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Introduction

The World Journal of Medical Education and Research (WJMER) (ISSN 2052-1715) is an online publication of the Doctors Academy Group of Educational Establishments. Published on a quarterly basis, the aim of the journal is to promote academia and research amongst members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from around the world. The principal objective of this journal is to encourage the aforementioned, from developing countries in particular, to publish their work. The journal intends to promote the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting edge technology and those who need to innovate within their resource constraints. It is our hope that this will help to develop medical knowledge and to provide optimal clinical care in different settings. We envisage an incessant stream of information flowing along the channels that WJMER will create and that a surfeit of ideas will be gleaned from this process. We look forward to sharing these experiences with our readers in our editions. We are honoured to welcome you to WJMER.

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A WELCOME MESSAGE FROM THE EDITORS

Dear Reader,

It is our great pleasure to present the thirty-second edition of the World Journal of Medical Education and Research (WJMER). This issue brings together a diverse collection of scholarly articles that reflect current innovations, challenges, and opportunities in medical education, health sciences, and public health across global contexts. The contributions highlight the evolving nature of healthcare education, with a particular emphasis on learner development, equity, pedagogy, and improvement at a systems level.

The opening article by Alarar et al. evaluates the effectiveness of an online scientific research methodology course for undergraduate students at Syrian universities. Using pre- and post-course assessments, the authors demonstrate significant improvements in students' research knowledge and skills, underscoring the value of structured e-learning approaches in strengthening research capacity, particularly in crisis-affected and resource-limited settings.

In the following article, Ponce-Garcia et al. explore microaggressions in medical education and reframe them as cumulative, identity-based trauma rather than isolated interpersonal incidents. Drawing on interdisciplinary evidence, the paper highlights the biological, psychological, and educational consequences of chronic identity-based stress and calls for trauma-informed institutional reforms to foster inclusive and supportive learning environments.

The next study by Nojoum et al. examines Iraqi medical students' perceptions of undergraduate breast curricula during the COVID-19 pandemic. Through qualitative interviews, the authors identify key themes related to e-learning, gaps in breast disease education, and barriers to clinical examination. The findings reveal widespread dissatisfaction with current teaching approaches while highlighting structural challenges that were exacerbated by the pandemic.

Farooq et al. investigate the relationship between emotional intelligence and academic performance amongst undergraduate medical students in Pakistan. The study demonstrates a significant positive correlation between emotional intelligence and academic success, suggesting that emotional competencies may play an important role in student performance, stress management, and motivation within demanding medical programmes.

This issue also includes a narrative review by Pratham and Bhalekar on the therapeutic potential of natural compounds in neurotransmitter-related diseases such as Parkinson's and Alzheimer's disease. The authors discuss emerging evidence on compounds such as curcumin and flavonoids, highlighting their neuroprotective and anti-inflammatory properties while emphasising the need for further research to translate these findings into effective clinical applications.

Singha and Majumder focus on medical education for community health workers. The paper synthesises evidence on educational strategies that enhance competencies, motivation, and public health outcomes, advocating for competency-based, digitally-supported, and rights-based approaches to professional development as a foundation for equitable health systems.

The effectiveness of integrative case-based learning and case seminar approaches in teaching pathology laboratory concepts to PharmD students is examined by Garalla and Burgeia in the next study. The findings indicate that active learning strategies significantly improve knowledge acquisition, critical thinking, and clinical preparedness compared to traditional teaching methods, reinforcing the value of learner-centred pedagogies.

In the subsequent article, Ayub Khan et al. assess alumni perceptions of a Master in Health Professions Education (MHPE) program in Pakistan. Using the RE-AIM framework, the study highlights perceived gains in teaching capacity, curriculum development, and leadership skills, while identifying areas for improvement in educational evaluation and mentorship to maximise programme impact across career stages.

The final article by John et al. explores the use of data analytics in improving health education outcomes, presenting a human-centred framework that integrates technology, pedagogy, ethics, and organisational capability. The paper offers practical recommendations for education leaders, demonstrating how analytics can enhance learner engagement, institutional decision-making, and community health literacy when implemented responsibly.

We sincerely hope that you find the articles in this edition educational, thought-provoking, and relevant to your academic and professional interests. Together, these contributions reflect WJMER's ongoing commitment to advancing scholarship that informs practice, promotes equity, and strengthens health education globally.

Ms Karen Au-Yeung
Associate Editor

Dr Rebecca Williams
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Evaluating the Effect of Online Research Methodology Course on Undergraduate Research Skills

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Abstract:

Background: Universities play a crucial role in advancing scientific research by fostering an environment that support researchers through their careers and ensures their continued success. Online education in scientific research methodology may hold significant value. This study aimed to evaluate the effectiveness of an online course "scientific research methodology" in improving the learning outcomes of undergraduate students at Syrian Universities.

Materials and Methods: The pilot study included 10 undergraduate students at Syrian Virtual University. An electronic content covering key topics in scientific research was developed, delivered, and explained to the participants via the Syrian Virtual University platform. Pre- and post-course tests were administered to assess the course's impact.

Results: Wilcoxon signed-rank test showed a significant improvment in students' overall test scores after completing the course (z = -2.81 P = 0.005), indicating the effectiveness of the course in enhancing knowledge and skills of participants.

Conclusion: The findings suggest that this online course can successfully improve undergraduate students' knowledge and skills in scientific research. The results hold valuable implications for learners, educators, and policymakers in designing effective e-learning environments to support education and resilience during crises.

Key Words:
Online Course; Scientific Research Methodology

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Introduction

Online learning has developed increasingly over the past few years, with a notable surge during COVID-19 pandemic when education institutions had to rely solely on distance education through online learning platforms[1].

In an online learning environment, it is essential to stimulate collaborative engagement, reduce feeling of isolation, and encourage deep learning[1].

As a form of distance learning, online learning has long been integrated into the American education system and has recently become the largest sector of distance education[2]. It involves using multimedia technologies and the Internet to improve educational quality by providing media access, distance collaboration, and support services[3].

The goal of e-training is to ensure that technology effectively contributes to developing individuals' skills and knowledge while supporting their career advancement[4]. E-training effectively addresses specific objectives such as identifying training needs, streamlining training delivery and

development, offering necessary support, enabling interaction between the trainer and trainees and providing continuous assessment via digital system[5].

Despite the extensive knowledge available online, many researchers lack fundamental skills to undertake research appropriately. As noted by Cattaneo and Chapman, 22% of scientific researchers experience difficulties initiating scientific research[6].

Researchers should have critical thinking skills and problem-solving skills, including the competencies to identify, define and analyse problems to develop interventions solutions[7].

Scientific analysis involves data processing using diagrams and statistical methods to examine differences and relationships among variables[7].

Communication skills are equally important for effectively summarizing and explaining research objectives, motivations, findings and conclusions, while tailoring messages to the audience's knowledge level[8].

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Scientific research skills, encompass various competencies that transform students into discoverer and an innovator rather than passive recipients these include observation, accurate citation, scientific writing, and summarization[9].

Such skills enable researchers to select appropriate research designs, locate information sources, formulate research problems, design experiments, and develop solutions[10].

This study, the first of its kind in the Syrian Arab Republic, was undertaken to assess the effectiveness of a newly developed online course in improving undergraduates' knowledge and skills related to scientific research methods.

Materials & Methods

This study was approved by the Ethical Approval Committee at the Syrian virtual university (number 90/0, date 19/1/2022). Scientific content was developed within the Medical Education master's program at the Syrian Virtual University, comprising seven educational units: The nature of scientific research, methodology, research skills, the role of the internet in scientific research, writing and publishing of scientific research, problem- solving challenges and constraints, problem formulation, and creative thinking skills[11,12]. The content was reviewed and modified under the supervision of a group of medical education program professors at the university after multiple discussion sessions. Subsequently, test questions covering the entire content were created.

All undergraduate students at Syrian Virtual University were invited via email to participate in the course, excluding those who had previously completed a course on scientific research skills. Twenty- five undergraduate students enrolled, but only ten were accepted.

The university administration created special user accounts for all participants on the SVU platform and invited them to take a pre-test on a scheduled date.

The course designer created the test, which included 50 questions divided across the seven course topics: the first topic had 7 questions, the second 6, the third 18, the fourth 4, the fifth 4, the sixth 4, and the seventh 7. The questions were a mix of multiple- choice and true/false formats. Each question was worth two points, making the total possible score 100 points. Students were allowed one minute per question, with a total time limit of 50 minutes. The pre-test link was sent to participants via email to complete the test and calculate their scores.

The course content was uploaded to the SVU platform as PowerPoint presentations and educational videos. The course consisted of 10 lectures each lasting between 40-60 minutes. Two lectures were scheduled weekly in the evenings to maximize student attendance and engagement. The entire course spanned five weeks.

The course designer delivered the lectures and facilitated a scientific forum for student- tutor discussions and questions.

Virtual classes were created for synchronous participation, and recorded lectures were uploaded afterward for asynchronous access.

Additionally, features such as lecture reminders and notifications were used to maintain student engagement throughout the course.

Upon completing the course, students completed a post-test consisting of the same questions and following the same criteria as the pre-test, administrated through a Google Form. Comparison pre- and post-test results allowed assessment of students' progress in knowledge and skills, thereby evaluating the course's effectiveness.

Statistical Analysis

The researcher utilized the Statistical Package for Social Sciences (SPSS) to analyze data related to assessing students' knowledge and skills acquired in scientific research methodology through the online course. This involved calculating the aggregate scores for each unit of the course, determining the mean value for each item within the units', and performing analysis.

The Wilcoxon Signed Ranks Test was used to examine differences in overall course performance before and after the online course:

Specifically, the Wilcoxon Signed Ranks Test was applied to compare student's pre-test and post-test results to evaluate the course's effectiveness in enhancing their knowledge and skills in scientific research methodology).

Results

Studying the differences at the level of each unit / before and after / applying the online course

Table 1 presents the post-test findings, indicating a clear range between minimum and maximum values across the assessed components. The mean scores demonstrate variability in learners performance, while the standard deviations reflect moderate dispersion within the data. These results suggest that performance levels were not uniform across domains, with certain areas showing more consistent attainment than others.

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Unit	Results of pre-test				Results of post-test			
	Minimum	Maximum	Std. Deviation	Mean	Minimum	Maximum	Std. Deviation	Mean
Nature of Scientific Research	4.00	14.00	3.24	7.60	10.00	14.00	1.75	11.80
Scientific Research Methodology	2.00	10.00	2.70	5.20	6.00	12.00	2.35	8.80
Scientific research skills	10.00	24.00	4.37	18.20	24.00	34.00	3.27	30.60
The role of the Internet in scientific research	4.00	8.00	1.75	6.20	2.00	8.00	1.93	5.20
Writing and publishing scientific research	2.00	8.00	1.70	5.00	2.00	8.00	1.99	6.20
Challenges and constraints of scientific research	2.00	4.00	1.03	2.80	4.00	8.00	1.75	5.80
Problem-solving, decision-making, and creative thinking skills	0.00	8.00	2.39	5.80	0.00	12.00	3.53	8.60

Table 1: The results of students in each unit of the course

The findings in *Table 2* suggest that the course was most effective in enhancing students understanding of the fundamental concepts and methodologies of scientific research, as well as their awareness of challenges and constraints in conducting research. However, the absence of significant improvement in units such as internet use, scientific writing and publishing, and problem-solving skills may indicate that these areas require more practical training, extended time, or supplementary resources to achieve measusrable progress.

In the units (nature of scientific research), (scientific research methodology), (scientific research skills) and (challenges and constraints to scientific research) the study found that *P*-value were less than 0.05 which is in favor of the post-test.

Table 2 presents the Wilcoxon Signed Ranks Test results for each unit of the course, showing the test statistic (Z) and the corresponding p-value. The results indicate statistically significant improvement (p < 0.05) in students' performance after the course in the "Scientific research methodology", "Scientific research skills" and "Challenges and constraints of scientific research" units.

This means students showed meaningful gains in knowledge and skills in these areas. However, for the units: the role of the Internet in scientific

Unit	Z	P-value
Nature of scientific research	-2.620-[b]	0.009
Scientific Research Methodology	-2.263-[b]	0.024
Scientific research skills	-2.810-[b]	0.005
The role of the Internet in scientific research	-1.508-[c]	0.132
Writing and publishing scientific research	-1.222-[b]	0.222
Challenges and constraints of scientific research	-2.392-[b]	0.017
Problem-solving, decision-making, and creative thinking skills	-1.550-[b]	0.121

Table 2: Wilcoxon functions and the significant function of the test

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research, writing and publishing scientific research, problem-solving, decision-making, and creative thinking skills. The p-values were greater than 0.05, indicating no statistically significant difference between pre- and post-test results. Thus, the course did not show measurable improvement in these specific topics based on this data.

Studying the differences at the total level of the course / before and after / applying for the online course

The differences between students' pre- test and post-test results after completing the online course were analyzed using the Wilcoxon Signed Ranks Test to evaluate the effectiveness of the course in improving their knowledge and skills in scientific research methodology.

According to **Table 3**, the test showed a Z value of -2.810 and a two-tailed P-value of 0.005 for the difference between post-test and pre-test scores. Since the P-value is less than 0.05, this indicates a statistically significant improvement in students' overall test scores after completing the course.

Discussion

This research aimed to evaluate the effectiveness of an online course on scientific research methodology in enhancing students' knowledge.

	Asymp. Sig. (2-tailed)	Z
Post-test score - Pre-test score	0.005	-2.810[b]

Table 3: *Difference between pre-test and post-test scores*

This course covers the basics of scientific research, characteristics of successful researchers, principles of topic selection, adherence to the scientific method, research steps, documentation standards, strategies for addressing challenges, and techniques for maximizing research benefits from them. Targeted at undergraduate students, the course allows learners to access the university's website at any time, enter the course, download lectures, and study at their own pace and convenience.

Students were trained to systematically write scientific research and to effectively utilize the Internet and electronic libraries to enrich their information. This course also emphasizes developing creative thinking and problem-solving skills.

While previous studies have addressed scientific research skills, few have focused on training courses specifically designed for new researchers' number of

publications that addressed the course for new researchers are limited. Consequently, many novice researchers often lack formal training in research skills and instead rely on prior experience rather than structured education[13]. This gap often leaves them unprepared to handle unexpected challenges arising from research questions and outcomes[14].

Statistically significant differences were found between pre- test and post-test scores, indicating that students substantially improved their knowledge and skills in scientific research methodology, after completing the online course. This confirms the course's effectiveness.

These findings align with previous research by Durmaz and Mutlu (2014), Seon and King (2000), Hueso-Montoro et al (2016), Isosomppi and Maunula (2016), all of which reported improvements in in students' research skills after similar interventions. For instance, Durmaz and Mutlu (2014), conducted a study with 43 Turkish university students divided into experimental (n = 23) and control (n = 20) groups. Their results demonstrated the course' success in enhancing scientific research skills and contributing to educational and research quality reforms[15].

Seon and King (2000), developed a course in the US, that included topics such as time management and stress reduction alongside research skills, leading to improved academic performance and research skills among participants[16].

Hueso-Montoro et al (2016) evaluated a course for health science students in Spain and found that 80% of participants showed significant gains in research skills and knowledge after completing the course[17].

Similarly, Isosomppi and Maunula (2016) reported improved performance among students at the Open University after a course integrating theoretical and practical training on dissertation writing and research methods[18].

The success of the current online course can be attributed to clear identification of training needs which guided the design of relevant objectives and content, ensuring the course and students' requirements.

The course content and delivery methods aligned closely with student needs, increasing demand, engagement, and skill consolidation.

The course provided psychological motivation by reinforcing students' confidence and fostering a competitive spirit to achieve high marks. Use of written materials and images catered to various learning styles, while interactive forums encouraged

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student participation and facilitated question-and-answer exchanges. The flexibility to review and download lectures at any time empowered students to reinforce their learning.

Easy access to learning materials and a user-friendly platform contributed to the course's success. Students were encouraged to explore scientific research topics independently via the Internet, motivating them to find quality resources and breaking the monotony of traditional classes, which enhanced attention and engagement.

It focused on practical skills and problem-solving more than just theoretical knowledge, supporting learners in applying what they learned.

Overall, this online course successfully addressed an important topic relevant to future researchers and provided a comprehensive, skill-based approach to scientific research training. However, this study included only undergraduate students at the SVU and the research should be followed up and compared with traditional education to include other universities.

Conclusion

The study aimed to evaluate the impact of an online course on enhancing students' knowledge of scientific research methodology. The course effectively contributed to the development of student' knowledge, skills and competencies in scientific research. Additionally, the study recommends that educators and stakeholders focus on strategies to improve course design and encourage students to be creative and innovative in scientific research, moving beyond traditional educational approaches.

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Cumulative Identity-Based Stress in Medical Education: The Trauma of Microaggressions

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Abstract:

Microaggressions in medical education are often perceived as minor interpersonal slights. Emerging research identifies them as cumulative, identity-based harms with biological, psychological, and educational consequences. This review synthesizes literature from psychology, education, and health sciences to position microaggressions as a form of chronic trauma that disproportionately affects learners with marginalized identities. Drawing on cumulative trauma theory, minority stress frameworks, and biomarker studies, we detail how repeated identity-based stress disrupts physiological regulation, undermines psychological well-being, and fractures professional development. We examine how hierarchical clinical learning environments and institutional silence leaves affected learners feeling unsupported. Trauma-informed models offer a comprehensive approach by addressing relational, structural, and cultural dimensions of harm. We recommend that healthcare education systems move beyond awareness toward structural redesign, including transparent reporting systems, trauma-informed faculty development, and accountability measures embedded in evaluation practices. Recognizing microaggressions as cumulative trauma is essential for creating educational environments where all learners can thrive.

Key Words:

Microaggressions; Cumulative Trauma; Identity-Based Stress; Trauma-Informed Education; Medical Education

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Introduction

In healthcare, trauma is often imagined as something dramatic. But some accumulate over time, slowly wearing on the individual. Microaggressions, brief and often subtle comments or actions that devalue, stereotype, or dismiss, are frequently minimized or overlooked. In clinical education settings, especially for those with marginalized identities, these experiences are common, persistent, and consequential.[1,2]

Microaggressions are patterns that shape how individuals are seen, heard, and treated. For racialized, gender-diverse, and other minoritized healthcare professionals, microaggressions influence feedback, affect relationships, and limit opportunities. Over time, they contribute to emotional fatigue, psychological stress, and the slow erosion of professional confidence.[3-5] Despite this, they are rarely treated as a form of trauma in medical training environments.[6,]

This review positions microaggressions as a form of cumulative trauma in medical education. Drawing on research from psychology, education, and physiology, we examine how these experiences affect individuals and the systems in which they train and conclude by making recommendations for trauma-informed and structurally responsive educational environments.

Conceptual Framework

Microaggressions are defined as subtle, often unintentional comments or behaviors that communicate hostile, derogatory, or negative messages to individuals based on their identity.[8] They often appear as slights, assumptions, or exclusions, especially in environments marked by hierarchy, time pressure, and evaluative stress. Though frequently dismissed as trivial or socially awkward moments, research suggests that microaggressions contribute to sustained psychological distress and structural marginalization when they occur repeatedly.[6,7,9]

Cumulative trauma theory and racial trauma frameworks offer a lens through which to understand this impact. These models emphasize the effects of repeated, identity-related harm, particularly in contexts where repair, recognition,

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or accountability is absent.[4,10] Trauma is shaped not only by the content of an experience but by its frequency, the inability to escape it, and the response—or lack of response—from others.[5,11] In medical training settings, these conditions are often met. Power differentials discourage response, institutional silence communicates indifference, and cultural norms around professionalism reward endurance rather than honesty.[7,12]

The concept of racial battle fatigue is useful in articulating how ongoing exposure to microaggressions results in both psychological and physiological depletion. Minoritized trainees are often required to suppress emotional reactions, manage internal conflict, and remain composed in the face of cumulative identity-based harm.[4,6] These patterns of vigilance and withdrawal mirror trauma responses, and they also contribute to burnout, disengagement, and attrition.[3,13]

Additionally, the minority stress model highlights how stigmatized identities are associated with chronic exposure to environmental stressors, even when those stressors are normalized within the institutional culture.[5] Research shows that the intersection of racial, gender, and sexual minority statuses intensifies this burden and amplifies the health and academic consequences.[3,5,13]

Some scholars in medical care education remain cautious about applying trauma frameworks to everyday interactions, out of concern that the term "trauma" may lose specificity. This concern is worth acknowledging. However, growing empirical evidence, including biomarker studies and repeated links to mental health symptoms, supports the argument that microaggressions meet the functional criteria for trauma, particularly in their cumulative form.[4,6,14]

Recognizing microaggressions as trauma also helps shift attention away from individual perception and toward structural accountability. The harm is about patterned experiences shaped by institutional policies, clinical culture, and power hierarchies that remain largely unexamined.[7,15] Reframing these dynamics is essential to building trauma-informed systems that do not just prepare individuals to survive, but that actively reduce the sources of harm.

Biological Consequences of Identity-Based Stressors
Chronic exposure to identity-based stressors has been shown to disrupt biological systems involved in stress regulation, including endocrine, immune, and autonomic nervous system pathways.[12,14] Biomarker data support these disruptions and provide measurable evidence of how microaggressions become embedded in the body.[16,17]

Multiple studies have found that individuals who report high levels of exposure to microaggressions or chronic discrimination often exhibit flattened diurnal cortisol slopes, which are commonly associated with allostatic load, chronic stress, and burnout.[12,16,17] These findings suggest that repeated identity-based stress interferes with the body's ability to regulate and recover from daily stressors.

