COMPETENCY BASED MEDICAL EDUCATION IN INDIA: RELEVANCE OF PROPOSED CURRICULUM TO PHYSIOLOGY

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Abstracts: A new competency based curriculum has been proposed by the medical council of India (MCI). It is being introduced in the coming academic session in all institutions across the country. The timeline, list of competencies, core and skill based competencies and which of these would involve integration in the same and across phases of the preclinical, paraclinical and clinical years are mentioned in three documents put on the website of the medical council of India. The change has begun with the proposed timetable being made by all institutions. Physiology is a core basic science, preclinical subject and one of the subjects from which the change will be initiated. Topics, related to the mentioned competencies in original MCI document, their integration with other departments and what is the probable role of physiologists to use their potential are discussed here. Also the global opinion and experience related to competency based medical education is mentioned to increase awareness of faculty and prepare them for the proposed change.

Key Words: Competency, Integrated teaching, Curriculum reform, Physiology education

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Introduction:

After two decades of following the conventional curriculum and teaching methodologies, the medical curriculum in India is undergoing a change to a competency based curriculum as proposed by the medical council of India (MCI). To a physiologist, this change provides new challenges as well as opportunities. The change involves identifying competencies related to all possible subject topics, writing objectives related to the broad goal of enhancing the medical student's understanding of the topic and acquiring necessary skills and finally identifying teaching-learning and assessment methods suited for each objective. Competency based medical education (CBME) is in practice in many countries with favorable results [1]. On the basis of current literature available, it can be postulated that the program not only favors skill development, but also delivers training in professionalism involving the correct attitude, ethics, and communication and thus helps in the overall development of the medical graduate. A paper from Tamil Nadu was one of the first to feature the rolling out of this new curriculum in India and to increase awareness and emphasize on its relevance to the medical fraternity [2]. Another author has discussed the challenges of implementation, lack of awareness of the program's intricacies, the decision of necessary benchmarks for assessment, the need for teacher and learner ethos and the limited resources available for implementation of CBME[3]. It is thus important to understand what is the current global opinion and status of CBME and Indian physiologists must know the topics where integration is expected according to the MCI document, and conceptualize the role which they will have to play in future. In addition this article will provide a showcase of the expected curriculum change in physiology to be used and incorporated in other medical universities.

What is known of 'competency based curriculum'?

It is a new system of learning aimed to enhance the skills and wholesome development of an individual. Presently, there is a global movement towards competency based curriculum. A comparison with the traditional system, strategy for implementation, and expected changes in assessment methodologies has been described [1]**.** Although the curriculum was first proposed for medical postgraduates, it is now realized that the changes should begin from the undergraduate years for ensuring educational continuity. Additionally, it has now been suggested that the teaching and assessment tools should be shared across institutions along with the success stories as this would improve the outcome, motivate the stakeholders, and prevent occurrence and repetition of mistakes [4]. Horizontal and vertical

integration of curriculum is another important issue as it provides better comprehension of the subject that can improve the outcome of CBME. A recent publication mentions about the competency based undergraduate curriculum and new MCI documents, the expected objectives, number of horizontal and vertical integration in various subjects including Physiology. The author points out that at present no major change is made at the assessment stage and that in the Attitude, Ethics and Communication (AETCOM) module, there is a mismatch between the intended competency and recommended method of assessment [5]. In another study, the role of regular and formative assessment to meet the objectives of the course and the concept of personalized crafted assessment to update the students of their progress and enrich their learning experience in Physiology is highlighted [6].

Global appreciation for CBME and Integration

Reports of appreciation of CBME in various aspects, related to its concept or its methodology or outcome are being discussed by various publications. A change from a discipline based curriculum to a system based curriculum in a medical college in Pakistan involved conduction of integrated practical examination for first two years, incorporating basic science principles with clinical relevance. This was appreciated by both the students and the faculty [7]. Competency based horizontal integration of the course schedule in first two semesters and a vertical integration in third semester was done in the core basic medical sciences program in the Sub Saharan University of Ibadan, Africa. Apart from addition of a new course titled 'Clinical application of basic medical sciences', teaching and assessment pedagogies were also improvised. Small group tutorials comprised 60% of the didactic lectures and practical classes and lectures were allocated a time ratio of 60:40. MCQ, short and long essay questions and practicals and orals were the assessment methods used. On evaluation of this program, the clinical assessors found that the knowledge of students was comparable, if not better than those students who had graduated following the previous curriculum [8]. These studies therefore suggest that the expected changes in CBME can have a favorable output. Participants in a study in Canada noted that assessment in CBME took more time and effort and had a sense of value for all stakeholders [9]. In addition to introducing a change in the curriculum it is important to take a regular feedback from all involved in its execution and students in order to improve upon it. In an evaluation of the competency base curriculum done at a university in United States some originally missing core competencies were introduced thus highlighting the importance of such evaluations for redesigning and improvement of curriculum [10]. In a recent publication, two methods of program evaluation of CBME in Canada have been described. In the Concerns Based Adoption Model (CBAM), three stages of 'creating the foundation, implementing and sustainability' were evaluated. The other model, 'outcome harvesting' is especially useful to understand how individual outcomes contribute to overall system wide changes [11].

