

Postgraduate training in anaesthesiology - A modular curriculum

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ABSTRACT

The primary objective of postgraduate medical education is to produce specialists who provide highest quality of health care to suffering patients and return them to the community in the most functional capability. The secondary objective is to advance the cause of science through research and training. A postgraduate, after undergoing the required training in anaesthesiology, should be able to recognise the health needs of the community and apply cognitive and psychomotor skills to provide optimal anaesthetic care. Additionally, the anaesthesiologist should function as a perioperative physician being adept in perioperative care, pain medicine and critical care medicine. The 3-year postgraduate curriculum comprises experience in basic, subspeciality and advanced anaesthesia training. This structured training programme with a curriculum of increasing difficulty and learning incorporates ascending grades of difficulty, posing a challenge to the trainee's intellect and technical skills. Experience in basic anaesthesia training is aimed to lay stress on basic and fundamental aspects of anaesthetic management. Subspeciality anaesthesia training is needed to lay stress on the theory, special considerations and practice of subdisciplines of anaesthesiology. This document proposes a modular-structured, continuous, objectively evaluated, systematic training process that is monitored frequently and periodically, such that the trainee, at the end of training, is capable of appropriate anaesthetic management of disease conditions in a wide variety of situations.

Key words: Anaesthesiology, continuing medical education, curriculum, postgraduate medical education

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INTRODUCTION

The new National Education Policy (NEP), based on the four pillars of access, equity, quality and accountability, states that 'professional education is an integral part of the overall higher education system'.^[1] Medical education needs to be re-envisioned, so that the duration, structure and design of the educational programme need to correlate with the graduate's requirement. The primary objective of postgraduate medical education for graduates in the medical discipline is to produce experts providing care to suffering patients and to return them to the community in the most functional capability. The secondary objective is to facilitate the

training and research for the advancement of science. The National Medical Commission (NMC) of India aims at (i) improving access to quality and affordable medical education, (ii) ensuring the availability of adequate and high-quality medical professionals in

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all parts of the country and (iii) promoting equitable and universal health care that encourages community health perspectives.^[2] Keeping these objectives in focus, in the speciality of anaesthesiology, we should aim that a qualified anaesthesiologist should be a perioperative physician who is skilful and adept in the management of surgical patients, pain management and critical care medicine. An anaesthesiologist should possess adequate knowledge and sound judgement, with proper clinical, psychomotor and technical skills to perform the clinical responsibilities in the entire scope of anaesthesiology. A trainee, on completion of training, should be able to plan and execute the appropriate perioperative protocols after logical discussion with the team members, patients and next of kin/family members, depending on the situational need. He/she must be capable of providing advice and defending opinions in all aspects of the speciality of anaesthesiology and must be capable of managing emergencies in a timely, independent and precise fashion. It is recommended that the postgraduate students participate in conferences, workshops and continuing medical education (CME) programmes regularly to upgrade their skills and knowledge. As of now, there is no uniformity in the postgraduate education in anaesthesiology, nor is the assessment of postgraduate trainees over the 3 years of residency period standardised across the country. In this manuscript, we would propose a scheme of modular training that encompasses all the aspects of training, and includes an objective assessment at regular intervals. A formative assessment if done, after every module, for example, at two-monthly intervals in modular training, would be of great help in improving the resident's performance in all the domains. Another point in favour of modular training is that instead of the student being judged only on the day of examination, a regular assessment and evaluation should go on throughout the training period.

The 3-year postgraduate curriculum comprises experience in basic, subspeciality and advanced anaesthesia training. It is a structured training programme with a curriculum of increasing difficulty and learning, incorporating ascending grades of difficulty, posing a challenge to the trainee's knowledge and skills.^[3] Basic anaesthesia training lays stress on the basic concepts and fundamental facets of anaesthesia.^[4] Subspeciality anaesthesia training is needed to lay stress on the theory, special considerations and practice of the concerned subspeciality of anaesthesiology, like obstetric

anaesthesia, paediatric anaesthesia, cardiovascular and thoracic anaesthesia, neuroanaesthesia, oncology anaesthesia, anaesthesia for day care surgery, regional anaesthesia, and pain and palliative care. The purpose of this article is to propose a structured programme of training that meets the requirements of the NEP in terms of access, equity, quality and accountability.