Nam et al. used ecological momentary assessment methods to assess salivary cortisol and alpha-amylase in Black adults in real-world contexts.[14] Participants who reported real-time discrimination showed physiological changes across the day, including altered stress hormone levels that persisted beyond the specific incident. These findings align with the narratives of minoritized medical learners who describe heightened emotional vigilance and exhaustion following repeated incidents of subtle bias.[4,6]

Longitudinal work adds further support by showing that adolescents who experienced racial discrimination displayed altered hypothalamic-pituitary-adrenal (HPA) axis function in early adulthood.[12] The effects were especially pronounced among participants who lacked a strong racial or ethnic identity. When experienced early in life, these biological changes may become embedded in physiological response patterns that carry into academic and professional environments.[5,12]

These studies make clear that microaggressions have physiological consequences, not just emotional or cognitive ones. Their impact is often cumulative, operating through repeated disruptions to regulatory systems that affect sleep, concentration, decision-making, and emotional balance.[14,17] In medical education, where learners are constantly assessed and expected to perform under pressure, these changes may go unrecognized or misinterpreted as burnout, disengagement, or poor resilience.[3,7] The biological embedding of harm provides further justification for treating microaggressions as a form of trauma and for designing educational environments that reduce exposure to these stressors rather than placing the burden of endurance on the individual.[6,9]

Educational Consequences of Identity-Based Stressors
Medical education occurs within structured, hierarchical systems where power is unevenly distributed. These systems shape how microaggressions are experienced, whether they are addressed, and how they influence learning. While

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institutions often promote values such as neutrality, meritocracy, or professionalism, these ideals can obscure identity-based harm and reinforce silence when that harm occurs.[7,11] The result is that many learners internalize exclusionary experiences, not as policy failures, but as personal deficits.[2,4]

Clinical training environments amplify this effect. Students and residents rely on preceptors and supervisors for grades, letters of recommendation, and rotation evaluations. These relationships can deter trainees from speaking up about bias or mistreatment, particularly when incidents are subtle or coded.[1,9] In one study, a student described being repeatedly referred to as "articulate" in ways that made them feel both visible and othered. Although the comments were framed as compliments, the repetition and context left them feeling hyper-scrutinized and unsure how to respond.[2]

Institutional responses to reported microaggressions are frequently slow, non-specific, or filtered through legal and reputational concerns. Valdez et al. describe a case in which a physician of color's concerns were dismissed in favor of maintaining high patient satisfaction scores.[8] In that case, professionalism was narrowly interpreted to prioritize patient perceptions over equity and well-being. Lukes and Bangs argued that anti-discrimination law tends to rely on clear intent and overt harm, which are often absent in microaggression cases.[15] As a result, legal standards and internal reporting structures are poorly suited to address the cumulative effects of repeated, subtle acts of bias.

Research in academic medicine and health professions education consistently finds that microaggressions are associated with imposter syndrome, disengagement, and professional withdrawal.[3,5] These effects are compounded for students who hold intersecting marginalized identities. Becerra et al. found that students managing the combined weight of racism, economic insecurity, and institutional invisibility reported significant disruptions to their learning and future planning.[13] To address this, institutions must build accountability into evaluation criteria, supervisory roles, and curricular oversight. While intervention strategies are discussed in later sections, it is worth noting that systems change requires more than awareness. It requires redesigning the conditions that allow bias to remain invisible. When institutions fail to acknowledge the harm caused by microaggressions, they are contributing to a cycle of trauma that undermines the very goals of medical education.

Legal and Cultural Barriers

Efforts to address microaggressions in medical education are often limited by the structures designed to maintain institutional stability. Legal frameworks prohibit discrimination and harassment but rarely account for the subtle, cumulative nature of microaggressions.[7,15] Civil rights protections are typically triggered by intent, severity, or repetition that can be documented.[15] Many microaggressions do not meet these thresholds, despite their lasting psychological and professional consequences.[4,6]

Institutional policies often mirror these legal standards. Student and trainee handbooks may include bias reporting systems, but these processes are frequently routed through compliance offices or Human Resources structures with narrow mandates.[7,9] Reports are often evaluated as interpersonal misunderstandings or professionalism concerns, rather than as signs of systemic bias.[7,8]

Professional norms reinforce this dynamic. In clinical settings, learners are expected to be resilient, deferential, and composed.[1,5] Raising concerns about identity-based harm can be interpreted as overreacting, especially in environments where feedback is subjective and dependent on senior faculty.[5,9] These power dynamics place students in a double bind. To advocate for themselves risks being labeled unprofessional, while remaining silent leads to further internalization of harm.[4,6,7]

Gatekeepers such as clerkship directors, faculty evaluators, and program leadership play a central role in maintaining these norms.[7,9] Even when they believe bias has occurred, many express uncertainty about how to intervene without legal precedent or institutional backing.[5,15] As a result, silence often becomes the default institutional response.[2,7] Learners understand this dynamic and may choose not to report at all, fearing retaliation, reputational damage, or bureaucratic inaction.[8,9]

When legal protections and cultural norms fail to acknowledge microaggressions as legitimate forms of harm, institutions become complicit in their persistence.[7,11] The result is not simply bureaucratic inefficiency but structural.[4,6] Moving forward, institutions must develop responses that are not limited to documentation or compliance but grounded in care, equity, and collective responsibility.[8,18]

Interventions and Interruptions

Efforts to address microaggressions in medical education have increased in recent years, but many interventions remain limited in scope. Common approaches include one-time workshops,

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communication skills training, or implicit bias modules.[7,18] While these interventions may raise awareness, they are often insufficient to counter the cumulative impact of institutionalized microaggressions.[8,18] Most programs target learners and emphasize individual self-awareness, active listening, and interpersonal empathy.[18] Only a small subset focused on faculty development, clinical power dynamics, or institutional responsibility. Few programs incorporate trauma-informed principles or engaged intersectional frameworks, limiting their ability to address the complexity of real-world bias.[9,18] These limitations suggest that many interventions remain rooted in diversity training paradigms that are ill-equipped to address cumulative harm.[7,11] Lasting change requires a shift from individual behavior modification toward structural and relational accountability.[5,7]

Some programs have demonstrated more promising outcomes. Walker et al. developed the VITALS framework to help medical students identify and respond to microaggressions using specific, structured strategies.[19] The curriculum emphasized validation, inquiry, and collaborative problem-solving, while offering opportunities for practice and reflection. Participants reported improved confidence in responding to bias, stronger peer connection, and reduced isolation. These findings support the idea that relational safety and practice-based learning are critical components of intervention success.[7,19]

Govindraj et al. introduced the LIFT framework through a bystander simulation curriculum for internal medicine residents.[20] The program focused on de-escalation, boundary-setting, and navigating power dynamics in clinical scenarios. Residents who completed the training reported increased awareness of subtle bias and greater comfort addressing it in practice. These results underscore the value of applying intervention strategies within realistic clinical settings where learners must balance interpersonal diplomacy with advocacy.[9,20]

Essakow et al. designed a virtual experiential learning model for educators, combining role-play, observation, and guided feedback.[21] The training aimed to help faculty identify and address microaggressions in real-time, while modeling accountability for students. Participants described increased confidence and greater clarity on their role in shaping safe learning environments. This reflects a growing recognition that faculty intervention is essential to shifting institutional culture.[2,7]

Despite these gains, most interventions still operate in institutions without consistent infrastructure for follow-up, accountability, or policy.[8,18] Many programs are introduced as pilot efforts without long-term funding or integration into curricular frameworks.[18] Others frame microaggressions as communication breakdowns or individual misunderstandings, which can obscure their structural origins.[7,11] These framing choices risk recentering individual discomfort rather than systemic harm.[7,9]

Trauma-informed models focus on recognizing patterns of power, repetition, and vulnerability, rather than singular intent.[5,11] They emphasize the importance of predictable, transparent response systems and shared responsibility for harm reduction.[7,18] Interventions grounded in trauma frameworks can also support collective healing and institutional change, rather than place the burden solely on those most affected.[7,9]

Finally, interventions must address the unequal distribution of responsibility. Trainees are often expected to recognize and respond to microaggressions without guarantees of support or safety.[19,20] This imbalance becomes institutionalized when faculty, supervisors, and leadership are not equipped or held accountable.[2,7] For interventions to succeed, they must shift the center of responsibility from individuals to systems, and from awareness to meaningful action.[7,8,21]

Trama-Informed Medical Education
Creating trauma-informed medical education environments requires a shift in how institutions define harm, distribute responsibility, and structure accountability.[7,11] Microaggressions reflect and reinforce broader institutional dynamics, including hierarchies, inequities, and professional norms that shape how learners are evaluated, supported, and heard.[7,9,11] Addressing these dynamics requires systemic strategies grounded in trauma theory, equity frameworks, and institutional commitment.[5,7,18]

Trauma-informed systems are anchored in principles including safety, trust, transparency, peer support, and empowerment.[5,7,18] These principles provide a foundation for creating educational environments that recognize harm, reduce re-traumatization, and affirm the identities and experiences of learners.[5,18] In practice, this means designing systems that proactively prevent exclusion and create space for honest reflection, institutional response, and sustainable repair.[7,8]

Walker et al. integrated trauma-informed strategies into small-group learning by preparing facilitators to recognize signs of learner distress and create space for debriefing microaggressions.[19] Students reported

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increased confidence in navigating identity-related tension and described the sessions as more emotionally safe. Similarly, Govindraj et al. embedded bystander response skills into clinical simulations using role-play and debriefing.[20] Residents who completed the program reported increased awareness of microaggressions and greater comfort responding during clinical rounds These findings support the conclusion that trauma-informed interventions can be effectively implemented in authentic clinical training spaces.

Institutions should develop enforceable standards at the policy level rather than relying on broad diversity statements.[7,15] Reporting systems must be clearly communicated, confidential, and designed to reflect institutional hierarchies and learner vulnerability.[8,9] Accountability structures should include options such as bias review committees with learner representation, periodic report trends audits, and outcomes documentation, even when no formal investigation is pursued.[7-9] Transparency and documentation are key to rebuilding institutional trust.[7,8]

Many educators report uncertainty about recognizing and responding to microaggressions, especially in patient-facing or supervisory roles.[2,21] Trauma-informed faculty development should be longitudinal, interactive, and linked to teaching.[5,18,21] These programs should address bias in grading, feedback, and mentorship, all of which significantly influence learner outcomes.[3,6] When supported in these efforts, faculty report greater clarity in their role and improved confidence in addressing identity-related harm.[7,21]

Microaggressions and cumulative trauma should be discussed throughout professional identity formation, ethics, communication, and systems-based practice curricula.[4,7,11] Programs that address these topics explicitly reduce learner isolation and increase student engagement.[6,19] Students participating in trauma-informed curricula have reported increased self-efficacy, stronger identity development, and a greater sense of institutional care.[9,19]

Institutions should reconsider how professionalism is assessed and whose norms define appropriate behavior.[1,5] Assessments that value peer advocacy, equity engagement, and learning environment contributions signal to learners that institutional priorities align with stated commitments to inclusion and wellbeing.[2,7,19] Faculty evaluation tools can also be updated to reflect responsibility for responding to harm and contributing to culturally responsive.[18,21]

Recommendations

Institutions must move beyond episodic training and toward sustained, systemic transformation. This includes embedding concepts such as racial battle fatigue, minority stress, and identity-based trauma into curricula, faculty development, and clinical learning environments. Structured frameworks such as VITALS and LIFT can serve as practical tools to help learners recognize, respond to, and recover from microaggressions. However, they must be integrated across developmental stages and reinforced through evaluation systems that prioritize cultural responsiveness, advocacy, and structural competence.

Faculty and preceptors should be supported through longitudinal training programs grounded in trauma-informed pedagogy. These programs must include experiential learning and skills-based practice in navigating identity-based harm. Evaluation and promotion systems must also be redesigned to reward equity work and hold individuals accountable for upholding inclusive learning climates.

In clinical settings, identity-based harm should be treated as a patient safety risk rather than as a diversity initiative. All members of the healthcare team, including clerical, support, and administrative staff, should receive role-specific training in culturally responsive communication on a recurring basis. Microaggressions directed at patients undermine trust and the quality of care, while those exchanged among staff weaken psychological safety and team cohesion. Medical and nursing curricula should adopt trauma-informed approaches in debriefing practices, communication modules, and professionalism assessments. Inclusion must be modeled consistently by attending physicians, nursing leaders, and senior staff to ensure clear expectations across all roles.

Conclusion

Equity in medical education cannot be achieved through awareness alone. Institutions must adopt a trauma-informed, structurally accountable approach that prioritizes transparency, relational repair, and learner empowerment. Faculty should be prepared to recognize, interrupt, and prevent identity-based harm. Evaluation systems must be revised to reward inclusive practices and equity leadership. Reporting mechanisms should be visible, responsive, and grounded in a culture of care and follow-up. Learners, particularly those from underrepresented and global backgrounds, must be engaged as co-creators in the ongoing effort to improve policy, pedagogy, and institutional culture.

Meaningful transformation requires a shift from

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documentation to disruption and from symptom management to system redesign. When microaggressions are understood as cumulative trauma, and when institutions respond with clarity, consistency, and courage, medical education can begin to cultivate a culture of care where all learners are seen, supported, and empowered to succeed.

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Iraqi Medical Students' Perceptions Towards Undergraduate Breast Curricula During the COVID-19 Pandemic

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Abstract:

Purpose: In Iraq, breast cancer is a leading cause of death amongst females, with a mortality rate of 23%[1]. There is a gap in the literature regarding medical students' experience of breast disease teaching and study methods in the setting of low income countries. This project aims to assess the availability of educational resources about breast disease available to medical students; and assess the advantages and disadvantages of breast curriculum for Iraqi medical students.

Methods: A qualitative approach and semi-structured interview was utilised. A purposive sample was used, and students were invited to an interview on a virtual platform. Transcripts were analysed using methodology outlined by Braun and Clarke[2].

Results: The findings of the study illustrate three key themes in relation to medical students' perspectives of breast teaching in Iraq: eLearning in the midst of a pandemic, learning about breast disease, and barriers to breast examination.

Conclusion: Overall, there was a sense of dissatisfaction regarding teaching experience of breast. Nevertheless, there are some key underlying issues which were potentially exacerbated by the pandemic. It is important to address these issues due to the predominance of breast disease in this region[3].

Key Words:
Breast Cancer; COVID-19; Developing Country; Iraq

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Introduction

In Iraq, breast cancer is a leading cause of death amongst females, with a mortality rate of 23%[1]. Females in Iraq tend to present later than their western counterparts,[4] with up to 47% of women presenting with advanced disease[5]. Therefore, there is a need to address the issues of breast cancer awareness and training[1].

There are many challenges regarding medical education in Iraq, key issues identified by physicians include a need to change the culture of medical education, such as changes to teaching style, and increasing educational opportunities[6]. However, provision of adequate clinical case exposure, and limited resources are issues in this country[6]. Unfortunately, these issues have been further exacerbated by the COVID-19 pandemic, and has led to the closure of universities, and medical teaching has been suspended and replaced with online teaching[7].

A literature search on medical students' experiences of breast teaching in low-income countries illustrated that there was an insufficient level of knowledge surrounding breast disease[8,9]. In this way, there is a need to explore medical students' experience of learning about breast disease. There is a gap in the literature regarding medical students' experience of breast disease teaching and study methods in the setting of low or low-middle income countries. This is a critical area of inquiry, particularly due to the changes implemented out of necessity during the COVID-19 pandemic, such as online learnin[7]. This project aims to assess the availability of online resources about breast disease; and assess the advantages, challenges, and areas of improvement for the breast curriculum for Iraqi medical students.

Materials and Methods
Data Collection

A pro forma for the interview was developed as shown in **Table 1**. Participants were invited to discuss various aspects of breast teaching; guided by the Royal College of Surgeons undergraduate curriculum for breast disease[10]. All participants were interviewed in a private room on a virtual platform. Interviews lasted 18-46 minutes. Respondents all answered all of the researchers' questions.

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Proforma
1. Breast Teaching Discuss resources/study methods/teaching methods used for each outcome by the student and by the university: 1.   Breast Examination 2.   Breast basic sciences including Anatomy & Genetics 3.   Breast Investigations 4.   Benign Breast Conditions 5.   Management of Breast cancer 6.   Breast History-taking 7.   Exposure to breast surgery/medicine/pathology/MDT in clinical practice 2. E-learning Impact of the COVID-19 pandemic Perceived/current role of e-learning in relation to medical education Applicability of eLearning in medical education Pros & cons of eLearning in medical education?

Table 1: Proforma

Sample

A purposive sample was used. Boundaries informed appropriate selection criteria, this included: Senior medical students attending a medical school in Iraq. Invitations to participate were distributed via word of mouth, and interested participants contacted the researcher via email or telephone (n=15). Information leaflets regarding the study were distributed, and any queries were discussed via email or telephone. A convenient time and virtual platform were arranged for each participant. All participants gave written, informed consent. Interviews were conducted by one of the research team (MN). The interviewer had no previous or ongoing relationship with the people they interviewed.

Data Analysis

Transcripts were analysed using methodology outlined by Braun and Clarke [2]. Data was analysed using primary and secondary cycle methodology [11].

Results

Of the students invited, ten completed the interview. See *Table 2*.

Name (Pseudonym)	University	Gender	Stage
Najla	University Al-Iraqia	Female	6th
Zeinab	University of Wasit	Female	6th
Souad	University of Baghdad	Female	6th
Rahaf	University Al-Mustansiriyah	Female	5th
Maryam	University of Wasit	Female	5th
Zakiya	University of Baghdad	Female	5th
Nassir	University of Baghdad	Male	6th
Qadr	University of Baghdad	Male	6th
Yahya	University Al Mustansiriyah	Male	6th
Hashim	University of Baghdad	Male	5th

Table 2: Data Sample

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The table below illustrates the overarching themes and descriptive codes used to analyse the transcribed data.

Themes	Descriptive codes
eLearning & the pandemic	Uncertainty Limited Clinical Exposure Significant Drawbacks of eLearning Potential Role of eLearning Preference for Active Learning
Learning about breast disease	Paternalism Lecture & textbooks based Passive learning Little Teaching Missing pieces Video-based resources Websites
Barriers to breast examination	Needs Improvement Limited experience Mannequin-based Teaching Gender Sensitivity Culture/family issues Distrust of Medical Students

Table 3: Themes and Descriptive Codes

eLearning and the Pandemic

The first theme that appeared from the study was the impact of the COVID-19 pandemic on students' education. The pandemic presented many challenges for senior students, particularly as they were approaching entering the workforce. One hundred percent of students reported that inability to experience clinical learning – including experiences such as patient communication, observing surgical operations, and seeing the management of medical cases had a negative impact on their studies. Fifty percent of the students interviewed reported that they had not met any patients with breast disease.

"I think that it's because of the pandemic most of the time we stayed at home and it was like e-learning and doctors would upload their lectures on YouTube and it was a self-study most of the time…We didn't see any patients the doctor said there were no patients that had breast problems at the time maybe that's why we didn't get to see patients and take history and examination"
Zakiya

Sixty percent of students reported that they felt a large degree of anxiety surrounding the COVID-19 pandemic and preparedness to enter the workforce. Of these students, there was an equal distribution between male and female gender.

"Actually because of the covid 19 situation I feel like I'm not prepared at all. I'm doing my best. But you know how it is, its covid and we take online classes… we don't know what will happen tomorrow, or if I go to, if I leave my home will I come back or not? This is the question. So, you don't have a lot of opportunities, being an Iraqi actually you don't have a lot of opportunities, you should like make your own path. Like you have to make your own path. Like if I was in their situation, I won't stay for one second in our country. Because today is stable but tomorrow you don't know, what will happen tomorrow."
Souad

Limitations of eLearning

Students unanimously reported that there were significant drawbacks in the utilisation of eLearning in medical education.

"I think it's not useful to us, we are medical students, we just study papers and that's it. We should go to see the patient and do the examination by ourselves, see operations with our eyes. And I think the system used now is useless. We are just memorising but not understanding. So, it's useless actually, useless and difficult at the same time."
Najla

Furthermore, 100% of participants reported a preference for active learning. The general definition

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of active learning is "any instructional method that engages students in the learning process. In short, active learning requires students to do meaningful learning activities and think about what they are doing". Medical students interviewed discussed the drawbacks of eLearning as primarily focused on the loss of active learning. Students expressed that patient interaction, simulated teaching, and teacher-interaction were better methods of learning about breast disease.

"It's important in theoretical subjects but clinically you need a patient in front of your eyes to feel it to examine it with your hands otherwise it will not become in your mind… We need to see them in clinical life and real life. Okay I'm studying that subject breast cancer and its features and how to investigate it, examine and so on but so as I said till now I don't see any patients with this case so it's difficult"
Yahya

Nonetheless, 90% of students expressed that there were benefits to eLearning, and that there was potentially a role for eLearning in medical education.

"..from the aspect of time we don't have to get up early and go to college, and in lectures while the doctor is explaining the student might miss stuff, and they don't catch it to write it down, so they don't get the whole information, but with eLearning if we miss something we can stop the recording and revise it. For theoretical stuff yes, the e-learning is so much better, and for us as medical student for theoretical stuff eLearning is better than in person"
Zeinab

Learning About Breast Disease

With regards to teaching and learning styles, all students reported that breast teaching was heavily based on lectures and textbooks. There was no literature on how undergraduate breast curriculum is taught in low-income settings. Most students expressed dissatisfaction with the level of teaching they received for Breast.

"(For Breast) 100 slides given in about 1-2 lectures only and the source they use they return to Bailey and Love Book of surgery… In our study we return to our surgery book Bailey and Love. It's our book, it is very popular here in Iraq and most of the college medical schools in Iraq we depend on it in surgery, so me and my colleagues we will return to Bailey and Love to study the breast in a better way."
Najla

All participants interviewed identified weak areas within the breast teaching curriculum. Firstly, 60% of students felt there was not enough breast teaching in their respective college curriculum. The gender divide was equal, with (n=3) females and males reporting that there should be more teaching for breast. 40% of students specifically expressed that they felt breast disease was an important topic within the Iraqi community, most students expressing this opinion were male (n=3).

"During the whole final year just one clinical session on the breast. It lasted about less than one hour. We only took one eLearning session for the breast, and I think it's not sufficient - I think we didn't learn the breast efficiently compared to how significant the breast issues are."
Qadr

An important area of discussion was factors that contribute to dissatisfaction with breast teaching. Firstly, 60% of students identified low resources, and large numbers of students as a reason contributing to limited teaching. Low resources identified included availability of simulated teaching mannequins, laboratory equipment, and private spaces to perform intimate examinations on patients.