Criticism for competency based medical education.

A difference of opinion exists, about the outcome of competency based curriculum. Although the curriculum is generally believed to be good for assessors and regulators, as it provides a good blueprint of the topics that are to be taught, with best suited methods for teaching and assessment in a systematic manner, however it is considered more important for societal and political reasons. There are critical viewpoints concerning the benefits to the medical students, in relation to learning of higher order skills at the workplace [12]. A research paper goes on to state that ticking a box in a form or getting a booklet signed by the faculty should not be the only focus of medical students, who should be motivated towards patient care and only then can we hope to produce good doctors [13].

What is the proposed change in Indian context?

A learner and patient centric and outcome oriented curriculum has been suggested by the MCI. A foundation course, early clinical exposure, options for electives and competency based curriculum with horizontal and vertical integration are some of the fundamental changes proposed. It has been recommended to give additional importance to ethics along with professional

attitude and communication in every semester of study. Dedicated time for sports and extracurricular activities, self directed learning, acquiring knowledge of languages required in different regions of the country along with English, computer training and humanities are welcome additions. The teaching methods may now be laying more emphasis on small group learning with reduction in the overall lecture time. The assessment pattern is to increase focus on formative assessment [14, 15].

What will CBME achieve in the Indian context?

The goal of incorporating the new teaching and assessment reforms in Indian medical education system is to create a medical graduate who being the first contact with the community and the patients, must be globally competent. This is further related to national, institutional and learner based goals. The national goals are in concordance to the national health policies and in addition aim to develop a scientific temper and augment educational experience for proficiency in the medical profession. The concept of holistic medicine and the promotive, preventive, curative and rehabilitative aspect of a health care system with the introduction of medical ethics depict a long term, positive, far-sighted approach. The institution has to provide a platform which enables the medical student to achieve individual goals and those in the nation's interests and at the same time cater to the student's needs to become a compassionate leader, a communicator, a member of the health care team, a lifelong learner and a professional [15].

Relevance of the competency table in Physiology

The competency based curriculum in Physiology is available as a document, on the MCI website [15]. It defines the different types of competencies like core, and non-core, which are related to their importance in the subject, the core competencies being necessary in order to complete requirements of the subject and the non-core being optional. These 137 competencies are grouped according into eleven topics and as integrated physiology. In addition, whether the competency is knowledge or skill based and what is the level of acquisition, (knows, knows- how, shows, shows-how or performs), according to the Miller's pyramid is defined. Teaching methods recommended involve both large and small group teaching and DOAP (demonstration, observation, assistance and performance). Assessment methods suggested in the document are written, viva, practical and OSPE, also the concept of skill certification is mentioned in all topics including how many times a skill has to be done for it to be certified. In addition to this, the horizontal or vertical integration requirements for each competency are also outlined.

Detailed analysis of the Physiology competency table.

In most topics of Physiology e.g. general, renal, endocrine and reproduction the competencies mentioned are knowledge based. In hematology (blood) there is one skill based or 'shows how' competency. This skill based competency includes estimation of all hematological investigations, which can be subdivided, and taught as DOAP sessions. Demonstration sessions for estimation of platelet and reticulocyte count and erythrocyte sedimentation rate, hematocrit and osmotic fragility can be done. In nerve muscle physiology the four skill based competencies are ergography, effect of mild moderate exercise on cardio-respiratory parameters, Harvard step tests and observation of computer assisted learning on amphibian nerve-muscle and cardiac experiments. In gastro-intestinal physiology, the skill based competency involves examination of abdomen in a normal volunteer or in a simulated environment. In cardiovascular system, 5 competencies are skill based, of which 4 are core and the autonomic function examination is a non-core competency. Measurement of blood pressure, examining the pulse and recording these in exercise and posture change are 3 certifiable competencies. Similarly, performing clinical examination of the respiratory system on a volunteer or in a simulated environment is certifiable. Two other competencies involving spirometry and performance of peak expiratory flow rate are skill based. In neurophysiology, there are 20 competencies, 6 each for sensory and motor systems and 8 for special senses. Demonstration of skills, for assessment of higher function, examination of sensory and motor examination,

cranial nerves and reflexes are the five competencies that require certification. Interpretation of normal EEG is described as a skill. Testing visual acuity, color vision, hearing, smell and taste sensation are competencies requiring certification and need integration with ENT and Ophthalmology. In the section of integrated physiology 14 competencies are mentioned, none of which require certification and whose skills include general physical examination and demonstration of basic life support in simulated environment.

