

Medical Education

Medical aptitude and its assessment

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ABSTRACT

The assessment of the suitability of an individual for the profession of medical science is carried out worldwide on the basis of several yardsticks. While a few methods assess domain knowledge of sciences, others focus on evaluating the cognitive aptitude skills of the candidate, while few others assess communicative skills. Though it has been considered that the possession of an aptitude for the profession is a prerequisite, considering its strenuous demands from the candidate, a comprehensive assessment of these areas under the construct of medical aptitude has not been analysed so far, though medical aptitude has been socially defined. This article attempts to develop a comprehensive construct to 'Medical aptitude', meant for the pre-medical student, which has been encapsulated with respect to the areas of its assessment. We did an extensive survey of the literature pertaining to the mode of selection of students towards medical profession and analysed their areas of assessments for admittance. This enabled to identify similarities in the areas of assessment which were then classified under several domains of assessment. Special reference to the keywords involving 'Aptitude' and 'Medical Aptitude' was made. We analysed the definitions to the construct of aptitude from the literature with respect to its relevance in the profession of medical science to be possessed by the pre-medical aspirant—in context. From this, a new construct of medical aptitude was formulated incorporating the existing construct of medical aptitude. Medical aptitude is a comprehensive construct that encompasses the dimensions of a consistent core, a peripheral content and the support of a scaffold. Each of these dimensions have their importance and distinct objective in being assessed in the pre-medical student. A perfect intertwining of these 3 dimensions can prove beneficial in assessing individuals to be fit for the profession of medical science.

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INTRODUCTION

Medical science is a complex course of professional studies offered in countries all over the world. The number of aspirants for the course in any country is larger than the number of positions

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available, suggesting that medical science is still one of the most sought after professions. This popularity can be attributed to several reasons ranging from a willingness to serve humanity through the profession,¹ parental influence,² influence from peers and relatives,³ acquisition of high social status,⁴ prestige associated with the profession⁵ and respect and honour accorded to the profession.⁶ The admission and selection criteria of medical aspirants is a rigorous process and involves competition of a high order. Medical science requires the candidate to have adequate intra- and interpersonal skills, a flexible approach to arrive at decisions, professionalism and an indomitable zeal to strive under stringent conditions, apart from possessing academic and clinical mastery of the subject. Assessing such individuals for admittance to the course is a challenge as it ranges from assessing knowledge of students in the spheres of pure sciences, cognitive aptitude and communication skills.

METHODS

We did a literature review from January 2015 to September 2017 using JSTOR, ProQuest, Google Scholar and PubMed. We searched for key words and phrases such as 'reasons for joining medical profession', 'attitude towards medical profession', 'aptitude', 'aptitude for medical profession', 'assessment of medical aptitude' and 'aptitude for pre-medical aspirants'. These keywords led us to an amalgam of books in educational psychology, research articles from medical journals, review articles, research papers, short communications, documents, publications and reports from government organizations, prospectus of medical institutions, editorials, websites of organizations and institutions responsible for conducting tests for admittance to the medical profession, published legal information, reports and documents published from the Medical Council of India (MCI) and the General Medical Council (GMC) of the UK, conference proceedings, chapters from electronic books and prospectus of agencies assessing the entry of pre-medical students. These 62 documents were reviewed. If full-text articles could not be traced, their abstracts were referred to. The articles were categorized based on the content of the paper and its respective subheadings.

Of the 62 documents, 11 research papers dealt with reasons for adolescents choosing the profession, 6 research papers citing peer influence, parental influence, societal expectations, self-interest and motivation were studied in depth as the data were obtained from empirical studies. The rest were not included as these were non-empirical. The articles chosen dealt with the concept of 'attitude towards the medical profession' that is essential for medical aptitude, which is the focus of our article. There were 6 documents with regard to 'Aptitude and its assessment' including books. Two articles in this section drew differences in the assessment of examinations and aptitude tests with special focus on essential aptitudes that doctors should possess. Five articles highlighted the existing lacunae among Indian medical graduates

with respect to possession of their cognitive skills. Three articles mentioned the need to assess communication skills and its relevance in doctor–patient relationship. Definitions from glossaries were included to provide authenticity to the terms used. Published legal information, reports and documents published from the MCI and the GMC of the UK were reviewed with respect to their perspective of traits that future doctors should possess. On searching for articles pertaining to emotional intelligence (EI), only those pertaining to their relevance in the medical profession were used for the study. From these, 4 were cited with special reference to a study where its need has been assessed among medical applicants through the development of a standardized tool. With respect to the importance of aptitude assessment in the medical science, 6 articles were reviewed, one of which was a comparative study to evaluate the existing differences in the aptitudes of medical students towards their profession.