Despite the barriers and issues medical students faced regarding breast teaching, many students displayed resourcefulness in overcoming the gaps in their learning. Seventy percent of students reported that they felt their curriculum was very self-directed, particularly in the advent of the COVID-19 pandemic. Ninety percent of students utilised online resources to supplement their learning and perceived missing pieces within the breast curriculum, this primarily included video-hosting websites and online Multiple-Choice Question (MCQ) banks. Other methods mentioned included spaced repetition, and peer learning. Fifty percent of students also reported going to clinical settings or seeking senior teaching out with formal hours to gain additional experience and learning. All students interviewed demonstrated the ability to identify and address their learning needs.

"One of our professors said that to be a good clinician you have to take history at least once every week, like you can't go a week without taking a history or doing a physical examination; so I try to stick to this advice. I double-masked and wore a face shield and just went to the hospital. That's the least I can do because it's important. I had my 3rd and 4th, and half of my 5th year, so why waste the skills I already have? I have to keep them."
Nassir

Barriers to Mastering Breast Examination

Eighty percent of students reported that breast examination was an area of concern within the breast curriculum. One hundred percent of male

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students reported that this was a key area for improvement, and 66.6% of female students reported the same sentiment. Students reported that teaching of breast examination skills was reliant on simulated learning using mannequins and medical models, and 80% of students interviewed had not performed breast examination on a real patient, this included both male (n=3) and female (n=4) students. The remainder of students had performed breast examination on a real patient once (n=2), and one student had performed breast examination twice (n=1). Eighty percent of students reported that skill-lab based teaching using mannequins to simulate real-life were the basis of breast examination teaching.

"As I tell you, now that I've completed my studies, I haven't examined a breast pathology as simple as fibroadenoma whatsoever, I didn't feel a breast lump last year or axillary lymph node or such pathology. So, if our doctors can help us to examine the patient that would be more helpful."
Qadr

Seventy percent of participants reported gender dynamics as a barrier to mastering breast examination. One hundred percent of male participants expressed this view.

"(Breast examination) teaching is sometimes difficult; you know we are in the Middle East so in the female clinical exam with females is sometimes very difficult… sometimes our doctors tell female students to do that (breast examination) we just look at them and sometimes the patient doesn't even accept for us to watch"
Hashim

Fifty percent of participants reported that distrust of medical students was a barrier to performing breast examination on patients.

Discussion
As a result of the COVID-19 pandemic medical schools across the world began to remove students from clinical environments as infection rates increased. Educators opted to move teaching online, as social distancing measures prohibited the gathering of medical students [12]. Previous studies in low-resource settings indicate that anxiety and uncertainty was prevalent in the medical student population. Students felt that inability to participate or learn actively from patient interaction was extremely challenging, as they felt that these experiences were beneficial for establishing competence [13]. These findings were echoed in the views of senior Iraqi medical students.

Earlier studies of the utilisation of distance learning

as an educational platform illustrates that students generally struggle with eLearning compared to in-person learning. Reasons for this include poor internet connection, limited communication opportunities and unfamiliarity with online study [14]. Indeed, this study illustrated that students preferred seeing patients in real time to further their learning and similar boundaries to benefitting from online learning were discussed.

Studies examining self-directed learning readiness in low-income settings illustrated that high readiness was more likely to be present in males compared to females. There was also a positive relationship between students that attended medical schools that implemented problem-based learning versus schools which encouraged rote learning [15]. Self-directed learning and the ability to persevere despite setbacks is a key skill for any medical professional, particularly as medicine is an ever-growing and ever-changing field [16]. In this way, it is a positive point that Iraqi medical students were able to be creative in their learning methods and take responsibility for their learning needs.

Cultural or religious beliefs may prevent learning opportunities for medical students, in particular male students. Furthermore, studies examining the effect of gender on learning clinical examination skills in the Arab world, found that patients of all sexes were more accepting of female students. In addition, tutors were more likely to select female students to perform intimate examinations. Conversely, male students did not feel encouraged or supported in conducting intimate examinations [17]. This may present a barrier for medical students learning to perform breast examination on a real patient.

As far as the researchers are aware, there is no good quality research on patient perspectives on the role of medical students in the setting of the developing world.

Improving Breast Teaching
Low resources following financial crises in Iraq have had a negative impact on medical education [6]. Moving towards a student-centred curriculum is a key priority for medical education in Iraq, and this can be achieved by introducing more clinical sessions, improving infrastructure, resources and facilities and increasing student-teacher interaction [18]. Senior medical students demonstrated a passion for medicine and were enthusiastic about improving teaching methods for upcoming generations of future doctors. This readiness to learn can be met by including breast clinics in surgical teaching blocks to increase student exposure to the breast speciality. Moreover, including a smaller number of

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students per teaching session would allow for more opportunities to learn and engage with patients and teachers. Another advantage of smaller groups is the likelihood of increasing patient readiness to consent to student examination. In addition to this, seniors need to take more responsibility with regards to ensuring students obtain enough experience of examining real patients. Senior supervised patient-student interactions are more likely to be acceptable to patients, although gender remains a barrier for breast examination.

Conclusions

The main findings of the study illustrate three key themes in relation to medical students' perspectives of breast teaching in Iraq: eLearning in the midst of a pandemic, learning about breast disease, and barriers to breast examination. Overall, there was a sense of dissatisfaction regarding teaching experience of breast, largely due to limitations imposed by the pandemic and sudden introduction of eLearning in the curriculum. Nevertheless, there are some key underlying issues which were potentially exacerbated by the pandemic. These included difficulties of limited resources, predominance of passive learning in the curriculum, and cultural barriers to learning breast examination. The authors recommend harnessing the enthusiasm and passion of the medical students to learn and improve learning by restructuring the inclusion of breast teaching into smaller groups for examination with good supervision and active learning opportunities.

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Relationship Between Emotional Intelligence and Academic Performance

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Abstract:

Background: Emotional intelligence promotes adaptive thinking, awareness of emotions' significance, and intellectual growth. Higher EI leads to better academic performance, as students manage stress, stay motivated, and learn effectively.

Objective: Our study intended to determine the relationship between emotional intelligence and academic performance in undergraduate medical students and correlate it with gender and academic year.

Methodology: A descriptive cross-sectional study was conducted at Rahbar Medical and Dental College, Lahore, Pakistan. 230 medical students from 1st year to final year were selected by convenient sampling and surveyed using already verified scales. Data examination included descriptive statistics. Ethical considerations such as informed consent and IRB approval were followed.

Results and Discussion: A study found that 33.9% of participants scored below average in emotional intelligence, while 64.8% fell within the average range. The Academic Performance Scale (APS) showed a distribution of students as failing, 2.2% as poor, 43% as moderate, 49% as good, and 4.8% as excellent. A Spearman's rank-order correlation analysis showed a significant positive correlation between emotional intelligence and academic performance (APS) ρ (230) = .361, $p < .001$. An ordinal logistic regression showed that students with below-average emotional intelligence had lower chances of achieving higher academic performance compared to those with above-average EI. The results indicated that students with below-average emotional intelligence (EI) had significantly lower chances of achieving higher academic performance compared to those with above-average EI, with a coefficient of $\beta = -5.91$, a standard error of SE = 1.02, and a p-value of $p < .001$, yielding an odds ratio (OR) of 0.0027.

Conclusion: The study reveals a significant and moderately positive correlation between emotional intelligence (EI) and academic performance, with higher EI scores indicating a potential strategy for enhancing academic success.

Key Words:

Emotional Intelligence; Medical Student; Academic Performance

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Introduction

Perceiving, controlling, and regulating emotions encourages adaptive thinking and an awareness of the significance and ramifications of emotions. This type of behavior is known as emotional intelligence. A person can grow intellectually, socially, and emotionally through this process of control, regulation, and adaptation.[1] The ability to accurately reason about emotions and to use emotions and emotional knowledge to improve thinking are both components of emotional intelligence (EI).[2] Since emotions are essential to human cognition, there is a substantial correlation between academic achievement and emotional intelligence.[3] As an essential defense against academic failure, these skills should therefore be linked to academic success in line with the theories of educational psychology and learning.[4] This relationship is sturdy,

according to learning and teaching psychology, evolutionary development, and the school of positive psychology, since emotional intelligence (EI) promotes mental processes, focus, and self-control under pressure.[5] There is disagreement among educators over the relative importance of emotional intelligence (EI) and intelligence quotient (IQ) in influencing academic achievement. Since working memory makes up a percentage of IQ.[6] High-quality projects have been linked to improved academic achievement by developing students' emotional intelligence skills.[7] Emotional intelligence might be important as Higher EQ is found in persistent students.[8] In a study of Malaysian students, it was discovered that students with high emotional intelligence performed better academically and had superior emotional awareness, management, and relational skills.[9] According to an Ethiopian study,

several variables, including age, family educational attainment, substance usage, and career development goals, are linked to emotional intelligence.[10] A study among Saudi students revealed that higher emotional intelligence improves academic performance.[11] According to a study conducted at KUST, Pakistan, undergraduate students showed emotional intelligence in several subdimensions, such as empathy, integrity, self-awareness, and self-development. Academic achievement was satisfactory, and there was a significant positive correlation between academic success and emotional intelligence, especially when it came to cumulative grade point averages.[12] Parker et al. concluded that students who received 80% or higher on their coursework were deemed academically successful, while those who received 59% or lower were deemed academically poor. They observed that students with higher emotional intelligence also performed better academically. They observed the groups' differences and concluded that the primary one was stress management. Students who excelled academically had more focus, which is a crucial component of stress management. Additionally, they discovered that intrapersonal and adaptability skills differed less.[13]

According to the literature, emotional intelligence has a significant role in better academic achievement. There isn't much research on this association among medical students. We set out to find out if any beneficial relationships among medical students would support the idea that their program should include emotional intelligence sessions to assist them in doing better academically.

Objective
The objective is to explore the connection between emotional intelligence and academic performance and to examine how these factors may vary by gender and academic year.

Methodology
Study Location and Period: The study was conducted at Rahbar Medical and Dental College in Lahore, a private medical institution, over a period of months, from to 2025.

Study Type and Sampling Process: A descriptive cross-sectional study utilizing data gathered through a random sampling method.

Sample Size: Sample size is calculated based on the following assumptions.
- Finite Sample Size = SS/ [1 + {(SS − 1)/Pop}]
- Confidence interval: 95%
- The margin of error: 5%
- Total population: 507
- Population size: 207

- Sample size calculated: 219
- Targeted 230 to account for incomplete forms.

Study Tool:
(1) Wong and Law Emotional Intelligence Scale (WLEIS)14
    Cronbach alpha = 0.9014
(2) Academic Performance scale15
    Cronbach alpha = 0.8515

Inclusion Criteria: Participants included both male and female undergraduate medical students from all academic years.
Exclusion Criteria: Participants who refused to provide consent, were absent, or had a chronic disease were excluded.
Details of Questionnaire: The questionnaire consisted of three parts:

Part 1: Demographic Information. This section captured the demographic details of the participants.

Part 2: Wong and Law Emotional Intelligence Scale (WLEIS). This part includes a 16-item measure of emotional intelligence rated on a 7-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree."

It assesses four dimensions:
1. Self-Emotion Appraisal
2. Regulation of Emotions
3. Use of Emotion
4. Others' Emotion Appraisal

Part 3: Academic Performance Scale (APS). This section contains eight items rated on a 5-point Likert scale, also ranging from "Strongly Disagree" to "Strongly Agree."

Ethical Issues: Anonymity of participants was maintained. Informed consent was implied through the consent form. Participants were informed of their right to refuse participation.

Results
Out of a total of 230 participants, 108 (47%) were female, while 122 (53%) were male. The distribution by year of study was as follows: 41 participants from the first year, 50 from the second year, 40 from the third year, 37 from the fourth year, and 62 from the fifth year.

In terms of emotional intelligence, 33.9% of participants scored below average, 64.8% fell within the average range, and only 1.3% demonstrated above-average emotional intelligence. Regarding academic performance, as measured by the Academic Performance Scale (APS), the distribution was as follows: 0.4% of students were classified as

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failing, 2.2% as poor, 43% as moderate, 49% as good, and 4.8% as excellent.

A Spearman's rank-order correlation analysis was conducted to examine the relationship between emotional intelligence, measured using the Wong and Law Emotional Intelligence Scale (WLEIS), and academic performance scores (APS).

A statistically significant positive correlation was found between emotional intelligence (EI) and

academic performance (APS), ρ (230) = .361, p <.001. This suggests that higher emotional intelligence is associated with better academic performance.

To explore this relationship further, we conducted an ordinal logistic regression by categorizing academic performance into three levels: Low, Moderate, and High. We also categorized emotional intelligence into Below Average, Average, and Above Average.

Analysis Type	Test/Metric	Value	Interpretation
Correlation Analysis	Spearman's rho	0.361**	Moderate positive correlation between EI and academic performance
	Significance (2-tailed)	p = 0.0001*	Statistically significant at the 0.01 level
	Sample Size (N)	230	

Table 1: Spearman's rank-order correlation linking Emotional Intelligence (WLEIS) and Academic Performance (APS)

Predictor (EI Level)	Coefficient (β)	Standard Error	p-value	Odds Ratio (e^β)	95% CI for OR	Interpretation
Below Average EI	-5.909	1.021	< .001	0.0027	[0.0004, 0.017]	Strongly reduced odds of higher APS
Average EI	-5.212	0.984	< .001	0.0054	[0.0009, 0.031]	Moderately reduced odds of higher APS
Above Average EI	Reference	—	—	1.00	—	Baseline category

Model Fit & Assumptions	Value	Interpretation
Model Type Model Chi-Square (df = 2)	Partial Proportional Odds Model 77.92	Used due to violation of proportional odds assumption Model significantly predicts APS (p<.001)
Nagelkerke Pseudo R²	0.336	Model explains ~34% of variance in APS
Proportional Odds Assumption (Brant Test) Zero Cell Adjustment Sample Size (N)	Violated (p<.05) Categories merged 230	Justified use of flexible modeling approach Addressed sparse data in contingency table Adequate for ordinal logistic regression.

Table 2: Ordinal Logistic Regression Results Linking Emotional Intelligence (WLEIS) to Academic Performance

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The partial proportional odds model was employed because the proportional odds assumption was violated (Brant Test p < .05). The model was found to be statistically significant, with $\chi^2(2) = 77.92$, p < .001, and it accounted for approximately 34% of the variance in academic performance, as indicated by a Nagelkerke R^2 of 0.336.

The results indicated that students with below-average emotional intelligence (EI) had significantly lower chances of achieving higher academic performance compared to those with above-average EI, with a coefficient of $\beta = -5.91$, a standard error of SE = 1.02, and a p-value of p < .001, yielding an odds ratio (OR) of 0.0027. Similarly, students with average EI also faced reduced odds of attaining higher academic performance, as shown by a coefficient of $\beta = -5.21$, SE = 0.98, p < .001, and an odds ratio of OR = 0.0054. The reference group for this analysis consisted of students with above-average EI.

It is important to note that approximately 11.1% of the data cells had zero frequencies, which may affect the reliability of the interpretation.

Discussion

The Academic Performance Scale (APS) was utilized to evaluate students' academic performance in educational settings, with variations depending on the institution. This study explored the relationship between scores on the Weighted Learning Emotional Intelligence Scale (WLEIS) and the APS, suggesting that emotional intelligence may influence academic performance. The APS evaluates student performance through various components, including grades, standardized test scores, attendance, behavior, participation, assignments, and projects. The quality and completion of homework and research projects were also assessed.

In our study, we had a total of 230 participants, consisting of 122 males (53%) and 108 females (47%). The participants were distributed across different academic years as follows: 41 from the 1st year, 50 from the 2nd year, 40 from the 3rd year, 37 from the 4th year, and 62 from the 5th year.

A Spearman's rank-order correlation was used to assess the relationship between emotional intelligence (EI), measured by the Wong and Law Emotional Intelligence Scale (WLEIS), and academic performance scores (APS). The analysis revealed a significant moderate positive correlation, ρ (230) = .361, p < .001, indicating that higher EI is associated with better academic outcomes.

An ordinal logistic regression further examined this relationship, categorizing academic performance as Low, Moderate, and High, and emotional intelligence as Below Average, Average, and Above Average. The model was statistically significant, suggesting that EI accounts for approximately 34% of the variance in academic performance.

Results indicated that students with below-average EI had significantly lower odds of achieving higher academic performance compared to those with above-average EI ($\beta = -5.91$, SE = 1.02, p < .001, OR = 0.0027). Similarly, students with average EI also exhibited reduced odds of higher performance ($\beta = -5.21$, SE = 0.98, p < .001, OR = 0.0054).

The connection between the Academic

WELIS VS APS
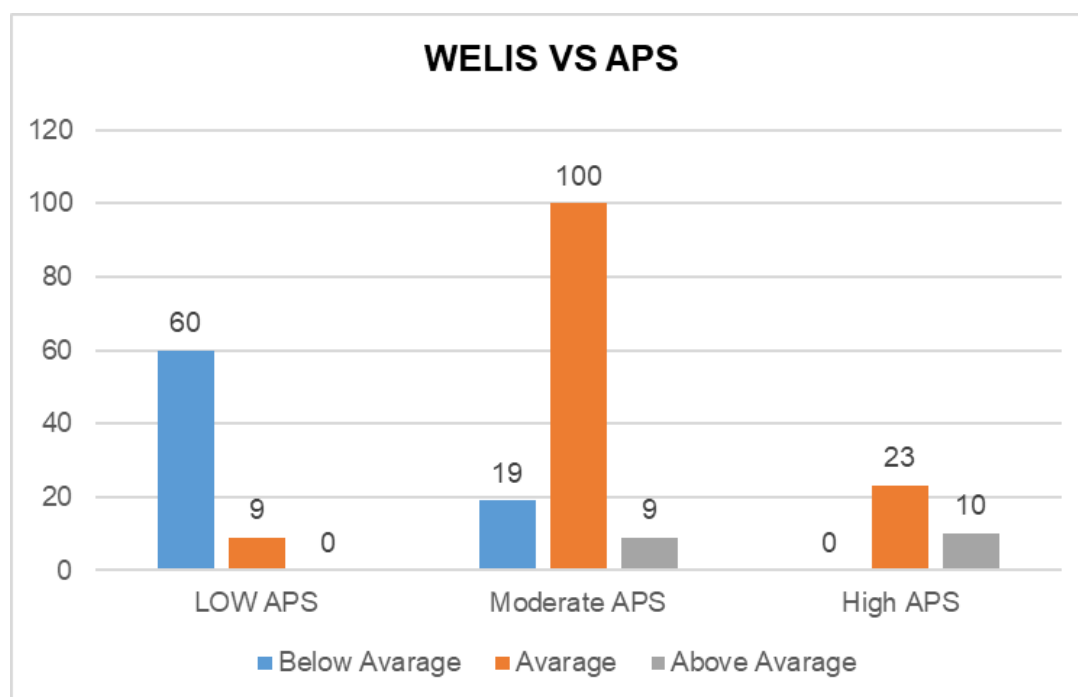
Performance Scale (APS) and Emotional Intelligence (EI) is significant, particularly in how students assess and enhance their academic performance. Emotional intelligence - encompassing the ability to recognize, understand, and manage emotions - has a strong influence on academic success. Research suggests that skills such as emotion perception and regulation are key predictors of academic self-efficacy.[16] Academic performance is influenced by factors such as cognitive abilities, study habits, motivation, and external circumstances like socioeconomic status and family support. Emotional intelligence (EI), which, includes emotional awareness and social skills, can impact performance differently depending on the context. For instance, ability-based EI predicts performance in the humanities better than in the sciences, while self-rated EI is a stronger indicator of grades compared to standardized test scores.[17] Emotional intelligence (EI) may influence academic success indirectly. While it might not directly improve grades, EI can help students manage stress, build relationships, and persist through challenges—factors that contribute to long-term success, even if they aren't immediately reflected in grades. Understanding the link between trait emotional intelligence (EI) and academic performance is complex. The relationship is likely reciprocal and dynamic, complicating efforts to clarify these processes.[18] Many studies indicate that emotional intelligence (EI) can positively influence academic success, particularly in areas such as emotional well-being and motivation. However, cognitive factors, such as intelligence and study habits, are more direct predictors of academic performance. This suggests that multiple factors including cognitive ability, motivation, study habits, and EI should be considered when evaluating academic outcomes, as different aspects of EI may impact performance in various ways.[19] Overall, academic performance is a complex construct. Emotional intelligence plays a crucial role in managing stress, motivating oneself, and enhancing interpersonal interactions. However, academic performance often depends more heavily on cognitive abilities and effective study habits. One study indicated that individuals with a CGPA above 4.50 scored significantly higher in emotional management ($p = 0.048$), emotional awareness ($p < 0.001$), social-emotional awareness ($p < 0.001$), and relationship management ($p = 0.030$). Additionally, males had higher overall emotional intelligence (EQ) scores compared to females ($p < 0.001$).20 Emotional intelligence (EI), significantly influences academic performance and mental health. It develops over time through life experiences, and research shows a positive correlation between EI and academic success. Three meta-analyses have confirmed that higher EI is linked to better academic outcomes, particularly among final-year medical students. Additionally, individuals with higher emotional intelligence report greater self-satisfaction and lower stress levels.[21] Emotional intelligence (EI) is positively related to contentment and life satisfaction when accounting for personality factors, which is another benefit of enhancing EI among medical undergraduates.[22] Emotional Intelligence (EI) measures how well a student performs academically and affects their emotional well-being and stress management. Research indicates that both Interpersonal and Intrapersonal EI significantly impact academic performance, with Interpersonal EI being the strongest predictor.[23] A study of medical students in Nottingham revealed that those with high emotional stability performed better on pre-clinical assessments.[24]

Larger studies may be needed to strengthen the link between EI and academic success.

Conclusion
The analysis reveals a statistically significant and moderately positive relationship between emotional intelligence (EI) and academic performance. Students with higher EI scores generally perform better academically. In particular, those with below-average or average emotional intelligence are significantly less likely to achieve high academic performance compared to their peers with above-average EI. This emphasizes the importance of fostering emotional intelligence as a potential strategy for enhancing academic success among students.

Limitations
The study's limitations include a small sample size and focus on a single medical college, affecting generalizability.
- Only 1.3% of participants had above-average emotional intelligence, potentially weakening comparisons across categories.
- About 11.1% of the contingency table cells had zero frequencies, which may impact the reliability of the logistic regression model.
- The Emotional Intelligence Scale (WLEIS) and Academic Performance Scale (APS) were based on self-reported data, which can lead to inaccuracies.
- Data collected at a single point in time restricts the ability to establish cause-and-effect relationships between emotional intelligence and academic performance.

