the MD Degree. Mar 2024

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Supplementary Material

Supplemental Content 1

Workshop General Characteristics

We obtained exempt status from the Institutional Review Board before the implementation of the wellness curriculum. Written informed consent was not required for the administration of our end-of-curriculum assessment to participants.

Workshops took place in a conference room with computer access, projection, and recording capabilities and were attended either in-person or remotely via video conference. The workshop series was comprised of four 60-minute small group sessions implemented over one academic year with the following characteristics:

1. 10-15 residents per workshop.
2. Each workshop took place during previously dedicated lecture times.
3. Each workshop was planned progressively to facilitate carryover.
4. Each workshop had a fundamental question that participants were to consider through

a) self-reflection and

b) small group discussion: "Who am I and who are we?", "what contributes to resilience?", "what challenges our resilience?", and "How can we combat challenges to resilience?".

Characteristics of the Lead Facilitator and Resident Wellness Advocate

The faculty advisor worked with an integrative health coach and studied physician well-being as part of the Duke Leadership Program in Health and Well-being over 1-2 years.[9] The advisor also served as a peer-to-peer support specialist for residents and physicians and was trained to facilitate Serious Illness Conversations based on Ariadne Labs. An interested RP was appointed as Resident Wellness Advocate and received coaching in small group facilitation, role-playing, and utility of reflective listening. While these educational development programs are optional for curriculum leaders, we recommend the facilitator have some background knowledge in resilience training and facilitation for which some of our faculty are open to receiving more training and knowledge.

Supplemental Content 2

End of Curriculum Assessment

To maintain participant anonymity, the data collected from the following survey will only be reported in aggregate.

1. Your gender is:
   - Male
   - Female
2. Your age is:
   - <25
   - 26-30
   - 31-35
   - 36-40
3. Please circle the items below that correlate with your educational achievements.
   - Bachelor of Arts or Science
   - Master's degree
   - PhD
   - DO
   - MD
4. Have you experienced any major life stressors (i.e., death of a loved one, relationship struggles/separation, personal injury/significant illness, traumatic events such as a natural disaster/theft/violence against you or a loved one, marriage, pregnancy/birth of a child, financial strain, increase in work responsibilities, or move) during this academic year?
   - Yes
   - No
5. How open were you to discussions regarding mindfulness, wellness, and well-being in the previous academic year?
   - Not open at all
   - Somewhat open

- Open
- Very open

6. How open are you to discussions regarding mindfulness, wellness, and well-being now at the end of this academic year?
    - Not open at all
    - Somewhat open
    - Open
    - Very open

7. Have you tried to make major and positive lifestyle changes during this academic year?
    - Yes, I made a change(s)
    - What changes did you make?
    - Were you successful?
    - Yes, I was successful
    - No, I was not successful
    - If not, what was the biggest challenge?
    - No, I did not make a change

8. How much control did you feel you had over your work schedule in the previous academic year?
    - No control
    - Some control
    - A lot of control

9. How much control did you feel you had over your work schedule during this academic year?
    - No control
    - Some control
    - A lot of control

10. How open were you to discussions with your peers regarding personal struggles in the previous academic year?
    - Not open at all
    - Somewhat open
    - Open
    - Very open

11. How open are you now to discussions with your peers regarding personal struggles?
    - Not open at all
    - Somewhat open
    - Open
    - Very open

12. How often did you feel connected to your co-workers in the previous academic year?
    - Never
    - Sometimes
    - Very Often
    - Always

13. How often did you feel connected to your co-workers during this academic year?
    - Never
    - Sometimes
    - Very Often
    - Always

14. How often did you feel loss of meaning or purpose in the previous academic year?
    - Never
    - Once a month or less
    - A few times a month
    - A few times a week
    - Daily

15.   How often did you feel loss of meaning or purpose during this academic year?

- Never
- Once a month or less
- A few times a month
- A few times a week
- Daily

16.   How often this academic year did you use strategies learned in the Resilience Series in times of stress?

- Never
- Once a month or less
- A few times a month
- A few times a week
- Daily

17.   Did you feel like the Resident Resilience Curriculum was helpful?

- Yes
- No

18.   Please specify areas for curriculum improvement.

A Narrative Review of Women in Medicine Interest Groups at the Pre-Medical, Graduate, and Post-Graduate Medical Education Levels

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Abstract

Women in Medicine (WIM) interest groups can provide collaboration and support for the professional development of women as they navigate the gender inequities that persist in the healthcare workplace. This narrative review assesses successful methods used by multiple institutions to form groups and toolkits catered to women's empowerment. Medical career education was stratified into three levels: Pre-Medical, Graduate, and Post-graduate Medical Education. A keyword literature search on peer-reviewed platforms including Google Scholar, PubMed, OVID, EBSCO, and gray literature (i.e. medical societies toolkits) was used to identify applicable articles. We aimed to develop a toolkit derived from literature findings consisting of a list of ten steps for creating and maintaining a successful WIM group based on successful measures reported in the literature. Twenty-three studies were selected after screening using the Scale for the Assessment of Narrative Review Articles (SANRA). Data extraction was conducted systematically by three researchers who independently reviewed and documented key information from selected studies. Our analysis identified common success factors across all educational levels, including mentorship, adequate resources, administrative support, networking opportunities, and safe spaces as critical elements for women's career advancement in medicine. Based on these findings, we developed a comprehensive ten-step toolkit for institutions seeking to establish or improve their WIM groups. These implications extend beyond individual career advancement to institutional transformation and patient care improvement. Future research should focus on longitudinal outcome measures to evaluate the long-term impact of these interventions on career trajectories, leadership representation, and organizational climate change.

Introduction

Despite the growing number of women in medicine, challenges of inclusion and equity remain within higher career levels,[1] such as wage disparities, and subtle or overt discrimination in the medical field. For over 25 years, women have constituted approximately 40% of incoming medical students.[3] According to the Association of American Colleges (AAMC) Physician Specialty Data Reports, the percentage of women in the physician workforce has increased steadily since 2007.[2] Yet, despite the increase from previous years, recent studies have highlighted a glaring gender disparity at the leadership level. In 2018, women accounted for merely 18% of hospital chief executive officers (CEOs) and 16% of all deans and department chairs within the United States.[3-4] Furthermore, while female physicians constitute 38% of full-time medical school faculty, only 21% are full-time professors.[6] These differences are not limited to categories within hospital administration and academia. In a recent study by Jagsi et al. reported that women are significantly underrepresented in positions of senior authorship and physician-focused medical societies.[5] Reasons for this disparity are multifactorial; however,

those most researched are professional isolation, the impact of family responsibilities, and discrimination of age and gender.[7] In a recent survey study, authors reported that female physicians were less likely to run for leadership positions, despite many of them being highly qualified and believing that more women were needed in these roles.[8] Within the same article, the authors identified several barriers to running for said positions such as a lack of protected time, work support, experience, and mentorship.[9] While each of the challenges mentioned above for female physicians in leadership has been thoroughly examined, solutions to such barriers are lacking. Thus, effective strategies are needed to improve female physician satisfaction and career advancement within medicine.

A Women in Medicine Interest Group (WMIG) is a professional organization within medical institutions that provides mentorship, networking, and career development support specifically for women in medicine. Women in Medicine (WIM) interest groups present a unique and cost-effective solution for addressing the gender disparity of female physicians in

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leadership. These groups include women and allies and work towards common goals for gender inclusion in the medical field. Current research has explored the implementation of Women in Medicine interest groups at each level of medical education (pre-medical, undergraduate, and medical graduate); however, to our current knowledge, to date, no study has attempted to summarize the data from Women in Medicine interest groups using the current literature at each educational level. To address this research gap, this study aims to develop a Women in Medicine interest group narrative review focused on identifying key components needed for female physicians in leadership, which can potentially be used as a toolkit for future WIM group endeavors. Visibility of women in medical conferences, participation on panels, and invitations to chair sessions have also been a focus of study.[20, 21] For 33 years, the American Academy of Neurology Annual Meeting had no female speakers in plenary sessions. Despite some progress being seen in the most recent years, some considerable gaps persist, and further investigation is needed to understand why this still happens. Furthermore, such opportunities create a safe space for female physicians to express their perspectives and ensure their voices are heard as well as supported.[1] Thus, the development of women in medicine interest groups offers a professional support system for many female physicians facing the previously outlined social barriers.

While there are multiple interesting initiatives ongoing regarding WIM groups and female empowerment, there is not yet enough literature or toolkits available on how to make such projects move forward and have a great impact. Our goal is to provide the readership with the right tools to achieve success and avoid pitfalls when setting up a WIM group in their institutions. For such reasons a narrative review was deemed necessary and appropriate at the current scenario.

Methods

A narrative review approach was used to examine Women in Medicine Interest Groups at the Pre-Medical, Graduate, and Post-graduate Medical Education Levels. Applying a narrative approach can provide valuable insights into best practices, challenges, and the broader context of supporting women in medicine. The Scale for the Assessment of Narrative Review Articles (SANRA) will be used to optimize the critical appraisal of selected sources and overall quantification of quality assessment. SANRA is the gold standard for narrative review quality assessment, with a 6-item questionnaire the authors could evaluate each criterion with a scale from 0 to 2 for manuscript quality and suitability to the review.

Search strategy and selection criteria

A semi-systematic literature review was conducted. A keyword literature search of peer-reviewed articles was conducted in November 2021 and in January 2023 on the following platforms: Google Scholar, PubMed, MEDLINE, OVID, and Ebsco. Gray literature (i.e. medical societies' websites) was also utilized to identify relevant articles such as Toolkits and Guides on starting a WIM Group at pre-medical, medical and graduate educational

levels. Levels of each educational level are as follows: Pre-medical: those at the undergraduate level that are involved in preparation for medical school, graduate: those enrolled in medical school, and postgraduate: as those defined as further education after medical school, which includes fellowships, medical residency, and Ph.D. programs.

Pre-defined keywords were used to identify potential articles of the current study. All search items were identified in accordance with the themes: Women in Medicine, Women Interest Groups, and/or Female Leadership.

Inclusion and Exclusion Criteria

Articles were included in the study if they were peer-reviewed publications or grey literature pieces curated by accredited medical societies, pertinent to women in medicine groups, published from 2020-2023, included English full-text, and provided a detailed step-by-step guide or case reports of successful WIM groups. Only articles in English were considered for this narrative review, no restrictions on article type were applied during database screening. Articles which scored a zero in any category of the SANRA and that were outside of the study scope were excluded from the study.

Data Synthesis

The selected articles were systematically analyzed by extracting relevant information to establishing WIM groups at various educational levels. The data were synthesized to identify common themes, strategies, and challenges associated with WIM groups. Findings were then organized narratively to provide a cohesive overview of effective practices, highlighting successful approaches. The data extraction process was conducted systematically by three team researchers (S.B., A.C. and G.S.) who independently reviewed and documented key information from the selected studies. The extracted data elements included educational attainment levels, study objectives, and primary research findings. All information was systematically organized and compiled in a collaborative document to ensure consistent data management and facilitate subsequent analysis. This collaborative approach to data extraction helped maintain accuracy and reliability through cross-verification among team members. Each team member was responsible for specific data elements, and regular meetings were held to resolve any discrepancies or uncertainties in the extraction process.

Ethical approval was not required for this review as it is based solely on analysis and synthesis of previously published literature. No primary data collection involving human participants, human tissue, or animal subjects was conducted. All cited studies were assumed to have obtained appropriate ethical approvals as reported in their original publications.

Results

Results highlight several connections of similarity among the respective educational levels. Through our literature search, we

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identified key success factors that informed the development of our toolkit. A Ten Steps guide *(Table 1)* was created based on the literature findings as an illustrative synthesis.

Table 1. 10 Steps of Creating and Maintaining a Successful WIM Group.

1. Identify prospective women in medicine within individual institutions
2. Gather resources to create a needs-based assessment for prospective WIM
3. Gather mentoring faculty and interested WIM alumnae within local institutions for further mentorship
4. Provide training materials and workshops to faculty and alumnae allocated from previous, successful WIM endeavors (e.g.: WIMS)
5. Advertise the program to WIM via local institutional resources
6. Determine regular meeting schedules and general organization
7. Foster student leadership within the WIM group
8. Encourage individual institutions to harbor and maintain connections with neighboring medical establishments for future opportunities
9. Facilitate meetings or networking with other WIM groups across the country to maintain camaraderie and build professional networks
10. Provide quarterly check-ins to identify gaps and successes within each WIM group

Legend: The table represents the summary of our findings.

Pre-medical Educational level

The pre-medical level involves students who are preparing to pursue undergraduate medical education. Within pre-medical literature, we sought to obtain successful common factors that led young women to develop interests in the medical field as well as factors that were lacking in their influence. It was found that programs specializing in Science, Technology, Engineering, and Mathematics (STEM) aimed to support pre-medical students by providing awards to departments and schools to promote their endeavors.[11] Through the Women in Medicine and Health Science Program (WMHSP), students were encouraged to explore interests ranging from academic career tracks to work-life balance. The program was developed to retain female faculty and support career advancement, but also offered mentorship to students interested in careers in academic medicine by cosponsoring classes, workshops, and events for female undergraduate, graduate, and medical students.[1]This developmental support can be accomplished by institutions through encouraging training amongst staff that focuses on obtaining a gender balance and educating about gender equities at an institutional level. We found that while these programs led to the promotion of mentorship and encouraged interaction between staff and students, there was an overall lack of women in high-achieving positions throughout many universities and establishments.[12] This has been discovered by evaluating sub-specialties of publications of women versus their male counterparts.

Socially, women are often considered different from their male counterparts due to historically constructed societal expectations typically placed on women such as household management, unpaid caretaking, child-rearing, etc. While women in the pre-medical levels dedicate time towards their goals in medical training, as demonstrated by the WMHSP, there is a large interest in work-life balance. The lack of childcare facilities and services while pursuing a pre-medical career is shown to be a problem that many medical schools and institutions do not typically cater to.[1] We deduce that women-to-women mentorship would further be necessary for this family-planning aspect as women will readily identify with. The last factor we found as a positive influence on women in the pre-medical field is opportunity. Increased positive interactions in the field, through clinical experiences such as shadowing, volunteering, or short-term positions in hospitals allow young women to experience the field despite the challenges of premedical coursework[13].

Medical Graduate Educational level

Shifting the focus to the medical graduate level of education, we found overlaps with the pre-medical education level in terms of mentorship being a crucial aspect of influence, opportunities to allow exposure into the medical field, and the importance of developmental support amongst staff.[14] The largest difference of influence that we discovered through literature studies was that the established groups that have already been developed within medical schools owe their success to perceived identity congruence among faculty. These groups focused on inclusion while emphasizing a sense of belonging by offering a wide range of opportunities (such as academic sponsorships, internships, and skill development strategies) for student involvement. Other successful endeavors included incorporating outside speakers and creating a safe space for students to seek mentorship, co-learning initiatives, and student resources.[15]

Post-graduate level

Regarding the post-graduate education level, we noticed a shift in the importance of empowerment.[16] Allyship and community amongst women physicians are key at post-graduate levels of medical education. Established women physicians and trainees benefited from advocacy of institutional change and developing a dialogue with institutional leaders regarding unconscious bias training, advocacy of motherhood rights, and for wellness and burn-out prevention.[16,17] Continuous follow-up by providing a space to gather while recognizing members` contributions, and ownership of their work with opportunities for CV building has the potential to lead to the overall promotion of women's equity.[18] The Forum for Women in Medicine (FWIM)[22] is one example of a structural solution implemented at the Department of Medicine of Washington University School of Medicine; started in 2014 it has supported more than 110 trainees per year over the course of eight years. FWIM presents sustainability and growth, as well as positive feedback and outcomes of trainees who participate in the program. They host a multitude of events, workshops, and lectures that teach women how to network and gain camaraderie.

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Additionally, the gender-based challenges existing in every level of medical education are further evidenced in the leadership gender disparity observed in healthcare. A recent study by Sanchez et al[23] shows that 74.01% of healthcare staff are women but the representation of women in management positions is around 33%, and among service chiefs, 24%. With such disparities WIM groups become even more relevant. The summation of our review considering all career levels is provided in **_Table 1._**

Discussion

The current study identified 10 essential steps of creating and maintaining a successful WIM Group.

Construction of the 10 Steps of Creating and Maintaining a Successful WIM Group.

Step 1: Identify prospective women in medicine within individual institutions. This step aims to identify the women who show interest in joining women in medicine groups or those who are interested in founding a group. Identifying and quantifying this allows resources to be properly allocated. It may also be beneficial for identifying those interested in leadership roles within the organization formed.

Step 2: Gather resources to create a needs-based assessment for prospective WIM groups such as monetary resources, faculty, and outreach methods. Each establishment varies in its foundation for starting women in medicine groups, with specific differences in institutional size, population, and age groups of the individuals involved (i.e. high school, college, post-graduate). Conducting a needs-based assessment helps identify institutional gaps for each WIM group to address what is lacking within the institution and what needs to be focused on in the group. While one institution may need to focus on advocacy, another may need to focus on opportunities for advancement. This assessment allows resources to be allocated toward fixing each institution's weaknesses in order to provide a holistic WIM group for interested individuals.

Step 3: Gather mentoring faculty and interested WIM alumni within local institutions for further mentorship. A lack of mentorship was found amongst all three education levels. Therefore, finding faculty within each institution who have a particular interest in mentorship can help build a basis for mentorship at the inception of the group. The use of alumnae from each institution, as well as from local hospitals allows for consistency and shared experiences amongst current students and trainees creating more substantial connections. Studies have shown that women as well as other underrepresented populations in medicine can gain substantially just from having equal representation at events such as medical conferences.[20]

Step 4: Provide training materials and workshops to faculty and alumni allocated from previous, successful WIM endeavors (e.g.: The Women in Medicine group). Many successful endeavors produce useful material that can be used beyond the originating group. Furthermore, skill-building sessions for members are a powerful tool wherein senior members or alumni can deliver workshops and seminars for junior members. Skill-building sessions can focus on a multitude of skills, from public speaking, work ethics, and team building to clinical techniques and research methods.

Step 5: Advertise the program to WIM via local institutional resources. Networking is a key factor in connecting women in medicine. A study by Santhosh18 et al. highlights the importance of community building and the creation of an identity for the group, e.g., validating members' experiences. We can conclude that advertising the program to women in medicine via methods such as social media is essential to expand the group`s network, and local institutional resources should be used for such a purpose. Twitter (X) has been a pivotal resource in accessing other women in medicine where several medical professionals are able to self-identify themselves in their designated fields to allow future physicians access to their daily tweets and to eliminate biased categorization that others may place upon them. This is evidenced by Hinson and Gonzalez who highlight the power of the younger generation of medical professionals seeing equitable representation.[20]

Step 6: Determine regular meeting schedules and organization such as group roles. Santhosh et al.[18] also mention the sustainability of professional women in medicine groups, which is related to having a structure that allows for committees and subcommittees with limited terms to allow for the rotation of power and avoid burdening a small group of individuals. Only through an organized and flexible schedule can it become possible to achieve such goals. Acknowledging the work put into the group is also advised, such as a reward system or public acknowledgment to other members in order to provide positive reinforcement. Acknowledgement can come in different forms; creating a culture of constructive feedback, recognition of authorship and leadership in projects and innovative ideas, keeping track of hours spent in the group, etc.

Step 7: Foster student leadership within the WIM group, through positions on subcommittees or to leading research endeavors. Establishing student leadership positions is a critical component of the development of women in medicine groups. Through early exposure to leadership positions within medicine, women gain the skills necessary to be successful leaders throughout their careers while encouraging women to strive for higher positions throughout their future careers.

Step 8: Encourage individual institutions to harbor and maintain connections with neighboring medical establishments for future opportunities. Connections between institutions on a local level present a collaborative approach toward success in women in medicine groups and broadening the mentorship network. These nuanced approaches create broader opportunities for current and future women in medicine.

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Step 9: Facilitate meetings within WIM groups across the country and world to maintain camaraderie and build professional networks. Meeting with neighboring institutions offers a unique opportunity for networking within established academic connections. Additionally, exposure to certain advancements of other establishments creates dynamic solutions for future leaders of women in medicine.

Step 10: Provide quarterly check-ins to identify gaps and successes within each WIM group. Regular check-ins provide an additional basis of support for women in medicine. These methods allow administrators to address the challenges and prevent the possibility of future gaps within the interest group. Finally, regular check-ins (via group meetings and/or individual feedback) provide students with an opportunity for growth, reflection, and learning from their current progress. A potentially helpful way of having check-ins is hosting listening sessions and periodically conducting a needs assessment.[22]

The review reveals a consistent thread of essential factors supporting women's career growth in medicine across all educational levels. Mentorship, adequate resources, administrative support, networking opportunities, and safe spaces emerge as critical elements at the pre-medical, undergraduate, and graduate medical education stages. However, the manifestation and impact of these factors evolve as women progress through their medical education journey.

At the pre-medical level, mentorship often focuses on encouragement and guidance for entering medical school, while at the graduate level, it shifts towards career specialization and leadership development. Despite these progressions, challenges persist across all levels, including stereotypes, imposter syndrome, and balancing personal and professional responsibilities. However, strategies to address these challenges become more sophisticated and targeted as women advance in their medical careers. This progression underscores the importance of continuity in support systems throughout the educational pipeline, with each level building upon the foundations laid in previous stages to foster the success of women in medicine.

Limitations
The paucity of literature did not allow for a systematic review with a meta-analysis of findings. Narrative reviews are more prone to selection bias, and even though there was an attempt to minimize it via ample inclusion criteria, it cannot be guaranteed the present paper is not subject to selection bias. Another limiting factor was the lack of studies evaluating the impact of WIM groups. We believe that such impact studies are an important method to gather evidence-based arguments for their implementation. They are also a way to measure the impact of WIM groups on gender equity in healthcare workspaces.

Strengths
While Toolkits and Guides for Women in Medicine Interest Groups exist in the literature[19], there are no conclusive

publications that provide an overview of the creation of women in medicine groups at different educational levels. Therefore, the present narrative review is novel and might serve as a trailblazer and guide for new WIM interest groups across the country and internationally.