DEFINITION OF MODULAR TRAINING

A modular training programme is a course composed of individual modules that can be assembled or that stand alone in different learning courses. Each module deals with a particular component of the training curriculum. These modules are further subdivided into chapter and lessons. Each module and training consists of its subject matter and learning objectives. By using modules, one can easily and conveniently customise the learning material to ensure completion of requirements before the completion of training. Assignments and assessments can be incorporated into each module to enhance the learning objectives. The advantages of modular training are (i) it emphasises self-learning methods rather than didactic sessions, (ii) the programme enhances mentor-mentee interaction regularly at periodic intervals, (iii) the trainee is up to date in his/her approach to subject, (iv) internal assessment is enhanced and regular and (v) it avoids last minute preparation just before the examination [Figures 1 and 2].

CURRICULUM

Three fundamental categories of curriculum for training in anaesthesiology are cognitive, psychomotor and affective. The cognitive or knowledge base of anaesthesiology is readily recognised as the basic medical sciences applied clinically. A dedicated clinical teacher gives time, with clinical credibility, in an interactive learning atmosphere for teaching. In the subject of anaesthesiology, psychomotor skill learning is an absolute requirement that needs a systematic methodology instead of a repetitive trial-and-error approach [Table 1].

Table 1: Systematic methodology for psychomotor skill lessons^[1,2]

1. Analyse and separate the skills into component parts and determine which aspects of the skill are most difficult to perform
2. Provide students with a model of the skill they are expected to perform, demonstrated effectively in its entirety
3. Make provisions for students to practise until the expected behaviour is mastered
4. Provide adequate supervision and an evaluation of the final performance

Affective teaching and learning deal with feelings or emotions, but remain inadequately understood and taught. Receiving, responding, valuing, organising and value complexing are important components of the taxonomy of affective learning.^[4,5]

A collaborative approach to create the evidence is required to implement competency-based medical education (CBME) judiciously and more effectively to have a positive impact on trainees, patients and the healthcare system.^[6] Each module incorporates the three domains (cognitive, psychomotor and affective) from a teaching and learning perspective. Because all assessment methods have their limitations, multiple methods are needed to compensate

for the shortcomings of any one technique. Pathway for each module is reflected in Figure 3.

Competency-based education in anaesthesia

The six core competencies recommended by the Accreditation Council for Graduate Medical Education (ACGME) and the American Board of Medical Specialties (ABMS) are (i) patient care, (ii) medical knowledge, (iii) professionalism, (iv) interpersonal and communication skills, (v) practice-based learning and improvement and (vi) systems-based practice.^[7] Competency is defined as ‘the ability to do something successfully and efficiently’,^[8] and in CBME, knowledge and/or skills are acquired and assessed throughout a continuum of learning. Assessment in CBME is