Recommendations
To improve outcomes, we should implement diverse student populations, emotional intelligence training programs, and accurate academic performance data. Balancing emotional intelligence and academic performance categories in future studies can help prevent zero-cell issues and enhance the reliability of statistical analyses.

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Therapeutic Potential of Natural Compounds in Neurotransmitter Diseases

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Abstract:
Brain disorders linked to neurotransmitters, such as Parkinson's and Alzheimer's disease, remain difficult to manage because of their complex causes and the lack of effective treatments. In recent years, scientists have started examining the role of natural compounds in treating these conditions. For instance, curcumin from turmeric has shown both anti-inflammatory and nerve-protective effects, which may help reduce nerve damage and inflammation. Similarly, flavonoids found in foods like blueberries and green tea have demonstrated protective effects on the brain, possibly supporting neurotransmitter balance and healthy nerve communication. While these results are promising, more research is still required to fully understand how these compounds work and to develop effective natural treatment approaches for neurotransmitter-related diseases.

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Introduction

Diseases linked to neurotransmitters, such as Parkinson's and Alzheimer's, put a huge strain on healthcare systems because they keep getting worse over time and lack effective cures. These disorders are caused by a mix of genetic, environmental, and lifestyle factors, which makes them hard to treat. Current medicines mostly reduce symptoms or try to slow the disease, but they often have side effects and limited success.

Recently, researchers have turned to natural compounds from plants and food sources as possible treatments. These compounds are attractive because they show antioxidant, anti-inflammatory, and nerve-protective properties. Curcumin, the main active compound in turmeric, has drawn much interest for its ability to affect several disease-related pathways in the brain.

Similarly, flavonoids, which are found in fruits, vegetables, and drinks like green tea and blueberries, can cross into the brain and help protect nerve cells by supporting communication between them and reducing inflammation. Even though early research looks promising, turning these findings into real treatments is still difficult. Challenges such as poor absorption in the body, deciding the right dosage, and avoiding drug interactions need to be solved before these natural compounds can be used effectively in patients.

This review focuses on what is currently known about natural compounds, especially curcumin and flavonoids, in managing neurotransmitter-related diseases. It highlights their possible mechanisms of action and reviews available research to support the search for new therapies for these serious brain disorders.
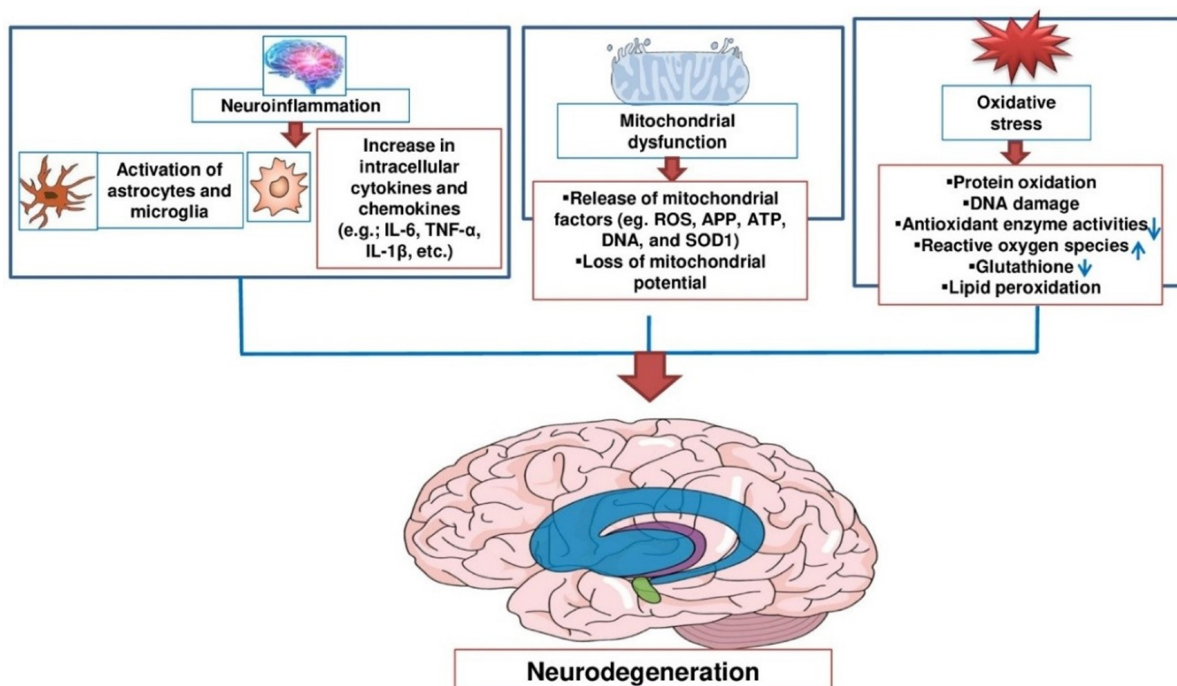
Most Prevalent Neurodegenerative Diseases

The most prevalent neurodegenerative diseases include:

Alzheimer's disease (AD): This is the leading cause of dementia and is marked by gradual memory loss, reduced thinking ability, and noticeable changes in personality and behavior. Alzheimer's accounts for most dementia cases globally.

Parkinson's disease (PD): A long-term movement disorder caused by the breakdown of dopamine-producing brain cells. Its main symptoms include tremors, muscle stiffness, slowed movements (bradykinesia), and problems with balance or posture.

Amyotrophic Lateral Sclerosis (ALS): Also known as Lou Gehrig's disease, this progressive condition damages motor neurons in the brain and spinal cord. As it advances, it causes muscle weakness, paralysis, and eventually difficulty in breathing.

Huntington's disease (HD): An inherited brain disorder caused by a defect in the huntingtin gene. It leads to uncontrollable movements, decline in thinking abilities, and psychiatric issues such as mood changes.

Multiple Sclerosis (MS): An autoimmune condition where the body's immune system attacks the central nervous system, leading to inflammation and damage of the myelin sheath around nerves.

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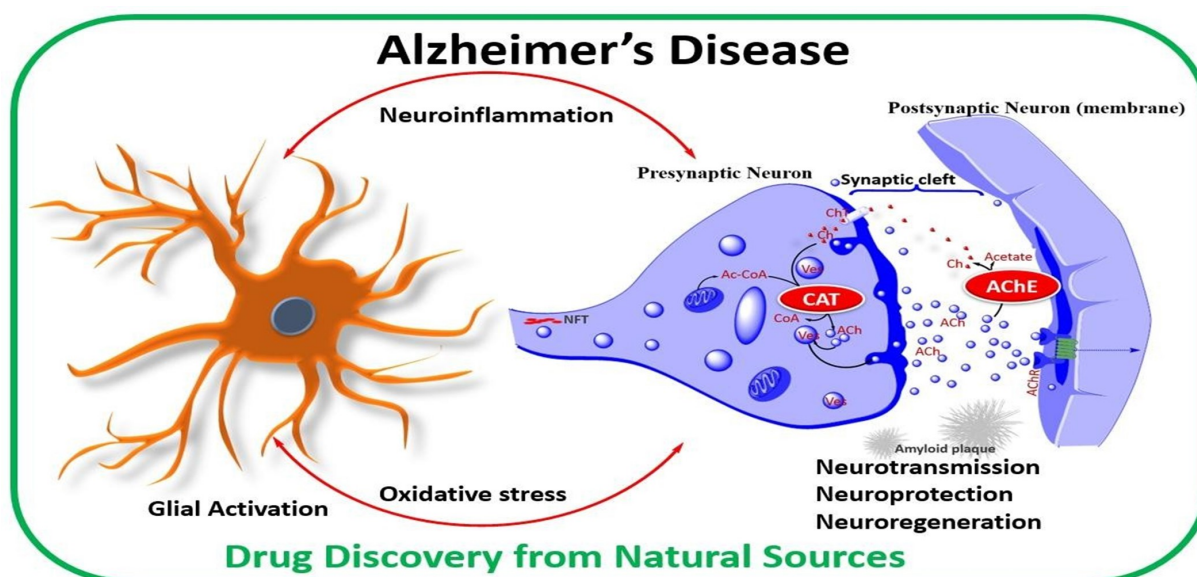
Symptoms can vary but often include tiredness, difficulty walking, sensory problems, and memory or concentration issues.

Frontotemporal Dementia (FTD): A group of brain disorders caused by degeneration of the frontal and temporal lobes. It often results in personality changes, difficulty with speech and language, and problems with decision-making or planning.

These neurodegenerative diseases pose significant challenges for patients, caregivers, and healthcare systems worldwide. Research efforts aimed at understanding their underlying mechanisms, identifying biomarkers for early detection, and developing effective treatments are ongoing to improve the management and outcomes of these conditions.

The Role of Natural Compounds in Treating Neurodegenerative Diseases

The use of natural compounds in managing neurodegenerative disorders is gaining more attention because of their ability to influence different cellular processes involved in these conditions. Diseases like Alzheimer's, Parkinson's, Huntington's, and amyotrophic lateral sclerosis (ALS) are marked by the gradual loss of brain cells and problems with nerve

communication, which lead to memory decline, movement difficulties, and eventually serious disability.

Plant- and diet-based compounds are emerging as promising candidates for therapy, as they carry multiple beneficial properties such as antioxidant, anti-inflammatory, and neuroprotective effects. These substances are capable of acting on key disease mechanisms, including protein misfolding, oxidative stress, inflammation in the nervous system, mitochondrial damage, and disrupted synaptic activity.

One of the most researched compounds is curcumin, a polyphenol from turmeric. Studies show that curcumin reduces inflammation, limits oxidative stress, and protects nerve cells. It also helps regulate harmful protein buildup and supports their clearance from the brain. Clinical research in Alzheimer's and Parkinson's patients suggests that curcumin may improve memory and motor functions, though challenges like poor absorption and unclear dosing still need to be resolved.

Flavonoids, found in foods such as berries, tea, and red wine, are another group of compounds with strong neuroprotective effects. They act as antioxidants, reduce inflammation, and support brain cell survival and regeneration. Regular consumption of flavonoid-rich diets has been linked with lower risks of developing neurodegenerative disorders and better cognitive performance in older adults.

Other compounds — such as resveratrol (from grapes), epigallocatechin gallate (EGCG) (from green tea), and quercetin (from apples and onions) — have also shown positive effects in laboratory models. They help protect nerve cells, maintain synaptic health, and reduce inflammation in the brain.

In summary, natural compounds provide multiple pathways for treating neurodegenerative diseases and hold great potential for future therapies. However, more research is required to improve their absorption, identify safe and effective doses, and confirm their benefits in clinical settings. If these challenges are overcome, natural compounds could play an important role in improving treatment outcomes for these debilitating conditions.

Natural Compounds in Clinical Trials for Neurodegenerative Diseases

Natural Compounds in Clinical Trials for Neurodegenerative Diseases Natural compounds are gaining growing attention in clinical research for treating neurodegenerative disorders because they offer protective effects on nerve cells and generally show lower toxicity compared to many synthetic drugs. Clinical trials have examined several of these compounds in conditions such as Alzheimer's, Parkinson's, and Huntington's disease.

1. Curcumin

Curcumin, the active polyphenol in turmeric, has been one of the most widely studied compounds. In Alzheimer's disease, it has been tested for its ability to improve memory and reduce inflammation in the brain. Although results are encouraging, its limited absorption in the body has led researchers to develop new formulations that can reach the brain more effectively. Key therapeutic actions of curcumin include:

Neuroprotection: Acts as a strong antioxidant and anti-inflammatory agent, helping to protect nerve cells in various brain disorders.

Amyloid binding: Binds to abnormal amyloid structures (Aβ and tau proteins), reducing plaque buildup that contributes to Alzheimer's disease.

Neurotransmitter modulation: Supports healthy brain chemistry by boosting serotonin and dopamine, which may also help relieve anxiety and depression symptoms.

Inhibition of protein aggregation: Prevents the

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clumping of α-synuclein, a protein strongly linked with Parkinson's disease progression.

Promotion of neurogenesis: Stimulates the production of brain-derived neurotrophic factor (BDNF), a protein that encourages nerve cell growth and strengthens connections between neurons.

2. Ginkgo biloba

Extracts from the leaves of the Ginkgo biloba tree, especially the standardized form EGb 761, have been widely studied in Alzheimer's disease. Some clinical trials suggest improvements in memory, attention, and daily functioning, while others show little to no benefit, making the overall evidence inconclusive.

Key actions of Ginkgo biloba:

Antioxidant neuroprotection: Shields brain cells from oxidative stress and helps preserve cognitive performance.

Improved blood circulation: Enhances microcirculation in the brain, which may aid memory and reduce balance-related problems.

Glutamate regulation: Ginkgolides control glutamate release and protect neurons from excitotoxicity by modulating calcium signaling.

Boosts neurotransmission: Enhances dopamine and norepinephrine activity in the cortex, supporting cognition and mood.

Clinical evidence: While some studies report benefits in Alzheimer's disease and mild cognitive impairment, results remain inconsistent, warranting further trials.

3. Omega-3 Fatty Acids

Omega-3 fatty acids, primarily obtained from fatty fish and plant-based sources, have been investigated for their protective role in neurodegenerative diseases such as Alzheimer's. Clinical studies have explored their ability to slow memory decline and reduce brain inflammation, though findings remain mixed.

Key actions of Omega-3s (DHA&EPA):

Structural role in brain membranes: DHA accounts for nearly 40% of the brain's polyunsaturated fats, essential for neuronal membrane integrity and neurotransmission.

Cognitive and vascular benefits: Regular omega-3 intake has been linked with better memory, learning ability, and improved blood flow to the brain, with few side effects.

Antioxidant and cell survival effects: Reduces oxidative damage in neurons and prevents programmed cell death (apoptosis).

Supports brain plasticity: Promotes the growth of new neurons (neurogenesis) and enhances synaptic connections (synaptogenesis).

Anti-inflammatory action: EPA and DHA help shift microglial cells toward an anti-inflammatory state, thereby lowering neuroinflammation.

4. Resveratrol

Resveratrol, a natural polyphenol present in grapes and red wine, has shown encouraging results in laboratory studies for conditions like Alzheimer's and Parkinson's disease. It demonstrates strong antioxidant and neuroprotective effects, with some clinical trials reporting improvements in memory and motor functions. However, results so far have been inconsistent, and more evidence is required to confirm its therapeutic potential.

5. Epigallocatechin Gallate (EGCG)

EGCG, the main catechin found in green tea, has been widely studied for its protective role in neurodegeneration. Early research suggests it may reduce oxidative stress, block harmful protein clumping, and support better brain function. Although human trials are ongoing, further studies are necessary to validate its effectiveness.

Key mechanisms of EGCG include:

Balancing synaptic transmission: Restores healthy communication between nerve cells by regulating glutamate and GABA signaling, thereby reducing excitotoxicity.

Antioxidant defense: Neutralizes free radicals, lowers lipid peroxidation, and enhances protective antioxidant enzymes such as SOD, CAT, GPx, and GR.

Anti-inflammatory action: Suppresses overactive microglia and lowers inflammatory mediators (TNF-α, IL-1β, IL-6) while inhibiting key inflammatory pathways (NF-κB, Akt, mTOR).

Prevents cell death: Reduces activation of caspase-3 and preserves mitochondrial function, which helps protect neurons from apoptosis in disease models.

6. Nicotinamide Adenine Dinucleotide (NAD$^+$) Precursors

Compounds such as nicotinamide riboside and nicotinamide mononucleotide, which act as precursors of NAD$^+$, have recently gained interest in the treatment of neurodegenerative diseases. Since NAD$^+$ is vital for energy production and

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cellular repair, its supplementation may help improve neuronal health and delay dysfunction.

Ongoing clinical trials are evaluating the safety and effectiveness of these compounds in Alzheimer's and Parkinson's disease.

Natural Compounds in Clinical Trials for Multiple Sclerosis

While these natural compounds hold promise as potential therapeutic agents for neurodegenerative diseases, it is essential to interpret clinical trial results cautiously and await further evidence from well-designed studies with larger sample sizes and longer follow-up periods. Additionally, addressing issues such as bioavailability, optimal dosing regimens, and potential drug interactions will be critical for the successful translation of natural compounds into clinical practice for the treatment of neurodegenerative diseases.

While there is ongoing research on the therapeutic potential of natural compounds in multiple sclerosis (MS), clinical trials specifically focusing on natural compounds are limited. However, some studies have investigated dietary interventions and supplements that may impact MS symptoms and disease progression. Here are a few examples:

Low-fat, plant-based diet: A randomized controlled trial (RCT) examined the effects of a low-fat, plant-based diet on MS symptoms and disease progression. The study found that participants following this diet experienced improvements in fatigue, quality of life, and other clinical outcomes compared to those following their regular diet[1].

Vitamin D supplementation: Several clinical trials have investigated the effects of vitamin D supplementation on MS. While not considered a traditional natural compound, vitamin D is synthesized in the body through sunlight exposure and is also found in some foods. Research suggests that maintaining adequate vitamin D levels may help reduce the risk of developing MS and may have beneficial effects on disease activity and progression[2].

Omega-3 fatty acids: Omega-3 fatty acids, commonly found in fatty fish and certain plant sources, have anti-inflammatory properties that may be relevant to MS. While clinical trials specifically focusing on omega-3 supplementation in MS are limited, some studies suggest potential benefits in reducing inflammation and improving clinical

outcomes in autoimmune conditions[3].

Herbal supplements: Certain herbal supplements, such as ginkgo biloba and turmeric, have been studied for their potential neuroprotective and anti-inflammatory effects in MS. However, evidence from clinical trials specifically evaluating these supplements in MS is limited, and more research is needed to determine their efficacy and safety[4].

Overall, while natural compounds hold promise as potential adjunctive therapies for MS, further research, including well-designed clinical trials, is necessary to establish their effectiveness and safety profiles in the management of MS.

Concluding Remarks

In conclusion, while there is growing interest in the therapeutic potential of natural compounds for multiple sclerosis (MS), particularly in dietary interventions and supplements, clinical trials specifically focusing on natural compounds are limited. Research suggests that interventions such as low-fat, plant-based diets and vitamin D supplementation may offer benefits in managing MS symptoms and disease progression. Additionally, omega-3 fatty acids and certain herbal supplements have been studied for their potential neuroprotective and anti-inflammatory effects, although evidence from clinical trials in MS is limited.

However, it is important to note that the evidence base for natural compounds in MS treatment is still evolving, and further research, including well-designed clinical trials, is needed to establish their efficacy, safety, and optimal dosing regimens. Additionally, given the complex nature of MS and its heterogeneity among patients, personalized approaches to treatment that consider individual patient characteristics and preferences are essential.

Overall, while natural compounds hold promise as potential adjunctive therapies for MS, they should be considered within the context of a comprehensive treatment plan that includes conventional disease-modifying therapies and management strategies tailored to the needs of each patient. Collaborative efforts between researchers, healthcare providers, and individuals with MS will be crucial in advancing our understanding of the role of natural compounds in MS treatment and improving outcomes for patients living with this challenging condition.

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Medical Education for Community Health Workers: Empowering ASHAs, Midwives, and Frontline Workers for Improved Public Health Outcomes

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Abstract:

Community Health Workers (CHWs) including India's ASHAs, midwives, and similar cadres worldwide play a pivotal role in bridging communities and the formal health-care system, especially across low-resource settings. Yet their effectiveness depends heavily on structured, context-appropriate medical education.

This review synthesizes global evidence on educational strategies that strengthen CHW competencies, motivation & public-health impact. Historically rooted in the Alma-Ata Declaration, CHW training has evolved from short, task-based orientations to competency-based, digitally enabled curricula. Innovative modalities - m-learning, simulation, peer mentoring, and inter-professional integration have improved skill retention and health outcomes. Supportive supervision, continuous medical education, and performance feedback sustain these gains. Evidence from India, Africa, and America demonstrates measurable improvements in maternal and child health, vaccination coverage, and early disease detection when CHW education is systematic and supervised. Looking ahead, the educational empowerment of CHWs should be viewed through a rights-based lens. Recognizing CHWs as lifelong learners entitled to structured professional development aligns with Sustainable Development Goal 4 on quality education. Global collaboration through south-south knowledge exchange, digital repositories, and open-access curriculum can bridge inequities between rural and urban training opportunities. Ultimately, the transformation of CHW education into a formalized, accredited career path will cement its role as a cornerstone of equitable health systems worldwide.

Key Words:

Community Health Workers; ASHA; Midwife; Medical Education; Training Programs; Digital Learning

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Introduction

Community health workers (CHWs) form the backbone of primary healthcare delivery in low- and middle-income countries (LMICs), acting as a bridge between underserved populations and the formal health system. They include Accredited Social Health Activists (ASHAs) in India, community midwives, village health volunteers, and similar cadres worldwide. In settings where health workforce shortages persist, CHWs have demonstrated measurable impact in improving maternal and child health, immunization coverage, disease surveillance, and health promotion[1,2]. Despite this, the effectiveness of CHWs hinges on structured, context-appropriate medical education that nurtures their competencies, confidence, and professional identity[3,4]. Medical education for CHWs is not merely a skill-transfer exercise, it represents a strategic investment in health system strengthening. A well-trained CHW can triage

illness, recognize early danger signs, guide families in preventive measures, and facilitate continuity of care. Globally, the expansion of competency-based and digitally supported CHW education has opened new pathways for scalable, sustainable learning[5]. The World Health Organization's 2018 guideline on optimizing CHW programs emphasized that training is not a one-off activity but a continuous professional-development cycle. Countries that embedded CHW education within national health-workforce policies such as Ethiopia, Rwanda, and Brazil have achieved stronger retention and better accountability frameworks. The global "Working for Health 2030" roadmap further encourages integration of CHW learning into tertiary and vocational education systems, ensuring standardized certification and portability of skills. These policy shifts highlight that CHW education is now seen as a core pillar of human-resources-for-health planning, not merely an auxiliary intervention

Evolution and Global Landscape of CHW Education

The CHW model emerged from the Alma-Ata Declaration (1978) that championed "Health for All" through community participation. Early pioneers such as China's "barefoot doctors," Brazil's Family Health Program, and Nepal's Female Community Health Volunteers demonstrated that local laypersons, once adequately trained, could deliver cost-effective essential health services. Subsequent systematic reviews reinforced that targeted CHW training reduced neonatal mortality, improved antenatal care attendance, and enhanced disease control outcomes[6]. In India, the National Rural Health Mission (NRHM, 2005) institutionalized the ASHA programme arguably the world's largest CHW initiative. ASHAs receive 23 days of modular training, covering maternal and newborn care, immunization, nutrition, sanitation, and communication. While this training has expanded outreach, periodic assessments reveal gaps in clinical reasoning, emergency recognition, and record-keeping attributable to inconsistent pedagogy and limited supervision[5,7]. Comparative analyses from sub-Saharan Africa and Latin America show that contextual customization of training length and pedagogy is crucial. In Malawi, three-month blended programs focusing on integrated community case management yielded sustained gains in malaria and pneumonia outcomes. Conversely, short crash courses in some Pacific nations improved initial coverage but failed to maintain quality once supervision lapsed. These findings reinforce the principle that the "dose" of education must match task complexity and community expectation, with periodic refreshers embedded within employment contracts. Internationally, CHW curricula vary widely from brief orientation courses in Sub-Saharan Africa to structured certificate programmes in the United States. The Philani Mentor Mother model in South Africa exemplifies a rigorous approach combining six weeks of classroom and field mentorship emphasizing maternal and child health. In the United States, the DULCE and PARENT models integrate CHWs into early childhood well-child care, underscoring their educational potential within multidisciplinary teams[4,8].