Conclusion
It is evident that adequate resources, including administrative and financial support, provided to WIM groups play a pivotal role in the success of those groups. After evaluation of common successes and pitfalls of previous groups available through literature, this narrative review outlines 10 Steps *(Table 1)* that pre-med, undergraduate, and graduate-level WIM groups may follow to obtain a level of success comparable to previous groups. Further research should be conducted on the impact of such groups in developing a more equitable work environment for physicians and healthcare workers.

Summary – Accelerating Translation

This narrative review, titled "Women in Medicine Interest Groups Across the Educational Continuum: A Narrative Review and Toolkit for Institutional Implementation," addresses the persistent gender disparities in medical leadership despite increasing numbers of women entering medicine. While women constitute approximately 40% of medical students, they represent only 18% of hospital CEOs and 16% of medical school deans and department chairs, highlighting the need for effective strategies to support women's career advancement throughout their medical education journey.

The study aimed to develop a comprehensive toolkit for creating and maintaining successful Women in Medicine (WIM) interest groups by examining effective practices across pre-medical, graduate, and post-graduate medical education levels. A narrative review approach was employed using systematic keyword literature searches across multiple databases including Google Scholar, PubMed, MEDLINE, OVID, and Ebsco, conducted in November 2021 and January 2023. Gray literature from accredited medical societies was also included to identify relevant toolkits and guides. Articles were evaluated using the Scale for the Assessment of Narrative Review Articles (SANRA) to ensure quality assessment, with screening and analysis performed by three team researchers who systematically extracted and analyzed data from selected studies.

Twenty-three studies met the inclusion criteria and were systematically analyzed to identify common themes, strategies, and challenges associated with WIM groups across different educational levels. The analysis revealed that mentorship, adequate resources, administrative support, networking opportunities, and safe spaces were consistently identified as essential factors for success across all educational levels. At the pre-medical level, programs like the Women in Medicine and Health Science Program demonstrated success through mentorship opportunities, work-life balance support, and clinical exposure experiences. Graduate-level programs showed success through identity congruence among faculty, inclusion initiatives, and comprehensive student resources. Post-graduate programs emphasized empowerment, allyship, community building, and institutional advocacy for policy changes addressing unconscious bias and wellness.

The synthesis of findings led to the development of a practical 10-step toolkit for establishing and maintaining successful WIM groups. These steps include: identifying prospective women in medicine within individual

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institutions, gathering resources to create needs-based assessments, recruiting mentoring faculty and alumni, providing training materials from successful programs, advertising through institutional resources, establishing regular meeting schedules and organizational structure, fostering student leadership opportunities, maintaining connections with neighboring medical establishments, facilitating networking with other WIM groups nationally and internationally, and conducting quarterly evaluations to identify gaps and successes.

The review demonstrates that while challenges such as professional isolation, family responsibilities, and discrimination persist across all educational levels, the manifestation and solutions for these challenges evolve as women progress through their medical careers. Mentorship focus shifts from encouragement for medical school entry at the pre-medical level to career specialization and leadership development at graduate levels. The importance of continuity in support systems throughout the educational pipeline was emphasized, with each level building upon foundations laid in previous stages.

This narrative review serves as both a trailblazer and practical guide for new WIM interest groups nationally and internationally. The research demonstrates that adequate administrative and financial resources are pivotal for group success, and the 10-step framework provides a evidence-based approach for institutions seeking to establish effective WIM programs. The study acknowledges limitations including the paucity of literature preventing systematic review with meta-analysis, potential selection bias inherent in narrative reviews, and the lack of impact studies evaluating WIM group effectiveness. However, the review's strength lies in its novel comprehensive overview of WIM group creation across different educational levels, filling a significant gap in existing literature. The authors conclude that further research should be conducted to evaluate the impact of such groups in developing more equitable work environments for physicians and healthcare workers, emphasizing the potential of WIM groups as cost-effective solutions for addressing gender disparities in medical leadership.

References

1. Write Bauman Bauman MD, Howell LP, Villablanca AC. The Women in Medicine and Health Science program: an innovative initiative to support female faculty at the University of California Davis School of Medicine. Acad Med. 2014;89(11):1462–1466.

2. Boyle P. Nation's Physician Workforce Evolves: More Women, a Bit Older, and toward Different Specialties. AAMC. 2021 Feb 2. Available from: https://www.aamc.org/news-insights/nation-s-physician-workforce-evolves-more-women-bit-older-and-toward-different-specialties.

3. Mangurian C, Linos E, Sarkar U, Rodriguez C, Jagsi R. What's Holding Women in Medicine Back from Leadership. Harvard Business Review. 2018 Nov 7. Available from: https://hbr.org/2018/06/whats-holding-women-in-medicine-back-from-leadership.

4. Lautenberger D, Raezer C, Bunton S. The underrepresentation of women in leadership positions at U.S. medical schools. AAMC Analysis in Brief. 2015;15(2). Available from: https://www.aamc.org/data/aib/425010/february2015.html.

5. Jagsi R, Guancial EA, Worobey CC, Henault LE, Chang Y, Starr R, et al. The gender gap in authorship of academic medical literature—A 35-year perspective. N Engl J Med. 2006;355(3):281–287.

6. Butkus R, Serchen J, Moyer DV, Bornstein SS, Hingle ST, Health and Public Policy Committee of the American College of Physicians, et al. Achieving gender equity in physician compensation and career advancement: A position paper of the American College of Physicians. Ann Intern Med. 2018;168(10):721–723.

7. Berg S. Challenges Faced by Women Physicians Don't Disappear with Age. American Medical Association. 2020 Jun 16. Available from: https://www.ama-assn.org/delivering-care/health-equity/challenges-faced-women-physicians-don-t-disappear-age.

8. Shillcutt SK, Parangi S, Diekman S, et al. Survey of women physicians' experience with elected leadership positions. Health Equity. 2019;3:162–168.

9. Kilminster S, Downes J, Gough B, Murdoch-Eaton D, Roberts T. Women in medicine—is there a problem? A literature review of the changing gender composition, structures and occupational cultures in medicine. Med Educ. 2007;41(1):39–49.

10. Gasparyan AY, Ayvazyan L, Blackmore H, Kitas GD. Writing a narrative biomedical review: considerations for authors, peer reviewers, and editors. Rheumatol Int. 2011;31(11):1409–1417.

11. Penny M, Jeffries R, Grant J, Davies SC. Women and academic medicine: a review of the evidence on female representation. J R Soc Med. 2014;107(7):259–263.

12. Gautam M. Women in medicine: stresses and solutions. West J Med. 2001;174(1):37–41.

13. Grace MK. Parting ways: Sex-based differences in premedical attrition. Soc Sci Med. 2019;230:222–233.

14. Rosenthal L, Levy SR, London B, Lobel M, Bazile C. In pursuit of the MD: The impact of role models, identity compatibility, and belonging among undergraduate women. Sex Roles. 2013;68(7–8):464–473.

15. Berge J, Macheledt K, Watson S, Dorr H, et al. Using a community-based participatory approach to address gender equity in academic medicine: The Center for Women in Medicine and Science at the University of Minnesota. Acad Med. 2022; 97 (3): 370-377.

16. Helitzer DL, Newbill SL, Cardinali G, Morahan PS, Chang S, Magrane D. Narratives of participants in national career development programs for women in academic medicine: identifying the opportunities for strategic investment. J Womens Health. 2016;25(4):360–370.

17. Choo EK, Kass D, Westergaard M, Watts SH, Berwald N, Regan L, et al. Best practice recommendations to support the hiring, recruitment, and advancement of women physicians in emergency medicine. Acad Emerg Med. 2016;23(11):1203–1209.

18. Santhosh L, Harleman E, Venado A, Farrand E, Gilbreth ME, Keenan BP, et al. Strategies for forming effective women's groups. Clin Teach. 2021;18(2):126–130.

19. Ibrahim H, Stadler DJ, Archuleta S, Anglade P, Cofrancesco J Jr. Twelve tips for developing and running a successful women's group in international academic medicine. Med Teach. 2019;41(11):1239–1244.

20. Hinson HE, Gonzales NR. On increasing the visibility of women and other groups underrepresented in medicine: To be it, you must see it. Neurology. 2020;95(22):991–992.

21. Singhal D, Bank AM, Poorman JA, Doshi TL, Parekh R, Parangi S, et al. Representation of women plenary speakers at the American Academy of Neurology Annual Meeting. Neurology. 2020;95(22):e3045–e3059.

22. Zhong L, Lee K, Baggstrom MQ, Bhayani RK. Investing in women trainees: Building a Women in Medicine Group at an academic institution. J Med Internet Res. 2023;25:e47783.

23. Pérez-Sánchez S, Madueño SE, Montaner J. Gender gap in the leadership of health institutions: The influence of hospital-level factors. Health Equity. 2021;5(1):521–525.

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Navigating the Digital Frontier: A Review on the Clinical Applications of Convolutional Neural Networks and Emerging AI Models in Medicine and Surgery

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Abstract

Artificial intelligence (AI) is being integrated into several fields worldwide due to its impressive capabilities in completing tasks, sometimes autonomously. Research by several groups worldwide has shown that AI could similarly be incorporated into clinical practice. Convolutional neural network (CNN) models have an inherent capability of recognising and classifying patterns, allowing them to be used in imaging and other diagnostic techniques in various clinical specialties. With some AI systems already in use, it is anticipated that several other AI models will come into clinical practice in the coming years to improve healthcare and patient outcomes. Hence, it is paramount that current medical students and practising doctors keep up with these recent advances in AI to provide the best standard of care for patients. This narrative review explores the basis of deep learning CNN models and summarises extensive literature to provide an overview of some of the recent applications of CNN models to various clinical specialties in medicine and surgery.

Introduction

Artificial intelligence (AI) has shown incredible promise in clinical medicine, with key advances including enhanced diagnostic accuracy, better disease detection and improved workflow efficiency.[1] Moreover, deep learning models, such as convolutional neural networks (CNN), have the extraordinary ability to constantly learn and develop reasoning from provided datasets. This allows CNNs to perform complex tasks such as recognizing and classifying patterns of disease from unorganized datasets into different categories.[2-3] Such capability makes deep learning models great candidates for use in various clinical specialties to aid in imaging and other diagnostic techniques, helping to increase accuracy rates and improve patient outcomes.[3] Several CNN models are being trialed by numerous research groups and are anticipated to be introduced into mainstream clinical practice in several specialties within medicine and surgery, including the ones illustrated in *Figure 1.* However, several gaps in the literature persist, such as the lack of real-world prospective studies, limited models showcasing generalizability, "blackbox" models with inadequate interpretability, and insufficient studies with external validation.[4-5] These limitations are currently preventing the adoption of several AI models into mainstream clinical workflow.

This narrative review aims to evaluate the current and potential applications of CNNs and other AI models in several clinical specialties, answering the following research question: How can CNN models and other AI-based models be utilized across various clinical specialties, and what are the current challenges and ethical implications hindering their widespread integration into clinical practice? Given the variability in assessment methods of AI models used in different studies in the literature, this review presents the latest advances through various evaluation metrics, including, but not limited to, accuracy percentages, specificity, sensitivity, F1 scores, and direct comparison of model performance with physicians. Where applicable, other metrics such as data quality and utility for real-world clinical integration are also discussed. It is crucial that not only currently practicing physicians, but also medical students and future doctors are aware of these recent advances in AI, which are expected to change the clinical landscape in the coming years.

Methods

The main aim of this narrative review is to evaluate relevant literature and analyze recent advances in AI in various clinical specialties. An extensive literature search was conducted using multiple appropriate databases, including MEDLINE, PubMed, Google Scholar, Web of Science, and Embase, to identify relevant original research studies and review articles for this narrative review. In addition, certain websites were used for technical

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information on AI products that are currently in use and where relevant articles were not available. Searches were made using keywords, including "artificial intelligence", "AI", "deep learning", "CNN models" and "large language models" for the range of clinical specialties covered in this narrative review. Studies were selected based on their inclusion of relevant recent advances using CNN models, deep learning algorithms or other AI models in the appropriate specialties discussed. The time frame of the included studies was 2017-2025. The scale for the quality assessment of narrative review articles (SANRA) guidelines was considered and used when reviewing literature.

Discussion

The Basis of AI Learning Algorithms

Initially, AI algorithms were designed and developed using machine learning (ML), an AI learning method that uses pattern identification to learn from presented data and minimize errors.[3] However, this type of learning requires large amounts of structured data for pattern recognition. Deep learning (DL), a subset of ML, can eliminate the manual task of data mining by using unstructured data to effectively group similarities and enhance pattern recognition.[2]

DL and ML are becoming the most common forms of AI learning that many organizations across the world are adopting, including organizations in the healthcare sector. For example, UC San Diego Health has adopted an AI model supported by Amazon Web Services (AWS) to analyze chest X-rays and assist radiologists in the detection of pneumonia in COVID-19 patients.[6] Moreover, the AI model helped diagnose pneumonia in COVID-19 patients where the typical symptoms were absent.[6] Another example includes the use of the Targeted Real-Time Early Warning System (TREWS) to identify patients at risk of developing sepsis by Johns Hopkins Medicine.

As part of a study, TREWS was used by over 4,000 clinicians across 5 hospitals, where the tool was used to treat 590,000 patients.[7] In contrast to previously tested electronic tools, which could correctly predict sepsis only 2-5% of the time, this AI model accurately predicted almost 40% of the sepsis cases among the 82% presented.[7]

Additionally, DL algorithms can be used to develop an artificial neural network (ANN) where there is an input layer, middle hidden layer(s), and an output layer to broadly function as neurons in a human brain. Data can be fed into the input layer, and information can be passed onto the next layer and receive an output, much like a brain.[8] Now, using such algorithms, researchers are developing a type of ANN called convolutional neural networks (CNN), which relies on computer vision (CV), where images and videos are fed into the neural network.[3] CNNs employ convolutional layers consisting of learnable filters, which are applied to the input image to detect specific features.[9] These features can be associated with clinically meaningful entities,

facilitating classification, detection and segmentation tasks, as shown in ***Figure 1.***[9]

With imaging investigations being central to the diagnosis and management of patients in several medical and surgical specialties, AI models, particularly CNNs, could aid medical teams in image analysis, allowing for better pathology detection.

If implemented correctly into clinical practice, these CNN models can allow for more accurate and faster diagnoses, leading to better healthcare outcomes.[10]

AI Use in Cardiology: Using AI models for ECGs, echocardiography and intravascular imaging

ECGs and Echocardiography

Cardiovascular medicine encompasses several serious heart conditions, including myocardial infarction (MI), heart failure (HF), or fatal arrhythmias requiring immediate medical attention. Several diagnostic techniques are used in diagnosis, with electrocardiograms (ECG) and echocardiography being some of the most requested investigations in cardiology, in addition to others. Analysis of an ECG accurately and efficiently is crucial for a diagnosis to allow the medical team to proceed with the appropriate management for the patient. However, ECGs may not always be correctly interpreted, with one meta-analysis study showing that the cardiologists' interpretation accuracy ranged from 49% to 92%.[12]

CNN models hold strong potential for enhancing the interpretation of ECGs with more accuracy, leading clinicians towards a more accurate diagnosis. Hughes et al. were able to train a CNN model to interpret a range of ECGs and even perform on par with cardiologists, and also exceed the standards of the currently in-use automated ECG detection system in 4 out of 5 diagnostic classes.[13] Further research has yielded more impressive results in not only recognizing abnormal ECG patterns but also classifying them into various cardiovascular diseases.[14-15] Yoon et al. used ECG graphs and converted them into grayscale images to train the CNN to recognize ECG patterns with a remarkable accuracy of 95.1%.[14] Going further, Makimoto et al. were able to train a CNN model to detect an MI from ECG images and outperformed 10 physicians with a higher F1 score (83% vs 81%) and higher accuracy (70% vs 67%).

However, while these results are impressive, it is important to note that generalizability holds significant weight in determining whether such models can be implemented into mainstream clinical practice. For instance, the methods used to train the CNN were different in these studies, with Yoon et al. using ECG graphs and converting them into grayscale images, while Makimoto et al. were able to train their model directly from ECG images.[14-15] Such differences indicate the need for further external validation, and importantly, research groups adopting a universal training protocol to prevent any overfitting to specific protocols and datasets.

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Figure 1. Overview of the Applications of AI Models Across Various Specialties in Medicine and Surgery.

Diagnostic Uses

Radiology
Automated pathology detection from different imaging modalities
AI-assisted image analysis.

Cardiology
AI-driven pathology recognition from ECGs and echocardiography
AI use in IVUS and OCT.

Dermatology
AI-enabled skin lesion recognition and classification
Ophthalmology
Automated retinal pathology detection and classification.

Applications of
AI Models
in Medicine and
Surgery

Procedural Uses

Gastroenterology
Colonoscopy
AI-assisted detection of colorectal polyps.

Capsule Endoscopy (CE)
AI-driven CE analysis for detection and classification of small bowel lesions

Surgery
Robot-assisted surgery
AI-assisted robotic surgery to enhance surgical precision.

Augmented reality surgery
AI-enhanced optimization of the surgical field.

Robotic laparoscopic suturing
AI-guided independent suturing for gastrointestinal anastomoses.

Legend: The diagram highlights various applications of artificial intelligence (AI) models in several clinical specialties in medicine and surgery, as discussed in this article.

In addition to ECGs, echocardiography is also a highly useful diagnostic tool for various cardiac pathologies. Echocardiography can be used to determine any abnormalities in cardiac size and shape, pumping strength via the ejection fraction, valvular disorders, cardiac muscle damage, congenital heart defects, as well as many others.[17] As with ECGs, there is a potential for misinterpretation of echocardiography images with inaccuracies up to 30% for transthoracic echocardiography (TTE). Using deep learning algorithms could help reduce interpretation inaccuracies as well as reduce the time required for echocardiogram interpretation.[18]

In one study, Madani et al. developed CNN models for TTE analysis through videos and images using over 250 echocardiograms, with the CNN model achieving an impressive overall accuracy of 97.8%.[19] Additionally, analysis on single images provided an accuracy of 91.7%, significantly higher than the accuracies of 70.2-84.0% achieved by board-certified echocardiographers.[19] In a similar study, Naser et al. trained two-dimensional and three-dimensional CNN models to classify cardiac views obtained from TTE.[20] The two-dimensional CNN achieved an overall accuracy of 96.8%, while the three-dimensional CNN had an overall accuracy of 96.3%.[20] These high diagnostic values emphasize the great potential for deep learning models to improve the diagnoses of cardiac diseases through echocardiography.

While these outcomes for the interpretation of ECGs and echocardiography imaging are encouraging, as indicated in **Figure 1,** several limitations hinder their widespread integration into daily clinical practice. Many of the studies highlighting the ability of CNNs to assist in clinical decision making are often trained on existing, retrospective datasets. Such datasets may be useful for initial training, but CNNs must be trained with prospective data to account for the variability seen in real-world clinical practice. Further, generalizability remains a critical issue, as models for both ECG and echocardiography interpretation must perform similarly when presented with different, diverse data.[21]

AI use for arrhythmia detection from wearable devices
Additionally, AI models are being integrated into wearable devices, such as smartwatches and smart rings, to aid in the early detection of arrhythmias.[22] One of the most widely used features on these wearables includes the detection of atrial fibrillation (AF), namely via smartwatches.[22] These devices monitor heart rate (HR) and rhythm through either photoplethysmography (PPG) or a single-lead ECG, or both, where the time intervals between heartbeats are calculated and various algorithms are used to classify the heart rhythm.[22-23] PPG works by illuminating the skin with a light-emitting diode (LED) and detecting the amount of light reflected, which varies according to changes in blood volume during the cardiac cycle.[23] A photodetector measures the intensity of the light reflected, building a pulse pressure waveform, which is not only used to calculate HR, but importantly, the time between each heartbeat corresponding to the R-R interval.[23] In AF, the pulse waveform is highly irregular, representing an irregular R-R interval, notifying the user of suggestive AF through an irregular pulse notification (IPN), which could be useful for paroxysmal AF.[23-24] Nevertheless, this technology is only suggestive and cannot confirm AF or other arrhythmias.[23] Devices capable of performing single-lead ECGs work by using two metal plates to create one positive electrode (often located on the back of the watch) and one negative electrode (often located on the digital crown), thereby allowing measurement of Lead I.[24] These devices can detect arrhythmias such as AF with more accuracy than those with only PPG capacity.[22] However, the main limitation of performing an ECG using such wearables is that only a 1-lead view is ever available.[24] Ultimately, this means that any abnormalities that would be seen

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in other leads are missed, and also increases the risk of artefacts such as poor sensor-skin contact and muscle motion, which could prevent accurate ECG readings from being recorded.[24]

To address these concerns, several wearables now incorporate DL detection algorithms to increase the accuracy of ECG recordings and PPG signals.[23] These algorithms aid in noise reduction, normalization of data and segmentation to increase the accuracy of PPG tachograms and ECG waveforms.[23] Moreover, CNNs can be employed not only to categorize unprocessed data, but also to detect complex patterns from PPG signals and spatial pattern recognition from ECG traces.[23] Such CNNs provide an additional advantage of detecting and analyzing dynamic changes throughout the day, allowing for continuous, passive ECG monitoring, provided that enough data is stored by the wearable.[23]

AI use in intravascular imaging

In addition to AI use for non-invasive investigations, there is potential for AI in invasive imaging modalities such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT), as highlighted in **_Figure 1_**.[25] Although both involve reconstructing images of intracoronary structures via a catheter inserted into coronary arteries, IVUS uses ultrasound, while OCT uses low-coherence light.[26] Additionally, IVUS offers deeper penetration of vessel walls (inclusive of adventitia) than OCT, making IVUS a useful investigation for arteries with increased plaque burden, albeit the low-resolution images.[26] In contrast, OCT provides high-resolution images compared to IVUS, offering greater detection rates of thin-cap fibroadenoma (TCFA), arterial plaque rupture and stent malapposition.[25-26]

Currently, with OCT images, automation is primarily limited to the segmentation of atherosclerotic plaques, where the quantification and characterization of any detected plaques are performed.[25,27] Similarly, with IVUS, DL algorithms can assist in feature extraction to increase the detection rates of TCFA.[25] However, interpretation of these intravascular images requires a clinician with extensive training, and can be repetitive after reviewing several images.[25] Implementing DL algorithms could help to relieve experts of this repetitive task, and also allow real-time analysis of intravascular images.[25] Going further, researchers have developed neural networks for this task, such as the one developed by Chu et al., where a neural network could automatically segment a single OCT frame in a remarkable 0.07 seconds.[25,28] Furthermore, pixel-based DL algorithms could allow for the incorporation of three-dimensional spatial data and also the segmentation of individual plaque components.[25] This could allow for more detailed and accurate identification of different plaques, aiding in clinical decision-making.[25,27]

However, despite the potential benefits of using AI models for intravascular images, more research is required before integration into mainstream clinical practice. As for AI use in ECG and echocardiography interpretation, AI for IVUS and OCT still requires large annotated datasets to test external validation on other datasets.[25] Further, models must be tested on datasets encompassing the wider population to ensure that they have similar performance in real-world clinical practice.[25]

AI use in Gastroenterology: Augmenting disease detection from imaging-based investigations

With high-definition photographic visuals being a crucial component for procedures in gastroenterology, the integration of CNNs into picture-based investigations could prove highly useful, as shown in **_Figure 1_**. Currently, colonoscopy and small-bowel capsule endoscopy (SB-CE) are some of the most popular investigations to integrate AI models.[29-30]

Colonoscopy

The integration of AI models into colonoscopies could be useful in identifying polyps. With current estimates indicating that physicians can miss colorectal polyps in colonoscopy up to 28% of the time, this type of AI could help to reduce the chances of missing such lesions.[31]

One way that AI is being integrated into colonoscopy is through devices such as 'GI Genius', a medical device that is built on deep learning for computer aided diagnosis (CAD) and is approved for use in the United States and the European Union.[29] The usefulness of this device was tested in a large, randomized multi-center trial where adenoma miss rate (AMR) was calculated for colonoscopies done with or without AI to identify colorectal neoplasia, a risk factor for the development of colorectal cancer.[29] Wallace et al. conducted this study in 2 groups, with 2 different arms, where in 1 group, colonoscopy was done with AI-enabled (GI-Genius enabled), followed by colonoscopy without AI-enabled, and vice versa in the other group.[29] Using this design, Wallace et al. showed that AMR was significantly lower at 15.5% in the group with AI first, compared to 32.4% AMR in the group with colonoscopy first, which is more than a 2-fold difference.[29] With the necessary further studies, AI could be used in colonoscopy to aid physicians, reducing the risk of missing colorectal polyps.

