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Addressing Challenges in Postgraduate Medical Education: A Focus on Faculty Training and Research Methodologies in India–A Systematic Review

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ABSTRACT
This paper examines the present condition of postgraduate medical education in India and suggests remedies to rectify its deficiencies. A significant concern is the insufficient faculty training and research methodologies. The proliferation of private medical institutions, fuelled by strong demand and high tuition rates, has resulted in a scarcity of faculty and imbalances in resources. The existing method of selecting candidates for postgraduate studies, which relies exclusively on entrance tests, is being called into doubt. Aptitude exams are recommended for evaluating potential at both the undergraduate and postgraduate levels. Although there is ongoing debate about the extent of faculty research involvement, it is crucial to recognize and emphasize the importance of excellence in teaching alongside research. The paper proposes promoting inventive pedagogical approaches. Ultimately, both students and doctors involved in education and research necessitate sufficient resources such as libraries, technology, and specialized teaching areas. Efficient medical education and research also require a specific allocation of time. India can enhance its postgraduate medical education system and cultivate a new cohort of exceptionally skilled medical professionals by tackling these difficulties.

Keywords: Workplace-based assessment, Clinical audit, Postgraduate medical education, Reliability, General practice, Research methodology.

INTRODUCTION

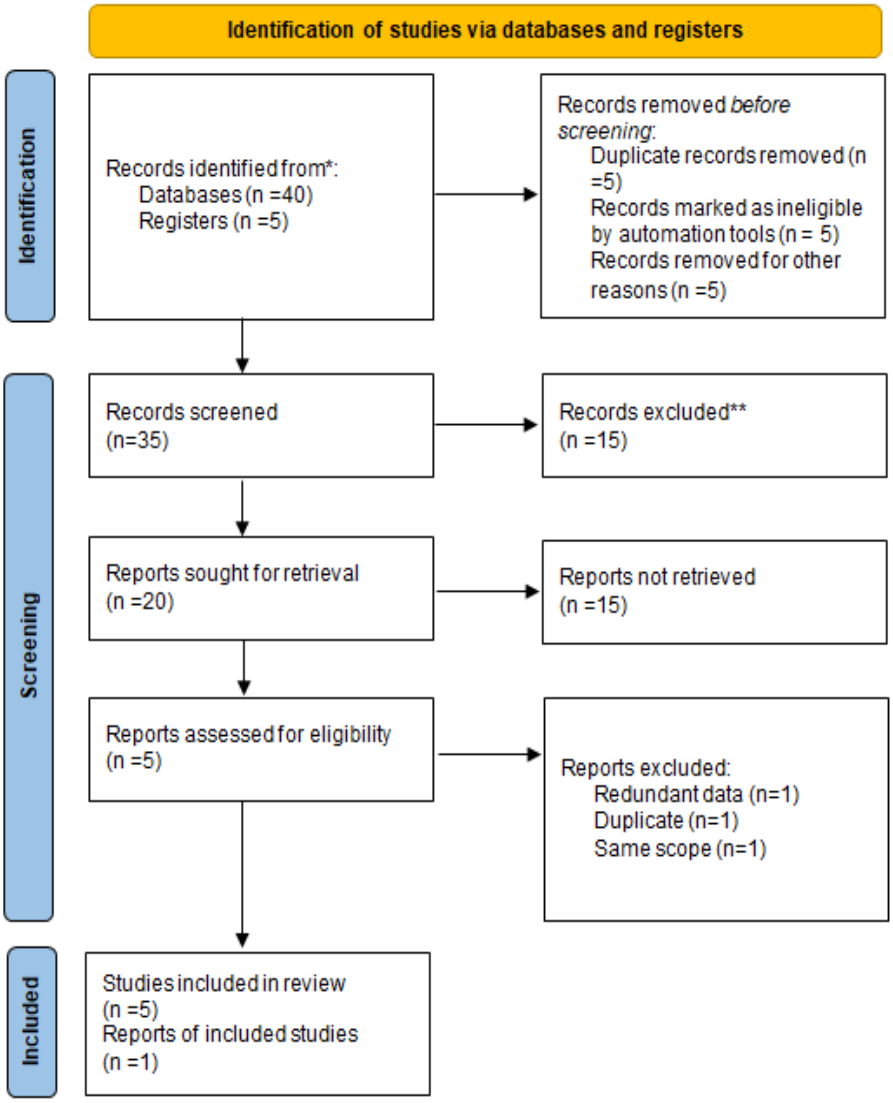
The progress of medical innovations is strongly dependent on a robust basis of health research. Developed nations allocate significant resources towards the identification and ranking of research requirements [1]. Nevertheless, India encounters obstacles within its health research ecosystem. Research activity has experienced a surge in the past decade, but it is primarily focused on a limited number of institutions and specific regions [2]. The absence of forums hinders collaboration and knowledge sharing. In addition, there needs to be more access to critical worldwide resources, and the training in research methodologies needs to be consistent [2-3]. These variables pose a danger to the overall integrity and volume of health research in India.The emergence of digital learning offers a potential avenue for education through Massive Open Online Courses (MOOCs) [4]. Massive Open Online Courses (MOOCs) provide a convenient and easily accessible method for acquiring research skills, demonstrating its efficacy in several healthcare education domains [4-7]. The popularity arises from offering high-quality learning experiences at any time and any place [7].