As the article focused on the areas of assessment for admittance into the medical profession, a substantial portion of the article pertains to this aspect. Three articles concerned with the need to assess aptitude for undergraduate medical education as a criterion where special emphasis has been made to the mode of selection of pre-medical students. Five documents concerning the evolution of standardized entrance tests internationally and in India have been reviewed including reports from governmental organizations and prospectus of 2 medical institutions. Seven websites of organizations responsible for conducting tests for admittance to the medical profession and the 2 previously mentioned prospectuses were extensively researched for delving into their respective areas of assessment with respect to medical aptitude. The weightage allotted to their dimensions of assessment has been calculated and presented in the respective subsections of these 9 testing agencies. The focus of the literature survey was to content analyse the objective underlining these agencies in selecting students for the profession. The components assessed in them were tabulated for ease of reference. Content analysis and tabulation enabled the researchers to identify similarities in them. These similarities were classified under several domains of assessment presented in the succeeding sections of the paper. While some papers stressed on evaluating their scientific knowledge, others focused on assessing cognitive skills and another on communication skills among potential aspirants. The objective of screening and incorporating areas of assessment with special reference to the contextual construct of medical aptitude was kept in mind while reviewing the literature. The definitions to the construct of aptitude from the literature were analysed with respect to its relevance in the profession of medical science to be possessed by the pre-medical aspirant. To conceptualize medical aptitude, the construct of medical aptitude as envisaged by the author was subjected to content validation by 2 experts in the field of medical education. The recommendations that emerged during the validation have been incorporated while framing the construct of medical aptitude in this article. From this, a new construct of medical aptitude was formulated incorporating the existing construct of medical aptitude provided by McGaghie in 1992.⁷

APTITUDE AND ITS ASSESSMENT

Aptitude can be defined in several ways. Freeman defined aptitude as ‘a combination of characteristics indicative of an individual’s capacity to acquire training or some specific knowledge, skill or composite knowledge, understanding or skill or set of organized responses’.⁸ Stalnaker⁹ defined aptitude as a psychological construct with respect to the readiness of an individual to acquire

training in some knowledge or skill. He felt it was important in testing of personnel to indicate the fitness for a profession in particular. This can be called an aptitude test which the National Council on Measurement in Education defines as ‘a test designed and used to predict how well someone might perform in a certain ability area in the future. Examples include scholastic, musical, clerical, verbal and mechanical aptitude’.¹⁰ Scholastic aptitudes assess the academic vigour of the individual with respect to proficiency in an area of future interest, skills and abilities while professional aptitudes assess the abilities of the individual with respect to the skills possessed by the individual for a specific profession or occupation. These include scientific, mechanical, engineering and medical aptitudes.¹¹

McManus *et al.*¹² highlighted the contrast in the objectives of examinations and aptitude tests. While examinations intend to measure achievement, accomplishment and mastery of an academic subject, aptitude tests assess cognitive ability by measures irrespective of knowledge gained through formal education. These tests of intelligence portray the stability and sustenance of the skills of the individual throughout life while achievement tests check the latest educational experience. The medical student and physician should possess aptitudes in tune with the demands of the profession. These aptitudes are requisites for sustenance in both medical education and thereafter in professional practice. Durkin,¹³ based on a validation study of 70 professional doctors, highlighted inductive reasoning and a keen sense of observation as 2 essential aptitudes that doctors must possess. While inductive reasoning helps in diagnosis, a keen sense of observation allows meticulous details to be assessed. Durkin also stated that despite possession of these aptitudes, the course of medical sciences is strenuous and motivation, determination and capacity for intense hard work are characteristics that would allow a person to sustain in the course.

ASSESSMENT FOR ADMITTANCE TO THE MEDICAL PROFESSION

Most countries have requisites for medical education that are similar in approach but vary slightly in their respective method. Nicholson has given a comprehensive view of the existing standardized tests such as the Biomedical Admission Test (BMAT), the Medical School Admissions Test (MSAT), the Graduate MSAT (GAMSAT) and the Personal Qualities Assessment (PQA) used to assess medical aptitude for applicants globally.¹⁴ He felt that the need for screening candidates for admission became necessary when the number of applicants surpassed the number of seats available for the course. Nicholson also mentioned that these tests evaluate not just intelligence but certain desirable non-cognitive traits too. Stalnaker⁹ stressed that every effort must be made to select future doctors with utmost care and help them develop better skills and techniques. He emphasized that this could be done by improving the selection of students to lower the rate of attrition from medical schools. However, Nicholson felt that ‘to be defensible, a selection method must be reliable within and across successive cohorts of applicants. It must select what it claims to test and it should predict the eventual performance of the potential doctor who is selected.’¹⁴ He also stated that the validity and reliability of the PQA has been established and it has also been able to distinguish candidates based on their intellectual ability and personality. However, its long-term follow-up with respect to the performance of a doctor is yet to be assessed.¹⁵ The predictive validity of the BMAT was analysed by Emery and Bell by correlating the BMAT selection tests for a cohort of 4 successive

years with respect to the performance of medical students in the preclinical examination. The section of BMAT assessing the candidate's knowledge of the sciences correlated much more with respect to their respective preclinical examination performance than did the section of BMAT that assessed their aptitude and skills.¹⁶