Core Competencies and Learning Objectives

The World Health Organization (WHO, 2018) identifies five competency domains essential for CHWs: (a) communication and interpersonal skills, (b) public health and disease prevention knowledge, (c) community mobilization, (d) service delivery and first aid, and (e) information management. Effective educational design must contextualize these within local epidemiological profiles and sociocultural realities. A global synthesis of CHW curricula highlights that adult-learning principles - experiential learning, peer discussion, problem-solving, and immediate feedback - outperform didactic instruction[9]. In India's ASHA modules, the shift toward competency-based assessment, using role-plays and case scenarios, has improved knowledge retention and confidence[10]. Similarly, programs in Ethiopia and Uganda employing participatory simulations have enhanced neonatal resuscitation skills and adherence to clinical guidelines[11]. Beyond biomedical competencies, behavioural and psychosocial dimensions of CHW education are increasingly recognized. Modules on communication, empathy, and stigma reduction enable CHWs to manage sensitive issues such as HIV disclosure, domestic violence, or adolescent reproductive health. Incorporating mental-health first-aid and stress-management techniques has reduced burnout and improved empathy scores in trials from Uganda and India. Such holistic curricula acknowledge that community health work is emotionally intensive and that resilience training is as vital as clinical skill acquisition. Key educational outcomes include improved recognition of obstetric emergencies, adherence to immunization schedules, and early referral. For instance, training CHWs in maternal danger-sign identification in Tanzania reduced perinatal mortality by 15 %[5]. Such findings affirm that structured, repetitive, supervised education directly translates into better health indicators (see *Table 1*).

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Program	Training	Curriculum Focus	Assessment	Accreditation	Key Education Innovations
India (ASHA Programme) [7]	23 days modular + refresher every 6 months	MCH, sanitation, communication, immunization	Field supervision by ANM & PHC staff	State-level competency certification	m-Learning via *ASHA Soft* and *Mobile Academy*
Ethiopia (Health Extension Programme) [12]	12 months classroom + field practice	MNCH, hygiene, malaria, family planning	Regular on-site mentoring	Government-accredited Level IV diploma	Peer learning circles, on-site supervision
Nepal (FCHV Scheme) [13]	18-day induction + annual refreshers	Nutrition, immunization, maternal care	Monthly review by local health post	Ministry-certified volunteer cadre	Use of pictorial manuals, participatory sessions
Brazil (Family Health Programme) [14]	8-week initial + periodic updates	Preventive care, NCDs, sanitation	Daily field supervision by nurse teams	National CHW certification	Inter-professional team-based learning
Bangladesh (BRAC Shasthya Shebika) [15]	21-day practical training	ORS, FP, TB, malaria	NGO field supervision every 2 weeks	NGO-issued competency badge	Micro-credentialing, social recognition
South Africa (Philani Mentor Mothers) [2]	6-week blended course + home-based mentorship	Maternal health, HIV care, nutrition	Daily supervision by NGO supervisors	NGO-endorsed certificate	Peer-led supportive supervision
USA (Promotoras / DULCE / PARENT) [4]	3–6 month community college or project-based	Preventive pediatrics, chronic disease	Clinic team review & performance dashboards	Certified CHW credential (state-level)	Digital patient navigation, team-based coaching

Table 1: Global Comparison of Community Health Worker (CHW) Education and Training Models: Program Structure, Curriculum Focus, Assessment Mechanisms, Accreditation Pathways and Key Educational Innovations

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Innovations in Educational Strategies (see *Figure 1*)

1. Digital and Mobile Learning.

The proliferation of mobile technologies has revolutionized CHW education. mHealth platforms deliver modular content via smartphones, allowing self-paced micro-learning even in remote areas[16]. Applications like Mobile Academy in India and mTrain in Kenya have reported increased post-test scores and reduced attrition[17]. Tele-mentoring programs based on the ECHO model provide virtual case discussions linking CHWs with physicians for real-time guidance[18].

2. Simulation-Based Learning.

Low-cost mannequins and scenario-based simulations strengthen psychomotor skills crucial for midwives and maternal-care CHWs. Studies in Nigeria and Nepal demonstrated significant improvement in newborn resuscitation skills after simulation workshops compared to traditional lectures[19]. Simulation also reinforces team coordination, decision-making, and stress management - vital during emergencies.
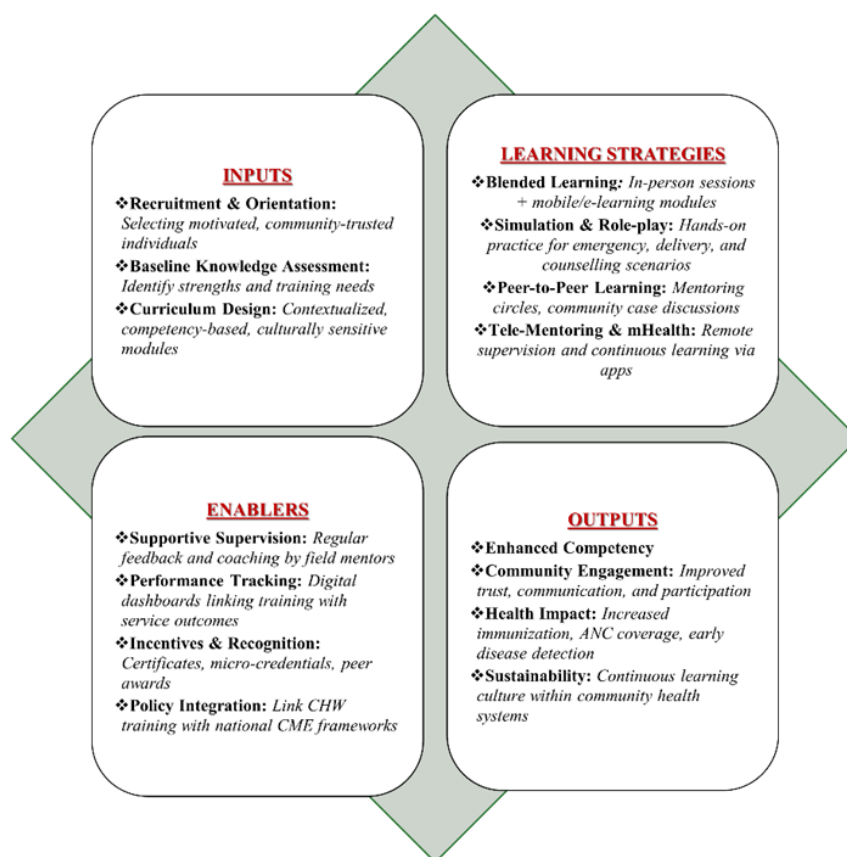
3. Peer-to-Peer and Community Mentorship.

Supportive supervision, defined as collaborative performance improvement rather than fault-finding, is a cornerstone of CHW motivation[3]. Peer-mentor systems where experienced CHWs supervise novices increase confidence, job satisfaction, and retention. The Philani Mentor Mother initiative illustrates how local mentorship not only sustains quality but also fosters community trust.

4. Integration with Formal Health Education.

Cross-training CHWs with nurses and medical students cultivates mutual respect and interprofessional collaboration (20). Some Indian states have piloted bridge programs enabling high-performing ASHAs to qualify as auxiliary nurse midwives (ANMs), thereby creating career pathways and reinforcing learning motivation. Interprofessional education initiatives, like India's "Skill Lab Connect" and South Africa's "Team Primary Care" projects, demonstrate tangible benefits when CHWs learn alongside nurses and medical trainees. Joint simulation drills foster mutual respect, clarify referral protocols, and align community-level triage with facility-level response. Evaluations have documented improved hand-off communication and reduced duplication of household visits, underscoring that shared learning environments cultivate cohesive primary-care ecosystems.

INPUTS
- ❖**Recruitment & Orientation:** *Selecting motivated, community-trusted individuals*
- ❖**Baseline Knowledge Assessment:** *Identify strengths and training needs*
- ❖**Curriculum Design:** *Contextualized, competency-based, culturally sensitive modules*

LEARNING STRATEGIES
- ❖**Blended Learning:** *In-person sessions + mobile/e-learning modules*
- ❖**Simulation & Role-play:** *Hands-on practice for emergency, delivery, and counselling scenarios*
- ❖**Peer-to-Peer Learning:** *Mentoring circles, community case discussions*
- ❖**Tele-Mentoring & mHealth:** *Remote supervision and continuous learning via apps*

ENABLERS
- ❖**Supportive Supervision:** *Regular feedback and coaching by field mentors*
- ❖**Performance Tracking:** *Digital dashboards linking training with service outcomes*
- ❖**Incentives & Recognition:** *Certificates, micro-credentials, peer awards*
- ❖**Policy Integration:** *Link CHW training with national CME frameworks*

OUTPUTS
- ❖**Enhanced Competency**
- ❖**Community Engagement:** *Improved trust, communication, and participation*
- ❖**Health Impact:** *Increased immunization, ANC coverage, early disease detection*
- ❖**Sustainability:** *Continuous learning culture within community health systems*

Figure 1: Integrated Educational Ecosystem for Community Health Workers (CHWs)

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Supervision, Support, and Continuing Education

While initial training establishes baseline competency, sustained supervision ensures skill reinforcement. Evidence from a qualitative synthesis across 19 LMIC studies emphasizes that infrequent or punitive supervision demotivates CHWs and erodes program quality[3]. Supportive supervision that combines observation, feedback, and emotional support correlates with better performance metrics and lower attrition[21]. Supervisory systems should be multi-tiered: (i) field-level peer support, (ii) technical supervision by nurses or public-health officers, and (iii) managerial oversight through digital dashboards. Bangladesh's BRAC and Ethiopia's Health Extension Program have demonstrated that supervisory visits every 4–6 weeks with structured checklists improve adherence to treatment algorithms[22]. Educational reinforcement is further strengthened by non-financial motivation. Recognition ceremonies, certification badges, and peer-champion models have increased morale and public credibility of CHWs. Linking refresher attendance to micro-credentials visible on digital ID cards not only validates learning but also creates pride and social capital within communities. Studies from Kenya and Indonesia reveal that such symbolic rewards enhance retention as effectively as small financial bonuses, provided feedback is timely and transparent[23]. Continuing Medical Education (CME) for CHWs through quarterly refreshers, WhatsApp discussion groups, or modular updates has proven feasible and impactful. In India, the ASHA Soft portal links refresher performance to incentive disbursals,

ensuring accountability. Globally, online platforms such as CHW Central and OpenWHO now provide multilingual CME modules, democratizing access to updated content (see *Figure 2*).

This conceptual diagram illustrates the stepwise development and integration of community health workers from selection and training through certification, contracting, and retention within the broader health system. It emphasizes competency-based education, supportive supervision, career progression, and system-level optimization leading toward universal "Health for All." Source: World Health Organization. WHO Community Health Worker guideline recommendations using lifecycle approach. Geneva: WHO; 2018. Available from: https://www.who.int/publications/i/item/9789241550369

Assessing Educational Outcomes and Impact
Evaluation of CHW education spans three domains: (a) learning outcomes, (b) performance outcomes, and (c) population health impact.

1. Learning outcomes - are measured through pre-/post-training tests and observational checklists. Studies reveal average knowledge gains of 20–30 % following structured education programs (11).
2. Performance outcomes - accuracy in drug administration, home-visit frequency, and record completeness improve significantly with supportive feedback loops.
3. Population impact - decline in maternal mortality, improved exclusive breastfeeding
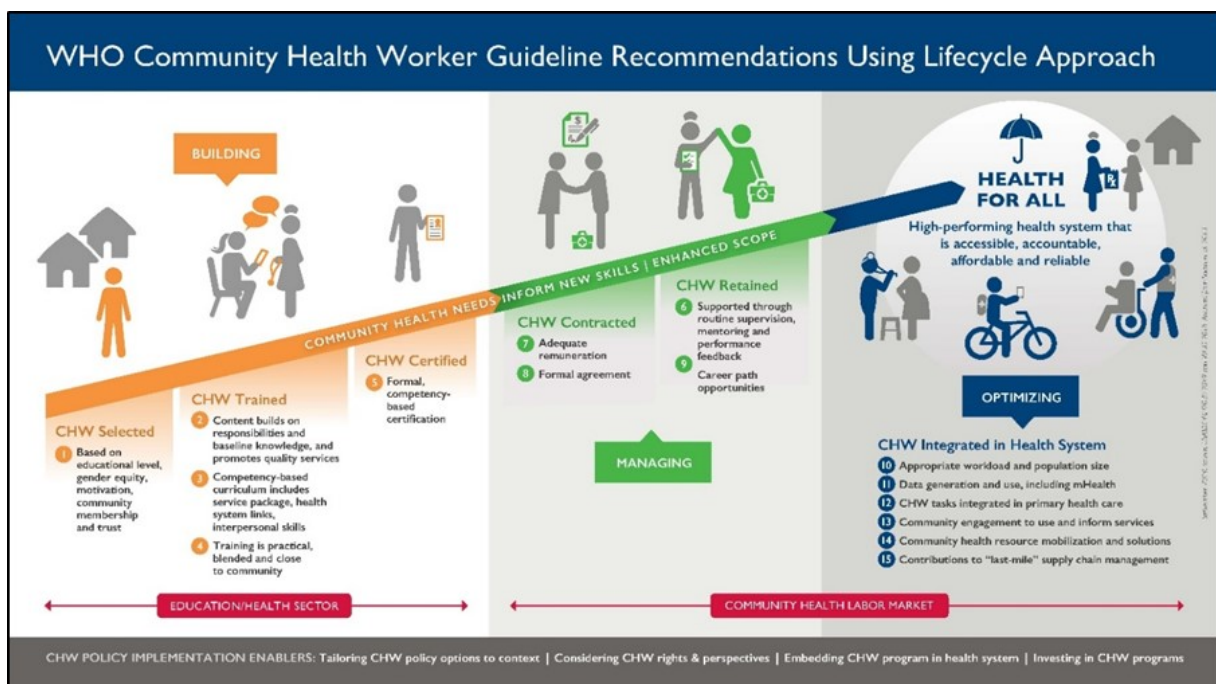
Figure 2: WHO Community Health Worker Guideline Recommendations Using a Lifecycle Approach

rates, and vaccination coverage validates long-term benefits.

For example, the Philani rural program demonstrated that mothers visited by trained CHWs were twice as likely to complete antenatal check-ups and 80% more likely to exclusively breastfeed for six months. Similarly, DULCE participants in the US achieved higher timely immunization and fewer emergency visits. Robust monitoring frameworks such as the Performance for Results (PforR) approach integrate CHW education metrics into national dashboards. However, the heterogeneity of programs and lack of standardized indicators complicate cross-country comparisons. The global CHW Assessment and Improvement Matrix (CHW-AIM) offers a promising solution by harmonizing indicators for supervision, training, and performance[12]. Emerging digital learning-management systems (LMS) now integrate analytics to track individual progress in real time. Dashboards aggregate attendance, quiz scores, and field performance, enabling supervisors to tailor mentoring. For example, Rwanda's "Smart-CHW" platform correlates training participation with immunization coverage in each district. Such data loops transform supervision from reactive inspection to proactive coaching, ensuring educational investments translate into measurable service gains.

Global Milestones and Groundbreaking Achievements of Community Health Workers

Across continents, community health workers have repeatedly demonstrated that well-trained non-medical individuals can deliver measurable, life-saving outcomes traditionally attributed to professionals. In Brazil, the Agentes Comunitários de Saúde integrated into the Family Health Program have achieved near-universal immunization and a 40% decline in infant mortality[14]. Ethiopia's Health Extension Workers, after one year of structured training, reduced under-five mortality by 25% and substantially improved antenatal attendance and latrine coverage[24]. In Nepal, Female Community Health Volunteers achieved national vitamin A coverage exceeding 90%, virtually eradicating xerophthalmia among children[13]. Bangladesh's BRAC Shasthya Shebikas, despite minimal formal education, pioneered oral rehydration therapy and family planning outreach, halving childhood diarrhoeal deaths[15]. India's ASHA network, the world's largest CHW workforce, contributed to a dramatic increase in institutional deliveries and immunization coverage under the National Health Mission[7]. Meanwhile, South Africa's Philani Mentor Mothers, through household mentoring, have improved exclusive breastfeeding and maternal

mental health in deprived communities[2,25,26]. Even in high-income settings, CHWs are redefining preventive care - Promotoras de Salud in the United States have improved chronic disease management and screening adherence among Latino populations[4]. Collectively, these initiatives illustrate that empowered, educated non-medical workers can bridge critical gaps in healthcare delivery, achieving population-level milestones once thought possible only through physician-led systems[27].

Challenges in Implementation
- **_Educational background and literacy._**
Many CHWs begin with minimal formal education, constraining comprehension of biomedical concepts. Simplified, pictorial, and language-appropriate materials improve understanding.
- **_Resource constraints._**
Inadequate training infrastructure, irregular funding, and limited teaching staff impede program scalability. Public-private partnerships such as India's collaboration with NGOs like CARE India have alleviated some gaps but sustainability remains an issue[15].
- **_Supervisory burden._**
Facility-based supervisors, often nurses, struggle with competing clinical responsibilities, leading to irregular field visits. Designating dedicated CHW supervisors with exclusive supervisory roles has improved consistency in several African programs [11,22].
- **_Gender and social barriers._**
Most CHWs are women, facing safety issues during night travel, cultural restrictions on male contact, and domestic workload pressures. Education must therefore include gender-sensitization, self-protection, and leadership modules.
- **_Recognition and career progression._**
Without clear advancement pathways, CHWs often experience "volunteer fatigue." Recognizing educational achievements through certification and linking them to formal health cadres enhance motivation and retention[14].

Future Directions: Reimagining CHW Education for the Next Decade
1. **_Institutionalizing CHW Education._**
Integrating CHW training into national medical and nursing education frameworks can elevate its academic legitimacy. Universities in South Africa and Brazil have begun offering accredited CHW diplomas, blending fieldwork with public-health theory [20].

2. _Digital Transformation._
Artificial intelligence-assisted adaptive learning platforms can personalize training, track competencies, and provide instant feedback. Data-driven analytics can identify weak areas and trigger

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Country / Region	Program / Cadre	Primary Focus	Major Achievements	Measured Outcomes / Impact
Brazil[14]	Agentes Comunitários de Saúde – Family Health Program	Primary care, immunization	Universal household registration, improved preventive coverage	↓ Infant mortality by 40%, ↑ vaccination rates
Ethiopia[24]	Health Extension Workers	Maternal–child health, sanitation	Community case management and hygiene promotion	↓ Under-five mortality by 25%, ↑ ANC visits
Nepal[13]	Female Community Health Volunteers	Nutrition, vitamin A supplementation	Nationwide vitamin A program	>90% coverage, elimination of xerophthalmia
Bangladesh[15]	BRAC Shasthya Shebikas	Family planning, diarrhoea control	Household ORS and contraceptive promotion	50% fall in diarrhoeal deaths, ↑ contraceptive use
India[7]	ASHA – National Health Mission	Maternal and child health	Home visits, facility linkage	↑ Institutional deliveries (from 39%→79%), ↑ full immunization
South Africa[2,25]	Philani Mentor Mothers	Maternal mental health, nutrition	Home-based counselling and supervision	↑ Exclusive breastfeeding, ↓ postpartum depression
United States[4,8]	Promotoras de Salud	Chronic disease prevention	Culturally tailored education	↑ Screening adherence, ↑ chronic disease follow-up

targeted refresher modules.

3. Global Standardization and Mutual Recognition.
The WHO's 2024 CHW Competency Framework encourages harmonized curricula across regions, facilitating mutual recognition and migration pathways. This approach may particularly benefit CHWs transitioning into nursing or paramedic roles.

4. Community Co-creation.
Sustainable education models must be co-designed with CHWs themselves. Participatory curriculum development ensures cultural alignment and practicality [28].

5. Linking Education to Outcomes.
Future research should employ longitudinal designs to correlate education quality with health outcomes moving beyond pre-/post-knowledge scores toward cost-effectiveness and system-level analyses [24].

Conclusion
Medical education for community health workers represents one of the most cost-effective, equity-oriented investments in public health. From India's ASHAs to South Africa's Mentor Mothers and the US's DULCE coaches, well-educated CHWs have repeatedly proven their ability to transform health outcomes. The global experience demonstrates that effective CHW education must be competency-based, context-specific, digitally supported, and continuously supervised. Empowering CHWs through structured medical education bridges the gap between communities and the health system, converts health awareness into health action, and sustains the vision of universal health coverage. As nations strive toward the Sustainable Development Goals, the future of public health will depend not only on physicians and nurses but equally on how well we educate, support, and value the community health worker [29].