Expectations from physiologists

An analysis of the topics of Physiology that are to be integrated in same phase and vertically through para and clinical years are mentioned in the table 1. It is found that neurophysiology with anatomy, function tests with Biochemistry and hematology with pathology are common areas of integration. These are topics and for competency the entire three volumes of MCI document should be read [15-17]. Table 2 shows the topics of other departments, whose competencies require integration with Physiology. As shown there is lot of scope to work in subjects like Anesthesiology, Pediatrics, Psychiatry and Surgery and the topics mentioned are interesting and need to be dealt in detail.

Table 1. Topics and Subtopics of Physiology in which integration of competencies are depicted in the MCI document.

Physiology topic/ No: of CP	**Department-No: of CP of HI Subtopic**	**Department-No: of CP of VI Subtopic**
General Physiology/9	**(Biochemistry-2)** Fluid compartment, pH.	(**Pathology-1)** Apoptosis.
Hematology/ 13	**(Biochemistry-3)** Plasma protein. Hemoglobin (Hb). Anemia. Jaundice	**(Pathology-6)** Anemia. Jaundice. Blood groups. Hemostasis. Estimation of Hb, RBC, RBC Indices TLC, DLC, BT, CT ESR. Reticulocyte and platelet count.
Nerve Muscle Physiology/18	**(Anatomy-3)** Neuron. Neuroglia Muscle. Myopathy **(Biochemistry-1)** Muscle metabolism	**(Medicine-3)** Peripheral nerve. Grading muscular activity. Muscular dystrophy. **(Pathology-1)** Myasthenia gravis **(Pharmacology-1, Anesthesia-2)** NM junction. Blocking agents*
Gastro-Intestinal (GI) Physiology/10	**(Anatomy-1)** Structure & Function of digestive system **(Biochemistry-5)** Composition of secretions. Digestion and Absorption of nutrients. Functions of liver, gall bladder. GI-function tests. Physiological aspects of GI Diseases	**(Medicine-1)** Pathophysiology of GI Diseases
Cardio Vascular Physiology/16	**(Anatomy-2)** Functional anatomy. Abnormal ECG	**(Medicine-5)** ECG: Normal, Abnormal & Interpretation. Arterial plethysmography. Micro circulation & regional circulation
Respiratory Physiology/10		**(Respiratory Medicine-1)** Spirometry.
Renal Physiology/9	**(Biochemistry-1)** Renal function test	**(Medicine-1)** Artificial kidney, Dialysis & renal transplantation
Endocrine Physiology/6	**(Biochemistry-1)** Function test-Thyroid, Pancreatic, Adrenal	
Reproductive Physiology/12	**(Anatomy-1)** Sex differentiation	**(Obstetric & Gynaecology-5)** Pregnancy. Diagnostic tests. Infertility. Contraceptive. Peri menopause & Menopause. **(Community Medicine-1)** Contraceptive.
Neuro Physiology/20	**(Anatomy-8)** Organization of nervous system. Cerebral cortex, limbic system. Basal ganglia, Thalamus, hypothalamus. RAS, ANS. Cerebellum. Spinal cord. Receptor, Synapse, reflex. Sensory & Motor tracts. Clinical examination of nervous system & cranial nerves.	**(Psychiatry-4)** Function of Cortex, basal ganglia, limbic system thalamus, hypothalamus, cerebellum & abnormality. Behavioral changes in sleep. EEG. Memory, learning and Speech. **(Otorhinolaryngology** or **ENT-5)** Smell&taste: Normal &Altered smell and taste. Physiology& Tests of hearing. Deafness. **(Ophthalmology-4)** Visual pathway and Lesions. Physiology of Image formation. Testing visual acuity, color, field of vision. Visual evoked potentials.
Integrated Physiology/14		**(Pediatrics-3)** Physiology of infancy & Anthropometric assessment in infants. Growth charts. **(Anesthesia+ Medicine-1)** Basic life support in simulated environment

No: - Number: CP-competency: VI-Vertical integration: HI- Horizontal integration .

* Both in Pharmacology & Anesthesia.

For details of competencies see MCI document.

Table 2. Summary of topics, where departments require integration of their competencies with Physiology.