Capsule endoscopy

With the success of AI in detecting colorectal polyps, there is great potential to incorporate AI into endoscopies, helping to increase accuracy and consistency in detecting gastrointestinal lesions.[30]

The introduction of capsule endoscopy (CE) provided a breakthrough for gastroenterologists to investigate the small bowel in a non-invasive manner for conditions such as blood content, vascular lesions, and inflammatory bowel diseases.[32] Although CE is beneficial in diagnosing and managing small bowel diseases, analyzing full-length CE videos with approximately 50,000 images can be a tedious and time-consuming task.[32] This can take between 30-120 minutes per video, leading to physicians reviewing CE videos at a great pace, with a recent study reporting a CE miss rate of 11% for all SB findings and 18.9% for single-mass lesions.[32-33] Using AI to aid

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specialists in reviewing CE videos could help reduce the time taken and could improve the miss rate of SB lesions.[34]

Ongoing research to implement AI systems into the analysis of SB-CE videos has shown promising potential. Ding et al. developed a CNN model to aid in the detection of multiple SB conditions, including ulcers, polyps, inflammation, vascular lesions, and lymphangiectasia through SB-CE.[34] The CNN model outperformed physicians with a higher sensitivity for per-patient analysis (99.88% vs 74.57%, respectively) and per-lesion analysis (99.90% vs 76.89%, respectively).[34] Additionally, the CNN model achieved a substantially shorter reading time than the physicians (5.9 ± 2.23 minutes vs 96.6 ± 22.53 minutes, respectively).[34] With a CNN reading time that is over 90 minutes less than conventional reading, the use of the model in clinical practice could potentially save significant time when reviewing SB-CE videos.

Further, a study highlighted the use of a CNN model for the detection and classification of SB lesions with hemorrhagic potential using CE images.[32] Similar to the study conducted by Ding et al., the researchers showed a high overall accuracy of 99%, sensitivity of 88%, and specificity of 99%.[32,34] Crucially, in addition to identifying lesions, this CNN model could also classify lesions from CE images, suggesting that such CNNs could soon have the capacity to classify other SB lesions.[32] If introduced into clinical practice, these CNNs could become key players for SB-CE analysis with minimal input from physicians, thereby reducing their workload, and importantly, could address the physician miss rate of SB lesions from CE.[33]

Nevertheless, in both studies, the researchers report several limitations, with the most important one being that still frames were used as opposed to moving images.[32,34] In reality, SB-CE provides moving, full-length videos, and further research is required to evaluate the true performance of these AI models on full-length SB-CE videos, helping to assess generalizability. Additionally, these studies have assessed the performance of CNNs on retrospective, existing data.[32,34] Moving forward, as highlighted by several researchers, prospective studies are necessary and are currently in progress to accurately evaluate the true clinical benefit of these AI-based models in patient care.[34]

AI use in Dermatology: Improving skin cancer detection
Using CNN models for image interpretation and pattern analysis can aid in recognizing skin conditions, especially skin cancers, as outlined in _**Figure 1.**_[35]

Researchers trained a CNN model using over 129,000 clinical images comprising over 2,000 skin diseases to distinguish between melanocytic and keratinocytic lesions.[35-36] The CNN model trained to classify epidermal and keratinocytic lesions achieved an accuracy of over 91%, and performed on par or even outperformed 21 board-certified dermatologists using clinical images.[35] Furthermore, the ability of the CNN model to classify melanomas using dermoscopic images, as opposed to clinical images, was also matched to the accuracy levels of dermatologists.[35] In another similar study from China, researchers

also demonstrated high diagnostic values for a novel CNN model to recognize certain skin diseases from a dataset comprising 14 different categories of common cutaneous diseases.[37] Similar to research conducted by Esteva et al., this CNN also showed a high overall accuracy of 94.8%, with a sensitivity of 93.4% and a specificity of 95.0%.[37] Although in a separate test against 280 board-certified dermatologists with 200 different images, the CNN and the dermatologists both had like-for-like figures for average accuracy (92.75% vs 92.13%) and specificity (94.07% vs 95.50%), the sensitivity was significantly higher compared to dermatologists (83.50% vs 68.51%).[37] These figures again emphasize the potential for the CNN model to perform at the same competency as dermatologists, and at times, at higher levels.[37]

The positive results of these trials suggest that AI could be used to classify skin cancers and even aid dermatologists in reducing workload and providing diagnoses. Moreover, Esteva et al. denote that the ability of the CNN model to classify lesions using clinical images as opposed to widely used dermoscopic images could be highly useful in introducing the technology to a smartphone app.[35] With the increasing use of smartphones across the world, such AI could be integrated into apps, providing skin lesion classification from just a smartphone camera.[35] This, in turn, could allow skin conditions, such as cancers, to be detected and classified in primary care, thereby allowing general practitioners to prioritize urgent or non-urgent referrals to dermatologists in secondary care.[35]

Down the line, this could allow for improved management of these conditions, reducing the risk of cancer development, and thereby providing a great public health benefit.[38] In addition, prioritizing appointments in this way would free up time for dermatologists, allowing them to use that time to complete other tasks or see more patients, as seen in a recent pilot project where the Skin Analytics AI-Powered Teledermatology was reviewed by the University Hospitals of Leicester NHS Trust in the UK.[32] This AI tool, known as DERM, which recently received conditional recommendation for use by the National Institute for Health and Care Excellence (NICE), reviewed skin lesion images and classified them as either "diagnosis of concern" or "benign".[39-40] The project showed there was a reduction in the NHS two-week wait referrals for cancers while freeing up 1,450 outpatient appointments, and achieving a clinical time saving of 263 minutes per 100 patients.[41] This pilot project showed promising results, suggesting there could be several benefits from such AI-based technologies, provided that more encouraging studies are carried out. Further real-world prospective studies are still required to evaluate the true benefit in the clinic and address any potential challenges before this AI technology can be introduced into clinical practice.[35]

AI use in Ophthalmology: Enhancing pathology detection from retinal imaging
Retinal imaging is used widely to diagnose several retinal pathologies, including diabetic retinopathy (DR), glaucoma, and

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age-related macular degeneration (AMD).[42] To make a diagnosis, an ophthalmologist is required to manually analyze and evaluate retinal fundus images, which is a time-consuming process, as with other imaging-based investigations in other specialties.[43] CNN models that can automatically analyze fundus images and categorize the pathology can assist ophthalmologists in making a diagnosis and point towards a management plan, as shown in *Figure 1.*

In a recent study, Pandey et al. trained an ensemble of 5 CNNs to recognize and classify retinal pathologies into the following 4 categories: DR, glaucoma, AMD, and normal eyes from 100 unseen fundus images.[42] With the performance of the CNN directly compared to 7 board-certified ophthalmologists, the CNN had a higher overall accuracy over all 4 categories, with a score of 79.2%, while the doctors scored 72.7%.[42] Furthermore, the CNN ensemble had a higher overall score for correctly classifying images as DR, with a mean score of 76.8%, while the doctors had a mean score of 57.5%.[42] The remarkable difference of over 19% highlights the impressive accuracy of the CNNs, which outperformed ophthalmologists.[42] The CNN ensemble and ophthalmologists had similar classification scores for the other 3 categories, which were not statistically significant.[42] These favorable results emphasize the great potential for using CNNs and other deep-learning algorithms to aid in the detection of retinal pathologies.

Nevertheless, although Pandey et al. used unseen clinical images to train the CNN, using only 100 images is not representative of all the pathologies seen in the real world.[42] In clinical practice, ophthalmologists often see a range of retinal diseases, more than the 4 conditions used in the study.[42] Furthermore, the images seen may not always be of high quality that CNNs can read with ease. Hence, CNNs trained on a large variable dataset are needed to target generalizability and avoid overfitting to one particular dataset, allowing them to be integrated for mainstream clinical use.

AI use in Radiology: Improving image interpretation and disease detection

The use of AI through CNNs has grown massively in radiology, with extensive research highlighting recent advances in image interpretation. Radiological imaging is an essential aspect of medical care, assisting clinicians in making crucial decisions in the management of a patient. Medical imaging consists of various modalities, including X-ray, ultrasound, computed tomography (CT), magnetic resonance imaging (MRI) and positron emission tomography (PET), which are central to various clinical specialties.[44] Traditionally, radiologists manually analyze these images and provide a report for clinicians to use in their decision-making process.[45] Extensive research has been carried out to evaluate the use of AI models to automate the analysis of radiological images to an extent, saving time for radiologists and potentially increasing accuracy.[46]

Research using CNNs for disease detection and classification has been promising, with prominent advances highlighted in *Figure 1.* Several studies have shown that CNNs can be trained to recognize certain patterns, shapes and contours in imaging to identify certain pathologies.[45] One meta-analysis comprising 20 studies highlighted that DL models could identify intracranial aneurysms, with excellent accuracy in detecting aneurysms more than 3 mm in size.[47] More importantly, as highlighted by Abdollahifard et al., using AI to assist clinicians with detecting intracranial aneurysms increased the clinicians' sensitivity by 12.8%.[47] Carefully using such AI systems to support radiologists could lead to better interpretation of medical imaging and increased accuracy. Going further, other studies detail the use of AI models to detect and classify disease on imaging. AI models such as Brainiomix and iSchemaView automatically complete the Alberta Stroke Program Early CT Score (ASPECTS) from non-contrast CT scans (NCCT) for patients with an acute stroke.[48] Grading using the ASPECTS system can be difficult due to the subtlety of ischemic changes on NCCTs, with a variable interobserver agreement, indicating that the grading of certain strokes may not always be unanimous.[48] Implementing such AI-based software into clinical practice can help to enhance consistency and reduce diagnostic uncertainty in medical imaging.

Additionally, CNNs could be widely utilized for image segmentation. Image segmentation is essentially the division of a medical image into distinct regions that correspond to specific anatomical or pathological regions, helping to inform clinicians on potential diagnosis and treatment planning.[49] Traditional segmentation algorithms have been in place for several years, allowing radiologists to see abnormalities in imaging. However, the performance of these segmentation methods is complicated by complex medical images with unclear contours, ambiguous boundaries and variations in intensity, leading to poor images.[49] Implementing CNNs to automatically extract features from highly complex, three-dimensional images to identify and outline pathological regions, and deliver superior performance can go a long way in detecting lesions.[49] One recent meta-analysis comprising nine studies highlights the strong performance of CNNs in meningioma segmentation from MRI scans, with a pooled Dice score of 89%.[50] Notably, CNN models trained on multiple MRI sequences performed better than those trained on single MRI sequences, emphasizing the need for high-quality datasets to develop robust and clinically viable CNN models.[50] Interestingly, the authors noted that the dataset size did not significantly impact the accuracy of the CNN models, underlining that the quality of the dataset outweighs the quantity of the data available.[50] However, the lack of performance differences could suggest possible overfitting to the specific datasets used, which could ultimately limit generalizability.[50]

Concerns around generalizability are significant, limiting the widespread integration of such AI models into clinical practice.[51] Several CNN models have been developed to assist with diagnostic tasks, and many excel with remarkable accuracy and performance. However, when implementing the same model on a different dataset or another task with minor differences,

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effective generalization and similar performance are not always seen.[51] Similarly, the lack of numerous well-annotated datasets presents a challenge in effectively training CNNs.[51] Using large-sized, well-labeled datasets helps to train CNNs to recognize complex patterns and features and also aids in reducing overfitting.[52] However, these annotations are only completed by radiologists, and being a significantly lengthy and tedious process has contributed to the scarcity of well-labeled datasets.[52] Using data augmentation techniques by applying transformations can help not only to expand the dataset, but also to increase the diversity of the existing data.[51] This can help to train CNNs on a more robust dataset and avoid learning patterns and features only from the original dataset, addressing generalizability.[53]

AI use in Surgery: Providing intraoperative assistance in robot-assisted surgery

Using the principles of image recognition and classification, CNN models could also be incorporated into surgical techniques, allowing for improved patient outcomes, as shown in *Figure 1.* Several studies described in this review have highlighted that AI can be useful in the detection and classification of pathologies into different categories.[32,35,42] This capability of CNN models can be useful for the pre-operative assessment of a patient's clinical condition, before proceeding with surgery.

There is great potential for integrating AI intraoperatively, though research is still emerging on this aspect of AI integration into surgery. One example includes an ML-based model that can predict the risk of developing hypoxemia, assisting anesthesiologists in anticipating such an event and proactively intervening.[54] Such AI tools can augment clinical decision-making during surgery, helping to improve patient safety.[54] Meanwhile, further research into intraoperative AI use has shown significant advancements in robot-assisted surgery, with autonomous and semi-autonomous surgeries coming to light due to the integration of algorithms and computer vision.[55] In recent years, there have been advances in orthopedics where specialists use robots such as the MAKO system for semi-autonomous robotic-arm assisted total knee arthroplasty (RATKA).[56] This system runs on complex pre-operative planning through a computer program to map the joint in a three-dimensional view.[56] From this, the surgeon guides the robotic arm to operate within the pre-defined areas, reducing the chances of an accident.[56-57] Moreover, a study highlights that RATKA can also lead to superior surgical precision and better positioning of implants than manual surgical methods.[56] These outcomes suggest that using such robotic surgical systems could lead to better outcomes and greater quality of care.

AI models can also be used to improve visuals of the surgical field.[58] During surgery, electrocautery devices are used for dissection and ligation of tissues, which subsequently creates smoke that can obscure the surgical field temporarily.[58] Wang et al. proposed a CNN model, linked to a Swin transformer that can remove surgical smoke from the surgical footage in robotic

surgery, improving image quality and producing a smoke-free surgical view.[59] Augmented reality (AR) surgery is another surgical discipline that has the potential to enhance a surgeon's capabilities by delivering real-time information in the surgeon's field of view to improve accuracy and safety.[60] Differentiating between native tissue and non-native surgical tools is a crucial challenge in AR for robotic surgery, which could be addressed by CNN models as shown by De Backer et al.[60] This DL model developed for AR-guided robot-assisted kidney transplantation, achieved an impressive Dice score of 97.1% in correctly identifying surgical instruments, suggesting that such models can be integrated into AR surgery.[58] Furthermore, studies highlight using CNN models to complete real-time robotic suturing.[58] Saeidi et al. developed a CNN model integrated into a robotic system, which could complete fully automated laparoscopic bowel anastomoses.[58,61] Compared to manual laparoscopic surgery and traditional robot-assisted surgery, the model showed superior consistency and accuracy when considering metrics such as needle placement, suture placement and completion time.[61]

Despite promising studies highlighting advances in using AI models in surgery, there has not been enough research carried out to integrate such technologies into mainstream surgery confidently. Applying AI to surgical fields can present a substantial challenge as surgical interventions rely heavily on a surgeon's practical skills, often in a high-risk, high-pressure, and highly dynamic operating theatre.[62] AI systems have not reached this capability yet, and further studies exploring this critical issue are pertinent. Moreover, training AI algorithms requires a large range of annotated surgical images taken from real-time surgeries. The scarcity and difficulty in obtaining such data from surgical environments present a further challenge, hindering the training of AI-based models.[62] Accountability remains a crucial issue that needs to be addressed to integrate AI-based surgical technologies into real-world clinical practice.[58] With the use of AI spanning from diagnosis, treatment planning, to robot-assisted procedures, it can be difficult to determine who would be responsible if a negative patient outcome occurs.[58] Further clinical research is necessary to address these limitations and integrate AI into surgical fields safely and effectively.

Current challenges, emerging AI models and pathways to clinical integration

The existing literature has shown that there have been significant advancements in AI systems to assist doctors, perhaps allowing for the provision of better care. However, one major limitation preventing the integration of AI models into mainstream clinical practice is the "AI blackbox theory".[63] The theory stems from the issue that although many AI models, such as CNNs, are shown to be highly effective in various specialties, they perform tasks through highly complex computational layers, making interpretability difficult.[64] Essentially, this leads to situations where the rationale behind decisions and recommendations from AI models cannot be explained, which is crucial for patient safety and clinician trust.[63] This also raises concerns about allocating responsibility if an AI system contributes to an adverse patient

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outcome, especially if clinicians cannot explain AI recommendations.[65] Furthermore, the lack of explainability of "blackbox" models can lead to issues with transparency requirements set by regulatory authorities when looking for integration into clinical practice.[63,66]

These issues have prompted research into Explainable AI (XAI), where AI models use tools such as saliency maps or heatmaps to improve the interpretability of algorithms and how certain decisions are reached.[67] These tools can improve AI models' interpretability and help reduce the "blackbox" nature.[68] However, as highlighted by Ghassemi et al., not all XAI models provide clinically relevant explanations.[69] Some XAI methods, such as LIME and SHAP, generate rationales including heat maps to explain decisions, but these lack medical causality and instead provide technical reasons.[69] Moreover, significant XAI research has been done using retrospective studies, which do not test real-world utility.[69] Further research is required to develop transparent models that can give explanations grounded in medical science and trained on real-world data to improve confidence among clinicians and patients. Real-world, large-dataset prospective studies with such models are critical to validate their clinical benefits and facilitate their integration into mainstream clinical practice.[69]

Another consideration is the recent emergence of open-source large language models (LLM) such as DeepSeek, which has altered the clinical AI landscape.[70] Many other LLMs rely on expensive application programming interfaces (API) or external cloud infrastructure, making it difficult for resource-limited healthcare institutions to access AI technologies, potentially widening global health disparities.[70-71] DeepSeek, unlike other LLMs, enables local deployment, allowing institutions to run such LLMs on their own network and has capabilities for continuous learning from publicly available open-source datasets.[70] This can allow adoption by healthcare institutions without the financial burden of costly APIs or cloud subscriptions.[70] Moreover, DeepSeek supports offline deployment, avoiding the need to transmit sensitive patient information through third-party servers, strengthening data security.[70] The cost-saving and data privacy benefits have already led to over 90 Chinese tertiary hospitals adopting DeepSeek for diagnostic image analysis, administrative tasks, and clinical decision support.[72] Nevertheless, despite these advantages with models like DeepSeek, these LLMs must be thoroughly investigated to ensure data privacy is intact and AI hallucinations do not lead to incorrect outcomes.[73]

Despite several studies showing great potential for AI to assist clinicians in providing enhanced healthcare, it is also paramount that other ethical considerations of using AI technology are not overlooked.[74] While using AI to process sensitive patient data can be beneficial, it is important to ensure that there are robust data protection measures to protect patient information.[74] Additionally, using AI to aid in the decision-making process should also be balanced with important input from clinicians.[75]

Crucially, AI must explicitly serve as a tool to enhance the decision-making process, rather than replace human judgment.[71] Using clinician expertise to identify errors made by AI and considering patient preferences should be of the utmost priority to provide the best patient-centered care.[74] Moving forward, further ethical considerations should be taken into account to make the most of AI in clinical practice, while maintaining the highest ethical standards.

Limitations of this Narrative Review

The fact that this paper is a narrative review poses a limitation, as there was no quantitative question being addressed. Nevertheless, the literature was reviewed and summarized using the SANRA guidelines to effectively address the qualitative research question outlined in the introduction. Additionally, the uses of AI were not covered in every medical and surgical specialty, as there would be too much to include in one narrative review. The specialties that had major developments were selected, and key AI advances were covered in this review

Conclusion

Integrating AI into the clinical setting can revolutionize healthcare in countless ways with recent studies showing encouraging results. The reviewed literature for this article has demonstrated a massive potential for the use of AI in several specialties that could lead to better patient care. There has been extensive research into the applications of AI in medicine and surgery, namely through the integration of deep learning algorithms with some systems using computer vision. Medically, researchers have achieved encouraging results in developing CNN models to detect, recognize, and classify clinical images to aid physicians in various disciplines and specialties. Surgical studies have highlighted using AI models in robot-assisted surgery to guide surgeons, helping to enhance accuracy and reduce the risk of complications, leading to better outcomes. However, despite these studies, more research is required to move ahead and implement AI into everyday clinical care, as many developed CNN models are still being tested on existing data from retrospective studies. Other prominent limitations in existing research include the development of "blackbox" models that lack interpretability, and limited models assessed on generalizability and external validation. Long-term, real-world prospective studies comprising diverse datasets are imperative to assess the true clinical benefits and address any potential drawbacks and limitations before AI can be introduced into mainstream clinical practice.

