



THE PROFOUND TRANSFORMATION OF MEDICAL EDUCATION FROM THE STONE AGE TO THE CLONE AGE

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ABSTRACT

Medical education has undergone a profound transformation, evolving from a teacher-cantered, knowledge-focused model into an outcome-based, student-centered, and technology-driven system. The field has shifted away from traditional lectures towards competency-based medical education (CBME), which focuses on achieving specific professional milestones rather than just passing time in training. The Portuguese first introduced Western medicine into India in the 16th century. The East India Company's first fleet of ships brought medical officers and Western medicine to India. Indian healthcare has progressed over the last three decades. In the post-independence period, the whole arena of medical education was streamlined with the establishment of the Medical Council of India. Computer and communications revolutions, rapid improvements in biotechnology, and genetic engineering research have remarkably developed over the past two decades. Competency-based medical education (CBME) has been introduced through the Graduate Medical Education Regulations (GMER) from the Medical Council of India. Education is assessment, and assessment is education. Medical education is transitioning from traditional, lecture-based apprenticeship models toward integrated, technology-driven competency-based frameworks. While the past focused on knowledge memorization and bedside training, the present emphasizes simulation, critical thinking, and empathy. The future promises AI-driven personalized learning and decentralized virtual environments.

KEYWORDS : Competency-based Medical Education (CBME) , Medical Council of India, Bedside Teaching, Skill Lab teaching, Artificial Intelligence (AI),

INTRODUCTION

The medical education in India can be traced back to the era of Charaka and Sushruta, who had their own doctrines in treating and teaching the indigenous system of Medicine in ancient India.(1)

The formal training of Indians in Medical Science started at the time of British rule in India, where initial emphasis was given to establish the medical schools that provided instructions to students in native languages. (2)

Even after independence, the medical education in India did not come out of the colonial yoke.(3)

In 1986, the Bajaj Committee called for the establishment of an educational commission for health sciences. (4)

These medical colleges have been successful in creating doctors who could cure diseases, but failed to provide comprehensive health care, which includes preventive, promotive, curative, and rehabilitative services to the people who are in need of health care services.(5,6)

Establishment of Medical Council of India (MCI) as a statutory body to the maintenance of uniform standards of medical education, both undergraduate and postgraduate.(7)

There is also a strong criticism that the statutory body itself hinders the flexibility of offering medical education in the country through its stringent rules and regulations.(8)

It represents a scenario marked by rhetorical wishful thinking rather than concrete steps in the right direction.(9)

Sticking to the age-old curricula, which were developed more than 100 years ago, which compartmentalizes the medical disciplines rather than giving a holistic understanding of the subject, is the root cause for these problems.(10)

Apart from curriculum, we still believe that the role of a medical teacher is like a "sage on the stage rather than a guide by the side."(11)

We often want our students to sit in the class like a rat, which is a passive and motivation-free recipient of stimuli and listen to the lectures of an elated faculty member for hours together, and feel scared to interact with him.(12)

The serious concern about the current-day syllabus is that it is stuffed with a lot of knowledge components, in medical education terms, the cognitive domain, with little of the psychomotor domain (clinical skills), with almost no emphasis on the affective domain (attitude).(13)

The most essential elements of the affective domain, such as empathy, professionalism, communication skills, ethics, and humanities, are not covered in any way in the syllabus (14)

Some people argue that these are the behavioural attributes that cannot be formally taught in the medical schools, thus the student needs to adapt them by observing their teachers – this is called as "hidden curriculum." (15)

The experiments in the West have proved that a student-centered, outcome-based mode of medical education is more effective than the current method we follow, which is teacher-centered and content-based.(16)

The learning outcomes or competencies are tailored to these needs. The teaching-learning methods and assessment are integrated by dividing the boundaries between specialties. (17)

In the current system of medical education, all these components of hypertension are compartmentalized, and students learn them separately across different years of the MBBS program and undergo assessment accordingly. (18)

The curriculum will set the goal of a learning program, define different roles for the stakeholders involved, design a set of competencies, divide the competencies into several subcompetencies, specify the learning objectives to fulfill them, tailor teaching-learning methods accordingly. (19)

There is a due emphasis given on introducing a module on attitudinal, ethics, and communication skills for the medical students from the day they enter medical school. (20)