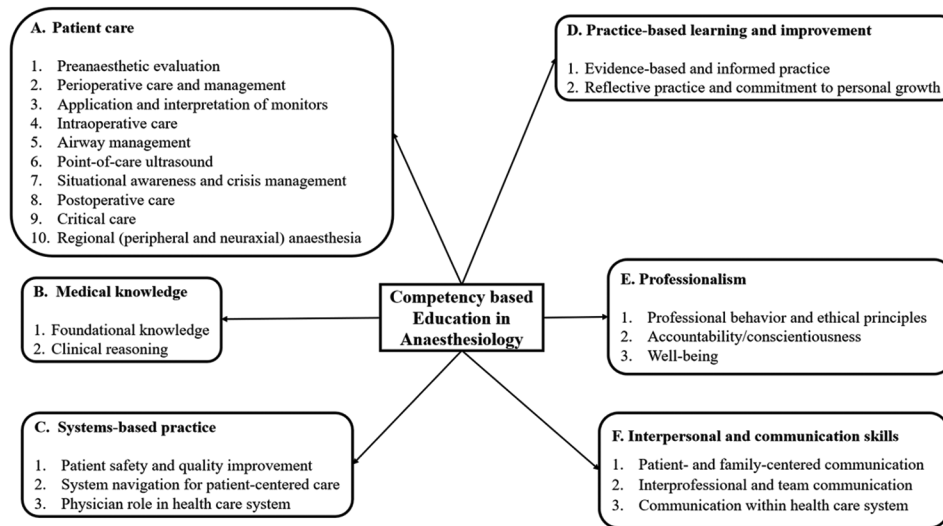
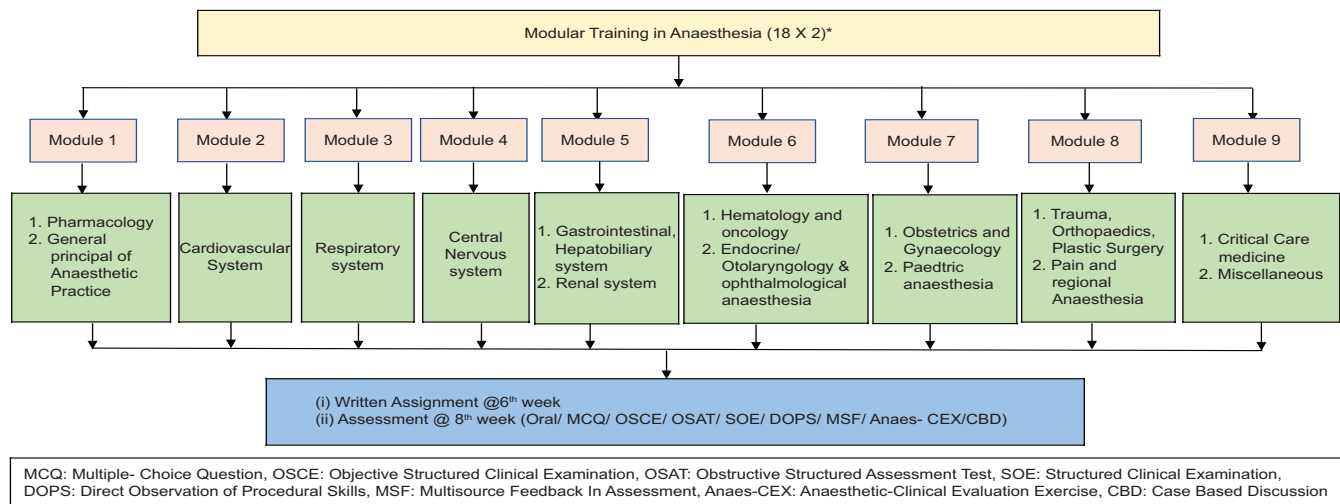


Figure 1: Competency-based medical education in anaesthesiology and sub-competencies



*The modular training will be completed in 18 months and repeated all over again for a second time during the 3-year period of postgraduate training.

Figure 2: Flowchart showing the scheme of the modular training programme; each module lasts for 2 months and deals with a specific component of anaesthesia, and this is inclusive of assignment and assessment in that component