Summary – Accelerating Translation

Artificial intelligence (AI) is currently being used in several sectors around the world to automate tasks. Clinical medicine is one field where AI can be beneficial to automate tasks, with several studies demonstrating that AI models can carry out tasks with impressive accuracy and efficiency. The main aim of this article is to evaluate the recent advances and applications of various types of AI models in different clinical specialties. Research was carried out through analysis of numerous peer-reviewed articles taken from online medical research databases, such as PubMed.

The research showed increasing evidence of AI models, such as convolutional neural networks (CNN), having the capacity to carry out

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complex tasks to aid physicians in their clinical decision-making across several specialties. CNNs, a type of deep learning (DL) model, can inherently recognize and classify patterns, making them great candidates for use in diagnostic investigations. In cardiology, several researchers showed the potential for CNNs to aid clinicians through automated analysis of electrocardiograms (ECGs) and echocardiography, allowing for recognition of various pathologies. Furthermore, DL algorithms can be applied to wearable devices, such as smartwatches, allowing them to passively monitor for arrhythmias with precision, which could be useful for clinicians to review if widely adopted. Other research also shows the potential for AI models to assist in complex intravascular imaging by recognizing image components with more accuracy, allowing for greater detection of cardiac arterial pathologies. In gastroenterology, greater detection rates of abnormal growths and other pathologies through CNN-based colonoscopy could lead to earlier identification of colorectal cancers. Similarly, CNNs can be useful in analyzing captured footage from capsule endoscopy, where a small camera attached to a pill is swallowed to take pictures and videos of the small intestine. This analysis is a typically time-consuming task for physicians, and CNNs could help by detecting abnormalities at a much greater pace and accuracy. Comparably, the same principle applies in ophthalmology, where CNNs could be used to evaluate retinal images, aiding ophthalmologists in detecting more pathologies of the eye.

In dermatology, research shows that CNNs can aid in recognizing skin cancers from clinical images with ease and accuracy, allowing for earlier detection rates. Moreover, recent studies show the integration of CNNs into software to detect and analyze images taken from a smartphone camera, allowing the expansion and revolution of teledermatology. Radiology is one field where the use of AI models is substantial and could be greatly beneficial. As with intravascular imaging, CNNs and other AI models could help radiologists in analyzing shapes and contours with more precision, allowing for better detection and classification of pathologies from imaging. These same principles could aid in surgical techniques and robot-assisted surgery, where AI models view and analyze

the surgical field before the surgery is commenced, assisting with the surgeon's precision. Furthermore, AI models could help to provide a clear view for the surgeon in augmented reality (AR) surgery, allowing for improved accuracy and safety. Remarkable studies have also shown that robotic surgery equipped with AI models can complete automated suturing, providing higher accuracy and consistency than traditional surgical techniques.

Recently, there has also been the introduction of large language models (LLMs) which can provide quick support and analysis for administrative tasks, diagnostic imaging and clinical decision support. Models such as DeepSeek can also run offline or on institutions' own networks, which provides a substantial financial benefit for resource-limited institutions and hospitals where expensive online services cannot be afforded. Nevertheless, despite the added advantage of these LLMs, further extensive research must be done to ensure that there are robust data protection measures.

Despite researchers showing the great potential for AI to be used in clinical practice, several challenges and concerns still exist that are preventing widespread clinical integration. The most significant limitation is the "AI blackbox theory", where the reasoning behind certain AI responses and decisions cannot be explained. This raises concerns around patient safety and clinician trust, and allocating responsibility if AI contributes to an adverse patient outcome. Although efforts have been made to introduce explainable AI (XAI) models, these are still not enough, as XAI models do not always provide medical rationale behind clinical recommendations. Furthermore, concerns remain around generalizability and external validation, where AI models do not have similar performance with different datasets. Additionally, many studies assessing AI models have been carried out on existing retrospective datasets. More research needs to be focused on real-time, large-dataset, diverse prospective studies with transparent AI models, where patient data and outcomes need to be followed to validate their true clinical benefit and facilitate mainstream clinical adoption.

References

1. Reddy S, Fox J, Purohit MP. Artificial intelligence-enabled healthcare delivery. J R Soc Med. 2019;112(1):22–8.

2. Arooj S, Rehman S ur, Imran A, Almuhaimeed A, Alzahrani AK, Alzahrani A. A deep convolutional neural network for the early detection of heart disease. Biomedicines. 2022;10(11):2796.

3. Kaul V, Enslin S, Gross SA. History of artificial intelligence in medicine. Gastrointest Endosc. 2020;92(4):807–12.

4. Yu AC, Mohajer B, Eng J. External validation of deep learning algorithms for radiologic diagnosis: a systematic review. Radiol Artif Intell. 2022;4(3):e210064.

5. Park SH, Choi J, Byeon JS. Key principles of clinical validation, device approval, and insurance coverage decisions of artificial intelligence. Korean J Radiol. 2021;22(3):442–50.

6. Buschman H. Artificial intelligence enables rapid COVID-19 lung imaging analysis at UC San Diego Health. 2020.

7. Henry KE, Adams R, Parent C, Soleimani H, Sridharan A, Johnson L, et al. Factors driving provider adoption of the TREWS machine learning-based early warning system and its effects on sepsis treatment timing. Nat Med. 2022;28(7):1447–54.

8. Pham TQ, Matsui T, Chikazoe J. Evaluation of the hierarchical correspondence between the human brain and artificial neural networks: a review. Biology. 2023;12(10):1330.

9. Sarvamangala DR, Kulkarni RV. Convolutional neural networks in medical image understanding: a survey. Evol Intell. 2022;15(1):1–22.

10. Kulkarni S, Seneviratne N, Baig MS, Khan AHA. Artificial intelligence in medicine: where are we now? Acad Radiol. 2020;27(1):62–70.

11. Krittanawong C, Johnson KW, Rosenson RS, Wang Z, Aydar M, Baber U, et al. Deep learning for cardiovascular medicine: a practical primer. Eur Heart J. 2019;40(25):2058–73.

12. Cook DA, Oh SY, Pusic MV. Accuracy of physicians' electrocardiogram interpretations: a systematic review and meta-analysis. JAMA Intern Med. 2020;180(11):1461–71.

13. Hughes JW, Olgin JE, Avram R, Abreau SA, Sittler T, Radia K, et al. Performance of a convolutional neural network and explainability technique for 12-lead electrocardiogram interpretation. JAMA Cardiol. 2021;6(11):1285–95.

14. Yoon T, Kang D. Bimodal CNN for cardiovascular disease classification by co-training ECG grayscale images and scalograms. Sci Rep. 2023;13(1):2937.

15. Makimoto H, Höckmann M, Lin T, Glöckner D, Gerguri S, Clasen L, et al. Performance of a convolutional neural network derived from an ECG database in recognizing myocardial infarction. Sci Rep. 2020;10(1):8445.

16. Attia IZ, Tseng AS, Benavente ED, Medina-Inojosa JR, Clark TG, Malyutina S, et al. External validation of a deep learning electrocardiogram algorithm to detect ventricular dysfunction. Int J Cardiol. 2021;329:130–5.

Review

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Navigating the Digital Frontier: A Review on the Clinical Applications of Convolutional
Neural Networks and Emerging AI Models in Medicine and Surgery

17. Chan JSK, Tse G, Zhao H, Luo XX, Jin CN, Kam K, et al. Echocardiography update for primary care physicians: a review. Hong Kong Med J. 2020;26(1):44–55.

18. Madani A, Ong JR, Tibrewal A, Mofrad MRK. Deep echocardiography: data-efficient supervised and semi-supervised deep learning towards automated diagnosis of cardiac disease. NPJ Digit Med. 2018;1(1):1–11.

19. Madani A, Arnaout R, Mofrad M, Arnaout R. Fast and accurate view classification of echocardiograms using deep learning. NPJ Digit Med. 2018;1(1):1–8.

20. Naser JA, Lee E, Pislaru SV, Tsaban G, Malins JG, Jackson JI, et al. Artificial intelligence-based classification of echocardiographic views. Eur Heart J Digit Health. 2024;5(3):260–9.

21. Biondi-Zoccai G, D'Ascenzo F, Giordano S, Mirzoyev U, Erol Ç, Cenciarelli S, et al. Artificial intelligence in cardiology: general perspectives and focus on interventional cardiology. Anatol J Cardiol. 2025;29(4):152–63.

22. Bayoumy K, Gaber M, Elshafeey A, Mhaimeed O, Dineen EH, Marvel FA, et al. Smart wearable devices in cardiovascular care: where we are and how to move forward. Nat Rev Cardiol. 2021;18(8):581–99.

23. Papalamprakopoulou Z, Stavropoulos D, Moustakidis S, Avgerinos D, Efremidis M, Kampaktsis PN. Artificial intelligence-enabled atrial fibrillation detection using smartwatches: current status and future perspectives. Front Cardiovasc Med. 2024;11:1432876.

24. Smith S, Maisrikrod S. Wearable electrocardiogram technology: help or hindrance to the modern doctor? JMIR Cardio. 2025;9:e62719.

25. Föllmer B, Williams MC, Dey D, Arbab-Zadeh A, Maurovich-Horvat P, Volleberg RHJA, et al. Roadmap on the use of artificial intelligence for imaging of vulnerable atherosclerotic plaque in coronary arteries. Nat Rev Cardiol. 2024;21(1):51–64.

26. Ono M, Kawashima H, Hara H, Gao C, Wang R, Kogame N, et al. Advances in IVUS/OCT and future clinical perspective of novel hybrid catheter system in coronary imaging. Front Cardiovasc Med. 2020;7:119.

27. Subhan S, Malik J, Haq A ul, Qadeer MS, Zaidi SMJ, Orooj F, et al. Role of artificial intelligence and machine learning in interventional cardiology. Curr Probl Cardiol. 2023;48(7):101698.

28. Chu M, Jia H, Gutiérrez-Chico JL, Maehara A, Ali ZA, Zeng X, et al. Artificial intelligence and optical coherence tomography for the automatic characterisation of human atherosclerotic plaques. EuroIntervention. 2021;17(1):41–50.

29. Wallace MB, Sharma P, Bhandari P, East J, Antonelli G, Lorenzetti R, et al. Impact of artificial intelligence on miss rate of colorectal neoplasia. Gastroenterology. 2022;163(1):295–304.e5.

30. El Hajjar A, Rey JF. Artificial intelligence in gastrointestinal endoscopy: general overview. Chin Med J (Engl). 2020;133(3):326–34.

31. Kim NH, Jung YS, Jeong WS, Yang HJ, Park SK, Choi K, et al. Miss rate of colorectal neoplastic polyps and risk factors for missed polyps in consecutive colonoscopies. Intest Res. 2017;15(3):411–8.

32. Mascarenhas Saraiva MJ, Afonso J, Ribeiro T, Ferreira J, Cardoso H, Andrade AP, et al. Deep learning and capsule endoscopy: automatic identification and differentiation of small bowel lesions. BMJ Open Gastroenterol. 2021;8(1):e000753.

33. Shim KN, Jeon SR, Jang HJ, Kim J, Lim YJ, Kim KO, et al. Quality indicators for small bowel capsule endoscopy. Clin Endosc. 2017;50(2):148–60.

34. Ding Z, Shi H, Zhang H, Meng L, Fan M, Han C, et al. Gastroenterologist-level identification of small-bowel diseases and normal variants by capsule endoscopy using a deep-learning model. Gastroenterology. 2019;157(4):1044–54.e5.

35. Esteva A, Kuprel B, Novoa RA, Ko J, Swetter SM, Blau HM, et al. Dermatologist-level classification of skin cancer with deep neural networks. Nature. 2017;542(7639):115–8.

36. Leachman SA, Merlino G. The final frontier in cancer diagnosis. Nature. 2017;542(7639):36–8.

37. Zhu CY, Wang YK, Chen HP, Gao KL, Shu C, Wang JC, et al. A deep learning based framework for diagnosing multiple skin diseases in a clinical environment. Front Med. 2021;8:–.

38. Koka SSA, Burkhart CG. Artificial intelligence in dermatology: current uses, shortfalls, and opportunities for further implementation in diagnostics and care. Open Dermatol J. 2023;17:–.

39. Health Innovation East Midlands. Skin Analytics. AI powered teledermatology shows considerable potential to reduce waiting lists. 2023 [cited 2025 Mar 9]. Available from: URL.

40. The National Institute for Health and Care Excellence. AI skin cancer detection system gets green light for conditional NHS use. 2025 [cited 2025 May 7]. Available from: URL.

41. An evaluation of AI Powered Tele Dermatology for Skin Cancer 2WW Pathway. 2023 [cited 2024 Jul 2]. Available from: URL.

42. Pandey PU, Ballios BG, Christakis PG, Kaplan AJ, Mathew DJ, Tone SO, et al. Ensemble of deep convolutional neural networks is more accurate and reliable than board-certified ophthalmologists at detecting multiple diseases in retinal fundus photographs. Br J Ophthalmol. 2024;108(3):417–23.

43. Bhulakshmi D, Rajput DS. A systematic review on diabetic retinopathy detection and classification based on deep learning techniques using fundus images. PeerJ Comput Sci. 2024;10:e1947.

44. Chen C, Mat Isa NA, Liu X. A review of convolutional neural network based methods for medical image classification. Comput Biol Med. 2025;185:109507.

45. Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJWL. Artificial intelligence in radiology. Nat Rev Cancer. 2018;18(8):500–10.

46. van Leeuwen KG, de Rooij M, Schalekamp S, van Ginneken B, Rutten MJCM. How does artificial intelligence in radiology improve efficiency and health outcomes? Pediatr Radiol. 2022;52(11):2087–93.

47. Abdollahifard S, Farrokhi A, Kheshti F, Jalali M, Mowla A. Application of convolutional network models in detection of intracranial aneurysms: a systematic review and meta-analysis. Interv Neuroradiol. 2023;29(6):738–47.

48. Soun JE, Chow DS, Nagamine M, Takhtawala RS, Filippi CG, Yu W, et al. Artificial intelligence and acute stroke imaging. AJNR Am J Neuroradiol. 2021;42(1):2–11.

49. Xu Y, Quan R, Xu W, Huang Y, Chen X, Liu F. Advances in medical image segmentation: a comprehensive review of traditional, deep learning and hybrid approaches. Bioengineering. 2024;11(10):1034.

50. Wang TW, Hong JS, Lee WK, Lin YH, Yang HC, Lee CC, et al. Performance of convolutional neural network models in meningioma segmentation in magnetic resonance imaging: a systematic review and meta-analysis. Neuroinformatics. 2025;23(1):14.

51. Quanyang W, Yao H, Sicong W, Linlin Q, Zewei Z, Donghui H, et al. Artificial intelligence in lung cancer screening: detection, classification, prediction, and prognosis. Cancer Med. 2024;13(7):e7140.

52. Chen X, Wang X, Zhang K, Fung KM, Thai TC, Moore K, et al. Recent advances and clinical applications of deep learning in medical image analysis. Med Image Anal. 2022;79:102444.

53. Chlap P, Min H, Vandenberg N, Dowling J, Holloway L, Haworth A. A review of medical image data augmentation techniques for deep learning applications. J Med Imaging Radiat Oncol. 2021;65(5):545–63.

54. Lundberg SM, Nair B, Vavilala MS, Horibe M, Eisses MJ, Adams T, et al. Explainable machine-learning predictions for the prevention of hypoxaemia during surgery. Nat Biomed Eng. 2018;2(10):749–60.

55. Feizi N, Tavakoli M, Patel RV, Atashzar SF. Robotics and AI for teleoperation, tele-assessment, and tele-training for surgery in the era of COVID-19: existing challenges and future vision. Front Robot AI. 2021;8:–.

56. Hampp EL, Chughtai M, Scholl LY, Sodhi N, Bhowmik-Stoker M, Jacofsky DJ, et al. Robotic-arm assisted total knee arthroplasty demonstrated greater accuracy and precision to plan compared with manual techniques. J Knee Surg. 2019;32(3):239–50.

57. Wall J, Krummel T. The digital surgeon: how big data, automation, and artificial intelligence will change surgical practice. J Pediatr Surg. 2020;55S:47–50.

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58. Knudsen JE, Ghaffar U, Ma R, Hung AJ. Clinical applications of artificial intelligence in robotic surgery. J Robot Surg. 2024;18(1):102.

59. Wang F, Sun X, Li J. Surgical smoke removal via residual Swin transformer network. Int J Comput Assist Radiol Surg. 2023;18(8):1417–27.

60. De Backer P, Van Praet C, Simoens J, Peraire Lores M, Creemers H, Mestdagh K, et al. Improving augmented reality through deep learning: real-time instrument delineation in robotic renal surgery. Eur Urol. 2023;84(1):86–91.

61. Saeidi H, Opfermann JD, Kam M, Wei S, Leonard S, Hsieh MH, et al. Autonomous robotic laparoscopic surgery for intestinal anastomosis. Sci Robot. 2022;7(62):eabj2908.

62. Bodenstedt S, Wagner M, Müller-Stich BP, Weitz J, Speidel S. Artificial intelligence-assisted surgery: potential and challenges. Visc Med. 2020;36(6):450–5.

63. Abgrall G, Holder AL, Chelly Dagdia Z, Zeitouni K, Monnet X. Should AI models be explainable to clinicians? Crit Care. 2024;28:301.

64. Yang G, Ye Q, Xia J. Unbox the black-box for the medical explainable AI via multi-modal and multi-centre data fusion: a mini-review, two showcases and beyond. Int J Inf Fusion. 2022;77:29–52.

65. Naik N, Hameed BMZ, Shetty DK, Swain D, Shah M, Paul R, et al. Legal and ethical consideration in artificial intelligence in healthcare: who takes responsibility? Front Surg. 2022;9:862322.

66. Palaniappan K, Lin EYT, Vogel S. Global regulatory frameworks for the use of artificial intelligence (AI) in the healthcare services sector. Healthcare. 2024;12(5):562.

67. Borys K, Schmitt YA, Nauta M, Seifert C, Krämer N, Friedrich CM, et al. Explainable AI in medical imaging: an overview for clinical practitioners – saliency-based XAI approaches. Eur J Radiol. 2023;162:110787.

68. Chaddad A, Peng J, Xu J, Bouridane A. Survey of explainable AI techniques in healthcare. Sensors. 2023;23(2):634.

69. Ghassemi M, Oakden-Rayner L, Beam AL. The false hope of current approaches to explainable artificial intelligence in health care. Lancet Digit Health. 2021;3(11):e745–50.

70. Temsah A, Alhasan K, Altamimi I, Jamal A, Al-Eyadhy A, Malki KH, et al. DeepSeek in healthcare: revealing opportunities and steering challenges of a new open-source artificial intelligence frontier. Cureus. 2025;17(2):e79221.

71. Jeyaraman M, Balaji S, Jeyaraman N, Yadav S. Unraveling the ethical enigma: artificial intelligence in healthcare. Cureus. 2023;15(8):e43262.

72. Chen J, Miao C. DeepSeek deployed in 90 Chinese tertiary hospitals: how artificial intelligence is transforming clinical practice. J Med Syst. 2025;49(1):53.

73. Zeng D, Qin Y, Sheng B, Wong TY. DeepSeek's "low-cost" adoption across China's hospital systems: too fast, too soon? JAMA. 2025;333(21):1866–9.

74. Elendu C, Amaechi DC, Elendu TC, Jingwa KA, Okoye OK, John Okah M, et al. Ethical implications of AI and robotics in healthcare: a review. Medicine (Baltimore). 2023;102(50):e36671.

75. Scott IA, Carter SM, Coiera E. Exploring stakeholder attitudes towards AI in clinical practice. BMJ Health Care Inform. 2021;28(1):e100450.

A Comprehensive Review of Hidradenitis Suppurativa: From Pathogenesis to Clinical Insights & Novel Therapeutic Advancements

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Abstract

Hidradenitis suppurativa (HS) is a chronic, recurrent, and inflammatory follicular skin disease that profoundly impairs patients' quality of life. Pathogenesis is thought to begin with follicular occlusion, leading to painful nodules, abscesses, and sinus tract formation. Pain is a central and debilitating symptom, occurring as both acute flare-ups and persistent chronic discomfort, significantly contributing to morbidity and psychological distress. This narrative review was conducted with methodological rigor, employing the Scale for the Assessment of Narrative Review Articles (SANRA) to ensure a thorough literature search and critical appraisal of evidence. Clinical diagnosis relies on the presence of characteristic lesions, typical involvement of intertriginous areas, and recurrence at least twice within six months. A major challenge remains the diagnostic delay, averaging 6 to 10 years from symptom onset, which is linked to increased disease severity, higher healthcare costs, and loss of productivity. Disease severity is commonly evaluated using tools such as the Hurley staging system, Sartorius scoring, and the HS Physician Global Assessment. Therapeutic options include antibiotics (e.g., clindamycin, rifampin), retinoids (e.g., acitretin, isotretinoin), hormonal agents (e.g., spironolactone, oral contraceptives), intralesional corticosteroids, botulinum toxin injections, laser hair removal, and photodynamic therapy. Biologic therapies, such as adalimumab and infliximab, represent emerging treatment modalities. Under-recognition and limited diagnostic tools continue to impede timely intervention. This review aims to improve awareness of HS, highlight its varied clinical presentations, and summarize evolving management strategies for the medical community.

Introduction

Hidradenitis suppurativa (HS), or acne inversa, is a chronic, inflammatory, and recurrent follicular skin disease that significantly impairs health-related quality of life[1,2] Typically presenting after puberty, HS is characterized by painful, deep-seated, inflamed lesions in apocrine gland–bearing regions, most commonly the axillary, inguinal, and anogenital areas, as defined by the HS Foundation consensus in 2009.3 The standardized point prevalence of HS in the United States is 98 per 100,000 individuals.[4]

Historically, HS was attributed to apocrine gland inflammation; however, current evidence implicates follicular occlusion as the primary pathogenic event. Occlusion leads to cellular debris accumulation, cyst formation, and, upon rupture, triggers local immune responses, pain, scarring, and, in some cases, malodor.[5,6] Pain is a prominent complication, manifesting as both acute nociceptive pain during flares and chronic discomfort, which can progress to reduced mobility and impair work performance and daily activities.[7] Scarring and malodor further contribute to the psychological and emotional burden of HS, alongside its physical comorbidities.[8–12]

Despite its substantial impact, the average diagnostic delay is close to 10 years, typically following multiple physician consultations, according to the VOICE project.[13] This delay prolongs patient suffering, worsens quality of life, and increases the risk of comorbidities such as anxiety, depression, inflammatory bowel disease, polycystic ovary syndrome, diabetes mellitus, thyroid disorders, inflammatory arthritis, obesity, metabolic syndrome, acne, pyoderma gangrenosum, and anemia.[7]

This review aims to address the gap between clinical presentation, recognition, and management of HS by evaluating disease pathogenesis, diagnostic approaches, current pharmacological strategies, and emerging therapeutic targets.