Research has demonstrated that MOOCs are efficient and effective for acquiring knowledge [8-10]. E-learning, akin to MOOCs, has demonstrated comparable effectiveness to conventional teaching approaches and even fosters self-directed learning [11].At now, colleges located in advanced nations [12] create the majority of MOOCs. More research needs to be conducted that specifically examines the experiences and issues encountered by MOOC providers [13]. In addition, there needs to be more research on the implementation and assessment of Massive Open Online Courses (MOOCs)in developing nations such as India [14-19].The National Medical Commission (NMC) acknowledges the significance of research training in postgraduate medical education.

Nevertheless, despite a substantial quantity of doctoral theses, there are still questions over the quality of research. Enhancing the quality of research methods training by utilizing Massive Open Online Courses (MOOCs) could resolve this deficiency[16-19]. The objectives include the enhancement of the research skills of medical practitioners. Further emphasis is placed on enhancing the output ofsuperior research that has a significant impact on healthcare practices and policies.

METHODS

In order to thoroughly comprehend the influence of e-learning on postgraduate students, we carried out a methodical examination of existing literature. We conducted a comprehensive search on four prominent databases: Web of Science, PubMed, ERIC, and CINAHL. We specifically examined studies that included participants who had completed their undergraduate education and assessed the effectiveness of any form of e-learning program. Studies that only described the aspects of e-learning without assessing its usefulness were not included.The intervention included searching for various articles related to the medical education audit, and the outcome included an analysis of the views of the participants on medical education in India.Further PRISMA analysis was performed to get a comprehensive understanding of the impact of e-learning on postgraduate medical education, we conducted a systematic search to study of current research. Studies that just reported the facets of e-learning without analyzing its efficacy were excluded.



PRISMA chart

DISCUSSION

Table 1: The medical statistical analysis performed by different authors

Sr. No.	Author(s)	Medical Statistical Survey	Intervention	Outcome
1	McWilliams et al. (1994) [18]	Postal surveys of all 18 deans of postgraduate medical education	Action research in the field of educational audit of postgraduate	Assessment of the current status and practices in medical education audit
2	Gharibi et al. (2023) [20]	Educational audit of the Tabriz Faculty of Management and Medical Informatics	Conducting an educational audit	Evaluation of educational performance based on the Tennessee Academic Audit Model
3	Chapman et al. (2015) [21]	Evaluation of the educational impact of participation in a student-led study	Participation in a student-led national collaborative study	Promotion of research and audit at medical school