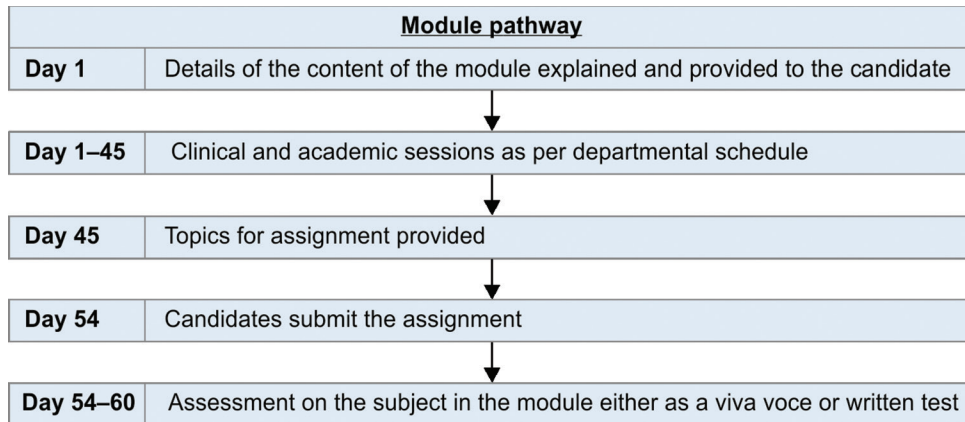


Figure 3: Pathway for each module

formative rather than summative, and a candidate is evaluated on practical implications of the knowledge and skill acquired to clinical situations faced in real life. The CBME is an outcome-based approach to planning, implementing and evaluating education programmes, and assessing learners throughout the training, utilising competencies or abilities under observation. The six domains of competency in anaesthesiology and associated sub-competencies can be grouped as shown in Figure 1.^[9]

RESOURCES AND PROCESS OF TEACHING

The teaching process includes didactic lectures, small group discussions, problem-based learning, journal clubs, bedside tutorials and simulation teaching. It is advisable to have an e-library to keep updated on recent advances in anaesthesiology. Multidisciplinary teams working together must develop protocols for the best medical care to be provided to patients. Aviation crew resource management (CRM) concepts can be effectively taught through group simulation exercises.^[7] Holzman *et al.*^[10] and Grogan *et al.*^[11] have emphasised the importance of anaesthesia crisis resource management (ACRM) as it improves interpersonal communication, awareness of the situation and utilisation of available patient care resources.^[12] Team decision-making, stress management and adverse event recognition should be considered seriously, and performance feedback is also important.^[13]

Although improved patient outcome from simulation education is intuitively obvious, the evidence to prove this is only scanty. Sedlack *et al.*^[14] have demonstrated that patients are more comfortable during gastrointestinal endoscopy performed by simulation-trained endoscopists than by patient-based trained endoscopists. Studies are available that show the educational benefit

of simulation technology.^[14] Educational strategies and simulation-based practice clubbed together can improve anaesthesiology trainee performance, as well as patient safety, ahead of patient care.^[15]

MODULAR TRAINING SCHEME FOR POSTGRADUATE TRAINING IN ANAESTHESIOLOGY FOR MASTER'S DEGREE (3 YEARS DURATION)

The subject-specific training objectives should be clear, competency based, supervised and conducted by well-trained mentors. In addition to the acquisition of skills and knowledge, stress should be laid on attitude, behaviour, safety, communication, discussion, audit, ethics and law. It is not possible to fix the number of hours or topics that need to be covered or prescribed. The trainee is expected to possess in-depth knowledge of the subjects from published textbooks, journals and other credible resources. Similarly, it is not the aim to cover all the topics as didactic sessions, and the postgraduate trainee is expected to devote a fixed amount of time to study on a daily and weekly basis. In fact, in the modular training system described below, it is proposed that assignments and evaluations should be done at 2-month intervals [Figure 1].

COMPONENTS OF TRAINING

There are six major components of training for the award of a master's degree in anaesthesiology: i) cognitive skills/knowledge base, ii) psychomotor skills, iii) affective domain and communication skills, iv) thesis and research, v) logbook, assignments, internal assessment and vi) final examination and certification.