Search Strategy and Selection Criteria

This narrative review utilized the Scale for the Assessment of Narrative Review Articles (SANRA) to ensure methodological rigor. Literature was identified through MEDLINE, Google Scholar, Web of Science, and EMBASE, focusing on peer-reviewed articles published in English between June 2014 and June 2024. FDA databases were also consulted for medication side effect profiles. Searches employed specific keywords (e.g., "hidradenitis suppurativa," "apocrine glands," "acne inversa," "skin nodules," "skin abscess") and Boolean operators ("AND," "OR") to optimize search sensitivity and specificity. Additional filters included article

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type (original research, reviews, case reports) and peer-reviewed status.

Titles and abstracts were initially screened for relevance by one investigator, with final article selection performed collaboratively by all authors in June 2024 to ensure comprehensive and unbiased inclusion. Exclusion criteria were non-peer-reviewed publications, letters to the editor, and studies older than ten years. Ultimately, sixty-six articles were included *(Figure 1).* This systematic and rigorous approach, guided by SANRA criteria, ensured the quality and comprehensiveness of this narrative review.

Epidemiology

The global incidence rate of HS is highly variable, with estimates ranging from 0.00033% to 4.1%.[15,16] In the United States, the prevalence rate is estimated to be nearly 10%, occurring three times more frequently in women than in men. The highest incidence is observed in women aged 20 to 29 years.[4] In addition to gender, race significantly influences HS prevalence in the United States; African Americans have an adjusted prevalence of 296 per 100,000, which is more than three times higher than that of Caucasian patients, who have a prevalence of 95 per 100,000.[4] Interestingly, in contrast to the gender prevalence observed in the United States, South Korean and Japanese studies found that in their population, HS occurrence was more prominent in men than women.[4]

Additionally, studies have shown that the clinical presentation of HS differs between women and men. Women more commonly develop cysts in anterior body regions, such as the groin and breasts, while men are more frequently affected in the gluteal region.[17] Furthermore, studies have demonstrated that up to 42% of patients with HS have a family history of the disease.[17] These findings suggest that genetic factors may play a significant role in the development of HS. The disease typically manifests after puberty, most commonly between the ages of 18 and 19, and can have a profound impact on the quality of life in this age group.[17]

Co-Morbidities

HS is associated with an increased risk of depression, further intensifying the burden of this chronic, painful, and socially isolating disease.[18] Moreover, patients with HS have been shown to experience higher rates of anxiety and completed suicide.[19] Feelings of shame, unworthiness, and being unlovable, encompassed under the term "internalized stigma," have been reported among these patients. Feelings of shame, unworthiness, and being unlovable—collectively referred to as "internalized stigma"—are frequently reported among those affected. Predictive factors for high internalized stigma include obesity, low income and educational level, and genital involvement.[20] These findings underscore the profound negative impact of HS, affecting not only physical health but also the psychological well-being of patients.

Figure 1. Literature Identification and Screening Process.
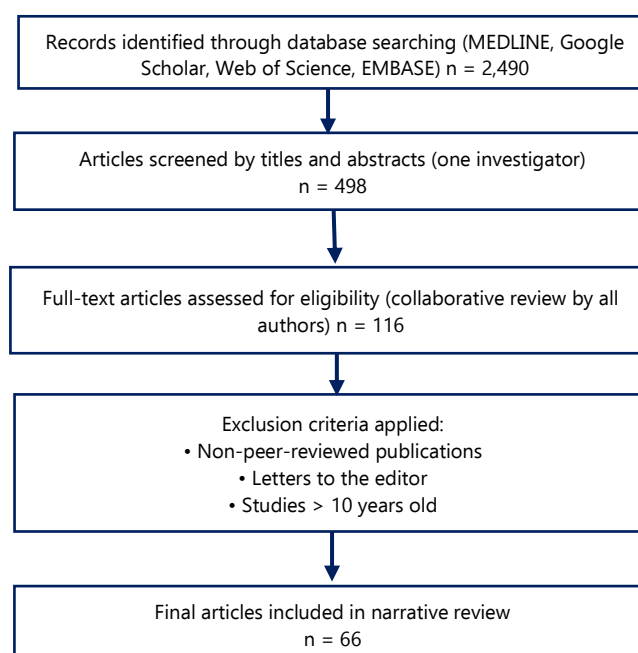
Legend: Articles were identified through MEDLINE, EMBASE, and Google Scholar between June 2014 and June 2024. Following duplicate removal and sequential screening, sixty-six studies were included in this narrative review in accordance with SANRA quality criteria.
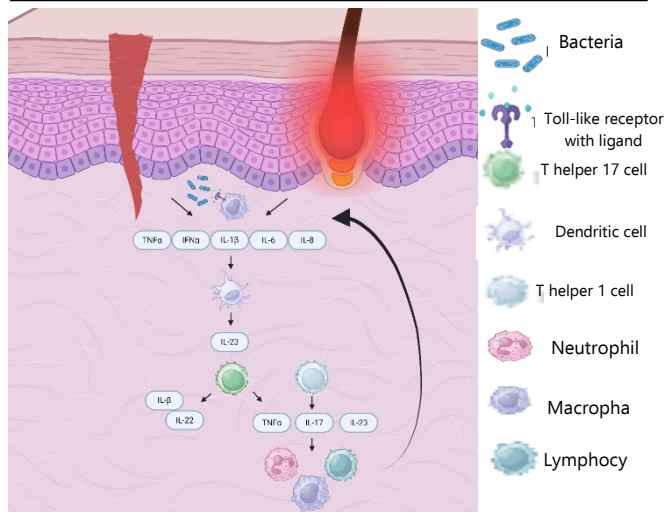
Hormones

It has been shown that patients with HS frequently have coexisting endocrine disorders, suggesting a role for hormonal imbalances in HS development. Polycystic Ovary Syndrome (PCOS) is one such condition, sharing several features with HS, including a predilection for young women and strong associations with metabolic syndrome and obesity.[18] In a cross-sectional study of 22,990 HS patients using a multi-health system analytics platform, the prevalence of PCOS among HS patients was 9.0%, compared to just 2.9% in individuals without HS (P < 0.0001).[21] The odds ratio for PCOS in HS patients was 2.14 (95% CI: 2.04–2.24), indicating that HS patients are more than twice as likely to have PCOS compared to those without HS.[18,21] These findings highlight the increased prevalence of concomitant PCOS in HS patients and underscore the potential role of hormonal factors in the development of both conditions.

Cardiovascular

The results of a study done in 2016 found that HS is associated with an increase in adverse cardiovascular outcomes, including ischemic stroke and myocardial infarction.[18,22] Moreover, HS patients presented a higher risk of cardiovascular-associated death than patients with severe psoriasis.[18] It is important to note that while there are no definite mechanisms outlined for the observed association between HS and cardiovascular outcomes, there are several shared risk factors that can play a role, such as obesity, smoking and metabolic syndrome, and chronic inflammation, all of which overlap with the pathophysiology of HS.

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Figure 2. The Role of Immune System Dysregulation in the Pathophysiology of Hidradenitis Suppurativa.

Bacteria

Toll-like receptor with ligand

T helper 17 cell

Dendritic cell

T helper 1 cell

Neutrophil

Macropha

Lymphocy

Legend: When the skin gets injured, pathogens can enter deeper layers and areas around hair follicles. These pathogens activate toll-like receptors, which trigger the release of pro-inflammatory signals called cytokines (such as TNFα, IFNα, IL-1β, IL-6, and IL-8). These cytokines then activate dendritic cells, which produce another signal called IL-23. IL-23 activates T helper cells, which further activate macrophages, dendritic cells, and neutrophils. Although this immune response is initially aimed at fighting infection and reducing inflammation, in HS it becomes a positive feedback loop. The continuous and excessive activation of immune cells leads to chronic inflammation, which in turn triggers more immune responses, perpetuating the cycle and causing ongoing tissue damage and painful skin lesions.

Smoking

Active smokers with HS tend to have more affected body areas than non-smokers.[17] Studies have shown that approximately 90% of individuals with HS are smokers.[23] Studies indicate that about 90% of HS patients are smokers, and a large U.S. cohort study identified smoking as a risk factor, with smokers showing twice the incidence of HS.[18] While the exact mechanism remains unclear, nicotine is linked to follicular plugging, increased cytokine production, neutrophil chemotaxis, and delayed lesion healing.[23] Additionally, nicotine may promote Staphylococcus aureus colonization, inflammatory mediator recruitment, and infundibular epidermal hyperplasia, all contributing to HS pathogenesis.[24]

Obesity

Obesity is well known to be associated with HS, with 60-77% of patients being overweight and 30% obese. Obese patients have increased friction and mechanical stress due to larger inverse skin areas.[25] The relationship between obesity and HS is characterized by the release of pro-inflammatory cytokines from adipose tissue, such as TNFα and IL-6, contributing to inflammation in HS patients. Moreover, HS patients exhibit a 50.6% prevalence of metabolic diseases, significantly higher than that of the general population.[18,26] Notably, HS is linked to hypertriglyceridemia, metabolic syndrome, and low high-density lipoprotein.[18] HS and metabolic syndrome exhibit a comparable adipokine profile, featuring increased levels of leptin, resistin, and visfatin, along with reduced serum adiponectin, which predisposes individuals

to both conditions. Further illustrating the link between HS and obesity, Thomas et al. documented a case of rapid HS improvement following bariatric surgery.[27,28]

Pathophysiology

The precise pathophysiology of HS remains incompletely understood, but it is widely accepted to be multifactorial.[29] Ongoing research into its underlying mechanisms is critical for informing effective treatment strategies. Although HS was once thought to be a suppurative disorder primarily affecting the apocrine sweat glands, recent advances highlight its characterization as a chronic disease driven by follicular occlusion within the pilosebaceous units.[30] Multiple factors are implicated in disease development, including immune system dysregulation, hormonal imbalances, genetic predisposition, and environmental influences.[31]

Immune System Dysregulation

Friction and microscopic epidermal injuries trigger an innate immune response, facilitating pathogen entry into the dermis and hair follicles in intertriginous areas, which leads to lesion formation.[32] The activation of the innate immune system promotes hyperplasia of the follicular epithelium, resulting in hair follicle rupture.[32] This rupture releases macrofollicular contents, such as keratin fragments, sebum, and bacteria, leading to the recruitment of additional inflammatory cells and abnormal activation of the complement system (e.g., C3a and C5a). As a result, inflammatory nodules, abscesses, and skin tunnels that open on the skin surface can form and become chronically inflamed.30 Activation of toll-like receptors by pathogen- and damage-associated molecular patterns triggers the release of pro-inflammatory cytokines such as TNFα, IFNα, IL-1β, IL-6, and IL-8, which in turn activate dendritic cells. These dendritic cells secrete IL-23, stimulating Th17 cell activation and subsequent keratinocyte proliferation, while promoting the production of IL-17, IL-22, IL-1β, and TNFα. 32 Both Th1 and Th17 cells release IL-17, IL-23, and TNFα, establishing a positive feedback loop that sustains chronic inflammation *(Figure 2).*[32] IL-17 further stimulates the release of chemokines, chemokine (C-X-C motif) ligand 1 (CXCL1), CXCL8, and CC motif chemokine ligand 20 (CCL20), attracting neutrophils, macrophages, and lymphocytes to HS lesion sites.[32]

Hormonal imbalances

The interplay between PCOS, obesity, insulin resistance, and increased levels of systemic pro-inflammatory mediators—such as insulin-like growth factor 1 (IGF-1), leukotrienes, and long-chain fatty acids—further underscores the significant role of hormonal and metabolic factors in the pathogenesis of HS.[33] Androgen-receptor-mediated inflammatory pathways linked to IL-23 may provide insights into how the Th17 pathway implicated in HS correlates with hormonal dysregulation.[33] Androgens, particularly testosterone, are associated with HS because they stimulate apocrine gland growth and secretion.[34] Hormones such as androgen, estrogen, progesterone, and prolactin may contribute to infundibular hyperkeratosis, follicular occlusion, and HS disease progression.[35]

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Figure 3. Current Therapeutic Approaches and Ongoing Research Biologics for Hidradenitis Suppurativa.
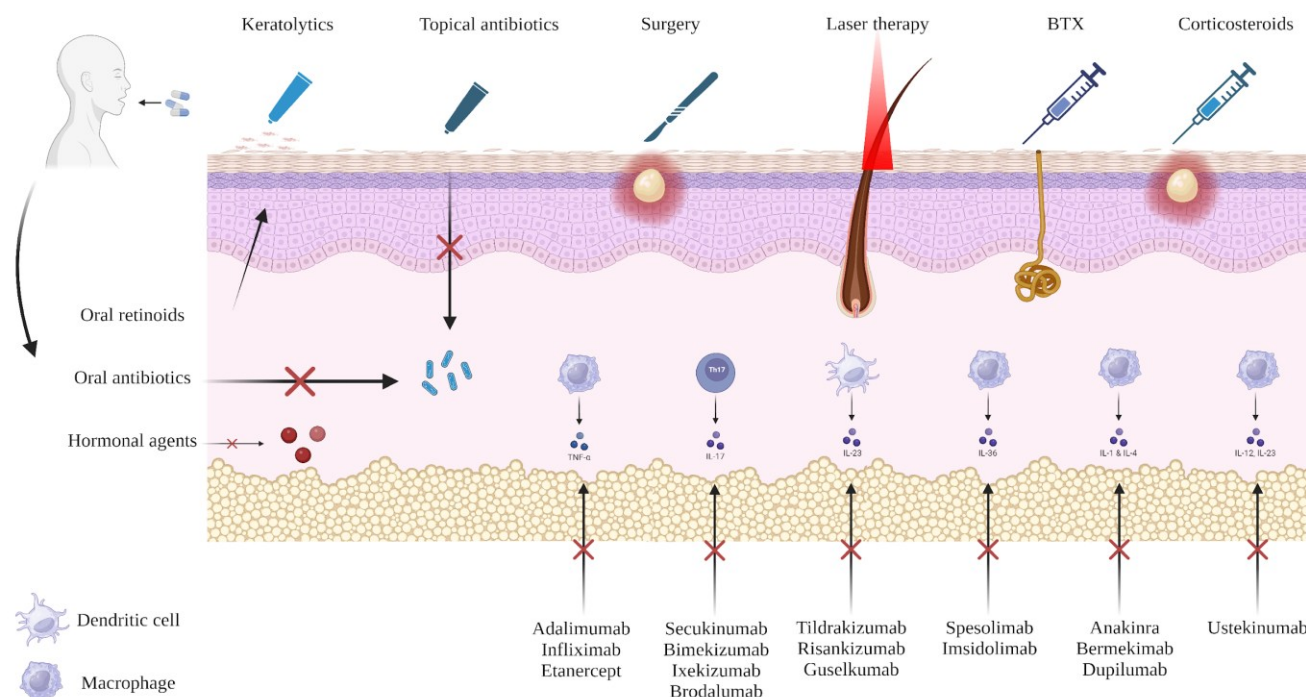
Legend: Therapeutic approaches for HS encompass a combination of interventions aimed at reducing inflammation, managing symptoms, and preventing disease progression. Medical treatments often begin with topical and systemic antibiotics to control bacterial infection and inflammation. Hormonal therapies, such as oral contraceptives and anti-androgens, are utilized in individuals with hormone-related HS. For moderate to severe cases, systemic anti-inflammatory drugs like retinoids and immunosuppressants are used. Recently, biologics have emerged as a significant advancement in HS treatment, with tumor necrosis factor-alpha (TNF-α) inhibitors like adalimumab and other FDA-approved biologics HS treatment. Other biologics targeting interleukin (IL)-17, IL-23, and IL-1 pathways have been recently approved by FDA while others remain under investigation, showing promising efficacy in clinical trials. Surgical interventions, including incision and drainage, deroofing, and wide excision of affected areas, are employed in certain cases.

Genetic factors

Evidence suggests a hereditary aspect of the autosomal dominant transmission pattern of HS, with approximately 33 to 40 percent of affected individuals reporting a first-degree relative with the condition.[34] Mutations in genes associated with gamma-secretase, an intermembrane protease complex that cleaves the intracellular domain of the Notch transmembrane receptor protein, affect keratinocyte differentiation in HS.[30] Notable mutations include those in presenilin-1 (PSEN1), presenilin enhancer-2 (PSENEN), and nicastrin (NCSTN).30 Additionally, variations in genes encoding IL-1, IL-12, and IL-23 are implicated in HS pathogenesis.[34]

Environmental influences

Several external factors contribute to the pathogenesis of HS, including mechanical stress, obesity, smoking, bacterial colonization, and certain medications.

Mechanical Stress

Increased mechanical stress from pressure, friction, or shear forces on intertriginous skin and areas such as beltlines and bra straps heightens the risk of follicular occlusion and rupture.[30]

Bacterial colonization

The warm and humid environment in conjunction with high concentration of pilosebaceous-apocrine units in intertriginous areas create favorable conditions for microbial growth.32 Antimicrobial peptides (AMPs) produced by epithelial and immune cells are vital for the skin's innate immune defense, preventing the overgrowth of commensal bacteria, inhibiting pathogen invasion, and facilitating cutaneous wound healing.[32] Disruption of AMPs and the complement system contributes to chronic inflammation and microbiota imbalances in HS. Early HS lesions show higher levels of commensal bacteria, while advanced lesions feature reduced commensals and increased pathogenic bacteria.[32] Sinus tracts and fistulas containing keratin debris and hair fragments can foster biofilm formation by gram-negative anaerobes, complicating treatment due to antimicrobial resistance.[32]

Medication use

Evidence suggests that androgens may exacerbate HS, as observed in female patients receiving oral contraceptives with androgenic progestins, intramuscular medroxyprogesterone acetate, or levonorgestrel-releasing intrauterine devices.[30] Additionally, HS has been reported in association with lithium

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therapy and, in rare cases, as an adverse effect of anti-TNF-alpha agents and other biologics used to treat chronic inflammatory diseases.[30]

Disease Presentation and Diagnosis

HS is diagnosed clinically using three main criteria: typical HS lesions, classical locations of intertriginous areas, and two or more occurrences within six months.[19,23,36] Typical HS lesions are described as inflammatory nodules, abscesses, and comedones.[20] Nodules and abscesses often rupture, secreting sanguineous & purulent material.[19,23] Lesions may occur singly or in multiple clusters, and with chronic disease progression, often lead to significant scarring and disfigurement.[36] Disease progression may connect adjacent nodules forming sinus tracts–deep dermal tunnels lined by epithelium and associated with inflammation.[19] Patients commonly experience pruritus, malodor, and painful & burning sensations.[23] An average of three misdiagnoses are made before achieving the correct diagnosis of HS.[20] Differential diagnoses include cutaneous abscess, inflamed epidermal cyst, furunculosis, cellulitis, necrotizing fasciitis, acne vulgaris, inflamed epidermal cysts, and cutaneous Crohn's disease.[20,36]

Most studies show a delay of HS diagnosis ranging from six to ten years after initial presentation, averaging ten years.[20] This diagnostic delay can lead to worse patient morbidity, higher costs to the healthcare system, and increased likelihood of patients' wage loss due to work absence.[20] The support of accurate and early recognition of the disease is needed to reduce diagnostic delays and, thus, the limitation of HS progress/management of the comorbidity burden.[37,38] Inadequate recognition and incorrect diagnosis of the disease may stem from the widespread lack of awareness about HS within the medical community and the significant variability in its clinical manifestation.[39] Research has shown that HS patients visited more than 3 different physicians on average including general practitioners, dermatologists, surgeons and gynecologists. The correct diagnosis was made by dermatologists in most cases.[37]

HS usually occurs in intertriginous anatomical locations (axillae, inframammary area, inguinal folds, gluteal cleft, and perianal region) and areas of friction (posterior neck, intermammary cleft, abdominal & flank folds, and medial thighs).[19] Less frequently, lesions may present in the lower abdomen, suprapubic area, retroauricular area, nape, eyelids, and scalp.[23]

The variation in clinical disease presentation, appearance, and response to treatment pose a challenge to accurately diagnosing HS.[40] Diagnosis is made by exclusion of other more common conditions, such as infectious abscess, cellulitis, cystic acne, or epidermal inclusion cyst.[41] To enhance a correct diagnosis, family history and history of other follicular occlusion diseases should be considered. Likewise, recurrence history or signs of previous episodes, along with the previously mentioned presence of comedones in typical areas, are valuable for differentiating HS.[41]

The most common tools used to assess the severity of HS are the Hurley staging, Sartorius scoring, and HS Physician Global Assessment systems.[23] The Hurley Staging System is the most used and is composed of three stages: (1) one or more lesions without sinus tract formation; (2) one or more widely separated lesions with sinus tracts and scarring; and (3) multiple lesions connected via sinus tracts and extensive scarring involving an entire anatomic area.[19] Worldwide, most HS patients are classified as Hurley stages I and II.[42] Typically, this system evaluates the entire body, and the highest stage would be applied, describing the patient overall rather than individual sites.[41] Patients classified with stage I may be treated with medical therapy, stage II with wide local surgery, and stage III with surgical excision of the entire affected region.[40]

The Sartorius Scoring System is a more accurate and precise method to define severity that was later proposed, though it is more time-consuming.[23] Meanwhile, the HS-Physician's Global Assessment is a fixed 6-point scale based on lesion counts in areas prone to inflammation.[43]