Subject/No: of CP	Topics where integration required
Anatomy/41	Muscle & Nervous tissue. Blood vascular and lymphatic system. Chamber and Conducting system of heart. Coronary arteries. Ischemic heart disease. Pulmonary, systemic and Fetal circulation. Embryonic basis of septal defects. Developmental basis of congenital anomalies. Surface marking of pleura and heart borders. Arterial, lymphatic and nerve supply of pleura. Root of lung. Bronchopulmonary segment. Mechanics and types of respiration. Functional areas of cerebral hemisphere. Basal ganglia. Limbic lobe. Thalamus. Hypothalamus. Circle of Willis. Ventricles. Circulation of CSF. White matter. Ascending and descending tracts at mid thoracic level. Cranial nerve .Medulla. Pons. Basis of cerebellar dysfunction.
Biochemistry/13	Organization of a cell. Common poisons that affect carbohydrate metabolism. Function of protein. Hemoglobin, derivatives, metabolism. Hemoglobinopathy. Innate and adaptive immune response. Common disorders of nucleotide metabolism. Maintenance of pH, electrolyte and water balance. Urine analysis. Minerals and their metabolism. Function testing and abnormality of liver, kidney, thyroid and adrenal.
Pathology/13	Obstructive airway disease. Cardiac failure. Acute coronary syndrome. Cardiomyopathy. Glomerular diseases. Thyroid swelling. Thyrotoxicosis. Hypothyroidism. Diabetes. Hyperparathyroidism. Adrenal insufficiency. Cushing's syndrome. Adrenal neoplasms.
Pharmacology/5	Skeletal muscle relaxants. Drugs acting on CNS, blood, anticoagulants, fibrinolytic, plasma expander, anti platelet, **in Anemia.** Colony Stimulating factor. Drugs acting on Renin- Angiotensin and aldosterone system.
Forensic/2	Blood as a Stain, Species identification & blood grouping
Community medicine	Contraceptives.
Ophthalmology	Functional anatomy of eye. Physiology of vision. Lesions of visual pathway .Visual evoked potentials. Testing visual acuity, color vision
Otorhinolaryngol-ogy	Smell and taste sensation. Functional anatomy of ear. Physiology of hearing. Pathophysiology of deafness. Testing smell, taste and hearing
Pediatrics/22	Physiology of lactation. Breast milk. Human and cow's milk. SAM and MAM. Obesity. Vitamin D deficiency and excess. Vitamin K and its role in health and disease. Acynotic heart disease. Cyanotic heart disease. Heart failure. Acute rheumatic fever. Infective endocarditis. Anemia. Thalassemia, Hereditary spherocytosis, Auto immune hemolytic anemia and Hemolytic uremic syndrome.
Medicine/35	Heart disease. (Rheumatic, Valvular, Ischemic, inflammatory, hyper trophic) Heart failure. Cardiac arrhythmia. Dyslipidemia, pathogenesis, complications of Atherosclerosis &IHD. Hypertension. Hyperbilirubinemia. Pathophysiology of liver injury. Hypoglycemia and counter hormonal response. Hyperthyroidism and hypothyroidism. Hypothalamo- pituitary thyroid axis and thyroid function tests. Physiological effects of acute blood and volume loss. UMN and LMN lesion. Disorders of speech. Locomotor system. Bladder dysfunction in CNS diseases. Hypercalcemia. Acid base disorder. Nutritional assessment in adults and disorders in elderly. Calorie requirement in illness. Protein- calorie malnutrition. Vitamin deficiency. Enteral and parenteral nutrition in critically ill.
Respiratory Medicine	Obstructive airway disease. Hypoxia and hypercapnia. Genetics of α1 anti trypsin deficiency in emphysema. Pulmonary function tests.
Psychiatry/4	Cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum. EEG and its characteristics during sleep. Memory, learning and speech.
General Surgery	Haemostasis. Metabolic changes in injury. Blood loss. Pathophysiology of burns and shock. Resuscitation including fluid replacement. Malnourishment in a surgical patient. Physiology of oesophagus. Thyroid swelling. Adrenal neoplasm
Obstetrics and gynecology/2	Menstruation, Ovulation, fertilization, implantation, gametogenesis. Physiology of pregnancy, parturition and lactation. Physiologic basis of pregnancy tests. Hormonal changes in perimenopuse and menopause. Infertility. Contraceptive.
Anesthesiology/3	Unconscious patient. Ventilator. Pain and its tolerance.

For details of competencies (CP), please refer to MCI document, Volumes 1, 2, 3. Topics and subtopics are summarized from list of integrated competencies and as mentioned in individual departmental table.