4	Cantillon & Jones (1999) [22]	Description of educational or audit practices	Continuing medical education, audit, research, and clinical effectiveness	Assessment of the impact of continuing medical education in general practice
5	Mak & Miflin (2012) [23]	Incorporating training in clinical audit in postgraduate medical education	Training in clinical audit	Improvement in care delivery for future generations
6	Brazil (2004) [24]	Involvement of emergency medicine trainees in audits	Involvement in undertaking audits of emergency medicine training needs	Identification of training needs and incorporation of audit in emergency medicine training
7	Saravanan & Shanmugapriya (2018) [25]	Study in 92 postgraduate medical students	Teaching the principles and methods of clinical audit to medical postgraduates	Evaluation of the effectiveness of teaching clinical audit principles and methods to medical postgraduates
8	Batstone (1990) [26]	Utilization of district medical education committees	Use of district medical education committees as audit advisory committees	Utilization of district medical education committees for audit advisory purposes
9	Neville et al. (2018) [27]	Analysis of audit and research training provision in medical school curricula	Analysis of audit and research training provision within medical school curricula	Demonstration of the need to improve the provision of audit and research training within medical school curricula
10	Murphy et al. (2009) [28]	Video of consultations, referral letters, criterion audit, and SEA	Not found to have high reliability	Design of valid and reliable systems of assessment in workplace-based assessment in postgraduate medical education
11	Kumar et al. (2021) [29]	Lack of a similar framework in place at the medical school	Implementation of Clinical Audit Platform for Students (CAPS)	Effective organization from both the medical school and students
12	Spencer & Barton (1994) [30]	Survey of Senior Clinical Undergraduate Teachers	Need for teaching in medical audit	Identification of the need for teaching in medical audit
13	Aitkenhead (2002) [31]	Design, delivery, and audit of a teaching programme	N/A	The necessity to allocate specific resources for designing, delivering, and auditing a teaching programme
14	Cheek et al. (2016) [32]	Australian and New Zealand medical programs	Assessment of research training and its extent	Analysis of research training and its extent in Australian and New Zealand medical programs
15	Iobst et al. (2010) [33]	Implementing competency-based training in postgraduate medical education	Assessment of competency-based training implementation	Assurance of learner competence to progress in training or to the next

				phase of a medical career
16	Mazzuca et al. (1990) [34]	Medical education program on diabetes mellitus as a function of clinical environments	Assessment of program effects in different clinical environments	Evaluation of program effects in different clinical environments
17	Hutchinson et al. (2002) [35]	Certification assessment processes in postgraduate medical education	Validation studies on certification assessment processes in postgraduate medical education	Reported validation studies on certification assessment processes in postgraduate medical education
18	Ratnapalan & Hilliard (2002) [36]	Core curriculum initiative for postgraduate medical education using needs assessment	Description of core curriculum initiative for postgraduate medical education using needs assessment	Successful implementation of a core curriculum initiative for postgraduate medical education
19	Wearne et al. (2012) [37]	Supervisors' response to postgraduate clinical education	Identification of Factors affecting supervisors' Response to postgraduate clinical Education	Understanding of factors affecting supervisors' response to postgraduate clinical education

The optimal doctor-to-population ratio is 1:1000, indicating a shortage of doctors. The majority of states need to meet this standard, which suggests a lack of doctors. States such as Bihar and Uttar Pradesh exhibit notably low ratios (about 0.4 doctors per 1000 population). Availability Gap: While the statistics does not clearly indicate the difference between the number of doctors needed and the number of doctors available, the low ratios of doctors to population strongly imply a substantial gap in most states. Expansion rate: Uttarakhand and Arunachal Pradesh, among other states, exhibit a notable rise in the number of doctors, with an annual growth rate of over 8%.

Nevertheless, more than this may be needed to expedite the process of narrowing the gap if the existing deficit is significant. Duration to Achieve Optimal Proportion: Based on the present rates of growth, it would take numerous states many decades to achieve the recommended doctor-to-population ratio. Bihar, for example, is confronted with an immense problem since it is anticipated to require 224 years to achieve the desired level of doctor availability. Economic Disparity: There is a correlation between a state's financial well-being, as measured by its Gross State Domestic Product (GSDP), and the availability of doctors. More affluent states such as Goa and Sikkim exhibit excellent doctor-to-population ratio in contrast to less prosperous areas like Bihar and Uttar Pradesh. This implies that fiscal constraints could impede endeavours to augment the number of doctors in certain areas. Bihar, Uttar Pradesh, Jharkhand, and Chhattisgarh exhibit a significant scarcity of doctors in relation to their respective populations, resulting in a catastrophic shortage. States such as West Bengal and Assam are experiencing a gradual growth in the number of doctors, which calls for the implementation of more rapid expansion methods [38].