Currently, HS is not diagnosed by a definitive serum or histology test.[19] Likewise, HS can't be diagnosed utilizing a skin culture or laboratory testing.[41] Commonly, the content of lesion or drainage cultures reveals several types of microorganisms or normal skin flora.[36] Point-of-care ultrasound (POCUS) may aid in visualizing collections filled with fluid in soft tissue and may show signs of chronic disease. Still, it isn't reliable to differentiate between HS and infectious abscesses.[41] The use of ultrasound in practice is currently limited due to a lack of standardization and validation. Lastly, laser speckle contrast analysis (LASCA) and optical coherence tomography (OCT) are other techniques that have been reported for the diagnosis and treatment monitoring of HS.[39]

Management

Over 50 treatments have been investigated for HS, including topical, systemic, and surgical modalities.[34] Medical therapies comprise antibiotics, retinoids, hormonal agents, intralesional corticosteroid and botulinum toxin injections, laser hair removal, photodynamic therapy, and biologics *(Figure 3)*[7] Ultimately, clinicians use Hurley staging to evaluate disease severity and determine the most appropriate treatment option for patients.[34]

Antibiotics

The first line of therapy in HS is systemic antibiotics due to bacterial colonization and biofilm formation in lesions.[44] In mild stages of the disease, monotherapy is possible, yet lower response rates and increased recurrence are observed in more advanced stages.[45] Typical therapeutic regimens include the prescription of tetracyclines (doxycyxline or minocycline), clindamycin monotherapy, clindamycin/rifampicin, clindamycin/ofloxacin, trimethoprim/sulfamethoxazole, dapsone, and ertapenem[34] Antibiotics are limited by bacterial resistance, requiring the implementation of other alternatives such as aseptic

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washes (e.g., benzoyl peroxide, chlorhexidine, bleach, and pyrithione zinc).[34]

Biological Agents

Unlike antibiotics, biologics represent a newer class of medications designed to treat HS and are used for long-term maintenance control.[34,46] They are the preferred treatment for moderate to severe HS.[44] The most common side effects for the following biologics include headache, diarrhea, nausea, infections, injection site reaction, joint & muscle pain, and tiredness.[47–58]

TNF

TNF inhibitors have seen a growing use in the treatment of HS.[34] Adalimumab, the most extensively researched biologic agent for HS, is the first FDA-approved medication for this condition.[59] It is a fully-humanized monoclonal antibody targeting both soluble and transmembrane TNF.[59] Infliximab is a chimeric monoclonal antibody that targets soluble and transmembrane TNF used as a second-line biological treatment for HS, particularly when Hurley stage III HS resists adalimumab therapy.[34]

Etanercept is a recombinant human TNF inhibitor that functions as a soluble TNF receptor, binding to TNF-α and TNF-β, with multiple open-label studies reporting its efficacy and safety in managing HS.[59] In four HS patients, three case reports were detailed using golimumab, a fully human anti-TNF monoclonal antibody that targets both soluble and transmembrane TNF.[59]

IL-17

Secukinumab, a monoclonal antibody inhibitor of IL-17, is the latest FDA-approved medication for treating adult patients with moderate to severe HS.[34,48] It has demonstrated efficacy as a potential treatment for HS since 2017.[59] The recommended dosage is 300 mg administered by subcutaneous injection weekly for five consecutive weeks, then every 4 weeks. However, its safety and effectiveness in pediatric patients with HS have not been established.[48] The most promising biologic in phase III trial is bimekizumab, a humanized IgG1 monoclonal antibody that specifically targets IL-17A and IL-17F used to treat plaque psoriasis in patients.[59]

Ixekizumab is a monoclonal antibody that inhibits IL-17 and is currently approved by the FDA for treating psoriasis and psoriatic arthritis.[59] A few studies have demonstrated its potential efficacy in treating HS, with two case reports indicating its use in patients with concomitant HS and psoriasis, and a small case series presenting four out of five patients that achieved Hidradenitis Suppurativa Clinical Response (HiSCR).[32] Likewise, brodalumab is a fully human IgG2 monoclonal antibody that binds to the IL-17RA subunit of the IL-17 receptor, thereby interfering with the signaling of various IL-17 isoforms, including IL-17A, IL-17C, and IL-17F. Three case reports have documented the promising use of brodalumab in HS patients.[59]

IL-23

Tildrakizumab is a humanized IgG1 monoclonal antibody which targets the p19 subunit of IL-23 and is approved to treat moderate-to-severe plaque psoriasis. Literature reviews also reveal reports of tildrakizumab-asmn being used in the management of HS.[60] Only two case series and two case reports have been published regarding its use as treatment in HS. Yet they provided encouraging results (e.g., abscess and nodule count reduction, improved quality of life, HiSCR achievement, etc).[61]

Risankizumab, a monoclonal antibody that selectively blocks IL-23 by binding to the p19 subunit, is approved to treat Crohn's disease, psoriasis, and psoriatic arthritis.[59,60] Three case reports documented it was successfully administered to four HS patients. Similarly, guselkumab is a IL-23 inhibitor approved for treating psoriasis and psoriatic arthritis, which has been identified as a novel biologic being studied for HS management with several case reports and case series documenting its effectiveness in patients with moderate-to-severe HS that is refractory to other systemic treatments.[59,60]

IL-12/23

Patients with severe HS who failed treatment with adalimumab and infliximab have been treated off-label with ustekinumab—a human monoclonal antibody against the p40 subunit of IL-12 and IL-23.[34,45] Several literature reports have shown its efficacy in treating HS, though it's currently approved for treating Crohn's disease, ulcerative colitis, plaque psoriasis, and psoriatic arthritis.[60]

IL-1 & IL-4

Though reports on its efficacy present fluctuating results, anakinra, a recombinant IL-1 receptor antagonist approved for rheumatoid arthritis, has been noted as a possible therapeutic agent for HS. Bermekimab, a fully human recombinant IgG1 monoclonal antibody that also inhibits IL-1α currently in phase II trials, shows promising results.[62] Likewise, Dupilumab—a monoclonal antibody targeting the IL-4a receptor presently approved for treating moderate-to-severe atopic dermatitis—has been used effectively in numerous case reports involving patients with both HS and concomitant atopic dermatitis.[60] In contrast, canakinumab is a human monoclonal antibody against IL-1β. No significant clinical trials have investigated its safety and efficacy in HS, and results from single case reports or case series remain ambiguous.[62]

Other agents

The upregulation of IL-36RA has been shown in HS lesions compared to healthy skin. Therefore, two phase II trials are currently underway for the anti-IL-36 receptor monoclonal antibodies spesolimab and imsidolimab in the treatment of HS.[32] Other biological agents that have shown varied results include CD20 inhibitors (Rituximab), complement C5a inhibitors (Vilobelimab, Avacopan), CD40 inhibitors (Iscalimab), leukotriene

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A4 inhibitor (LYS006), phosphodiesterase-4 inhibitors (Apremilast), CXC receptors (LY3041658), and janus kinase inhibitors (INCB054707, Tofacitinib, Upadacitinib).62

Keratolytics

Retinoids are used in HS treatment due to similarities with acne vulgaris pathogenesis. [44,45] Oral retinoids, including acitretin and isotretinoin, have also been used to treat HS.[34] Oral retinoids such as acitretin and isotretinoin have been employed, though isotretinoin has shown mixed results in HS despite its anti-inflammatory and keratinocyte-modulating effects. Acitretin, which inhibits epidermal growth and differentiation, has demonstrated overall response rates around 50% and high recurrence with monotherapy, making its efficacy controversial. [60, 62,63] Evidence for topical retinoids in HS is limited to a single case report of successful use alongside chlorhexidine wash, clindamycin solution, and oral doxycycline.[63] Additionally, topical resorcinol, valued for its keratolytic, antimicrobial, and anti-inflammatory properties, appears safe and effective for long-term management of mild-to-moderate HS.[44]

Hormonal agents

Monotherapy with hormonal agents (e.g. spironolactone, metformin, finasteride, and ethinylestradiol) may be beneficial for female patients with mild-to-moderate HS, especially those reporting increased flares during menstruation or have features of Polycystic Ovarian Syndrome (PCOS).[34,44,45]

Surgery

Usually, surgical intervention is performed when pharmacologic care doesn't control the disease.[45] Incision & drainage (I&D) is recommended only upon abscesses, and though it can provide symptom relief, it doesn't alter the condition's recurrence rate or long-term prognosis.[46] I&D is associated with recurrence rates close to 100%.[45] Deroofing is another surgical approach that consists in opening sinus tract formations to both drain and heal lesions by secondary intention, and is preferred to simple drainage.[45,46] Lastly, wide local excision (WLE) consists of a wide margin excision of all affected hair-bearing areas.[46] It has been the cornerstone of conventional surgery, leading to no disease reoccurrence in the excision-performed areas.[45] Thus, it's considered the only potentially curative therapy for HS, with low recurrence rates ranging from 10-20%.[46]

Intralesional corticosteroid injections

Intralesional corticosteroid injections are recommended, either as a standalone treatment or as an adjunct to systemic therapies, for managing acute flares, refractory nodules, and sinus tracts in HS.[60] This therapy targets isolated HS nodules by activating glucocorticoid receptors and blocking pro-inflammatory cytokine production.[44] While its efficacy for acute HS flares is well-established, high doses and prolonged oral steroid regimens are not recommended due to the risk of flare-ups after tapering. However, the optimal dosages and volumes for intralesional steroid administration still need to be determined.[62]

Botulinum toxin injections

Botulinum toxin (BTX) injections are a beneficial treatment for HS.[64] All patients across the pertaining literature tolerated the treatment well, with most experiencing clinical improvement and remission lasting between six to twelve months.[64,65] Notable benefits included significant reductions in HS lesions and patient-reported pain, healing of sinus tracts, and improvements in DLQI scores. The treatment was applied to areas such as the axillary, inframammary, groin, and gluteal regions, with repeated applications every three to ten months.[7] Although the role of BTX in HS pathogenesis remains unclear, it´s believed to aid by decreasing moisture, follicular rupture, and the spread of follicular material though the dermis.[64]

Lasers

Laser and phototherapy have shown effectiveness in preventing future outbreaks by targeting hair follicles and causing thermal damage to bacteria.[19] Carbon dioxide (CO_2) lasers were the first to be employed in HS treatment–utilized for excision, marsupialization, and vaporization of the affected skin–and appear to be linked to low recurrence rates. However, they may result in prolonged healing times.[45]

Prevention

Primary prevention involves proactive measures to prevent disease onset and is a widely implemented strategy in many well-characterized conditions. However, as of the time of writing this review, preventive approaches for HS are not feasible due to the incomplete understanding of its pathophysiology. In contrast, secondary prevention aims to limit disease progression and prevent complications after diagnosis.[25] In the context of HS, secondary prevention is effective and focuses on preventing the development of new nodules or fistulas following the onset of infundibulofolliculitis. It also involves interventions to prevent patients with Hurley stage I disease from advancing to more severe stages, such as stage II or III. [25]

A study assessing the impact of secondary preventive measures in HS patients demonstrated their effectiveness in reducing disease severity and progression.[25] Additionally, two patients with concurrent gluten-sensitive enteropathy experienced significant improvement in HS symptoms following the adoption of a gluten-free diet. Similarly, seven patients reported notable symptom relief after implementing a low-dairy, low-carbohydrate diet.[25] It is also important to note that shaving can irritate the skin and trigger the inflammatory cascade in HS, and should therefore be avoided.[25]

Additional lifestyle modifications recommended to reduce HS flare-ups include smoking cessation, engaging in physical activities that minimize excessive sweating, and adopting a Mediterranean diet. Supplementation with zinc (90–100 mg for 3–4 months), vitamin D, and myo-inositol has also been suggested to improve HS outcomes. [7]

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Study Limitations

The limitations of this review include potential lack of generalizability due to variability in study populations and designs among the included articles. Selection bias may be present, as some relevant studies could have been missed, and publication bias may influence conclusions since studies with positive results are more likely to be published. These factors should be considered when interpreting the findings of this review.

Conclusion

Future research should prioritize evaluating the safety, efficacy, and optimal dosing of current off-label therapies, as well as novel agents targeting pathways such as IL-1, IL-12, IL-10, IL-36, C5a, IFN γ, and JAK. Further investigation into the pathophysiology of HS is also needed to clarify its etiology and molecular mechanisms. Improved recognition of HS is essential for timely diagnosis and treatment. This review aims to enhance awareness of the disease, its diverse clinical presentations, and available therapeutic options within the medical community.

References

1. Chen W, Plewig G. Should hidradenitis suppurativa/acne inversa best be renamed as "dissecting terminal hair folliculitis"? Exp Dermatol. 2017 Jun;26(6):544–7.

2. Kimball AB, Kirby J, Ingram JR, Tran T, Pansar I, Ciaravino V, et al. Burden of Hidradenitis Suppurativa: A Systematic Literature Review of Patient Reported Outcomes. Dermatol Ther. 2024 Jan;14(1):83–98.

3. Shavit E, Alavi A, Bechara FG, Bennett RG, Bourcier M, Cibotti R, et al. Proceeding report of the Second Symposium on Hidradenitis Suppurativa Advances (SHSA) 2017. Exp Dermatol. 2019 Jan;28(1):94–103.

4. Garg A, Kirby JS, Lavian J, Lin G, Strunk A. Sex- and Age-Adjusted Population Analysis of Prevalence Estimates for Hidradenitis Suppurativa in the United States. JAMA Dermatol. 2017 Aug 1;153(8):760.

5. Zouboulis CC, Nogueira Da Costa A, Fimmel S, Zouboulis KC. Apocrine glands are bystanders in hidradenitis suppurativa and their involvement is gender specific. J Eur Acad Dermatol Venereol. 2020 Jul;34(7):1555–63.

6. Prens E, Deckers I. Pathophysiology of hidradenitis suppurativa: An update. J Am Acad Dermatol. 2015 Nov;73(5):S8–11.

7. Johnston LA, Alhusayen R, Bourcier M, Delorme I, George R, O'Brien E, et al. Practical Guidelines for Managing Patients With Hidradenitis Suppurativa: An Update. J Cutan Med Surg. 2022 Sep;26(2_suppl):2S-24S.

8. Zouboulis CC, Benhadou F, Byrd AS, Chandran NS, Giamarellos-Bourboulis EJ, Fabbrocini G, et al. What causes hidradenitis suppurativa?—15 years after. Exp Dermatol. 2020 Dec;29(12):1154–70.

9. Ingram JR, Jenkins-Jones S, Knipe DW, Morgan CLI, Cannings-John R, Piguet V. Population-based Clinical Practice Research Datalink study using algorithm modelling to identify the true burden of hidradenitis suppurativa. Br J Dermatol. 2018 Apr 1;178(4):917–24.

10. Jfri A, Netchiporouk E, Raymond K, Litvinov IV, O'Brien E. Association of clinical severity scores with psychosocial impact in patients with hidradenitis suppurativa. J Am Acad Dermatol. 2021 Jun;84(6):1712–5.

11. Fimmel S, Zouboulis CC. Comorbidities of hidradenitis suppurativa (acne inversa). Dermatoendocrinol. 2010 Jan;2(1):9–16.

12. Nikolakis G, Kaleta KP, Vaiopoulos AG, Wolter K, Baroud S, Wojas-Pelc A, et al. Phenotypes and Pathophysiology of Syndromic Hidradenitis Suppurativa: Different Faces of the Same Disease? A Systematic Review. Dermatology. 2021;237(5):673–97.

13. Garg A, Neuren E, Cha D, Kirby JS, Ingram JR, Jemec GBE, et al. Evaluating patients' unmet needs in hidradenitis suppurativa: Results from the Global Survey Of Impact and Healthcare Needs (VOICE) Project. J Am Acad Dermatol. 2020 Feb;82(2):366–76.

14. Baethge C, Goldbeck-Wood S, Mertens S. SANRA—a scale for the quality assessment of narrative review articles. Res Integr Peer Rev. 2019 Dec;4(1):5.

15. Nguyen TV, Damiani G, Orenstein LAV, Hamzavi I, Jemec GB. Hidradenitis suppurativa: an update on epidemiology, phenotypes, diagnosis, pathogenesis, comorbidities and quality of life. J Eur Acad Dermatol Venereol. 2021 Jan;35(1):50–61.

16. Alotaibi HM. Incidence, Risk Factors, and Prognosis of Hidradenitis Suppurativa Across the Globe: Insights from the Literature. Clin Cosmet Investig Dermatol. 2023 Mar;Volume 16:545–52.

17. Bukvić Mokos Z, Miše J, Balić A, Marinović B. Understanding the Relationship Between Smoking and Hidradenitis Suppurativa. Acta Dermatovenerol Croat ADC. 2020 Jul;28(1):9–13.

18. Cartron A, Driscoll MS. Comorbidities of hidradenitis suppurativa: A review of the literature. Int J Womens Dermatol. 2019 Dec;5(5):330–4.

19. Jenkins T, Isaac J, Edwards A, Okoye GA. Hidradenitis Suppurativa. Dermatol Clin. 2023 Jul;41(3):471–9.

20. Snyder CL, Chen SX, Porter ML. Obstacles to Early Diagnosis and Treatment of Hidradenitis Suppurativa: Current Perspectives on Improving Clinical Management. Clin Cosmet Investig Dermatol. 2023 Jul;Volume 16:1833–41.

21. Garg A, Neuren E, Strunk A. Hidradenitis Suppurativa Is Associated with Polycystic Ovary Syndrome: A Population-Based Analysis in the United States. J Invest Dermatol. 2018 Jun;138(6):1288–92.

22. Egeberg A, Gislason GunnarH, Hansen PR. Risk of Major Adverse Cardiovascular Events and All-Cause Mortality in Patients With Hidradenitis Suppurativa. JAMA Dermatol. 2016 Apr 1;152(4):429.

23. Scala E, Cacciapuoti S, Garzorz-Stark N, Megna M, Marasca C, Seiringer P, et al. Hidradenitis Suppurativa: Where We Are and Where We Are Going. Cells. 2021 Aug 15;10(8):2094.

24. Acharya P, Mathur M. Hidradenitis suppurativa and smoking: A systematic review and meta-analysis. J Am Acad Dermatol. 2020 Apr;82(4):1006–11.

25. Kurzen H, Kurzen M. Secondary prevention of hidradenitis suppurativa. Dermatol Rep [Internet]. 2019 Oct 25 [cited 2024 Jul 24];11(2). Available from: https://www.pagepress.org/journals/index.php/dr/article/view/8243

26. Gold DA, Reeder VJ, Mahan MG, Hamzavi IH. The prevalence of metabolic syndrome in patients with hidradenitis suppurativa. J Am Acad Dermatol. 2014 Apr;70(4):699–703.

27. Thomas CL, Gordon KD, Mortimer PS. Rapid resolution of hidradenitis suppurativa after bariatric surgical intervention. Clin Exp Dermatol. 2014 Apr;39(3):315–8.

28. Mintoff D, Benhadou F, Pace NP, Frew JW. Metabolic syndrome and hidradenitis suppurativa: epidemiological, molecular, and therapeutic aspects. Int J Dermatol. 2022 Oct;61(10):1175–86.

29. Hoffman L, Ghias M, Lowes M. Pathophysiology of hidradenitis suppurativa. Semin Cutan Med Surg. 2017 Jun;36(2):47–54.

30. Ingram JR. Hidradenitis suppurativa: Pathogenesis, clinical features, and diagnosis [Internet]. UpToDate. 2023 [cited 2024 Jun 17]. Available from: https://www.uptodate.com/contents/hidradenitis-suppurativa-pathogenesis-clinical-features-and-diagnosis?search=pathophysiology+of+hidradenitis+supurativa&source=search_result&selectedTitle=1~66&usage_type=default&display_rank=1

31. Goldburg SR, Strober BE, Payette MJ. Hidradenitis suppurativa: Epidemiology, clinical presentation, and pathogenesis. J Am Acad Dermatol. 2020 May;82(5):1045–58.

Rivera-Díaz J., et al.

A Comprehensive Review of Hidradenitis Suppurativa: From Pathogenesis to Clinical Insights & Novel Therapeutic Advancements

32. Chen R, Guo R, Petty AJ, Jaleel T. Immune Dysregulation and Current Targeted Biologics in Hidradenitis Suppurativa. Immuno. 2024 Feb 2;4(1):57–76.

33. Kozera EK, Lowes MA, Hsiao JL, Frew JW. Clinical considerations in the management of hidradenitis suppurativa in women. Int J Womens Dermatol. 2021 Dec;7(5):664–71.

34. 35. Diaz MJ, Aflatooni S, Abdi P, Li R, Anthony MR, Neelam S, et al. Hidradenitis Suppurativa: Molecular Etiology, Pathophysiology, and Management—A Systematic Review. Curr Issues Mol Biol. 2023 May 17;45(5):4400–15.

35. Chu CB, Yang CC, Tsai SJ. Hidradenitis Suppurativa: Disease Pathophysiology and Sex Hormones. Chin J Physiol. 2021;64(6):257–65.

36. Garg A, Naik HB, Kirby JS. A Practical Guide for Primary Care Providers on Timely Diagnosis and Comprehensive Care Strategies for Hidradenitis Suppurativa. Am J Med. 2023 Jan;136(1):42–53.

37. Kokolakis G, Wolk K, Schneider-Burrus S, Kalus S, Barbus S, Gomis-Kleindienst S, et al. Delayed Diagnosis of Hidradenitis Suppurativa and Its Effect on Patients and Healthcare System. Dermatology. 2020;236(5):421–30.

38. Shelby D. Hidradenitis Suppurativa: A Disease Under-Diagnosed and Under Treated. [Internet]. 2018 [cited 2024 Jun 18]. Available from: https://www.skinbonescme.com/2018/02/01/hidradenitis-suppurativa-disease-underdiagnosed-undertreated/

39. Kirby J, Kim K, Zivkovic M, Wang S, Garg V, Danavar A, et al. Uncovering the burden of hidradenitis suppurativa misdiagnosis and underdiagnosis: a machine learning approach. Front Med Technol. 2024 Mar 25;6:1200400.

40. Preda-Naumescu A, Ahmed HN, Mayo TT, Yusuf N. Hidradenitis suppurativa: pathogenesis, clinical presentation, epidemiology, and comorbid associations. Int J Dermatol [Internet]. 2021 Nov [cited 2024 Jul 24];60(11). Available from: https://onlinelibrary.wiley.com/doi/10.1111/ijd.15579

41. Okun MM, Flamm A, Werley EB, Kirby JS. Hidradenitis Suppurativa: Diagnosis and Management in the Emergency Department. J Emerg Med. 2022 Nov;63(5):636–44.