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Effectiveness of Integrative Case-Based Learning and Case Seminar Approaches in Teaching Pathology Laboratory for the PharmD Program

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Abstract:

In the evolving landscape of medical education, efficient teaching methodologies are crucial for achieving desired educational outcomes. Active learning strategies, such as Case-Based Learning (CBL) and the case seminar approach, have become popular for enhancing student engagement and facilitating a deeper understanding of complex concepts like pathology. The data were analyzed using qualitative content analysis. Approximately 40% of participants rated CBL and seminars as very effective for knowledge acquisition, which is significantly higher than the 27% rating for traditional methods. Additionally, 40.9% believed these active learning strategies enhanced critical thinking skills. A strong preference was noted, with 45.2% preferring CBL and seminars for clinical preparation, compared to 29% for traditional approaches. This study demonstrate that integrative CBL and the case seminar approach significantly enhance the understanding of pathology concepts, critical thinking, and strengthen the connection between theoretical knowledge and clinical practice among PharmD students.

Key Words:
Case Seminar; Case-Based Learning (CBL); Student-Centred Activities; PharmD Students; Pathology

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Introduction

Traditional pathology education relies on lectures, autopsy demonstrations and microscopy exercises, often resulting in passive learning. Research indicates these methods do not consistently produce robust learning outcomes[1,2,3]. Educational theory supports active learning, where students construct knowledge through participation and interaction. This study aims to align educational outcomes with active learning by emphasising critical thinking and practical application. Case-based learning (CBL) and seminars are employed to achieve these goals. Their effectiveness is measured through a questionnaire that evaluates how well student perceptions align with the intended outcomes.

Medical education is shifting towards student-centred methods such as case-based learning (CBL) and case seminars, which are recognised for increasing engagement and deepening understanding. CBL transforms lectures into interactive, student-led problem-solving sessions that apply theory to clinical scenarios. Case seminars support this by encouraging collaborative analysis and discussion of real cases, assisting students to interpret information in relevant contexts.

Research on student learning identifies two primary approaches: surface (reproduction-directed) and deep (meaning-directed) learning[9]. CBL and case seminars promote meaning-directed learning by encouraging students to engage deeply with the material and connect it to their academic and professional experiences. This active engagement is associated with intrinsic motivation, where a genuine interest in the studies identifies two main learning approaches: surface and deep learning. CBL and case seminars encourage deep learning by prompting students to engage with material and relate it to their experiences. This active engagement fosters intrinsic motivation and a firmer commitment to learning. The introduction of innovative teaching methods in the third and fourth academic years aims to promote meaningful learning.

Materials and Methods

This cross-sectional survey compared case-based teaching with traditional methods in the PharmD pathology curriculum. The study population consisted of PharmD students at the Faculty of Pharmacy, Libyan International Medical University, during the 2024-2025 academic year.

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Design of the Case Seminar

The case seminar has been implemented for the first time as a teaching approach for histopathology laboratory material for PharmD students by Dr. Hanan M Garalla, Associate Professor of Pathology. The case seminar evaluated in this study comprises two sessions, named "macro" and "discussion". The case seminar has been implemented in the pathology course, which is delivered through lectures and histopathology laboratory material. This seminar format enables students to collaborate in small groups, analyze gross and microscopic images of surgical specimens, and review patient histories prepared by the pathology teacher. Each group selects a leader to present their cases to peers, describe the specimens using gross and microscopic images, ask questions, explain the associated diseases, causes, and pathological mechanisms at the tissue level, and make a diagnostic suggestion.

The seminar employs diverse forms of dialogue: instructors pose clarifying questions to ensure comprehension, probing questions to foster deeper thinking, and summative questions to assess understanding. During the discussion session, instructors review the pathological mechanisms depicted in the images. At the conclusion, students participate in an interactive quiz and group discussion with the instructor. These seminars enable instructors to address questions and challenges, supporting a deeper understanding of the material.

Case-Based Learning Methodology

Case-based learning (CBL) was incorporated into the pathology course to enhance the education of PharmD students. Following each tutorial, students collaborated in groups on clinical cases pertaining to the covered topics. Group leaders presented diagnoses and discussed the associated risk factors and outcomes. This initial implementation of CBL aimed to cultivate critical thinking and practical skills. Real-time faculty feedback offered immediate clarification and guidance, enhancing understanding and facilitating the adoption of this model at other campuses.

Data Collection and Analysis

A structured questionnaire evaluated students' experiences and perceptions of the instructional methods. Ninety-three third- and fourth-year PharmD students took part in the study. The questionnaire was distributed electronically via Moodle to ensure accessibility. Quantitative data were analysed in Microsoft Excel using descriptive statistics.

Results

A total of 93 participants responded to the survey regarding the effectiveness of CBL and case seminars as newly developed teaching methods in the pathology curriculum. The data indicated that the majority of students in their professional years of the PharmD programme were in their fourth year (53.8%), closely followed by third-year students (46.2%) as depicted in *Figure 1*.

Regarding understanding pathology concepts, the majority of the students rated case-based learning and case seminars as very well
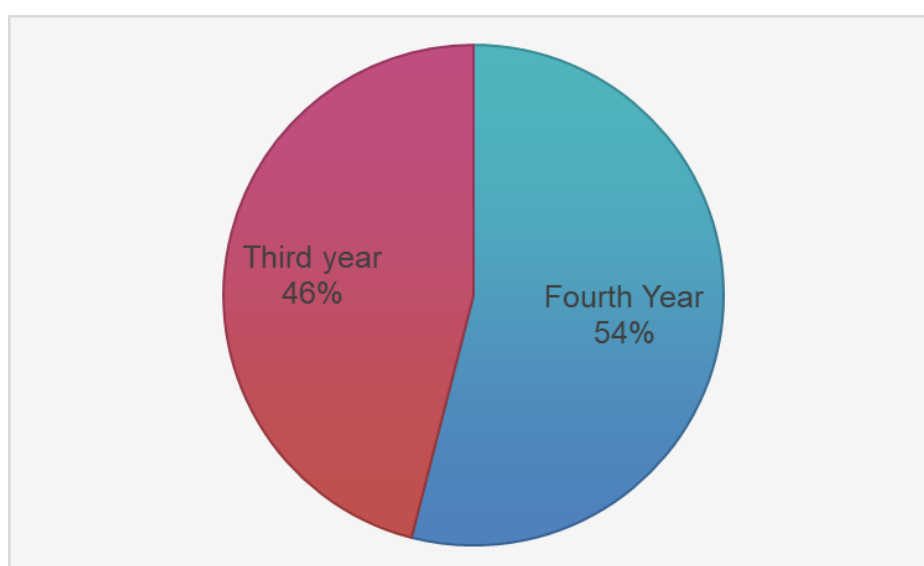
Figure 2: Educational Stage Representation in PharmD Curriculum
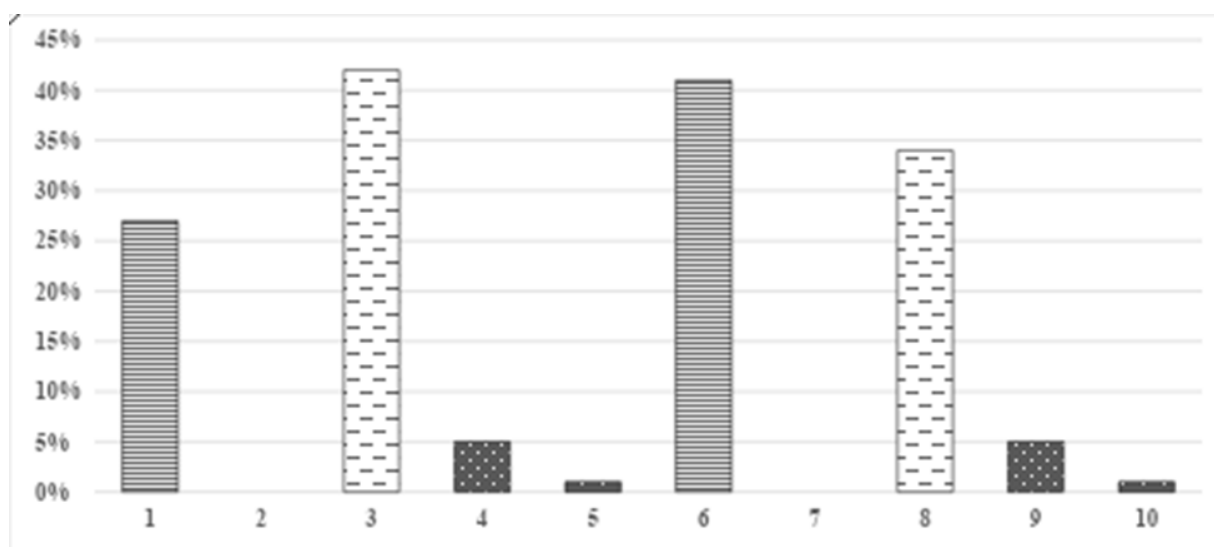
Figure 2: Comparison of Student Perceptions on the Effectiveness of Didactic Teaching vs. Case-Based Teaching in Understanding Pathology Concepts

Figure 3: Student Preferences for Teaching Methods that Enhance Critical Thinking Skills

(approximately 40%) which promotes efficient knowledge building, maximising students' understanding of pathology through real clinical cases.

While only around 27% was received by traditional teaching, as indicated in *Figure 2*. As illustrated in Figure 3, the findings reveal that the majority of students (40.9%) believe that case-based teaching and case seminars are the most effective methods for enhancing critical thinking skills. In contrast, traditional didactic teaching received 3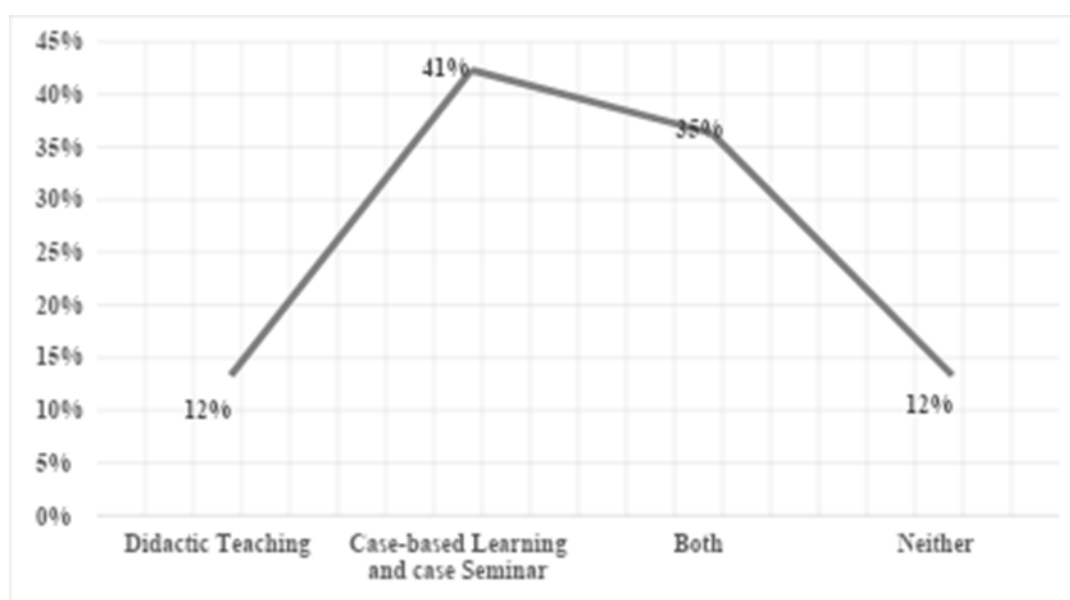5.5% of the responses, indicating a strong preference for more interactive and applied learning approaches. The effectiveness of each teaching method in connecting theoretical knowledge with clinical practice was also assessed. A significant number of students rated case-based teaching as "very effective" (around 40%) in Figure 4, whereas traditional didactic teaching received fewer positive responses.

When asked which learning method best prepares them for clinical application in pharmacy, 45.2% of the students preferred case-based learning and case seminars, as illustrated in Figure 5, in contrast to 15% who preferred traditional methods. These findings highlight the value of contextual learning, demonstrating that students value the applicability of case-based experience to their future clinical practice.

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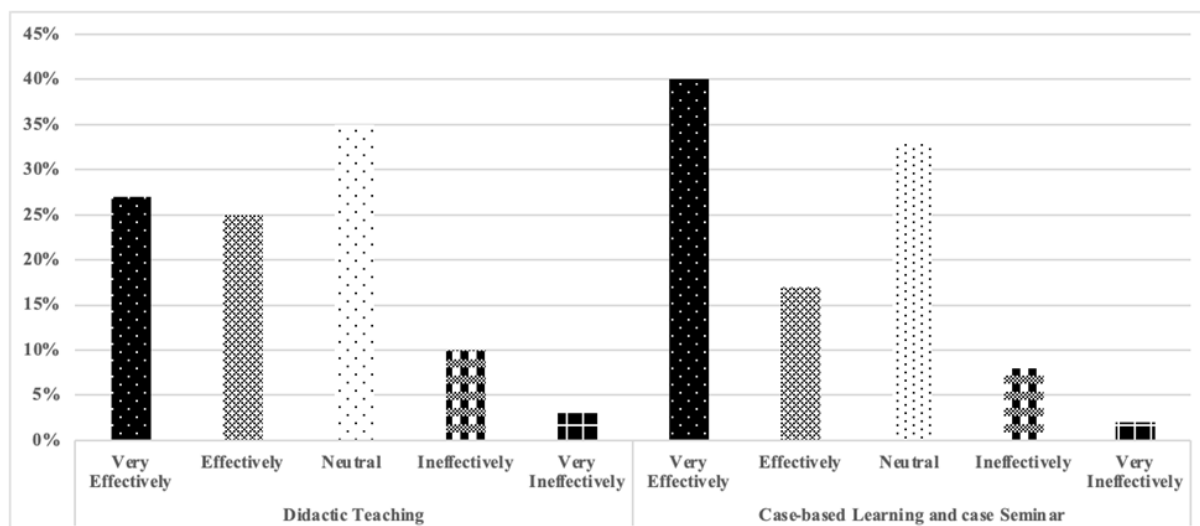
Figure 4: *Bridging Theoretical Knowledge with Clinical Practice*
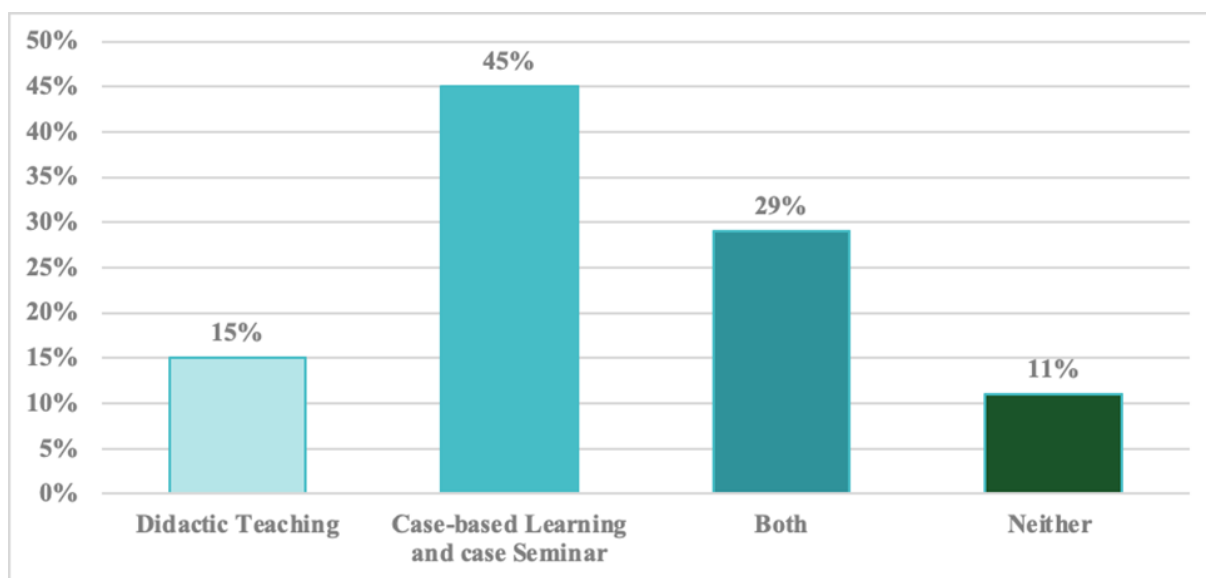
Figure 5: *Teaching Approach Best Equips Pharmacy Students for Practical Application in Pharmacy*

Discussion

The current research assessed the success of integrative case-based learning (CBL) and case seminar methods in teaching pathology to PharmD students at the Faculty of Pharmacy within Libyan International Medical Students. The results show that most students indicated that the case seminars and CBL provided a beneficial learning experience. Several key factors that contribute to learning were recognised, including motivational elements, knowledge construction, contextual factors, collaborative dynamics, and the relevance of case-based experiences in clinical practice.

Active Learning and Engagement

The results demonstrated that a substantial majority of students (approximately 40%) rated CBL and case seminars as highly effective in enhancing their understanding of pathology concepts. This

aligns with existing literature that emphasises the benefits of active learning strategies in fostering deeper comprehension and preservation of complex material[14,15]. The transition from passive to active learning environments is critical in medical education, where the application of knowledge to real-world scenarios is essential for developing competent healthcare professionals.

Critical Thinking Development

One of the most notable outcomes of this study was the preference expressed by 40.9% of participants for CBL and case seminars as the most effective methods for enhancing critical thinking skills. This finding supports previous research highlighting the role of CBL in promoting analytical skills[16]. During the seminars, students engaged in small group work, which many found beneficial.

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They highlighted the collaborative aspects of learning, such as the opportunities to discuss topics with peers and instructors, as well as having time to ask questions. Research on the cognitive impact of small group learning in case-based learning indicates that group discussions facilitate the activation of prior knowledge, enhance information recall, evaluate evidence, and develop differential diagnoses, thereby enhancing the cognitive skills essential for clinical practice[17].

Clinical Application and Relevance

The preference of 45.2% of students for CBL and case seminars as the methods that best prepare them for clinical application. The ability to connect pathology concepts with clinical scenarios is vital for PharmD students, as it facilitates a comprehensive understanding of disease processes and their implications for patient care[17]. The study's findings suggest that students perceive these methodologies as instrumental in providing a contextual framework that enhances their readiness for clinical responsibilities.

Limitations of Traditional Didactic Methods

The integration of traditional lecturing with problem-based learning, particularly through case-based learning, enhances educational engagement. Lectures efficiently provide a clear and organised presentation of content, cover extensive material within a limited timeframe, and ensure uniform educational standards across the curriculum[18]. Traditional teaching methods can lack the interactive elements necessary for fostering critical thinking and problem-solving skills[19]. In contrast, CBL and case seminars engage students actively, promoting collaboration and critical thinking through real-world clinical scenarios. However, CBL and case seminars require more time and resources, and their success is contingent upon group dynamics and instructor efficacy[20]. A balanced integration of these methodologies is pivotal for optimising learning outcomes in pathology education.

Implications of Integrating Case-Based Learning in Pathology Education

The incorporation of case-based learning (CBL) and case seminars into the pathology curriculum bears profound implications for medical education[21]. These student-centred activities facilitate the application of fundamental sciences to clinical medicine, bridging the divide between normal and abnormal physiology and histology. By fostering collaboration, discussion, and practical knowledge application, CBL and case seminars augment student motivation and engagement[22,23]. Additionally, these methods cultivate lifelong learning skills, indispensable for adapting to the dynamic healthcare landscape, ultimately equipping students to become competent healthcare professionals[24].

Conclusion

In summary, this study's findings advocate the adoption of integrative CBL and case seminar methodologies as effective teaching strategies for pathology in PharmD programmes. These innovative approaches actively engage students by incorporating surgical specimen images, microscopic visuals, and patient clinical histories, which not only stimulate their interest and motivation but also cultivate active participation, critical thinking, as well as connecting theoretical knowledge to real-life scenarios and practical applications. Students reported that these experiences enhanced their comprehension and retention of pathology concepts while encouraging meaningful discussions with both peers and instructors. These methods elevate the educational experience, underscoring the significance of student-centered learning techniques and better-equipping students for their future roles as healthcare professionals.

Limitations

This research has several constraints that ought to be acknowledged. Firstly, the sample size was rather limited, which restricts the applicability of the results to a broader population. Moreover, the study was conducted at only one institution, which may introduce contextual biases not representative of students in diverse educational settings. Lastly, whilst the study concentrated on short-term outcomes, it did not evaluate the long-term retention of knowledge or skills gained through CBL and case seminars.

Future Work

Future research ought to build upon the findings of this study and include longitudinal investigations to assess the long-term retention of knowledge gained through case-based learning (CBL) and case seminars. Expanding the research to encompass diverse medical schools will enhance generalizability. Comparative research across various medical fields will highlight the advantages and disadvantages of these methodologies.

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Bukhatwa, the PharmD Program Director at the Faculty of Pharmacy, Libyan International Medical University. Her guidance and support in the adoption and implementation of innovative teaching methods, including case-based learning (CBL) and case seminars, have played a pivotal role in enhancing the educational experience for PharmD students in the pathology curriculum.

Declaration of Interest
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From Theory to Practice: Perceived Outcomes of Master in Health Professions Education Program in Pakistan

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Abstract:
Pakistan's medical and dental institutions face a shortage of qualified faculty, many of whom lack formal training in curriculum design, instructional strategies, and educational leadership. Masters in Health Professions Education programs aim to address these gaps by preparing clinicians as competent educators. This study evaluated alumni perceptions of the MHPE program at Shifa Tameer-e-Millat University (STMU) to determine its impact on professional development, leadership readiness, and interprofessional collaboration. A descriptive cross-sectional study was conducted among MHPE graduates of STMU, who graduated between 2015 to 2024. Data was collected through a validated questionnaire based on the RE-AIM framework, covering nine domains of educational impact. Responses were rated on a 5-point Likert scale. Seventy-four alumni participated. Participants reported moderate-to-high perceived gains in educational knowledge, teaching capacity, curriculum development, and interprofessional collaboration. Only one domain—enhancement in patient care outcomes—showed a statistically significant difference by duration of healthcare experience ($F_{(3,70)}$ =3.95, p=.012; Welch's F=5.61, p=.004). Mid-career professionals reported the greatest perceived gains. Alumni perceived the MHPE program as strengthening educational competencies. However, the application of educational evaluation frameworks remained limited. Future program improvements should emphasize authentic evaluation projects, structured leadership mentorship, and career stage–specific support to optimize impact.