Overview of Online Medical Education Course Involvement and Results: This report provides a concise summary of the involvement, achievement, and input received from a recent web-based medical education program. Below is an analysis of the main discoveries: Attendees: The course had a total enrollment of 24,385 participants. More than half (54%) of the individuals were postgraduate medical students (PGs) who were actively pursuing either MS or MD degrees. Faculty members constituted 11% of the participants. Out of the total participants, the remaining 35% consisted of individuals with diverse backgrounds, such as medical diploma students, MPH holders, and non-medical professionals.

Evaluation of performance in assignments and exams: Completing the online assignments was a requirement that had to be fulfilled in order to be eligible to take a proctored exam. However, the exam was ultimately cancelled owing to the COVID-19 pandemic.The passing rates for medical postgraduates were very high, with 81% completing their tasks. Only 40% of the faculty members completed the assignments. In total, 60% of the participants completed the assignments. In light of the pandemic, certificates were granted to all those who completed the proctored exam by fulfilling the requirements of passing assignments and registration. Metrics measuring the level of involvement and successful fulfilment of tasks: The completion rates for lectures showed a progressive reduction from the commencement to the conclusion of the course, encompassing both faculty members and postgraduate students. Approximately 38% of the faculty members successfully finished all of their duties. Approximately 77% of postgraduates completed all of their tasks. The pass rates for assignment submissions were consistently high, ranging from 97% to 99.9% for both groups. The lectures on tool development and biostatistics received the lowest average scores from both faculty members and postgraduate students [39].

Forum Activity: A total of around 1,850 questions were posted by the participants in the discussion thread. 81% of the concerns were administrative in nature and pertained to enrolment, technical issues, assignments, eligibility, and examinations. Academic inquiries pertaining to course material accounted for the remaining 19%. Feedback from participants: Out of all the participants, only a mere 5% took the initiative to submit feedback, resulting in a total of 1,305 responses. The course received a good level of overall satisfaction, with an average rating of 4.5 out of 5 for teaching quality. The feedback emphasized the following: Gratitude for the lucidity of the topic, thorough explanations, engaging presenting style, and effective speaker delivery. Recommendations for enhancement comprised Further elucidation on particular subjects. Practical instruction in the field of biostatistics, covering topics such as sampling, determining sample sizes, utilizing data management tools and enhancing lectures by incorporating additional examples, pictures, images, animations, and clinical scenarios. This report offers vital insights regarding the efficacy of the online medical education course. The course was well-accepted based on the high rates of participation, excellent performance in assignments, and good feedback received. Organizers can utilize the input to enhance the content and distribution techniques for future versions of the course [39].

This article outlines the process of creating and executing a Massive Open Online Course (MOOC) focused on research methodologies for medical professionals in India. The initiative sought to enhance research proficiency among postgraduate students and academic members.Indian Medical Education achieved a milestone with the introduction of this online course, which is both mandated and overseen by an external body, marking a unique and innovative method in the country. This demonstrates the regulatory body's dedication to updating medical education and improving the quality of research. Research indicates that online learning can be equally successful as traditional approaches, particularly for adult learners in medical subjects. Previous research on web-based courses for nurses and doctors corroborates this claim. Dropout Rates: Like other Massive Open Online Courses (MOOCs), this course encountered a decrease in the number of participants. Possible contributing factors include procrastination and the relatively inexpensive initial investment. Challenges faced by participants: Previous research has indicated that technological constraints and an unhelpful educational setting might impede the experience of taking MOOCs. Rise in the number of students registered: Efforts are underway to devise strategies that would enable the expansion of the target audience.

Content Updates and Resources: The course content will be updated and improved depending on feedback, and extra supplementary reading materials will be made available. The Mentorship Program aims to provide direct help to college and regional learners by

addressing their inquiries. Improved Learning Experience: In response to participant input, future versions will incorporate the following enhancements: Illustrative instances pertaining to a specific lecture, Frequently Asked Questions docs, and Reading books suitable for beginners in the open-source field. Webcast sessions are available for live interaction in real time. Administrative Streamlining: An online chatbot will be implemented to automate the handling of simple queries, while human assistance will be provided for more intricate matters. Disseminating information and influencing outcomes: The authors anticipate that their experience will offer a beneficial blueprint for initiating comparable MOOCs on a national or regional scale. The purpose of this knowledge-sharing initiative is to provide benefits to the broader medical education community and enhance the development and implementation of online health research courses [39].