42. Díaz D, Rivera A, Otero V, Rueda L. Epidemiology of Hidradenitis Suppurativa: Current Status. Curr Dermatol Rep. 2022 Oct 11;11(4):336–40.

43. Saunte DML, Jemec GBE. Hidradenitis Suppurativa: Advances in Diagnosis and Treatment. JAMA. 2017 Nov 28;318(20):2019.

44. Ghanian S, Yamanaka-Takaichi M, Naik HB, Alavi A. Medical Management of Hidradenitis Suppurativa with Non-Biologic Therapy: What's New? Am J Clin Dermatol. 2022 Mar;23(2):167–76.

45. Alikhan A, Sayed C, Alavi A, Alhusayen R, Brassard A, Burkhart C, et al. North American clinical management guidelines for hidradenitis suppurativa: A publication from the United States and Canadian Hidradenitis Suppurativa Foundations. J Am Acad Dermatol. 2019 Jul;81(1):91–101.

46. Singh S, Desai K, Gillern S. Management of Pilonidal Disease and Hidradenitis Suppurativa. Surg Clin North Am. 2024 Jun;104(3):503–15.

47. Gerriets V, Goyal A, Khaddour K. Tumor Necrosis Factor Inhibitors. [Internet]. StatPearls. 2023 [cited 2024 Jun 27]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482425/

48. U.S. Food and Drug Administration. COSENTYX® (secukinumab) injection, for subcutaneous or intravenous use [Internet]. 2023 [cited 2024 Jun 10]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2023/125504s066,761349s004lbl.pdf

49. U.S. Food and Drug Administration. BIMZELX® (bimekizumab-bkzx) injection, for subcutaneous use [Internet]. 2023 [cited 2024 Jun 10]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2023/761151s000lbl.pdf

50. U.S. Food and Drug Administration. TALTZ (ixekizumab) injection, for subcutaneous use [Internet]. 2022 [cited 2024 Jun 10]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2022/125521s024lbl.pdf

51. U.S. Food and Drug Administration. SILIQTM (brodalumab) injection, for subcutaneous use [Internet]. 2017 [cited 2024 Jun 10]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2017/761032lbl.pdf

52. 53. U.S. Food and Drug Administration. ILUMYATM (tildrakizumab-asmn) injection, for subcutaneous use [Internet]. 2018 [cited 2024 Jun 10]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2018/761067s000lbl.pdf

53. U.S. Food and Drug Administration. SKYRIZI® (risankizumab-rzaa) injection, for subcutaneous use [Internet]. 2022 [cited 2024 Jun 10]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2022/761105s014lbl.pdf

54. U.S. Food and Drug Administration. TREMFYA® (guselkumab) injection, for subcutaneous use [Internet]. 2020 [cited 2024 Jun 11]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2020/761061s009lbl.pdf

55. U.S. Food and Drug Administration. STELARA® (ustekinumab) injection, for subcutaneous or intravenous [Internet]. 2016 [cited 2024 Jun 11]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2016/761044lbl.pdf

56. U.S. Food and Drug Administration. KINERET® (anakinra) injection, for subcutaneous use [Internet]. 2020 [cited 2024 Jun 11]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2020/103950s5189lbl.pdf

57. U.S. Food and Drug Administration. DUPIXENT® (dupilumab) injection, for subcutaneous use [Internet]. 2022 [cited 2024 Jun 11]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2022/761055s042lbl.pdf

58. U.S. Food and Drug Administration. ILARIS® (canakinumab) for injection, for subcutaneous use [Internet]. 2016 [cited 2024 Jun 11]. Available from: https://www.accessdata.fda.gov/drugsatfda_docs/label/2016/BLA125319_858687lbl.pdf

59. Molinelli E, Gioacchini H, Sapigni C, Diotallevi F, Brisigotti V, Rizzetto G, et al. New Insight into the Molecular Pathomechanism and Immunomodulatory Treatments of Hidradenitis Suppurativa. Int J Mol Sci. 2023 May 8;24(9):8428.

60. Mital R, Gray A, Minta A, Almhana F, Amin S, Hydol-Smith J, et al. Novel and Off-Label Biologic Use in the Management of Hidradenitis Suppurativa, Pyoderma Gangrenosum, Lichen Planus, and Seborrheic Dermatitis: A Narrative Review. Dermatol Ther. 2023 Jan;13(1):77–94.

61. Ruggiero A, Picone V, Martora F, Fabbrocini G, Megna M. Guselkumab, Risankizumab, and Tildrakizumab in the Management of Psoriasis: A Review of the Real-World Evidence. Clin Cosmet Investig Dermatol. 2022 Aug;Volume 15:1649–58.

62. Macca L, Li Pomi F, Ingrasciotta Y, Morrone P, Trifirò G, Guarneri C. Hidradenitis suppurativa and psoriasis: the odd couple. Front Med. 2023 Jul 7;10:1208817.

63. Molinelli E, Gioacchini H, Marani A, Rizzetto G, Gambini D, De Simoni E, et al. Topical and Systemic Retinoids in the Management of Hidradenitis Suppurativa: A Comprehensive Literature Review. Dermatol Ther. 2024 May;14(5):1079–91.

64. Shih T, Lee K, Seivright JR, De DR, Shi VY, Hsiao JL. Hyperhidrosis treatments in hidradenitis suppurativa: A systematic review. Dermatol Ther [Internet]. 2022 Jan [cited 2024 Jul 24];35(1). Available from: https://onlinelibrary.wiley.com/doi/10.1111/dth.15210

65. Alster TS, Harrison IS. Alternative Clinical Indications of Botulinum Toxin. Am J Clin Dermatol. 2020 Dec;21(6):855–80.

Review

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Surgical Management of Refractory Pulmonary Actinomycosis: A Case Report

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Abstract

Background: Pulmonary actinomycosis is an uncommon disease with a non-specific clinical presentation, challenging and usually leads to a misinterpretation of malignancy rather than infection. **The Case:** A 30-year-old female patient began her illness a year and a half ago with cough, chest pain, weakness, and hemoptysis. She received medical treatment; however, the episodes of hemoptysis persisted. A bronchoscopy was performed, where a mass was found, and a biopsy was taken. Subsequently, a diagnosis of pulmonary actinomycosis was made when sulfur granules with dystrophic calcification were found in the biopsy. Therefore, treatment with amoxicillin was given for 12 months. Three months later, she persisted with occasional hemoptysis, so it was decided to perform a right lung lobectomy, showing clinical improvement. After six months, the symptoms improved completely. **Conclusion:** Since the introduction of penicillin, the incidence of pulmonary actinomycosis has decreased significantly to the point that only 94 cases were reported in the first decade of the 21st century. In addition to this, it is a great mimic of malignancy, being misdiagnosed as a pulmonary neoplasm. The most used treatment is penicillin for six to 12 months. Pulmonary lobectomy can be an effective treatment for refractory pulmonary actinomycosis with persistent hemoptysis despite prolonged antibiotic therapy. It is important to consider it among the differential diagnoses in patients with non-specific symptoms and a negative result for the most common pathogens.

Introduction

Pulmonary actinomycosis is a disease caused by a gram-positive filamentous bacteria which, under normal circumstances, is part of the normal commensal flora of several human mucosal sites, including the oropharynx, urogenital tract, and gastrointestinal tract.[1] It is characterized by suppurative granulomatous inflammation, abscess formation, and the presence of sulfur granules.[1]

Due to its nonspecific presentation, pulmonary actinomycosis often mimics malignancies, leading to delayed or incorrect diagnoses, rather than an infective process.[2] We present the case of a patient with pulmonary actinomycosis with nonspecific clinical symptoms.

The Case

Clinical Presentation

A 30-year-old female patient with no relevant history who began her current condition a year and a half ago with cough, chest pain, weakness, tiredness, dizziness and hemoptysis. She received unspecified medical treatment, improving her symptoms, however, two days later the symptoms returned, and she went to consult with a physician and was later referred to our unit for further management.

Highlights:
- Pulmonary actinomycosis is rare and often misdiagnosed as malignancy.
- Diagnosis relies on identifying sulfur granules.
- Treatment involves penicillin; surgery is used for persistent cases.

Initial Evaluation

Upon arrival, laboratories were taken *(Table 1).* She was started on proton pump inhibitors and benzonatate, as a more common infection was suspected, then she was hospitalized for further management.

Hospital Course

The treatment was subsequently modified to benzonatate and Ambroxol Hydrochloride, which reduced her cough episodes, however, she continued with hemoptysis at least once a day.

Diagnostic Workup

A simple computed tomography (CT) scan of the chest was performed for suspicion of malignancy, which revealed bronchiectasis of the right posterior basal segment with no evidence of active infection or neoplasm. Acid-fast staining was negative, ruling out mycobacterial infection.

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Case Report

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Bronchoscopy Findings

One week later a bronchoscopy was performed, reporting erythematous, edematous mucosa and a mass in the right lower lobe which caused an obstruction of 80% of the airway, an endobronchial biopsy, bacterial culture, gram staining, acid-fast stain and KOH test were performed, with negative results for bacterial culture, acid-fast stain and KOH test. The patient remained stable and was discharged with follow-up by the pneumology service.

Histopathology

Endobronchial biopsy results revealed squamous metaplasia, acute and chronic inflammation, and sulfur granules with dystrophic calcification, confirming pulmonary actinomycosis. Due to the diagnosis, the patient was referred to the infectious disease service for specialized management.

Table 1. Initial Laboratory Findings on Admission in a Patient with Refractory Pulmonary Actinomycosis.

Paraclinical report	Value	Reference value
Leukocytes (cells/mm^3)	10,300	4,000 – 10,000
Platelets (cells/mm^3)	238,000	150,000 – 400,000
Glucose (mg/dL)	96.3	70 - 99
Sodium (mEq/L)	137	135 – 145
Potassium (mEq/L)	3.3	3.5 - 5

Management and Treatment

The patient started treatment with amoxicillin 2 g every 12 hours for 12 months, due to the lack of Penicillin G in the institution. Three months later, the patient came for follow-up showing clinical improvement but with occasional presence of symptoms, so the same treatment was continued, and chest CT was requested in 3 months. Three months later a new simple CT scan was performed, which showed progression of bronchiectasis and recurrent pneumonia, so it was decided to perform a new bronchoscopy, which reported a brown mass suggestive of necrosis, mucopurulent plug and abundant whitish mucopurulent secretions in the bronchial tree, a new biopsy was performed, reporting again pulmonary actinomycosis and squamous metaplasia.

Due to persistent hemoptysis and progression of bronchiectasis despite prolonged antibiotic therapy, right lower lobectomy was performed, showing clinical improvement and disappearance of hemoptysis.

Follow up

After six months of follow-up, the patient continued without recurrence of symptoms.

Three months post-surgery, the patient reported marked clinical improvement with a significant reduction in cough episodes, so treatment with amoxicillin was suspended, and an appointment was made in three months for follow-up. She attended the follow-up visit and reported resolution of the cough, so it was decided to discharge her from the infectious disease department.

Discussion

This case highlights the diagnostic challenges of pulmonary actinomycosis, a rare infection that can mimic lung malignancies, and underscores the role of surgical intervention in refractory cases.

Historically, pulmonary actinomycosis was an infection with high mortality,[3] however, its incidence has been drastically reduced since the introduction of penicillin, reaching an annual incidence of 1 case per 300,000 people.[4]

It has been shown to affect two to four times more men than women and to occur at any age, showing a bimodal distribution between 11-20 and 40-50 years of age,[5] none of which matches the patient, who was a 30-year-old female at the time of diagnosis.

The most common symptoms are cough, chest pain, hemoptysis, fever and weight loss,[5] most of them observed in the patient. Due to the nonspecific symptoms, more common diagnoses such as bacterial pneumonias, lung cancer, and tuberculosis are usually considered.6

In addition to this, few cases have been reported, Kim et al. (2013) reported 94 cases during the first decade of the 21st century,[7] so it is unlikely to be considered among the main differential diagnoses.

The diagnosis is often challenging because it is a great mimic of malignancy,[8] as in the case of the patient who was found to have a mass on bronchoscopy. Zhang et al. (2017) demonstrated the misdiagnosis in their retrospective study, in which only five patients had the correct initial diagnosis, 60 were diagnosed with lung cancer, the rest between tuberculosis and lung abscesses.9

For all this, bronchoscopy is used as part of the management and if any mass is located, take a biopsy to rule out malignancy, then perform a microbiological examination identifying sulphur granules, they are formed by masses of filaments extending in a radiating, spoke-like fashion and is the hallmark of identification and diagnosis,10 as in the case of the patient.

Regarding treatment, Endo et al. (2002) in their review of the literature, indicate that the treatment of choice is with antibiotics of the penicillin group and in some cases, surgery,[11] in the case of the patient it was decided to use amoxicillin for 12 months with surgery because the surgical intervention is indicated in refractory hemoptysis ,[12] which has shown better results than in patients in whom it is not performed.[13] Although there is a risk of complications due to the complexity of the procedure, the benefits are greater and have demonstrated better outcomes.

In the medical literature, Aydin et al. (2022) 14 reported a case in which lobectomy was performed for refractory fhemoptysis, with positive outcome.

There is no established follow-up period, different articles reported a follow-up between three to 12 months,11 in the case of the patient, at the time of writing this article, she was followed up at three months, without complications.

Pulmonary actinomycosis remains a diagnostic challenge due to its nonspecific presentation and ability to mimic malignancies. While prolonged antibiotic therapy is the mainstay of treatment, surgical intervention, such as lobectomy, should be considered in cases of refractory hemoptysis or disease progression. This is a single case report, and outcomes may vary in larger patient populations. Further studies are needed to establish guidelines for surgical intervention in refractory pulmonary actinomycosis.

Summary – Accelerating Translation

Pulmonary actinomycosis is a rare condition with nonspecific clinical presentation, often mimicking malignancy or other chronic infections. Diagnosis can be challenging and is frequently delayed. This case highlights the role of lobectomy in managing refractory hemoptysis, highlighting surgical intervention as a viable treatment for refractory cases.".

References

1. Wong VK, Turmezei TD. Actinomycosis. BMJ. 2011;343:d6099.

2. Suzuki M, Araki K, Matsubayashi S, Kobayashi K, Morino E, Takasaki J, et al. A case of recurrent hemoptysis caused by pulmonary actinomycosis diagnosed using transbronchial lung biopsy after bronchial artery embolism and a brief review of the literature. Ann Transl Med. 2019;7(5):1–6.

3. Brook I. Actinomycosis: diagnosis and management. South Med J. 2018;101(10):1019–23.

4. Boyanova L, Kolarov R, Mateva L, Markovska R, Mitov I. Actinomycosis: a frequently forgotten disease. Future Microbiol. 2015;10(4):613–28.

5. Mabeza GF, Macfarlane J. Pulmonary actinomycosis. Eur Respir J. 2003;21(3):361–73.

6. Kim SR, Jung LY, Oh IJ, Kim YC, Shin KC, Lee MK, et al. Pulmonary actinomycosis during the first decade of 21st century: cases of 94 patients. BMC Infect Dis. 2013;13:216.

7. Moniruddin A, Begum H, Nahar K. Actinomycosis: an update. Med Today. 2010;22(1):43–7.

8. Zhang M, Zhang XY, Chen YB. Primary pulmonary actinomycosis: a retrospective analysis of 145 cases in mainland China. Int J Tuberc Lung Dis. 2017;21(1):825–31.

9. Katsenos S, Galinos I, Styliara P, Galanopoulou N, Psathakis K. Primary bronchopulmonary actinomycosis masquerading as lung cancer: apropos of two cases and literature review. Case Rep Infect Dis. 2015;2015:609637.

10. Miller M, Haddad AJ. Cervicofacial actinomycosis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998;85(5):496–508.

11. Boot M, Archer J, Ali I. The diagnosis and management of pulmonary actinomycosis. J Infect Public Health. 2023;16(4):490–500.

12. Endo S, Murayama F, Yamaguchi T, Yamamoto S, Otani S, Saito N, et al. Surgical considerations for pulmonary actinomycosis. Ann Thorac Surg. 2002;74(1):185–90.

13. Song JU, Park HY, Jeon K, Um SW, Kwon OJ, Koh WJ. Treatment of thoracic actinomycosis: a retrospective analysis of 40 patients. Ann Thorac Med. 2010;5(2):80–5.

14. Aydin Y, Arslan R, Filik M. Pulmonary actinomycosis mimics lung cancer. Rev Soc Bras Med Trop. 2022;55:e0195.

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Port-a-Cath Fragmentation Causing Recurrent Chest Pressure and Dizziness in an Elderly Man: A Case Report

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Abstract

Background: A port-a-catheter is a long-term vascular access device designed for patients requiring prolonged access to a large venous vessel. These devices are typically surgically inserted into the internal jugular vein, subclavian vein, or superior vena cava. **The Case:** A 71-year-old male with a history of follicular lymphoma in remission following treatment with six cycles of rituximab, cyclophosphamide, doxorubicin, vincristine, and prednisone (R-CHOP) presented with a 10-week history of intermittent chest pressure and dizziness. During a routine follow-up visit with his oncologist, a screening computed tomography (CT) scan revealed a fragmented port-a-catheter. The catheter fragment was coiled within the right and left main pulmonary arteries. The patient underwent fluoroscopic-guided retrieval of the fragment, resulting in complete resolution of his symptoms. **Conclusion:** Fractured port-a-catheters can migrate to the pulmonary arteries, leading to increased pulmonary pressure and irritation of the pulmonary endothelium. This can manifest as chest discomfort, chest pressure, dizziness, and episodic hypertensive emergencies. Prompt recognition, confirmation with imaging, and retrieval of the fractured catheter are crucial to prevent serious complications. Physicians should consider catheter fragmentation and migration as possible causes when diagnosing patients with similar symptoms who have a known indwelling port.

Introduction

A port-a-catheter is a long-term vascular access device commonly used in patients requiring prolonged access to large venous vessels such as the subclavian vein. It consists of a subcutaneous injection port connected to a central venous catheter (CVC), offering significant advantages for patients undergoing chemotherapy, including a lower risk of infection, reduced pain from repeated needle sticks, and prevention of peripheral venous damage caused by chemotherapy agents.1 Although port-a-catheter complications are relatively rare, a recent single-center retrospective study estimated the incidence of port-a-catheter fracture to be approximately 1.8%. Among these cases, migration of the fractured catheter to the pulmonary artery is exceedingly rare.2 We present an unusual case of a patient who experienced intermittent chest pain and dizziness due to a rare etiology.

The Case

A 71-year-old male with a history of grade 3a follicular lymphoma in remission following chemotherapy, thyroid cancer treated with radioactive iodine ablation, hypertension, and hyperlipidemia presented to his oncology office for a follow-up computed tomography (CT) scan to evaluate his follicular lymphoma. He had previously completed six cycles of rituximab, cyclophosphamide, doxorubicin, vincristine, and prednisone (R-CHOP), with a follow-up positron emission tomography (PET) scan confirming a complete response.

Highlights:

- It is important to ensure proper chemotherapy catheter placement, educate patients on device care, and perform routine maintenance and surveillance imaging to detect early signs of mechanical issues.
- A physician must be vigilant for symptoms like chest pain, dizziness, or arrhythmias in patients with port-a-catheters. Use imaging and ECG to confirm catheter fracture or migration.
- It is critical to stabilize symptomatic patients, retrieve the fractured catheter via endovascular techniques, and address complications such as thrombus formation or vascular irritation.

For the past 10 weeks leading up to his oncology visit, the patient reported experiencing intermittent chest pressure and dizziness. Ten weeks earlier, he had presented to the emergency department with burning chest discomfort. A comprehensive workup at that time revealed a negative D-dimer and troponin, an unremarkable complete metabolic panel, and a complete blood count showing mild, stable macrocytic anemia. A chest radiograph confirmed the presence of a port-a-catheter and showed no evidence of an acute cardiopulmonary process. He was discharged without any further intervention.

In the subsequent weeks, the patient experienced episodes of intense chest pressure, lightheadedness, and flushing, particularly with exertion, though occasional symptoms also occurred at rest. These episodes, lasting 2–5 minutes, resolved spontaneously. During these episodes, he measured his blood pressure using a

home monitor, frequently noting systolic pressures exceeding 170 mmHg. Prior to this, his hypertension had been well-controlled with carvedilol, losartan, and amlodipine, which he was still taking.

Figure 1. CT (Computed Tomography) Scan of Chest with Contrast, Axial View with Red Arrow Showing Fragmented Port-a-catheter.
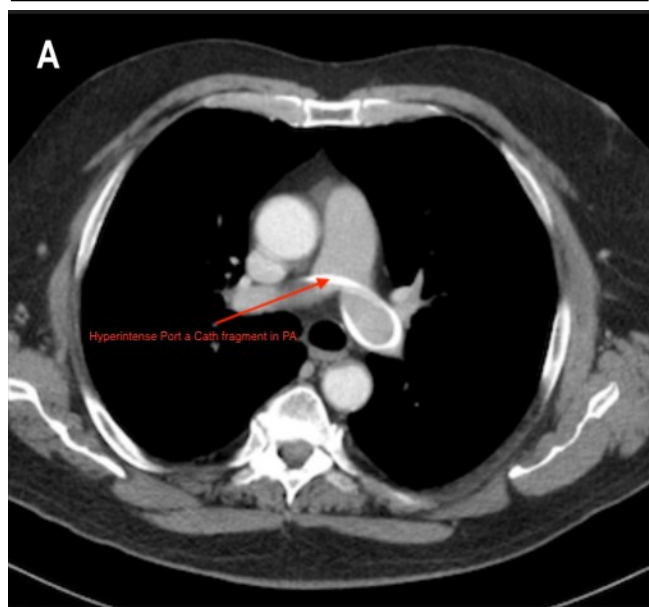
The patient followed up with his cardiologist three weeks after his emergency department visit and was prescribed an ambulatory cardiac monitor. A stress test was recommended if the episodes persisted. In the following weeks, the patient continued to experience chest pressure, dizziness, and flushing. During one such episode, he recorded a systolic blood pressure greater than 210 mmHg for which he called the emergency medical services, but the episode resolved before paramedics arrived, and he declined transport due to symptom resolution.