COGNITIVE SKILLS/KNOWLEDGE BASE

There are nine modules aimed to cover major portions

Table 2: Components of modular training

Module no.	Subject	
Module 1	Pharmacology	General principles of Anaesthetic practice
	1) Inhaled anaesthetics – mechanisms of action	1) Anaesthesia machine
	2) Inhaled anaesthetic uptake, distribution, metabolism and toxicity	2) Physics as relevant to anaesthesia
	3) Pulmonary pharmacology and inhaled anaesthetics	3) Patient positioning and associated risks
	4) Inhaled anaesthetics: delivery systems	5) Perioperative fluid and electrolyte therapy
	5) Intravenous anaesthetics	6) Perioperative acid–base balance
	6) Opioids	7) Neuromuscular physiology
	7) Nonopioid pain medications	8) Neuromuscular disorders including malignant hyperthermia and other genetic disorders
	8) Intravenous drug delivery systems	
	9) Pharmacology of neuromuscular blocking drugs	
	10) Reversal (antagonism) of neuromuscular blockade	
	11) Drugs for premedication (including antiemetics)	
Module 2	Cardiovascular system	
	1) Cardiac anatomy and physiology (applied)	
	2) Cardiovascular monitoring	
	3) Electrocardiography and interpretation	
	4) Perioperative echocardiography	
	5) Hypertension	
	6) Ischaemic heart disease and perioperative myocardial infarction	
	7) Anaesthesia for noncardiac surgery in cardiac patients	
	8) Anaesthesia for cardiac (ischaemic, valvular) surgical procedures	
	9) Implantable cardiac pulse generators: pacemakers and cardioverter-defibrillators	
	10) Anaesthesia for correction of cardiac arrhythmias	
	11) Anaesthesia for vascular surgery	
	12) Extracorporeal membrane oxygenation and cardiac devices	
	13) Cardiopulmonary resuscitation and advanced cardiac life support	
	14) Recent advances in cardiovascular anaesthesia	
Module 3	Respiratory system	
	1) Respiratory anatomy and physiology (applied) and pathophysiology	
	2) Respiratory monitoring	
	3) Pulmonary function tests	
	4) Basic chest radiology examination (chest X-ray)	
	5) Anaesthesia for patients with respiratory disease	
	6) Airway management in the adult (includes difficult airway)	
	7) Anaesthesia for thoracic surgery (includes one-lung ventilation)	
	8) Recent advances	
Module 4	Central nervous system	
	1) Cerebral anatomy, physiology (applied) and the effects of anaesthetic drugs	
	2) Neurological monitoring	
	3) Monitoring the state of the brain and central nervous system during general anaesthesia	
	4) Basics of CT, MRI and brain imaging	
	5) Anaesthesia for intracranial/neurological surgery and neurointerventions	
	6) Recent advances and Journal Club presentation	
	7) Cognitive dysfunction and other long-term complications of surgery and anaesthesia	
	8) Anaesthesia and psychosomatic illnesses	
Module 5	Gastrointestinal, hepatobiliary system	Renal system
	1) Gastrointestinal anatomy/physiology (applied) and pathophysiology, liver function tests	1) Renal anatomy, physiology, renal function tests
	2) Hepatic anatomy and physiology (applied), pathophysiology and anaesthesia in hepatic disease	2) Renal pathophysiology and AKI
	3) Anaesthesia for bariatric surgery	3) Chronic renal failure
	4) Anaesthesia for abdominal organ transplantation	4) Anaesthesia and the renal and genitourinary systems
	5) Recent advances	5) Recent advances
Module 6	Haematology and oncology	Endocrines/ENT and ophthalmological anaesthesia
	1) Patient blood management: transfusion therapy	1) Diabetes mellitus
	2) Coagulation and monitoring of coagulation	2) Anaesthesia for thyroid disorders
	3) Anaesthesia for blood disorders	3) Anaesthesia for phaeochromocytoma

Contd...

Table 2: Contd...