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Introduction

Pakistan's medical and dental institutions face a significant shortage of qualified faculty[1], with many lacking formal trainings in evidence-based curriculum design, assessment, instructional strategies, and educational leadership. Ever growing complexity in healthcare systems mandates health educators to indoctrinate curriculum reform, foster inter professional collaboration and improve patient care through fine quality training systems. Faculty development should be entailed to enrich with expertise in educational theory, research, and leadership ensign with global and national healthcare education needs[2,3,4].

Globally, Master's in Health Professions Education (MHPE) programs have emerged as key pathways for preparing clinicians to become effective educators, leaders, and researchers[5]. These programs aim to enhance teaching competencies, curriculum development skills, and scholarly engagement, enabling graduates to influence both institutional practices and healthcare outcomes[6,7]. The RE-AIM framework—addressing Reach, Effectiveness, Adoption, Implementation, and Maintenance—offers a comprehensive approach to evaluating their impact at individual and system levels[8].

In Pakistan, the number of universities offering MHPE program is growing, yet little is known about the outcomes of these programs. Specifically, there is limited evidence on how graduates apply their training in real-world educational and clinical contexts. We yet need to ascertain whether program benefits vary by career stage. Understanding these outcomes is essential to ensure that MHPE programs meet international standards, deliver value to healthcare institutions, and ultimately improve patient outcome. This study examines alumni perceptions of the MHPE's influence on their professional roles, leadership readiness, and inter professional collaboration, with the aim of identifying strengths and areas for

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improvement in program delivery system.

Research Question:

How does a master's degree in health professions education affect leadership, instructional responsibilities, and interprofessional collaboration of graduates across the experience in health care education?

Materials and Methods
Study Design

We conducted a descriptive cross section study to evaluate the impact of MHPE from the participants who graduated between 2015 to 2024. This design was used to have a comprehensive perception tailored in a questionnaire to evaluate the influence of the MHPE and have a deeper understanding of the tangible benefits of MHPE programs and their role in transforming healthcare environments.

Settings

Shifa Tameer-e-Millat University (STMU) has been offering a MHPE since 2015. MHPE-STMU includes four semesters over two calendar years, totaling forty credit hours (thirty-two credit hours of coursework and eight credit hours for research). The goal is to create a health professions education faculty that prioritizes research and educational scholarships.

Data Collection
Questionnaire

The questionnaire was designed by the School of Health Professions Education at STMU, informed by existing literature on MHPE outcomes and the RE-AIM evaluation framework. Items covered nine domains: educational knowledge, instructional design, curriculum development, educational evaluation, teaching capacity, learner/colleague feedback, patient outcomes, inter professional collaboration and leadership preparedness. The initial draft was reviewed by a panel of three experts in health professions education for content validity. Minor adjustments were made to improve clarity and relevance. The instrument was piloted with a sample of five MHPE graduates, who hitherto finished the master's degree and were excluded from this study; feedback confirmed clarity and relevance of items. The questionnaire consists of nines items regarding understanding of educational concepts, impact on medical education practice, frequency of utilizing educational concepts, enhance capacity to instruct, feedback from colleagues, enhancement in patient care outcomes, enhancement in interprofessional.

Recruitment of Participants

All alumni who successfully completed the MHPE program at STMU were included in the study were invited to participate via Whats App messages sent through alumni groups maintained by the department. The invitation included a brief study description, a consent statement, and a secure link to the Google Forms questionnaire. We acknowledge that this recruitment method may have led to self-selection bias, with more engaged or motivated alumni possibly overrepresented in the sample. The respondents were asked to indicate their agreement using a 5-point Likert scale, ranging from strongly agree (5), agree (4), uncertain (3), disagree (2), Strongly disagree (1).

Data Analysis

IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM CORP) was used to analyze the data, presenting each item as Means (M) and Standard Deviations (SD). A one-way analysis of variance (ANOVA) was conducted to examine whether the duration of experience in healthcare influenced participants' perceptions of the MHPE program's impact across multiple domains. Graph generations were performed using Pivot Tables and charting tools in the latest version of Microsoft Excel (Microsoft 365). We designated impressions as 'positive' when the corresponding score was above 3.

Ethical Approval

We obtained ethical approval from the institutional review board & ethics committee of STMU (reference number IRB# 615-24, approval date 26-DEC-2024). The participants could withdraw at any time for any reason.

Results

The study comprised 74 participants from diverse academic positions, with the greatest representation from Professors (28.4%) and Assistant Professors (24.3%). The duration of experience in the healthcare sector ranged from 5 to 16 years, with a mean of 11.14 years (SD = 4.67) and a median of 11 years. The most frequently reported duration of experience was 16 years (41.9%), followed by 11 years (23.0%), 5 years (20.3%), and 6 years (14.9%). Mean and Standard Deviation of items of each group based on years of experience in health care education is shown in *Table 1*. One-Way ANOVA results comparing MHPE Program Impact by duration of experience in health care is shown in *Table 2*. The Mean, standard deviation, p-values in bold indicate statistical significance at $p < .05$. Welch's F reported where applicable for heterogeneity of variances. Only one item showed a statistically significant difference across the groups: I have observed enhancements in patient care outcomes. The F-statistics for this item were 3.94, with a significant value of 0.01. The robust tests of equality of means also support this finding, with a Welch statistic of 5.60 and a Brown-Forsythia

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Item	≤5 yrs Mean (SD)	6–10 yrs Mean (SD)	11–15 yrs Mean (SD)	≥16 yrs Mean (SD)
The MHPE program increased my understanding of educational theories	3.80 (0.86)	3.82 (0.75)	3.82 (0.88)	3.61 (0.84)
The level of confidence in implementing instructional design concepts into healthcare education practice enhanced	3.40 (0.74)	3.55 (0.52)	3.53 (0.80)	3.58 (0.92)
The MHPE program impacted my medical education methodology in curriculum development	3.47 (1.13)	4.00 (0.63)	3.71 (0.85)	3.55 (1.21)
How frequently do you utilize the concepts of educational practice	2.33 (1.23)	3.00 (1.18)	2.53 (1.07)	2.81 (1.22)
I frequently utilize the concepts of educational practice	3.67 (0.72)	4.18 (0.75)	4.18 (0.88)	3.74 (0.93)
The MHPE enhanced my capacity to educate others	3.53 (0.64)	4.18 (0.60)	3.94 (0.66)	3.84 (0.64)
The learners provided positive feedback on educational practice	3.20 (0.41)	3.36 (0.81)	3.59 (0.62)	3.77 (0.50)
I observed enhancements in patient care outcomes	3.80 (0.77)	3.91 (0.94)	3.53 (0.87)	3.65 (0.98)
The MHPE program enhanced Interprofessional collaboration	3.47 (0.83)	3.55 (0.69)	3.41 (0.94)	3.48 (1.15)
The MHPE program has strong overall influence on me as a faculty member	3.40 (1.24)	4.46 (0.82)	3.41 (1.18)	3.84 (1.29)

Table 1: Groups are based on years of healthcare experience: ≤5 years, 6–10 years, 11–15 years, ≥16 years. M = Mean; SD = Standard Deviation.

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Item	M	SD	F	p	Welch's F	p (Welch)	Post Hoc Test (Tukey HSD)
The MHPE program increased my understanding of educational theories	3.73	0.83	0.34	.794	0.33	.802	—
The level of confidence in implementing instructional design concepts into healthcare education practice enhanced	3.53	0.80	0.17	.917	0.18	.910	—
The MHPE program impacted my medical education methodology in curriculum development	3.64	1.04	0.67	.573	1.14	.349	—
I frequently utilize the concepts of educational practice	2.68	1.18	0.90	.444	0.85	.479	—
The MHPE enhanced my capacity to educate others	3.89	0.87	1.71	.173	1.81	.165	—
The learners provided positive feedback on educational practice	3.85	0.66	2.34	.081	2.34	.093	—
I observed enhancements in patient care outcomes	3.55	0.60	3.95	.012	5.61	.004	Significant difference between 0–5 yrs and >15 yrs experience groups (p = .028)
The MHPE program enhanced interprofessional collaboration	3.69	0.91	0.48	.696	0.49	.692	—
The MHPE program equipped me for leadership	3.47	0.97	0.04	.988	0.06	.979	—
The MHPE program has strong overall influence on me as a faculty member	3.74	1.23	2.20	.096	3.30	.032	Significant difference between 6–10 yrs and >15 yrs experience groups (p = .041)

Table 2: Note. M = Mean; SD = Standard Deviation; F = F-statistic; p = probability value. Welch's F and p (Welch) are reported where the assumption of homogeneity of variances was violated. Post hoc comparisons were conducted using Tukey's Honest Significant Difference (HSD) test. Bolded p-values (< .05) indicate statistically significant differences among duration-of-experience groups.

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statistic of 3.35, both with significance values less than 0.05. This suggests that the observation of enhancements in patient care outcomes varies significantly among individuals with different durations of healthcare experience. For all other items, the significance values were greater than 0.05, indicating no statistically significant difference between the groups.

Graph I compares the experience in health care education wise the MHPE program increased my understanding of educational theories (blue), the level of confidence in implementing instructional design concepts into healthcare education practice enhanced (red) and impact methodology in curriculum developments (grey). *Graph II* compare the experience in health care education wise I utilize the concepts of educational evaluation to evaluate my educational programs (blue), the MHPE enhanced my capacity to instruct healthcare professionals (red), feedback provided by my colleagues concerning the modification I have instituted and observed enhancements in patient outcomes that was directly linked to the modification in health care education (grey),enhanced inter professional calibration and equipped me for leadership positions in health care education (yellow).

Discussion

This study evaluated MHPE graduates' perceptions of how the program influenced their educational and professional practices, leadership readiness, and collaboration in healthcare education. Consistent with international literature[4,5,6], participants reported moderate-to-high perceived improvements in knowledge, teaching capability, curriculum design, and inter professional collaboration. These findings reinforce the MHPE's role as a catalyst for developing skilled health professions educators capable of advancing institutional teaching quality and teamwork.

However, the consistently low ratings for the application of educational evaluation frameworks highlight a critical gap between conceptual understanding and application. Similar challenges have been noted in other contexts, where competing clinical demands, limited institutional support[4,6], and insufficient hands-on training limit the translation of theory into practice. Embedding authentic evaluation projects, mentorship in program evaluation design, and reflective practice exercises could bridge this gap.

Leadership preparedness emerged as moderate benefit, suggesting that while MHPE curricula introduce core leadership concepts, additional structured pathways—such as mentorship, leadership skills, exposure to governance, and targeted training in strategic leadership—are needed to translate learning into institutional influence[6]. Notably, mid-career professionals reported the highest perceived gains across multiple domains, indicating that career stage may influence receptivity and application of MHPE learning. Admissions policies could leverage this by balancing intake between early-career and mid-career educators to optimize institutional return on investment. The learning and teaching capabilities of early-carrier
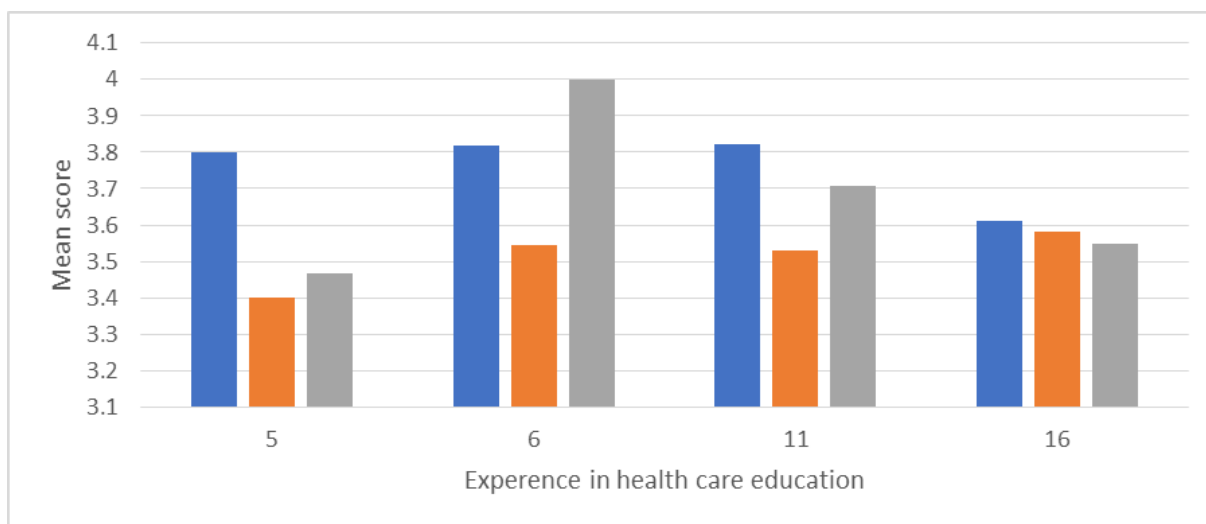
Graph 1: **Comparison of mean scores by experience level**

Graph 1: Experience in years in health care education wise mean score of the MHPE program increased my understanding of educational theories (Blue), the level of confidence in implementing instructional design concepts into healthcare education practice enhanced (Red) and impact methodology in curriculum developments (grey).

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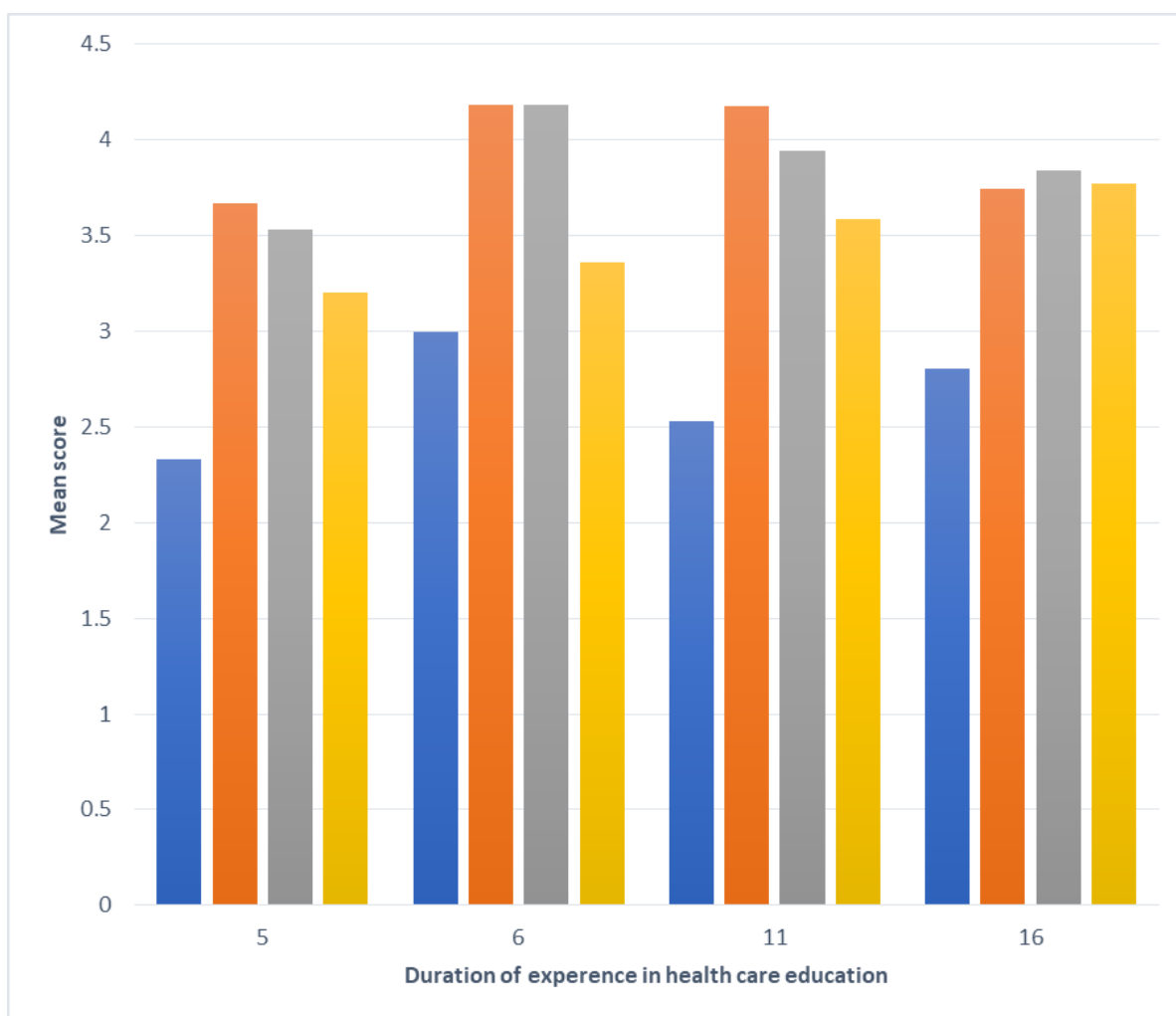
Graph II: Experience in years wise mean score I utilize the concepts of educational evaluation to evaluate my educational programs (blue) , the MHPE enhanced my capacity to instruct healthcare professionals (red), feedback provided by my colleagues concerning the modification I have instituted and observed enhancements in patient outcomes that was directly linked to the modification in health care education(grey),enhanced Interprofessional calibration and equipped me for leadership positions in health care education(yellow)

educators need to be enhanced. The application of knowledge among the mid-carrier educators needs to be emphasized and re-evaluated.

The study's reliance on a single institution and self-reported measures limits the generalizability and objectivity of findings. Future research should adopt multi-institutional, longitudinal designs incorporating objective performance metrics and patient care outcomes to validate and extend these results.

Conclusion

The MHPE program at STMU was perceived by graduates to enhance educational knowledge, teaching capacity, inter professional collaboration, and leadership readiness, though the consistent application of educational evaluation frameworks remains limited. To maximize program impact, three priorities are recommended: Integrate applied

evaluation training through authentic projects using frameworks such as CIPP and Kirkpatrick; Strengthen structured leadership development with mentorship and exposure to institutional governance; Tailor support to career stage, particularly for early- and mid-career educators who may demonstrate the greatest gains.

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The Use of Data Analytics in Improving Health Education Outcomes

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Abstract:

Data analytics transforms how health education is designed, delivered, and evaluated. This study examines how analytics improves teaching quality, learner engagement, and institutional decision making in health-related programs. It presents an integrated framework that connects three enablers, technology infrastructure, organizational capability, and pedagogical application, showing how they work together to enhance education outcomes.

Unlike existing studies that treat analytics mainly as a technical tool, this framework links data analytics, ethics, and pedagogy to create a balanced, human-centered approach. It draws on global evidence and practitioner insights to illustrate how predictive analytics, dashboards, and machine learning can personalize learning, track performance, and inform resource allocation.

Practical recommendations and case-based examples demonstrate how education leaders can use analytics to improve both institutional performance and community health literacy. Key challenges, data privacy, infrastructure gaps, and governance, are discussed with strategies for ethical and sustainable implementation.

This paper contributes a managerial and actionable model for using analytics in health education. It positions analytics not only as a technology innovation but as a strategic capability that drives measurable learning and health outcomes.

Key Words:

Data Analytics; Health Education; Predictive Analytics; Ethical Governance; Digital Transformation; Learning Outcomes; Evidence-Based Management

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The rapid growth of information technology has changed how education and public health systems operate. In health education, where learning outcomes directly influence well-being, data analytics provides a powerful way to improve teaching, engagement, and institutional performance. Health education spans many settings, from professional medical training to community based health literacy programs. Yet traditional methods often depend on fixed curricula and outdated evaluation tools that miss real-time learner behavior and progress. With the rise of big data, artificial intelligence (AI), and machine learning (ML), educators can now track engagement, assess comprehension, and predict learner performance with greater accuracy. For instance, predictive analytics can flag students at risk of poor performance, allowing timely support. Interactive dashboards give instructors visibility into learning trends and help them personalize content. Beyond classrooms, analytics also help policy designers and administrators evaluate public health programs and allocate resources more efficiently.

However, integrating analytics into health education is not without barriers. Data privacy, limited infrastructure, ethical risks, and low staff data literacy often slow adoption. The real challenge is not access to technology but the readiness of institutions to use analytics responsibly and effectively.

This study explores how health education institutions can strategically apply data analytics to improve learning outcomes and decision-making. It brings together lessons from research and practice to develop a conceptual model that links technology, organizational capacity, and pedagogy. The goal is to offer education leaders, policymakers, and IT professionals a practical, ethical, and sustainable roadmap for implementing analytics in their institutions.

Literature Review

The application of data analytics in education has evolved from basic reporting to a sophisticated, insight-driven discipline that informs both pedagogy

and institutional strategy. Within health education, data analytics enables educators to interpret complex learner interactions, identify learning gaps, and evaluate training effectiveness with precision. This section reviews the theoretical and empirical foundations shaping analytics adoption, emphasizing its evolution, technological enablers, pedagogical impact, and ethical dimensions.

Evolution of Data Analytics in Education

Data analytics in education emerged from early digital learning management systems (LMS) that primarily tracked attendance and test scores. Over time, research began emphasizing a paradigm shift from intuition-based teaching to data-informed instruction. The evolution of learning analytics (LA) and educational data mining (EDM) brought more refined tools for real-time feedback, adaptive learning, and predictive modeling.

In health education, these developments have enabled instructors to move beyond assessing knowledge acquisition, instead visualizing how learners engage with complex materials such as disease modeling, health promotion, or epidemiological simulation. Simulation-based analytics, for example, allows educators to assess comprehension of health protocols and adjust content dynamically to learners' needs. This progression a decisive movement evidence-based teaching and performance optimization.

Information Technology as an Enabler

Information technology (IT) serves as the operational backbone for analytics implementation. Advanced data infrastructures, including cloud computing, machine learning platforms, and data visualization dashboards, allow for scalable data capture and analysis. Integration of these tools into academic ecosystems ensures not only data accessibility but also interdisciplinary collaboration across education, clinical training, and public health systems.