A significant obstacle is the need for more training of faculty members in essential areas such as ultrasound, hemodynamic monitoring, and research techniques. The article posits that a highly skilled faculty is vital in the production of high-calibre graduates. NTTC and FAIMER now assist in curriculum design and teaching methodologies. However, further help may be necessary. It is stressed that faculty members should also act as exemplars for collaboration, effective communication, and understanding.

The proliferation of private medical colleges, fuelled by solid demand and exorbitant tuition costs, has placed a burden on available resources. The rapid expansion has resulted in a need for more instructors and an uneven allocation of competent educators. The efficacy of the current system, which relies exclusively on entrance tests, is being called into question. The paper suggests the implementation of aptitude tests for both undergraduate and postgraduate medical education in order to more effectively evaluate the potential of candidates. The National Exit Test (NExT) and the updated selection algorithm, which incorporates MBBS exit tests and a licentiate exam, have been seen as favourable measures for enhancing skill development during internships. The necessity for faculty members to actively participate in research, which is frequently considered when determining promotions, is a subject of ongoing discussion. While several individuals argue that participating in research improves the quality of teaching, others stress the need to recognize teaching excellence on its own merits. The paper proposes promoting and incentivizing inventive pedagogical approaches. Educational materials and effective allocation of time: Students and doctors engaged in academic and research activities require sufficient resources such as libraries, technology, and dedicated teaching facilities. Frequent evaluations of these materials are essential. Efficient medical education and research necessitate a significant amount of focused time. Program managers should prioritize and allocate dedicated time for these activities. In essence, the paper emphasizes the necessity of employing a comprehensive strategy to enhance postgraduate medical training in India. To establish a robust system for training the next generation of talented medical professionals, India should focus on developing instructors, optimizing the selection process, fostering a research-oriented culture in addition to emphasizing teaching excellence, and providing sufficient time and resources [40].

CONCLUSION

Postgraduate medical education in India is confronted with both obstacles and chances for enhancement in its landscape. Empowering educators can be achieved by faculty development programs, implementing a revamped selection procedure that takes into account aptitude, and promoting creative teaching approaches in addition to research. It is essential to tackle the issue of faculty shortages and resource imbalances resulting from the rapid expansion of medical institutions. The National Exit Test (NExT), which has been recently proposed, has the potential to improve skill development during internships. India can

establish a robust system for educating and training highly skilled medical professionals by applying these ideas and allocating specific time for teaching and research.