Module no.	Pharmacology	General principles of Anaesthetic practice
	4) Anaesthesia for oncology	4) Anaesthesia for ophthalmic surgery 5) Anaesthesia for otolaryngological and head-neck surgery
Module 7	Obstetrics and gynaecology 1) Anaesthesia and analgesia for obstetrics 2) Anaesthesia for foetal surgery and foetal therapy 3) Anaesthesia for nonobstetric surgery during pregnancy Anaesthesia for gynaecological surgery 4) Recent advances	Paediatric anaesthesia 1) Paediatric anaesthesia (general principles and for specific conditions) 2) Anaesthesia for paediatric cardiac surgery 3) Neonatal emergencies and anaesthesia 4) Regional anaesthesia in children 5) Recent advances
Module 8	Trauma, orthopaedics, plastic surgery 1) Anaesthesia for orthopaedic surgery 2) Anaesthesia for trauma 3) Prehospital care for medical emergencies and trauma 4) Anaesthesia for plastic surgery 5) Recent advances	Pain and regional anaesthesia 1) Local anaesthetics 2) Spinal, epidural and caudal anaesthesia 3) Peripheral nerve blocks and ultrasound guidance for regional anaesthesia 4) Acute postoperative pain 5) Management of the patient with chronic pain 6) Recent advances
Module 9	Critical care medicine ICU topics including the following: 1) Acute and anaesthetic care of the burn-injured patient 2) Paediatric and neonatal critical care 3) The postanaesthesia care unit 4) Mechanical ventilation, modes and weaning; management protocols 5) Recent advances	Miscellaneous 1) Quality improvement in anaesthesia practice and patient safety 2) Avoiding patient harm in anaesthesia 3) Patient simulation 4) Ethical aspects of anaesthesia care 5) Ambulatory (outpatient) anaesthesia 6) Nonoperating room anaesthesia 7) Clinical care in extreme environments: at high altitude and in space, high pressure, immersion, drowning, hypo- and hyperthermia 8) Occupational safety, infection control and substance abuse 9) Geriatric anaesthesia 10) Clinical research

AKI=acute kidney injury, CT=computerised tomography, ICU=intensive care unit, MRI=magnetic resonance imaging

of the subject of anaesthesia based on the requirement to manage the whole spectrum of patients at the end of the training. This includes preoperative, intraoperative, postoperative, intensive care management and pain and palliative care. The aim is to have the nine modules [Table 2] covered in 18 months to allow for the second rotation of topics for comprehensive coverage and revision over 3 years. Each module will have a basic science component at the beginning. Each module is to be completed in 2 months as follows: the first 45 days for coverage of the subject and the next 15 days for case presentations, scenarios discussion [Table 3] with assignment writing and evaluation of the subject (to have a written examination of 1-h duration in the subject covered towards the end of the second month of a particular module) [Figure 2]. This will be considered for internal evaluation.

Psychomotor skills: (as per the physiological organ system in the module concerned)

AFFECTIVE DOMAIN

The **affective domain**, one of the three domains in Bloom's Taxonomy, includes how people deal with external and internal phenomena emotionally, ranging from simple to complex feelings. As a teacher, our aim should be to not only impart knowledge and improve skills, but also improve interpersonal behaviour. This domain is categorised into five levels, which include receiving, responding, valuing, organisation and characterisation. Suggestions for teaching and assessment at each level of the affective domain are^[16] (i) **receiving:** trainees are exposed to all types of techniques (video clip, story/use of written or digital media) and can be assessed in the form of a quiz or short answers; (ii) **responding:** a response is required (written, verbal or digital) to teaching techniques like case-based exercises, role-play and the use of standardised patients or simulations; (iii) **valuing:** a voluntary expression of the new