History

With the advent of the British in India, the system of medicine known as Western medicine or modern medicine was introduced in this country. The entrance qualification for the former course was a pass in the Matriculation examination, and for the latter course, the Intermediates were eligible. Subsequently, the Licentiate qualification was abolished, and the degree M.B.B.S. was awarded by the Universities. (21)

The qualification of M.B.B.S. granted by the different Universities was recognized by the General Medical Council of Great Britain, and the standards conformed to the requirements laid down by the General Medical Council for such recognition. (22)

A School of Tropical Medicine was established in 1922 at Kolkata in eastern India. The establishment of this school marked a conscious shift from a medical to a public health school. In 1933, the Medical Council of India was constituted, which took over the functions hitherto exercised by the General Medical Council of Great Britain for the maintenance of uniform standards for medical education in the country. The public health workforce constituted personnel from a medical and nonmedical background that included ANMs, nurses, midwives, traditional birth attendants, sanitary inspectors, sanitary assistants, health officers, and physicians. (23)

The establishment of the All-India Institute of Hygiene and Public Health (AIHH and PH), Kolkata, in December 1932, made it the oldest school of public health in Southeast Asia (24)

It was a welcome development toward imparting public health education in India. The institute was established with a generous donation from the Rockefeller Foundation to develop health manpower by providing postgraduate (training) facilities of the highest order and to conduct research directed toward the solution of various problems of health and diseases in the community, thus prompting an application of knowledge to a large community and training students in these methods. (25)

Public health and medicine have been mutually dependent and interact with each other, in the past as well as in modern times. (26)

The Mudaliar Committee further sought to strengthen public health education in the country by recommending schools of public health in every state to train medical officers, public health nurses, maternity and child welfare workers, public health engineers and sanitarians, dieticians, epidemiologists, nutrition workers, malariologists, and field workers. (27)

The Indian Association of Preventive and Social Medicine,

which was founded in 1974, is a "not-for-profit" professional organization dedicated to the promotion of public health by bringing its members' expertise to the development of public health policies, an advocate for education, research, and programs of Community Medicine, and providing a forum for the regular exchange of views and information. (28)

The Shrivastava committee report in 1975 went on to advocate for a change in the structure of medical education to meet the changing requirements of health care and plan adequately for the future. (29)

The committee noted that the role of the general practitioner is far from the treatment of sickness and the prevention of disease, but extends to include the social and cultural problems that contribute to the fabric of health. (30)

Past Medical Education

While essential for building foundational knowledge, this approach is evolving toward evidence-based memory techniques—active recall, spaced repetition, and mnemonics—rather than passive cramming to manage massive information loads

Bedside Teaching in Medical Students.

A distinct feature of clinical teaching in medical school is the shift from the lecture hall to the hospital or clinic setting. This is a valuable tool for developing communication skills, examination techniques, and professionalism, which are integral to being an excellent clinician.

Bedside teaching has been impacted by the COVID pandemic, with most teaching taking place online to minimise the infection risk to both students and patients. While the pandemic has accelerated the development of many creative remote 'work-around' teaching tools, studies have shown that most students still show a preference for face-to-face learning, highlighting the unique role of bedside teaching in medical school (31)

However, bedside teaching is time- and labour-intensive. Student groups are limited in size – contrast this to a lecture format where information is taught in one sitting to hundreds of students. Bedside teaching is more likely to be waylaid by factors beyond the doctor's control. Most of all, a busy ward with high clinical demands can make it difficult for doctors to set aside time for a break, and it may feel even more impossible to dedicate an extra hour to teaching (32)

A medical student in their first clinical year may find it intimidating to approach patients and would benefit from learning the basics, such as introducing themselves to patients and asking for consent. (33)

Focusing on active recall and information retrieval simulates a realistic clinical environment (34,35)

Informing students on the 'topic of the day' can reduce anxiety around being quizzed and help to increase student engagement. Equally, deciding which students will be examining the patient early on can help to alleviate anxiety (36)

One of the key advantages of small group bedside teaching is the flexibility to tailor to the students' requirements. Limit the learning objectives to only a few key points tailored to the students' learning needs and avoid overloading them with information. (37)

Foundation doctors may wish to incorporate visual teaching aids into their bedside teaching sessions to illustrate key learning points. Furthermore, it would be helpful to provide printouts so that students can focus solely on the teaching in

the session instead of being preoccupied with making notes. Multimedia learning has immense benefits in engaging a learner's sensory, working, and long-term memory (38)

Present Medical Education

Skill Lab Teaching

"The education of the younger generation has shifted from 'bookish learning to skill learning. Integration between disciplines, bridging gaps between hospital-based medicine and community medicine.