REFERENCES

1. Institute of Medicine (US) Committee on Health Research and the Privacy of Health Information. The HIPAA Privacy Rule. Beyond the HIPAA Privacy Rule: Enhancing Privacy, Improving Health Through Research [Internet]. Nass SJ, Levit LA, Gostin LO, editors. Washington (DC): National Academies Press (US); 2009 [cited 2020 Oct 7]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK9578/ (DOI not available)
2. Kalita A, Shinde S, Patel V. Public health research in India in the new millennium: A bibliometric analysis. Glob Health Action. 2015;8:1–10. doi: 10.3402/gha.v8.27576. eCollection 2015.
3. Nagoba B, Davane M. Current Status of Medical Research in India- Where are we? Walawalkar Int Med J. 2017;4(1):71–6. pISSN 2349-2910, eISSN 2395-0684.
4. Sánchez J, Salinas A, Contreras D, Meyer E. Does the New Digital Generation of Learners Exist? A Qualitative Study: New Digital Generation of Learners. Br J Educ Technol. 2011;42(4):543–56. ISSN: ISSN-0007-1013
5. Chauhan A. Massive Open Online Courses (MOOCS): Emerging Trends in Assessment and Accreditation. Digit Educ Rev. 2014;25:7–17. DOI: https://doi.org/10.1344/der.2014.25.7-17
6. Liyanagunawardena TR, Williams SA. Massive Open Online Courses on Health and Medicine: Review. J Med Internet Res. 2014;16(8):e191. DOI: 10.2196/jmir.3439
7. Alhazzani N. MOOC's impact on higher education. Soc Sci Humanit. 2020;2(1):100030. DOI: 10.1016/j.ssaho.2020.100030
8. Keramidas CG. Are Undergraduate Students Ready for Online Learning? A Comparison of Online and Face-to-Face Sections of a Course. Rural Spec Educ Q. 2012;31(4):25–32. https://doi.org/10.1177/875687051203100405.
9. Hew KF, Cheung WS. Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. Educ Res Rev. 2014; 12:45–58. http://dx.doi.org/10.1016/j.edurev.2014.05.001.
10. Veletsianos G, Shepherdson P. A Systematic Analysis and Synthesis of the Empirical MOOC Literature Published in 2013–2015. Int Rev Res Open Distrib Learn [Internet]. 2016 Mar 1. 17(2). DOI: https://doi.org/10.19173/irrodl.v17i2.2448
11. Ayoub A, Amin R, Wani ZA. Contribution of developed countries towards MOOCs: an exploration and assessment from a representative platform Coursera. Asian Assoc Open Univ J. 2020;15(2):251–62. https://doi.org/10.1108/AAOUJ-03-2020-0016.
12. Pouezevara S, Horn L. MOOCs and Online Education: Exploring the Potential for International Educational Development [Internet]. RTI Press; 2016 Mar Available from: http://www.rti.org/publication/ moocs-and-online-education-exploring-potential-international-educational-development. DOI: 10.3768/rtipress.2016.OP.0029.1603
13. Deng R, Benckendorff P. What are the key themes associated with the positive learning experience in MOOCs? An empirical investigation of learners' ratings and reviews. Int J Educ Technol High Educ [Internet]. 2021;18(1):9. Available from: https://doi.org/10.1186/ s41239-021-00244-3.
14. Deng R, Benckendorff P, Gannaway D. Understanding Learning and Teaching in MOOCs from the Perspectives of Students and Instructors: A Review of Literature from 2014 to 2016. In: Delgado Kloos C, Jermann P, Pérez-Sanagustín M, Seaton DT, White S, editors. Digital Education: Out to the World and Back to the Campus. Cham: Springer International Publishing; 2017. p. 176–81. (Lecture Notes in Computer Science). https://doi.org/10.1186/s41239-021-00244-3.