Table 3: Cases for discussion

Respiratory system	Haematology, oncology
Bronchial asthma in a 24-year-old female for appendicectomy	Patient with anaemia
Bronchoscopy for foreign body aspiration/biopsy	Oral tumour
Lung tumour for resection (thoracotomy/OLV)	Central nervous system, neuromuscular disorders
Intercostal drain	Brain tumour and craniotomy
Chronic obstructive pulmonary disease for cholecystectomy	Carotid endarterectomy
Morbid obesity and obstructive sleep apnoea	Cerebral aneurysm
Cardiovascular system	Spine surgery
Valvular heart disease for noncardiac surgery	Myasthenia gravis
Patient with pacemaker/implantable cardioverter-defibrillator for TURP	Trauma, orthopaedic surgery, plastic surgery
Ischaemic heart disease and noncardiac surgery	Forearm surgery needs brachial plexus block
Buerger's disease	Scoliosis for correction
Tetralogy of Fallot	Lower limb surgery – nerve blocks of the LL
Transposition of the great arteries	Hypertensive and diabetic patient for hip replacement surgery
Patent ductus arteriosus	Burns
Paediatric anaesthesia	Fracture mandible
Tracheo-oesophageal fistula	TM joint ankylosis
Congenital diaphragmatic hernia	Endocrinal system
Cleft lip/palate	Thyroidectomy for thyrotoxic goitre
Meningocele	Thyroidectomy for thyroid mass
Hydrocephalus	Diabetic and hypertensive patient undergoing laparoscopic surgery
Pyloric stenosis	Diabetic foot ulcer
Airway obstruction in childhood: stridor and croup syndromes	Phaeochromocytoma
CTEV	Renal system, urogenital system
Congenital heart disease for noncardiac surgery	Chronic kidney disease and kidney transplantation
GIT, hepatobiliary system	Ischaemic heart disease for TURP
Intestinal obstruction	Obstetrics
Obstructive jaundice for cholecystectomy	Peripartum haemorrhage
Portal hypertension	Pre-eclampsia/eclampsia and hypertensive disorders of pregnancy
ENT and ophthalmological surgery	Foetal distress and mitral stenosis for LSCS
Post-tonsillectomy bleeding	Appendectomy in a pregnant patient
Tracheostomy	Pregnancy with anaemia
Open eye injury	

CTEV=congenital talipes equinovarus, ENT=ear, nose and throat, LSCS=lower segment Caesarean section, OLV=one-lung ventilation, LL=lower limb, TM=Temporomandibular, TURP=transurethral resection of prostate, GIT=gastrointestinal tract

values is demonstrated through the techniques (review of journals, debriefing with real cases or simulation, activity logs, etc.); (iv) **organising**: assess for quality care and systems (team communication and system-based practice) and (v) **characterising**: consistent performance reinforcement to ensure a positive and encouraging environment.

Thesis and research: The following guidelines are recommended for thesis writing and fundamentals of research:

1. The thesis protocol/synopsis must be submitted to the Scientific Review Committee (SRC)/Academic Ethics Committee (AEC)/Institutional Review Board (IRB) for approval within 2 months from the date of joining.
2. The thesis protocol/synopsis must be submitted to the university/National Board of Examinations within 3 months of joining.

3. The status of the thesis must be submitted to the research department in a prescribed format once in every 6 months.
4. The final completed thesis must be submitted at least 6 months before the date of the final theory examination.
5. The thesis work can be assessed at three-monthly intervals till submission.

EVALUATION

The educational loop is only completed if the evaluation process is instituted for planning and implementing the teaching process. The implementation of effective CBME requires a meaningful assessment of competence involving timely ongoing assessments and comprehensive periodic reviews for the continuous progress of the trainee.^[17] Students, teachers, programme and patient outcome are needed for the

process of evaluation. Evaluation will include periodic internal formative and summative assessments and the final examination. As the healthcare system enters a new era with newer technologies for teaching, the importance of team-based care grows beside the newer methodology of training. The healthcare community and administrators must themselves be equipped with the requisite knowledge, skills and attitude for a seamless transition from the conventional to the evolving newer modes. This will lay a strong foundation for effective teamwork in our daily clinical practice for enhanced outcomes in the perioperative environment.^[18,19]

CONCLUSION

Postgraduate education in anaesthesiology involves development of cognitive, psychomotor and affective skills, which transforms a basic medical graduate into a full anaesthesiologist cum perioperative physician with the capability of managing varied nature of surgical and critical care patients. This manuscript describes a modular training programme that splits the curriculum into 18 (9 × 2) modules of 2 months duration each, with assignments and assessments being carried out at the end of each module. This system encourages mentor–mentee interaction periodically; it is objective and envisages that equitable education all across the country can be provided.

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Conflicts of interest

There are no conflicts of interest.

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