Skill laboratories play a crucial role in medical education by *bridging the gap between theoretical knowledge and practical clinical skills.*

In these laboratories, medical students not only acquire clinical skills but also gain confidence and valuable experience essential for their future careers in the medical profession.

In each Skills Lab, students engage in a practical group activity such as case study analysis, discussion, and role-play. Finally, during 'Present', students get an opportunity to present their work and receive feedback on their group outcomes.

The Clinical Skills laboratory will *provide a model of the patient care environment* where students can learn and apply cognitive, psychomotor, and affective skills.

The skills laboratory will help to ensure that all students have the necessary learning opportunities and *appropriate assessment and feedback before approaching real patients.*

This skill lab will give the students, individually and as teams, *the opportunity to work closely with each other to develop clinical skills*, effective communication, and teamwork skills.

These skill sets are the foundation for fostering a culture of safety in the medical field.

It will also facilitate learning and *objectively measure the student's performance and competency at a given task.*

Currently, medical students have underperformance in their clinical skills because of a decline in bedside teaching.

The seniors spent less time in rounds because of their other responsibilities, leading to a decrease in bedside teaching.

Therefore, there should be some alternate options for the betterment of the clinical skills of medical students.

Clinical Skill Labs (CSLs) is a valuable places for students to acquire clinical skills as it provides opportunities to practice essential medical skills on manikins systematically and safely before dealing with patients.

Such skill-learning opportunities enable students to train themselves via effectual educational facilities according to their requirements. High efficiency and cost-effectiveness are some of the striking features of working in skill labs.

The National Medical Commission (NMC) of India has indeed issued guidelines for the development of skills laboratories at medical colleges.

These guidelines outline the requirements and standards for setting up and operating skills labs, ensuring that medical students receive comprehensive training in clinical skills before interacting with patients in real clinical settings.

The skills lab guidelines cover various aspects such as infrastructure, equipment, staffing, curriculum integration, assessment methods.

Skill labs are useful

1. To deliver hands-on learning experiences, educational materials, and course goals as directed by the syllabus.
2. To accommodate the novel learning requirements of students and educational experiences
3. To increase students' preparedness before their introduction to clinical training in hospitals and dealing with high-risk cases
4. To enrich communication skills, cognitive skills, and psychomotor skills
5. To determine the importance of collaboration and team building

Medical education will continue to move away from the outdated model of "see-one, do-one, teach one" and, in all probability, skills lab training will increasingly advance to be a worldwide norm.

In addition to further developments in simulation-based learning and training, an increase in methodologically convincing, randomized-controlled, double-blind studies investigating the effectiveness.

The term "Bench to Bedside" is used to describe the process by which the results of research done in the laboratory are directly used to develop new ways to treat patients, according to the National Cancer Institute (NCI) dictionary.

Bedside Teaching (BST) is an essential didactic format with a longstanding tradition in medical education

It can be briefly described as "the process of active learning in the presence of a patient."

Critical Thinking,

Critical thinking is a high-level thinking process that can be used in conceptual learning for students.(39)

It is defined as the ability to identify and analyze problems as well as seek and evaluate relevant information to reach an appropriate conclusion.(40)

Thus, critical thinking enables medical students to assess their needs for learning and comprehend their perspectives. This may aid in enhancing their problem-solving ability and making effective clinical decisions during their routine clinical encounters in the future.