More topics of cross-disciplinary integration can be suggested. However, no integration is proposed in the MCI document in departments of dentistry, dermatology, microbiology, orthopaedics, radio-diagnosis, radiotherapy and rehabilitative medicine. It is unusual and therefore some topics are mentioned in table 3 which can be considered for these departments. In addition to fulfilling the academic requirements, this concept of integration is an opportunity to make physiology more innovative and clinically oriented. Such endeavors have been carried out by many universities where competency based curriculum has been introduced. A new course designated as "Preclinical skills" was designed by the University School of Medicine, Spain [18]. Here in the first two years of their medical school, the students were trained to use the concepts of basic medical sciences in order to understand clinical scenarios. Along with academic changes this endeavor can provide additional opportunities. Some of the suggested growth potentials of Physiologists as health care professionals are shown in Table 4.

Table 3. Suggestions for Integrated topic for few departments.

Departments	Topic suggestion
Dentistry	Blood flow, Growth of buccal mucosa. Teeth. Oral hygiene. Malocclusion and health. Normal peridontal tissue.
Dermatology	Cutaneous blood flow. Aging. Hormones and Acne Phototherapy. Allergic disorders
Microbiology	Pathophysiology of infectious diseases.
Orthopedics	Bone growth and remodeling. Aging and Osteoporosis. Vitamin D. Hormonal regulation of bone growth. Inflammatory disorders. Pain. Fractures in elderly. Range and strength of muscle movement. Amputation.
Radio-diagnosis	Blood flow to organs in health, inflammation and diseases. Physiological changes in pregnancy. Doppler. Age estimation.
Radiotherapy	Radiation and chemotherapy effect on normal tissue. Protection from radiation.
Rehabilitative medicine	Restoration to normal function following injury. EMG, NCV. Pain pathways. Rigidity. Spasticity. Early mobility. Disability in elderly

EMG - Electromyography, NCV - Nerve conduction pathway.

Table 4. Opportunities for physiologists in CBME curriculum

CBME curriculum	Growth opportunities
Foundation course	1. To become coordinator (administrative& leadership) 2. Introducing sports Physiology, yoga, time and stress management, communications, exercise Physiology concepts.
Competency based curriculum	1. To make Physiology more task and skill oriented. 2. To reduce redundancy
Horizontal integration	1. To avoid duplication and do networking with anatomy and Biochemistry. 2. To correlate the preclinical subjects and update information of other subjects
Vertical integration	1. To give a clinical touch to Physiology curriculum. 2. To do networking with the clinical and para-clinical departments. 3. To get resource and teaching material in terms of ECG, EEG, strips, bone densitometer recording, EMG etc. 4. To teach Physiology to second and third professional students.
Electives	1. To develop Physiology related curricular program. 2. To encourage students towards research. 3. To encourage students towards a career in preclinical sciences.
Curricular governance	1. To become member of curriculum committee, curriculum subcommittee, alignment and integration team, quality assurance team. 2. To get feedback and evaluate and improve curriculum.
Teaching methods	1. To develop small group teaching methods.
Assessment methods	1. To develop new assessment methods. 2. To develop log books and portfolios. 3. To create avenues for 'e' learning 4. Develop avenues for self directed learning.
Skill Training	1. To develop a Physiology skill lab.

What can improve the CBME outcome?

It was felt that in CBME, one of the drawback is that the focus is not on actual performance of care for the patient. Therefore the outcome must be framed in the context of a clinical care environment, with integration of abilities across multiple competencies, their domains and application [19]. In a novel publication, the 'promises and progress' of CBME are written and the new concepts of 'milestones' and 'entrustable professional activities' (EPA), which are intended to improve the outcome of CBME are discussed [20]. The milestones provide a roadmap for competencies and sub competencies and EPA's represent core clinical activities of the health professional that are done to improve clinical care of the patient. Some examples of EPA are also mentioned in this article [21]. In a Canadian publication, 12 EPA are mentioned, similar and comparable to 13 of American medical colleges. The authors opined that there is a freedom to add more training requirements, and integrate the EPA's with the curriculum and therefore CBME can co-exist in the existing medical education environment, without compromising the autonomy and diversity of any institution [22].

Conclusion:

The present challenge is to incorporate changes and introduce the CBME based curriculum in Physiology, an important core subject. Enthusiastic physiologists should use this opportunity to fulfill their dreams of doing innovations, within the framework of guidelines suggested by the medical council. Similar analysis is needed for other subjects to improve understanding of the new curriculum. Infrastructure and staff deficiency could be a limitation and this issue should be addressed at the institute and university level by ensuring optimal utilization and motivation of existing faculty members.

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