In health education, IT enables the merging of academic datasets with real-world clinical outcomes, creating comprehensive learning ecosystems that connect classroom analytics to population health insights. Predictive dashboards now assist administrators in reallocating teaching resources or refining curricula to align with emerging health competencies, demonstrating how IT infrastructure underpins continuous quality improvement.

Analytics for Learning and Institutional Improvement

Empirical studies consistently show that analytics-driven insights enhance both individual and organizational outcomes. In nursing education,

predictive analytics has been shown to reduce failure and dropout rates through early detection of at-risk students. Similarly, adaptive feedback systems in public health training have improved learner engagement and comprehension.

At an institutional level, analytics informs strategic decisions by identifying performance trends, optimizing budgets, and tracking the return on educational investment. National health academies in Singapore and Canada have used analytics dashboards to evaluate educator effectiveness and learner engagement, leading to policy level reforms. Such evidence demonstrates analytics as both a pedagogical instrument and a strategic management tool.

Ethical, Cultural, and Practical Challenges

While the advantages of analytics are significant, ethical, and infrastructural challenges remain substantial. Data privacy, ownership, and algorithmic fairness are recurring concerns, particularly when personal health or behavioral data are involved. In low-resource contexts, technical infrastructure, and human capacity constraints often hinder adoption.

Moreover, ethical governance frameworks such as GDPR and HIPAA have increased awareness about transparency and accountability but also introduced compliance burdens that many institutions struggle to meet. Researchers emphasize that institutions must build ethics into their analytics architecture, not as a compliance checkbox, but as a cultural value ensuring learner trust and equity.

Identified Gaps and Conceptual Implications

Although analytics has advanced substantially, the literature reveals key gaps. Most studies focus on academic performance metrics, such as grades, retention, or satisfaction, without linking analytics to broader health outcomes or behavioral change. Furthermore, few frameworks explicitly integrate the

Methodology

Research Design

This study adopts a conceptual review design, integrating insights from peer-reviewed journals, institutional reports, and case studies on data analytics in education and public health. Rather than testing a specific hypothesis, the goal is to synthesize theoretical and practical findings into a unified framework that explains how data analytics enhances health education outcomes.

A qualitative interpretive approach was employed to identify key success factors, recurring challenges, and best practices. This design was selected because

it allows the researcher to connect diverse strands of literature, spanning information systems, education, and management, into a cohesive perspective relevant for both scholars technological, organizational, and pedagogical dimensions required for sustainable analytics adoption.

This study addresses these gaps by proposing a conceptual model that unites these domains under a single framework, illustrating how strategic use of data analytics can improve both educational effectiveness and community health outcomes. By emphasizing the intersection of technology, human capacity, and ethics, this model aligns with the SMR ethos of actionable research that bridges theory and managerial relevance.

Research Questions

The central question guiding this review is:

How can data analytics be effectively utilized to improve health education outcomes across diverse learning contexts?

Three supporting sub-questions shape the synthesis:

- What analytical tools and technologies are most effective in health education?
- How do institutions use analytics to support curriculum design, learner engagement, and performance evaluation?
- What organizational and ethical challenges affect sustainable analytics adoption?

Data Sources and Selection Criteria

Secondary data were drawn from academic databases, including Scopus, ScienceDirect, IEEE Xplore, Google Scholar, and PubMed.

Inclusion criteria:

- Studies published between 2012 and 2024
- Focus on analytics, information systems, or data-driven approaches in education or health training.
- Empirical findings, conceptual models, or applied case studies.
- Published by reputable academic or professional organizations such as WHO or EDUCAUSE.

From over 120 initial results, 37 publications met the inclusion criteria after screening for quality and relevance. These works collectively represent higher-education, clinical-training, and public-health contexts across multiple continents.

Analytical Framework

The literature was analyzed thematically through three iterative stages:

1. Theme Identification: extracting recurring ideas such as predictive analytics, adaptive learning, and data governance.
2. Categorization: grouping themes into conceptual categories: technological enablers, organizational capability, and pedagogical applications.
3. Integration: developing a conceptual model illustrating interrelationships among analytics adoption, institutional readiness, and improved learner outcomes.

Methodological Limitations

Because this study relies solely on secondary data, it does not include primary empirical collection. Differences in study design and data quality may limit generalizability. Nevertheless, the breadth of sources allows for a rich cross-disciplinary synthesis valuable for theory building and managerial insight.

Results and Analysis

These results emphasize that analytics is not simply a technological innovation but a strategic enabler of improved learning outcomes, institutional accountability, and health impact.

Learner Personalization

Data analytics enables the customization of learning paths based on student engagement, performance history, and learning styles.

AI-driven dashboards give instructors real-time visibility into learner progress and content mastery (Ferguson, 2019). By analyzing assessment data and participation trends, educators can tailor teaching methods and learning materials to individual needs.

For instance, a World Health Organization

(2023) pilot program in Sub-Saharan Africa recorded a 30% increase in course completion when adaptive feedback loops were introduced through analytics dashboards. Similarly, Zhou and Han (2024) found that personalized, analytics-informed learning modules improved concept retention among health trainees by 25%.

Personalization, therefore, strengthens learner engagement, self-efficacy, and motivation, core determinants of effective health education.

Predictive Intervention

Predictive modelling transforms analytics into an early-warning system for learners at risk of poor performance or attrition.

In a European nursing education program, regression-based predictive analytics identified 87% of at-risk students before midterm assessments (Choi, Kim, & Park, 2020). Targeted mentoring subsequently reduced course failures by 18%.

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Beyond academic forecasting, predictive systems can also flag behavioral or emotional disengagement, allowing earlier support and well-being interventions (McKinsey & Company, 2023). These tools help educators shift from reactive responses to proactive, data-driven engagement strategies, improving both student experience and institutional efficiency.

Evidence-Based Decision-Making

At an institutional level, analytics supports data-informed policy and managerial decision- making. Dashboards aggregate metrics such as course participation, learner satisfaction, and resource utilization (Johnson, Smith, & Brown, 2021).

Such transparency enables leaders to make informed adjustments to staffing, curriculum design, and budget allocation.

Deloitte (2022) reported that organizations using analytics-based performance tracking achieved 20–35% gains in operational efficiency and better alignment between training and organizational goals. In health education, this means that analytics dashboard can help track instructor effectiveness, identify program bottlenecks, and ensure accountability to stakeholders.

By combining academic analytics and administrative data, institutions can optimize resources and improve strategic outcomes.

Organizational Transformation

Analytics adoption fosters a data-driven culture that enhances institutional learning and innovation.

Singapore's Health Education Board and Canada's National Health Training Institute have both demonstrated how analytics integration promotes continuous improvement through leadership engagement and cross- departmental collaboration (WHO, 2024).

Transformative analytics implementation relies on capacity building, ethical governance, and technological infrastructure (Martinez & Okeke, 2023). When these dimensions align, analytics become embedded in institutional routines, creating a resilient, adaptive organization capable of responding to new health challenges and learning trends.
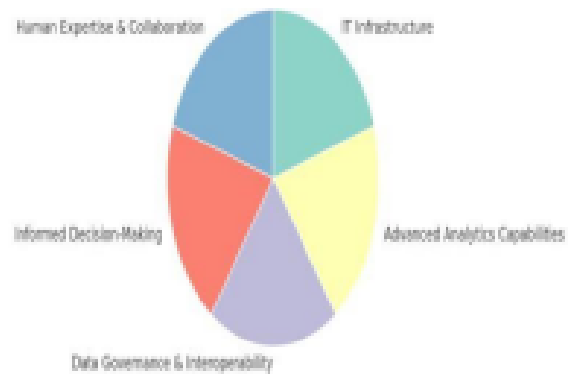
Figure 1: Conceptual Framework of Data Analytics in Health Education

Description:

This conceptual model depicts three interdependent components of analytics-driven health education:

- Technology Infrastructure:cloud computing, secure databases, and analytics software.
- Organizational Capability:leadership, culture, and staff data literacy.
- Pedagogical Application: adaptiveinstruction, predictive analytics, and data dashboards.

Flow:

Data flows from infrastructure to application, while organizational capability enables feedback loops that refine teaching, learning, and management decisions. The framework represents a cyclical, adaptive system designed to improve educational quality and community health outcomes.

Dimension	Analytical Function	Academic Evidence	Industry Evidence	Impact on health education
Learner Personalization	Adaptive learning paths	Ferguson (2019)	WHO (2023)	Increased retention and motivation
Predictive Intervention	Early Identification of at-risk students	Choi et al (2020)	Mc Kinsey (2023)	Reduced dropout rates
Evidence-based management	Data-driven policy & resource allocation	Johnson et al (2021)	Deloitte (2022)	Improved efficiency & transparency
Organizational Transformation	Institutional capacity building	Martinez & Okeke (2023)	WHO (2024)	Sustainable innovation & governance

Table 1: Summary of Analytical Dimensions and Their Impact

Phase 1 Preparation (0–3 months):
Audit data systems, assess skill readiness, and define analytics goals.
Phase 2 – Pilot and Integration (3–9 months):
Deploy analytics tools in selected programs, train educators, and collect pilot data.
Phase 3 – Institutionalization (9–24 months):
Embed analytics insights into strategic planning, review ethical compliance, and track health-related outcomes.
Outcome:
A self-sustaining ecosystem of continuous learning, data literacy, and adaptive decision-making.

Focus Area	Best Practice	Supporting Source(s)	Implementation Insight
Governance	Develop clear data policies	WHO (2024); Martinez & Okeke (2023)	Embed ethics into analytics design
Infrastructure	Adopt scalable, secure platforms	Alabi et al. (2021); Deloitte (2022)	Use cloud-based and open-source tools
Skills	Build educator data literacy	McKinsey & Company (2023)	Conduct faculty workshops
Evaluation	Align KPIs with health outcomes	Johnson et al. (2021); Ferguson (2019)	Link data metrics to public
Sustainability	Promote leadership ownership	WHO (2023)	Ensure cross-sector collaboration

Table 2: Best Practices for Data Analytics Implementation in Health Education

Figure 2: Analytics Implementation Roadmap for Health Education

Together, these figures and tables synthesize how analytics functions as a multi-layered system that enhances teaching, institutional learning, and societal health outcomes. They serve as practical guides for education leaders and policymakers aiming to implement analytics ethically and sustainably.

Discussion

Analytics has quietly become the new literacy of leadership. In health education, it's redefining how organizations learn, adapt, and act. The convergence of information technology (IT) and educational strategy has transformed data from a passive reporting tool into a dynamic engine for decision making. The proposed Dynamic Analytics Maturity Model for Health Education (DAMM-HE) shows that progress depends on three interconnected drivers: technological infrastructure, analytical capability, and data-informed leadership. Together, they form a continuous improvement loop, collecting insights, applying them to programs, and using results to refine learning and delivery.

When these components align, analytics become more than a technical upgrade, it becomes a strategic differentiator. Organizations can personalize learning experiences, identify gaps in knowledge, and evaluate program outcomes with precision. The result is not just better education, but measurable improvements in health literacy, behavioral change, and patient outcomes.

1. The New Foundation: Interoperability and Governance

A key lesson from leading institutions is that analytics only work when systems can talk to each other. Health education involves multiple stakeholders, universities, hospitals, NGOs, and ministries, each managing distinct data silos. Without interoperability, valuable insights stay trapped.

Progressive organizations are addressing this by investing in open architectures, data-sharing protocols, and ethical frameworks aligned with global standards like HIPAA and GDPR. For example, the European Digital Education Hub has built a federated data-sharing ecosystem that allows public health universities to exchange anonymized learning data securely. This not only ensures compliance but enables collective innovation.

The managerial takeaway is clear: governance and technology must advance together. Without trust and transparency, even the most advanced analytics models will fail to achieve impact.

2. Predictive and Prescriptive Intelligence: From Insight to Action

Health education leaders are no longer satisfied with descriptive dashboards that explain the past, they want predictive and prescriptive systems that shape the future. Predictive analytics identifies patterns in learner engagement or demographic trends to anticipate who might disengage or underperform. Prescriptive analytics goes further, recommending specific interventions such as the best time to deliver digital modules or the ideal format for community outreach.

For instance, Johns Hopkins Bloomberg School of Public Health uses machine learning to predict.

dropout risks in its online epidemiology courses, allowing faculty to intervene early. Meanwhile, WHO's OpenWHO platform leverages real-time engagement data from over six million global learners to optimize course design, boosting completion rates by more than 20%.

These examples show analytics in action, not as a research tool, but as a management instrument for designing more inclusive, data- driven education systems.

3. Ethics and the Human Factor

Technology amplifies both strengths and weaknesses. While analytics can improve access and efficiency, poorly designed algorithms can entrench inequity. Biased datasets or overreliance on quantitative measures can ignore cultural and

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emotional factors that drive learning success.

The next generation of analytics must therefore be human-centered, designed to support, not replace, educators' empathy and expertise. Leaders must ensure that algorithms are transparent, interpretable, and used responsibly. In this context, ethical governance becomes not just a compliance function but a strategic capability that builds institutional legitimacy.

participation, the platform continuously refines its course catalog. The result: a 25% improvement in learner retention and a broader reach into low-resource regions.

Johns Hopkins Bloomberg School of Public Health:
Their Data Analytics for Health Learning Initiative integrates predictive models that flag learners at risk of dropping out of online courses. These alerts

Step	Action	Key Managerial Focus
1. Define Objectives	Clarify measurable educational and health outcomes	Align analytics with mission priorities
2. Assess Data Readiness	Audit existing data and identify quality gaps	Build awareness of what is already available
3. Form a Cross-Functional Team	Blend IT, education, and public health experts	Promote interdisciplinary problem-solving
4. Launch Pilot Projects	Start with one or two small-scale initiatives	Demonstrate quick wins and refine approach
5. Adopt Scalable Tools	Use open-source or cloud-based platforms	Reduce cost and increase flexibility
6. Establish Governance	Define privacy, ethics, and access protocols	Build stakeholder trust
7. Build Data Literacy	Train educators and managers to interpret data	Foster a data-informed culture
8. Institutionalize Continuous Feedback	Use dashboards and analytics loops for ongoing learning	Create adaptability and accountability

Table 3: Steps, Actions, and Managerial Focus for Health Education Leaders

4. Managerial Recommendations: A Practical Roadmap
For health education leaders, especially those operating with limited budgets, the question is not whether to adopt analytics, but how to start smart. The following roadmap provides a practical sequence for implementation:

5. Illustrative Case Insights
OpenWHO (World Health Organization):
Launched to democratize access to health knowledge, OpenWHO uses analytics to monitor user engagement globally. By examining metrics like completion rates, device usage, and regional

trigger personalized instructor outreach, cutting attrition by an estimated 15% annually.

The Global Digital Health Network (GDHN):
This consortium leverages analytics to evaluate the real-world behavioral impact of health education campaigns, linking digital learning data with community health indicators. The integration provides policymakers with evidence-based insights to redesign national awareness programs.

Together, these examples illustrate that when analytics is embedded strategically, it doesn't just optimize learning, it transforms institutional agility and policy design.

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6. Strategic Imperatives for Health Education Leaders

Health education leaders must now evolve from information managers to data strategists. Three imperatives define the path forward:

Treat Analytics as Leadership Capital:

Analytics is no longer a back-office function; it's a leadership skill. Decision-makers must learn to ask data-driven questions and translate insights into policy.

Shift from Data Collection to Decision Intelligence:

The goal is not amassing more data but extracting meaning that drives smarter, faster decisions. Leaders should measure impact in behavioral and societal outcomes, not just course completion.

Build Ethical Advantage:

In a trust-conscious era, institutions that prioritize transparency and fairness in data use will gain a reputational edge. Ethical analytics is both a moral duty and a strategic differentiator.

Illustrative Case Insights

To move beyond conceptual discussion, this section presents three real-world cases that demonstrate how data analytics is already improving health education outcomes. Each example highlights practical lessons for educators and managers.

Case 1: Johns Hopkins Bloomberg School of Public Health

Johns Hopkins developed an Analytics for Health Learning Initiative that uses predictive modeling to identify learners at risk of dropping out of online epidemiology and health systems courses. The analytics system flags disengaged learners based on logins, quiz activity, and discussion participation.

Faculty receive early alerts and intervene through personalized feedback and short coaching sessions. This targeted approach has cut dropout rates by 15% annually and improved overall course satisfaction. The case shows how combining predictive analytics with human support improves learning outcomes and demonstrates that analytics can enhance, not replace, educator judgment.

Case 2: World Health Organization's OpenWHO Platform

The OpenWHO digital platform delivers free online courses to millions of global learners in multiple languages. Through analytics, the platform tracks learner engagement, course completion, device use, and geographic reach.

By analyzing participation data, WHO discovered that learners using mobile devices in low bandwidth regions often dropped out early. The organization redesigned mobile courses, simplified modules, and added low-data video options. These changes increased retention by 25% and expanded access in underserved regions.

OpenWHO demonstrates how global health education programs can use data analytics to make informed adjustments that improve both access and completion.

Case 3: Global Digital Health Network (GDHN)

The Global Digital Health Network uses data analytics to link online health education with real world behavioral outcomes. It collects data from digital training platforms and compares them with community health indicators, such as vaccination uptake or preventive care participation.

This integration allows policymakers to see how online learning translates into measurable public health results. For example, in Kenya and the Philippines, analytics from GDHN-supported courses informed national campaigns on maternal health awareness, leading to higher attendance at prenatal checkups.

The GDHN case demonstrates analytics as a bridge between education and policy, showing how learning insights can drive health system performance.

Managerial Roadmap and Toolkit

To help education leaders translate analytics theory into practice, this section outlines a step-by step roadmap and practical toolkit. The focus is on how to start, scale, and sustain analytics driven improvement in health education.

Toolkit Snapshot: Practical Actions for Leaders

● Set priorities: Start with one critical problem, like student retention or engagement, and build around it.
● Simplify data flows: Consolidate data sources (LMS, surveys, assessments) into one analytics dashboard.
● Use dashboards for decisions: Review insights monthly to guide staffing, funding, and curriculum updates.
● Measure behavior, not just grades: Track participation and completion trends to understand motivation.
● Reward data-informed teaching: Recognize faculty who use analytics to improve learning.
● Integrate ethics from the start: Embed privacy and fairness checks in every analytics project.

Step	Action	Key Managerial Focus
1. Define Clear Objectives	Identify measurable learning and health outcomes.	Align analytics goals with your institutional mission and strategy.
2. Assess Data Readiness	Audit existing data systems and identify skill or infrastructure gaps.	Ensure data quality and establish clear ownership.
3. Form a Cross-Functional Team	Bring together IT staff, educators, and public health professionals.	Encourage collaboration across academic and administrative units.
4. Launch Small Pilot Projects	Start with one or two programs to test analytics tools.	Demonstrate early wins to build stakeholder confidence.
5. Choose Scalable Tools	Use open-source, cloud-based, or low-cost analytics platforms.	Maintain flexibility and control costs.
6. Build Data Literacy	Train educators and managers to interpret and apply analytics.	Foster a data-informed culture and reduce resistance.
7. Establish Ethical Governance	Define privacy, transparency, and fairness policies.	Build trust among staff and learners.
8. Create Continuous Feedback Loops	Use dashboards and regular reviews to refine programs.	Integrate analytics into long term strategic planning.

Table 4: Managerial Roadmap for Implementing Data Analytics in Health Education

The New Mandate: Human + Machine Collaboration

Sustainable success lies in integrating IT infrastructure with human expertise. Technology alone cannot drive transformation, it must be guided by educators, policymakers, and technologists who share a unified purpose. When analytics insights inform daily decisions, health education moves from reactive content delivery to proactive knowledge management. The most forward-thinking organizations are already demonstrating this future: where data fuels inclusion, technology scales compassion, and education becomes a continuous act of innovation.

Conclusion

This study shows that data analytics is reshaping health education by improving how knowledge is delivered, assessed, and managed. Analytics enables institutions to personalize instruction, strengthen decision-making, and link educational performance to broader public health outcomes.

The proposed framework integrates three essential drivers, technology infrastructure, organizational capability, and pedagogical application, to create a continuous feedback system for learning improvement. Unlike models that focus only on tools or data systems, this framework connects analytics to leadership, ethics, and institutional culture, making it both strategic and sustainable.

Analytics in health education should not be viewed as a one-time innovation but as a long-term capability. Institutions that invest in data literacy, ethical governance, and cross-functional

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collaboration build resilience and adaptability. The managerial roadmap and case studies presented in this paper demonstrate that analytics, when applied responsibly, leads to measurable improvements in learner engagement, retention, and policy design.

The evidence suggests that analytics success depends as much on human factors, leadership, trust, and collaboration, as on technology. As digital transformation accelerates, education leaders must see analytics not as a reporting tool but as a core management discipline that drives accountability and innovation.

The insights and framework provided here give educators, policymakers, and administrators a clear foundation to begin or refine their analytics journey. By treating analytics as both a technical and human system, institutions can achieve lasting impact in education and health outcomes.

Limitations and Future Research
This study provides a conceptual and integrative framework for using data analytics to improve health education outcomes. However, it is important to note that the work remains conceptual rather than empirical. The findings and models are derived from secondary data and synthesis of existing literature, not from direct field investigation or original data collection.

While this design allows for a broad and interdisciplinary understanding, it also limits the paper's ability to test relationships empirically or measure real-world impact. The insights presented here should therefore be viewed as theoretical propositions that guide managerial practice rather than definitive empirical evidence.

Future research should focus on validating and expanding this framework through practical fieldwork and data-driven evaluation. The following areas are recommended:

Empirical Validation:
Conduct case studies, surveys, or longitudinal research across diverse health education institutions to test how analytics-driven interventions influence learner performance and behavioral outcomes over time.

Framework Testing:
Use structural equation modeling (SEM) or similar quantitative techniques to examine how the three enablers—technology infrastructure, organizational capability, and pedagogical application—interact to drive educational impact.

Ethical and Cultural Dimensions:
Explore how privacy practices, algorithmic fairness, and local data policies affect analytics adoption in different cultural or regulatory contexts.
Implementation Science:

Identify scalable and cost-effective analytics strategies for low-resource health institutions, where infrastructure and digital capacity are often limited.

Cross-Sector Collaboration:
Evaluate how partnerships between governments, universities, and NGOs can enhance analytics deployment and bridge the gap between learning systems and public health outcomes.

These research paths would strengthen the theoretical model and guide evidence-based policy in global health education.

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