Problem-based Learning

It is an innovative teaching methodology that provides students with real-life scenarios to motivate them to seek out a deeper understanding of the given topic. In this, students learn to monitor their own learning process, directing them toward building on existing conceptual knowledge frameworks.(41)

Case-based Learning

It is an effective tool that promotes active learning by linking theory to practice. It utilizes the clinical case scenario, which is reflective of real-life experiences. Advanced study is required by the students before discussing the cases with their peers.(42)

It encourages critical thinking by directing the learners toward the path of lifelong learning.(43)

Think, Pair, and Share Strategy

It is one of the forms of cooperative learning strategy, where students are actively involved in group discussions. They critically analyze the given question at an individual level and then practice sharing with their peers to achieve a pertinent solution to the given question and to further share that with a larger group.(44)

Flipped Classroom Teaching

With an aim to address the higher-order skills and active involvement of students inside the classroom, this model of teaching was introduced in 2007.(45)

The term “flipping” refers to providing the students with the resource material in advance before the classroom and utilizing the classroom time for active learning, fostering problem-solving skills, and enhancing their critical thinking skills.(46)

Reflective writing

It is the process of creating a new insight in which experiences are recollected, critically analyzed, and then transformed into words in the form of writing.(47)

It may strengthen and promote the development of critical thinking skills of medical students.(48)

Script Concordance Test

The script concordance test (SCT) is an innovative tool to assess the clinical and critical reasoning skills of medical students. It is based on the script theory, which assumes that the clinician has a network of knowledge called scripts to make judgments for the clinical encounters they have in their routine practice. These scripts are imbued by any medical student during their evolving stage from novice to expert in a medical college. As the career advances, these are further refined depending on their exposure to the clinical practice. In this test, trainees are exposed to ill-defined case vignettes that pertain to diagnostic, therapeutic, or investigative problems, for which there is no definitive answer. This serves as a very effective tool in probing into the critical thinking skills of medical students. The answers given by the trainees are then compared with the answers given by the panel of experts, and the final scoring is done.(49)

Future Medical Education

New Transformations to Boost Medical Education in India.

The medical education system in India is the largest in the world, consisting of more than 750 medical colleges with an intake capacity of 81,979 students each year.

The healthcare sector is growing rapidly as the global population increases. Research in medicine has a great scope. Multidisciplinary Science is the combination of different scientific disciplines to handle some of the world's most pressing challenges. Crossdisciplinary science is the combination of different scientific disciplines to handle some of the world's most significant challenges. The role of clinicians will continue to evolve into a broader team that engages with a wide range of disciplines and plays leading roles in the healthcare of the future. Interdisciplinary promotes innovation by mixing diverse knowledge and perspectives. Technological advancements, such as Artificial Intelligence (AI), often arise from the convergence of computer science, Organ-on-Chip (OCC), and Genome Editing. Engineering and Medical sciences are closely related fields that are highly interdependent. Future trials would be based on artificial intelligence (AI) and Machine learning. Image interpretation improves precision medicine and immunology. Bioengineering, translation medicine, Biotechnology, Genetic engineering, Medical electronics, artificial organs, Biosensors, Biomedical robotics.MRN technology, Neurotechnology,3D Printing, and CRISPR will change the healthcare system. Specialist surgeons will use remote robots to operate on patients on different continents. Babies will have their DNA sequenced before they are even born. Patients will be able to generate new blood in their bodies without needing a blood donor.

By 2050, medical education is projected to undergo a radical transformation, moving away from traditional lecture-based

learning toward a highly specialized, AI-integrated, and simulation-driven model. Medical education in India and throughout the world has undergone significant changes due to rapid advances in medical technology. Modern medicine has challenged the traditional method of clinical skills teaching, training, and learning. “The education of the younger generation has shifted from bookish learning to skill learning”. The ongoing skill and simulation center project aims to provide teaching, training, and learning in various clinical procedures for both medical students and clinicians.

Medical Advances by 2050

Specialist surgeons will use remote robots to operate on patients on different continents. Babies will have their DNA sequenced before they are even born. Patients will be able to generate new blood inside their bodies without the need for a blood donor.

CONCLUSION

Medical Education traditionally relied on heavy knowledge memorization, with students cramming vast amounts of data in anatomy, Physiology, and pharmacology for high-stakes exams. While essential for building foundational knowledge, this approach is evolving toward evidence-based memory techniques—active recall, spaced repetition, and mnemonics—rather than passive cramming to manage massive information loads. Medical advances that significantly improve the diagnosis, treatment, or prevention of disease are often called ‘breakthroughs’. With the recent changes in medical education and the fast pace of technological development, CSLs have become important educational environment for the acquisition of clinical skills.

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