15. Agarwal J, Kulkarni M, Mohan U, Das V, Singh V, Das S, et al. IndiaClen recommendations for improving postgraduate medical research & publication. Clin Epidemiol Glob Health. 2013;1(2):54–7. https://doi.org/10.1016/j.cegh.2013.07.001.
16. Pillai RK, Mehendale S, Awasthi S, Ravi VG. The significance of research in postgraduate education and ways to facilitate. Clin Epidemiol Glob Health. 2015;3(2):1–5. DOI:https://doi.org/10.1016/j.cegh.2015.03.002.
17. McWilliams A, Bayley T, Hart D, Gilliatt P. Educational audit of postgraduate medical education. Med Educ. 1994;28(3):246-9. DOI: 10.1111/j.1365-2923.1994.tb02702.x.
18. Marathe P, Tilak S, PranavG Gawande, Chitnis K, DhananjayK Kokate. An audit of medical postgraduate theses registered in the Clinical Trials Registry of India in 2019. Perspectives in clinical research [Internet]. 2023 Jan 1,14(3):156–6. doi: 10.4103/picr.picr_222_22.
19. Gharibi F, Imani A, Tavani ME, Dalal K. Evaluating educational performance of postgraduate students based on the Tennessee Academic Audit Model. Shiraz E-Medical Journal. 2023;24(2):e116552. DOI: https://doi.org/10.5812/semj-132682.
20. Chapman SJ, Glasbey JCD, Khatri C, Kelly M. Promoting research and audit at medical school: evaluating the educational impact of participation in a student-led national collaborative study. Med Teach. 2015;37(4):327-32. DOI 10.1186/s12909-015-0326-1
21. Cantillon P, Jones R. Does continuing medical education in general practice make a difference? BMJ. 1999;318(7193):1276-9. DOI: 10.1136/bmj.318.7193.1276
22. Mak DB, Miflin B. Clinical audit in the final year of undergraduate medical education: towards better care of future generations. Med Teach. 2012;34(7):e495-500. https://pubmed.ncbi.nlm.nih.gov/22455717/#:~:text=PMID%3A%2022455717-,DOI%3A%2010.3109/0142159X.2012.660216,-Abstract
23. Brazil V. Audit as a learning tool in postgraduate emergency medicine training. Emerg Med. 2004;16(2):158-62. DOI: 10.1111/j.1742-6723.2004.00611.x
24. Saravanan T, Shanmugapriya S. A study on the effectiveness of teaching the principles and methods of clinical audit to medical postgraduates. Curr Med Res Pract. 2018;8(2):48-52. https://doi.org/10.1016/j.cmrp.2018.03.001.
25. Batstone GF. Educational aspects of medical audit. BMJ. 1990;301(6753):245-8. DOI: 10.1136/bmj.301.6747.326
26. Neville RG, Hoskins G, Smith BA. Medical research and audit skills training for undergraduates: an international analysis and student-focused needs assessment. Postgrad Med J. 2018;94(1117):87-92. DOI: 10.1136/postgradmedj-2017-135035
27. Murphy DJ, Bruce DA, Mercer SW, Eva KW. The reliability of workplace-based assessment in postgraduate medical education and training: a national evaluation in general practice in the United Kingdom. Med Educ. 2009;43(2):140-7. DOI: 10.1007/s10459-008-9104-8
28. Kumar PR, Hashmi Y, Morad R. Clinical audit platform for students (CAPS): a pilot study. Postgrad Med J. 2021;97(1146):393-7. DOI: 10.1136/postgradmedj-2020-138426
29. Spencer JA, Barton AG. The need for teaching in medical audit: a survey in one medical school. Med Educ. 1994;28(6):481-5. doi: 10.1111/j.1365-2923.1994.tb02720.x.
30. Aitkenhead AR. Undergraduate and postgraduate education. Best Pract Res Clin Anaesthesiol. 2002;16(1):1-15. DOI: 10.1053/bean.2002.0220
31. Cheek C, Hays R, Allen P, Smith JD. Research knowledge and skills in primary medical training: a cross-sectional audit. Med Educ Publ. 2016;5(2). (https://doi.org/10.15694/mep.2016.000101)
32. Iobst WF, Sherbino J, Cate OT, Richardson DL. Competency-based medical education in postgraduate medical education. Med Teach. 2010;32(8):651-6. DOI: 10.3109/0142159X.2010.500709

33. Mazzuca SA, Vinicor F, Einterz RM. Effects of the clinical environment on physicians' response to postgraduate medical education. J Contin Educ Health Prof. 1990;10(1):27-34. PMID: 7772393PMCID: PMC1239176
34. Hutchinson L, Aitken P, Hayes T. Are medical postgraduate certification processes valid? A systematic review of the published evidence. Med Educ. 2002;36(1):73-91. doi: 10.1046/j.1365-2923.2002.01120.x
35. Ratnapalan S, Hilliard RI. Needs assessment in postgraduate medical education: a review. Med Educ Online. 2002;7(1):4570. DOI: 10.3402/meo.v7i.4542
36. Wearne S, Dornan T, Teunissen PW. General practitioners as supervisors in postgraduate clinical education: an integrative review. Med Educ. 2012;46(12):1161-73. DOI: 10.1111/j.1365-2923.2012.04348.x
37. Agarwal A, Balani K, Venkateswaran S. MEDICAL EDUCATION IN INDIA A STUDY OF SUPPLY-SIDE DYNAMICS [Internet]. 2023
38. Chapman SJ, Glasbey JCD, Khatri C, Kelly M, Nepogodiev D, Bhangu A, et al. Promoting research and audit at medical school: evaluating the educational impact of participation in a student-led national collaborative study. BMC Medical Education. 2015 Mar 13;15(1). DOI 10.1186/s12909-015-0326-1.
39. R, MD, DA DSubha. Survey on postgraduate medical education (Anaesthesiology) in India. Journal of Medical Science And clinical Research. 2020 Mar 9;08(03). DOI: https://dx.doi.org/10.18535/jmscr/v8i3.27.
40. Bhutoria A. Personalized education and Artificial Intelligence in the United States, China, and India: A systematic review using a Human-In-The-Loop model. Computers and Education Artificial Intelligence [Internet]. 2022 Jan 1;3:100068. Available from: https://doi.org/10.1016/j.caeai.2022.100068