Despite these recurring episodes, the patient did not believe the symptoms were significant, given his prior negative emergency department workup. He presented to his oncology office for a routine CT scan to evaluate his follicular lymphoma. The CT scan revealed no changes in lymphadenopathy but incidentally identified a fragmented port-a-catheter located in the main pulmonary artery and the proximal right and left main pulmonary arteries *(Figure 1).*

The oncologist was immediately informed, the patient admitted, and an urgent referral to interventional radiology was made. The following day, the patient underwent successful retrieval of the Port-a-Cath fragment via percutaneous transcatheter retrieval using a snare device, performed under fluoroscopic guidance with femoral venous access. The procedure was well tolerated, and the patient suffered no adverse effects. Since the procedure, he has experienced no further episodes of chest pressure, dizziness, or flushing and has resumed his active lifestyle.

Discussion

The most common complications of chemotherapy catheters are infection, thrombosis, and mechanical malfunction (including fracture and embolization), with overall complication rates for Port-a-Caths in adults typically between 8% and 15%.[3] Catheter fracture and embolization are rare but recognized complications, most often related to the mechanical compression of the catheter between the clavicle and the first rib, typically when the catheter is inserted via the subclavian vein.[3,4] The risk is higher with percutaneous subclavian insertion compared to surgical cut-down.[4]

The most common cause of port-a-catheter fractures is device defects, followed by improper placement or access techniques, and patient-related factors. While many fractured port-a-catheters are asymptomatic, documented complications include arrhythmias, cardiac perforations, and thrombosis.[1,3-5] These findings underscore the importance of prompt retrieval of fractured catheters to prevent serious outcomes. Recent studies report a success rate of minimally invasive fractured catheter retrieval of approximately 96%.[6]

Although the exact cause of the fractured catheter in our patient remains uncertain, we suspect it resulted from a device defect. The catheter had functioned properly throughout the patient's chemotherapy cycles, and the patient denied any trauma or increased physical activity that could have contributed to the fracture. The resolution of chest pain and dizziness following the retrieval strongly suggests that the fractured catheter was the etiology of the symptoms.

The presence of the catheter fragment in the pulmonary artery likely caused direct endothelial irritation, leading to chest discomfort. Additionally, the coiled fragment may have increased pulmonary artery resistance, thereby elevating pulmonary artery pressure. Unlike carotid baroreceptors, pulmonary artery baroreceptors respond to increased pressure by enhancing sympathetic tone, resulting in vasoconstriction.[7] This mechanism likely played a role in the patient's recurrent hypertensive episodes, which manifested as chest pain and dizziness. Since the retrieval of the catheter fragment, the patient has remained symptom-free and has resumed his active lifestyle, including aerobic exercise.

This case highlights the rare but significant complication of port-a-catheter fracture with migration to the pulmonary artery. Although the incidence of such fractures is low, their potential to cause symptomatic complications underscores the need for prompt recognition and intervention. In this instance, the coiled catheter fragment in the pulmonary artery contributed to intermittent chest pain, dizziness, and hypertensive episodes through vascular endothelial irritation and increased pulmonary artery pressure. The successful removal of the fragment resolved the patient's symptoms, enabling him to return to his usual activities.

As a single-case, retrospective report, the findings are limited in generalizability and causal inference, with potential influences

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Case Report

Tepfenhart T., et al..

Port-a-Cath Fragmentation Causing Recurrent Chest Pressure and Dizziness in an Elderly
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from reporting bias. Additionally, the lack of long-term follow-up data restricts understanding of any delayed complications, emphasizing the need for larger, prospective studies. Nonetheless, this case provides valuable insight into an unusual clinical presentation and its associated risks. It emphasizes the importance of heightened clinical awareness of this complication in patients presenting with unexplained chest discomfort and hypertension, particularly those with a history of port-a-catheter placement. It also underscores the critical role of interventional radiology in safely managing these cases. Moving forward, efforts to reduce the risk of port-a-catheter complications should focus on ensuring device quality, employing meticulous placement techniques, and providing patient education on proper device care and potential warning signs.

Summary – Accelerating Translation

Title: Port-a-Cath Fragmentation Causing Recurrent Chest Pressure and Dizziness in an Elderly Man, A Case Study

Main Problem to Solve:

Some patients who undergo long-term treatments like chemotherapy receive a small medical device called a port-a-catheter, which helps deliver medications into the body. Although these devices are generally safe, they can sometimes break and fragments of the broken device may move into critical areas such as the lung's blood vessels, potentially causing chest pain, high blood pressure, or other serious complications.

Aim of the Study:

This study aimed to understand the issues that arise when a port-a-catheter fractures and a fragment migrates into the pulmonary artery. It also sought to demonstrate that a minimally invasive procedure can safely remove the fragment and resolve the patient's symptoms.

Methodology:

The study focused on a single patient who experienced chest pain, dizziness, and episodes of high blood pressure following a port-a-catheter fracture. Researchers reviewed the patient's medical history, symptoms, and diagnostic tests. They then hypothesized how the fragment in the lung's blood vessel might have led to these symptoms. Finally, they documented the process and outcome of a minimally invasive procedure performed by interventional radiology to remove the broken fragment.

Results:

The patient's symptoms, including chest discomfort and high blood pressure episodes, were strongly linked to the presence of the catheter fragment in the pulmonary artery. After the fragment was successfully removed using a minimally invasive technique, the patient experienced a complete resolution of symptoms and was able to return to normal daily activities. This outcome not only demonstrated the effectiveness of the removal procedure, but also highlighted the importance of early detection and intervention in such cases.

Conclusion:

This case study shows that although port-a-catheter fractures are rare, they can lead to significant health issues if the broken fragment migrates to critical areas like the pulmonary artery. The successful use of percutaneous transcatheter retrieval to retrieve the fragment provides evidence that prompt intervention can effectively resolve symptoms and prevent further complications. By understanding both the causes and the proper management of this complication, healthcare providers can better prevent, recognize, and treat similar cases in the future. This research emphasizes the need for careful device handling, proper placement techniques, and close monitoring of patients with port-a-catheters to ensure their safety and well-being..

References

1. Khalid SI, Maasarani S, Shanker RM, Wiegmann AL, Wu R, Skertich NJ, et al. Outcomes following port-a-catheter placement in the Medicare population. Surg Open Sci. 2021 Jan;3:39–43.

2. Li Y, Guo J, Zhang Y, Kong J. Intravascular treatment for abnormal catheter positioning of Port-a-cath system in the subclavian vein: a single-center study. J Interv Med. 2022 May;5(2):103–10.

3. Subramaniam A, Kim KH, Bryant SA, Kimball KJ, Huh WK, Straughn JM, et al. Incidence of mechanical malfunction in low-profile subcutaneous implantable venous access devices in patients receiving chemotherapy for gynecologic malignancies. Gynecol Oncol. 2011 Oct;123(1):54–7.

4. Debets JM, Wils JA, Schlangen JT. A rare complication of implanted central-venous access devices: catheter fracture and embolization. Support Care Cancer. 1995 Nov;3(6):432–4.

5. Lin C, Wu H, Chan D, Hsieh C, Huang M, Yu J. The mechanisms of failure of totally implantable central venous access system: analysis of 73 cases with fracture of catheter. Eur J Surg Oncol. 2010 Jan;36(1):100–3.

6. Li Y, Chen J, Li Z, Lu H, Ren K, Ren J, et al. Successful percutaneous transvenous retrieval of intravascular fractured port catheter: a single center experience. J Cardiothorac Surg. 2020 May 18;15(1).

7. Hainsworth R. Cardiovascular control from cardiac and pulmonary vascular receptors. Exp Physiol. 2013 Oct;99(2):312–9.

Case Report

Cite as

Tepfenhart T, Fort C, Twahirwa M, Jensen B. Port-a-Cath Fragmentation Causing Recurrent Chest Pressure and Dizziness in an Elderly Man: A Case Report. Int J Med Stud. 2025 Oct-Dec;13(3): 465-468.

A Reflective Case Study: Complex Presentation of a Veteran Patient with Cardiomyopathy and a History of Facial Reconstruction

Zainab AL-Rubaiy.[1] iD

The Experience

During a clinical shadowing placement in a family medicine clinic, I encountered a veteran patient whose seemingly routine gastrointestinal complaint concealed a complex history of cardiomyopathy and prior facial trauma sustained during military service. His initial denial of past treatment, coupled with trauma-related coping behaviors, demonstrated how unspoken histories can shape patient engagement and adherence. This case provided a valuable opportunity to reflect on trauma-informed care, the role of electronic health records in clarifying hidden histories, and the importance of integrating psychosocial awareness into clinical reasoning and medical education.
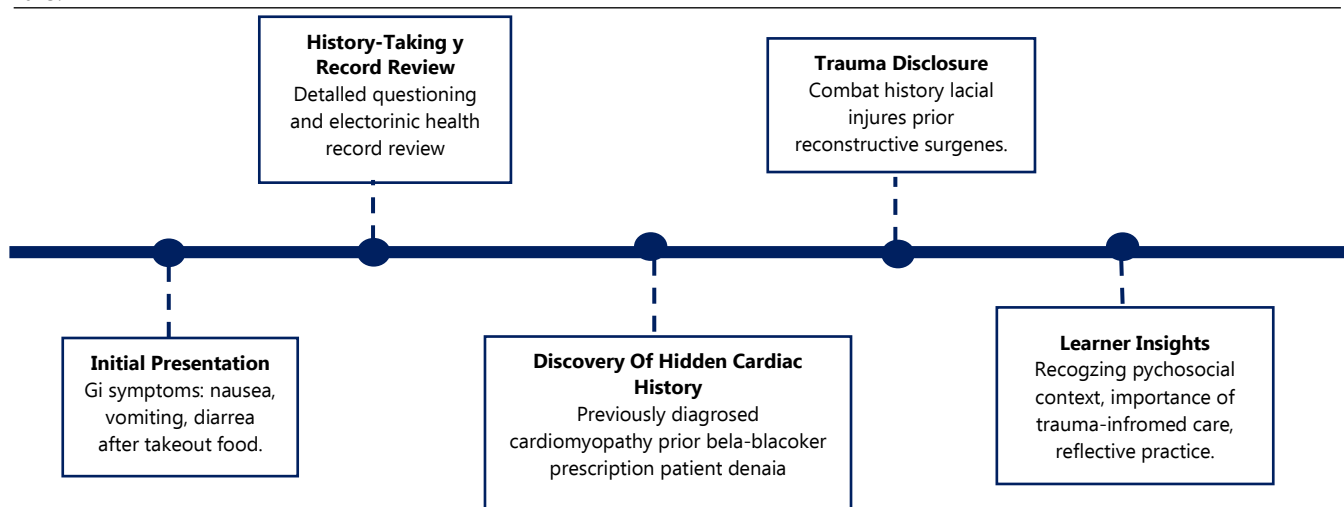
Reflection

This experience highlighted how hidden patient histories and trauma-related behaviors can profoundly influence clinical encounters. The veteran patient's denial of prior cardiology treatment and subtle coping mechanisms stemming from combat-related facial trauma illustrated how unspoken histories may obscure critical health information. Reflecting on this case, it became clear that understanding patients' psychological and social context is as important as recognizing biomedical signs, particularly when past trauma may affect adherence and engagement.

The encounter also emphasized the value of electronic health records in reconciling discrepancies between patient-reported and documented histories, providing a more complete clinical picture. Integrating trauma-informed care principles—such as recognizing avoidance behaviors, building trust, and avoiding re-traumatization—proved essential in understanding the patient's perspective. For medical students, this case reinforces the importance of curiosity, empathy, and reflective practice in bridging clinical knowledge with human experience, preparing future clinicians to deliver patient-centered and context-sensitive care.

Figure 1. Timeline of Clinical Events and Medical Interventions in a Veteran Patient with Cardiomyopathy and Facial Reconstruction, UAE, 2025.

History-Taking y Record Review
Detailed questioning and electorinic health record review

Trauma Disclosure
Combat history lacial injures prior reconstructive surgenes.

Initial Presentation
Gi symptoms: nausea, vomiting, diarrea after takeout food.

Discovery Of Hidden Cardiac History
Previously diagrosed cardiomyopathy prior bela-blacoker prescription patient denaia

Learner Insights
Recogzing pychosocial context, importance of trauma-infromed care, reflective practice.

1 Second-year Medical Student. University of Sharjah, Sharjah, United Arab Emirates.

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Experience

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Figure 2. Conceptual Framework Linking Trauma History, Psychological Defenses, and Trauma-Informed Care to Educational Lessons, UAE, 2025.
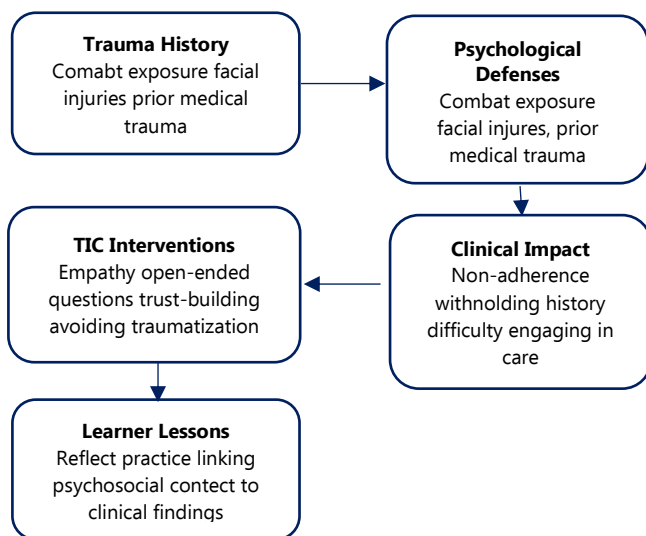
Learning Points

- Trauma history may present through denial, avoidance, or non-adherence to treatment.

- Electronic health records are invaluable for resolving discrepancies in patient-reported histories.

- Facial and combat-related trauma can have long-term psychological and behavioral effects.

- Trauma-informed care improves communication, engagement, and trust with vulnerable patients.

- Reflective practice enables medical students to integrate psychosocial context into clinical reasoning.

- Experiences with complex patients, such as veterans, provide lessons transferable across diverse healthcare settings.

Summary – Accelerating Translation

العنوان:
دراسة حالة تأملية: عرض معقد لمريض من المحاربين القدامى يعاني من اعتلال عضلة القلب وتاريخ من جراحة ترميم الوجه

المشكلة الرئيسية:
غالبًا ما يقدم المحاربون القدامى الذين لديهم تاريخ من الصدمات القتالية تاريخًا طبيًا معقدًا أو مخفيًا. في هذه الحالة، بدا شكوى المريض الأولية بسيطة، لكن حالته الصحية وتاريخ الصدمات النفسية جعلت فهم وضعه الصحي تحديًا.

هدف الدراسة:
تهدف هذه الدراسة إلى توضيح كيف يمكن للصدمات النفسية، والإنكار، والتاريخ الطبي المخفي أن تؤثر على اللقاءات الطبية، وتسليط الضوء على أهمية الرعاية المبنية على معرفة الصدمات والتأمل في الممارسة الطبية في تعليم الطلاب.

المنهجية:
تعتمد هذه الدراسة على سرد تأملي لتجربة ظلية سريرية في عيادة الطب الأسري. لاحظت الطالبة المحارب القديم، وراجعت سجلاته الصحية الإلكترونية تحت إشراف الطبيب المشرف، وسجلت التناقضات بين ما أبلغه المريض وما هو موثق في سجلاته. ركز التأمل على الجوانب السريرية والنفسية والتعليمية لهذا اللقاء.

النتائج:
بدأ المريض بعرض أعراض معدية معوية، لكن المراجعة التفصيلية كشفت عن تاريخ من اعتلال عضلة القلب، وتوقف عن تناول الأدوية القلبية، وإصابات وجهية سابقة تطلبت جراحة ترميمية. أظهر إنكار المريض لعلاجه السابق وآليات التكيف النفسية الخفية كيف أن تؤثر الصدمات على سلوك المريض والالتزام بالعلاج، والإفصاح عن التاريخ الطبي. أبرز اللقاء أيضًا أهمية سجلات المرضى الإلكترونية في توضيح التاريخ الطبي، وقيمة تعليمية لملاحظة ممارسات الرعاية المبنية على معرفة الصدمات.

الخلاصة:
توضح هذه الحالة أن اللقاءات الطبية تتشكل ليس فقط من الأعراض الظاهرة، بل أيضًا من تجارب المرضى السابقة والدفاعات النفسية. بالنسبة لطلاب الطب، الدروس الرئيسية تشمل أهمية أخذ التاريخ الطبي بعناية، والوعي بسلوكيات مرتبطة بالصدمات النفسية، وفوائد الرعاية المبنية على معرفة الصدمات، وأهمية التأمل في الممارسة الطبية. فهم هذه العناصر يمكن أن يحسن تفاعل المرضى، والالتزام بالعلاج، والتفكير السريري، ويعد المهنيين الصحيين المستقبليين لتقديم رعاية حساسة وسياقية ومتعاطفة..

References

1. Yancy Yancy CW, Jessup M, Bozkurt B, Butler J, Casey DE Jr, Drazner MH, et al. 2013 ACCF/AHA guideline for the management of heart failure. J Am Coll Cardiol. 2013. Available from: https://www.acc.org/Latest-in-Cardiology/Journal-Scans/2013/06/06/16/29/2013-ACCF-AHA-Guideline-for-the-Management-of-Heart-Failure. Cited 2025 Aug 19.

2. Moser DK, Watkins JF. Conceptualizing self-care in heart failure: a life course model of patient characteristics. J Cardiovasc Nurs. 2008. Cited 2025 Aug 19.

3. Glaesmer H, Brähler E, Gündel H, Riedel-Heller SG. The association of traumatic experiences and posttraumatic stress disorder with physical morbidity in older age. Psychol Med. 2011. Cited 2025 Aug 19.

4. Lew TA, Walker JA, Wenke JC, Blackbourne LH, Hale RG. Characterization of craniomaxillofacial battle injuries sustained by United States service members in the current conflicts of Iraq and Afghanistan. J Oral Maxillofac Surg. 2010. Cited 2025 Aug 19.

5. Kaufman MR, Bell TM, Hunsberger JB, O'Rourke PP. Psychological effects of facial trauma: implications for acute care. J Trauma Nurs. 2013. Available from: https://journals.lww.com/jtraumanurs/Abstract/2013/05000/Psychological_Effects_of_Facial_Trauma__Implications.6.aspx. Cited 2025 Aug 19.

6. Seal KH, Bertenthal D, Miner CR, Sen S, Marmar C. Bringing the war back home: mental health disorders among 103,788 US veterans returning from Iraq and Afghanistan seen at Department of Veterans Affairs facilities. Arch Intern Med. 2007. Available from: https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/769661. Cited 2025 Aug 19.

7. Substance Abuse and Mental Health Services Administration. Trauma-informed care in behavioral health services. Treatment Improvement Protocol (TIP) Series 57. Rockville (MD): SAMHSA; 2014. Available from: https://store.samhsa.gov/product/TIP-57-Trauma-Informed-Care-in-Behavioral-Health-Services/SMA13-4801. Cited 2025 Aug 19.

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Experience

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8. DiMatteo MR. Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. Med Care. 2004. Cited 2025 Aug 19.

9. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington (VA): American Psychiatric Association; 2013. Available from: https://www.psychiatry.org/psychiatrists/practice/dsm. Cited 2025 Aug 19.

Cite as

Rubaiy Z.. A Reflective Case Study: Complex Presentation of a Veteran Patient with Cardiomyopathy and a History of Facial Reconstruction. Int J Med Stud. 2025 Oct-Dec;13(4): 469-471.

Retraction

"Frequency Rhythmic Electrical Modulated System (FREMS) and its Effect on the Treatment of Painful Diabetic Peripheral Neuropathy: A Systematic Review and Meta-analysis"

Published in:
https://doi.org/10.5195/ijms.2024.2849
International Journal of Medical Students (IJMS), Volume 12, Supplement S337, 2025
Retraction issued by: Editorial Board, International Journal of Medical Students
Date of Retraction: December 3, 2025.

Retraction Notice
This notice retracts the abstract "Frequency Rhythmic Electrical Modulated System (FREMS) and its Effect on the Treatment of Painful Diabetic Peripheral Neuropathy: A Systematic Review and Meta-analysis", published in the International Journal of Medical Students (IJMS), Volume 12, Supplement S337, 2025.

After publication, the journal received:
1. A formal authorship dispute submitted to the IJMS indicating that several contributors were omitted from the published author list.

– According to COPE guidelines,[1] authorship disputes do not in themselves justify retraction when the validity of the work is not in question, but they may warrant a correction if documentation supports an authorship change.

2. A written request from the first author, Dr. Khaled Moghib, requesting withdrawal of the abstract due to ethical concerns regarding authorship recognition.

In his communication to the journal, Dr. Moghib stated:
"In the interest of ethical standards and proper authorship recognition, I kindly request the withdrawal of the published abstract."

Given that:
– the primary (first) author does not wish the work to remain published,
– the authorship dispute cannot be resolved through correction because the journal cannot verify the full authorship contributions with certainty, and

– COPE guidelines allow editors to retract a publication when authorship cannot be verified or when there are serious concerns about accountability for the work.[1]

The Editor-in-Chief and the IJMS Editorial Board have concluded that the most transparent and ethically appropriate action is retraction.

This retraction is issued to maintain accuracy and integrity of the scholarly record, consistent with COPE guidance stating that the purpose of retraction is to correct the literature—not to punish authors.[1]

The authors were notified of this decision prior to the publication of this notice.

The original abstract will remain accessible with a RETRACTED watermark and linked to this notice, following COPE and NISO CREC transparency standards.

Category of Retraction:
Retraction (authorship-related; inability to verify authorship accountability)

Reason for Retraction:
Unresolved authorship dispute and inability to verify proper authorship contributions, following a withdrawal request from the first author.

Issued by:
Editorial Board
International Journal of Medical Students (IJMS)

References

1. Committee on Publication Ethics, COPE Council. COPE Retraction guidelines — English. Version 3. Eastleigh (UK): Committee on Publication Ethics; 2025. 17 p. Available from: https://doi.org/10.24318/cope.2019.1.4