One of the earliest standardized tests used to assess medical aptitude was the Moss Test in 1928⁷ by the Association of American Medical Colleges. Over the years it has been replaced by the Medical College Admission Test (MCAT) that has undergone several revisions (1946, 1962, 1977, 1991 and 2015). The purpose behind the introduction of an aptitude test for medical studies was to reduce the rate of attrition from American medical schools.^{7,9} The primary objective of the MCAT was to evaluate applicants for their readiness for professional education. In India, since May 2016, the Central Government has introduced the National Eligibility-cum-Entrance Test (NEET) for admission to medical/dental sciences through a single examination throughout the country.^{17,18} However, the All India Institute of Medical Sciences (AIIMS), New Delhi and Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry continue to conduct their own tests for admission.^{19,20}

To understand the construct of medical aptitude, it is essential to look at assessment for admittance to the medical course. Contextual and thematic analyses of the documents and areas of assessment conducted worldwide from the test conducting authorities have been employed. These can be grouped under 4 areas:

1. Domain-specific knowledge of pure sciences
2. Cognitive aptitude
3. Linguistics and communication skills
4. Interpersonal understanding

Domain-specific knowledge of pure sciences

A student of the science stream after having qualified in the higher secondary school examination of class XII or pre-university

course with physical, chemical and biological sciences as core subjects is eligible to study medical science. This is the basic eligibility for school leavers in India and several Asian countries. In the USA, New Zealand and Australia, aspirants must hold a graduate degree in the Bachelor of Health Sciences or any Life Science allied programme to be eligible to apply for the Bachelor of Medicine and Bachelor of Surgery—the undergraduate medical education programme. Hence, the possession of exhaustive and in-depth knowledge of physics, chemistry and biology is essential not just for admittance but also for application of the fundamentals of medical science in succeeding years of the course. Biophysics and biochemistry being interdisciplinary branches of physics and chemistry, respectively, form a part of medical curricula. These subjects are taught in the first year of the course.²¹ The objective of teaching these subjects is to allow medical students to apply knowledge of these interdisciplinary branches to the functioning of the human body and principles in diagnostic procedures.

Table I shows that the GAMSAT, United Kingdom Clinical Aptitude Test (UKCAT), Undergraduate MAT (UMAT) and the Health Professions Admission Test (HPAT)-Ireland do not assess scientific knowledge of the candidate. The GAMSAT conducted by the Australian Council for Educational Research in conjunction with the Consortium of Graduate Medical Schools permits selection of students to the graduate-entry medical and health programmes in Australia, Ireland and the UK, and evaluates the extent of abilities and skills gained through prior experience and learning, including concepts in basic science.²² Nevertheless, the assessment of reasoning in humanities and social sciences, and in biological and physical sciences is ascertained—rather than content knowledge of the sciences. UKCAT also lays focus on the 'most appropriate mental abilities, attitudes and professional behaviours required for new doctors and dentists to be successful in their clinical careers',^{23,24} UMAT is not a curriculum-based academic test that assesses subject knowledge. Prior knowledge of pure sciences or mathematics is not necessary as it assesses other skills required for the profession of medical science.²⁵

TABLE I. Assessment of domain-specific knowledge of pure sciences with weightage per section

Test	Sections of assessment	Weightage (%)
MCAT	Biological and biochemical foundations of living systems	33.3
	Chemical and physical foundations of biological systems	33.3
	Psychological, social and biological foundations of behaviour	33.3
GAMSAT	Nil	0
BMAT	School-level physics	26
	School-level chemistry	26
	School-level biology	26
	School-level mathematics	22
UKCAT	Nil	0
HPAT-Ireland	Nil	0
UMAT	Nil	0
NEET-UG, India	Physics from higher secondary school curriculum	25
	Chemistry from higher secondary school curriculum	25
	Biology from higher secondary school curriculum	50
AIIMS, New Delhi, India	Physics from higher secondary school curriculum	33.3
	Chemistry from higher secondary school curriculum	33.3
	Biology from higher secondary school curriculum	33.3
JIPMER, Puducherry, India	Physics from higher secondary school curriculum	33.3
	Chemistry from higher secondary school curriculum	33.3
	Biology from higher secondary school curriculum	33.3

MCAT Medical College Admission Test GAMSAT Graduate Medical School Admissions Test BMAT Biomedical Admissions Test UKCAT United Kingdom Clinical Aptitude Test HPAT-Ireland Health Profession Admission Test-Ireland
 UMAT Undergraduate Medicine and Health Sciences Admission Test NEET-UG National Eligibility-cum-Entrance Test
 Undergraduate AIIMS All India Institute of Medical Sciences JIPMER Jawaharlal Institute of Postgraduate Medical Education and Research

Among the tests that assess the domain-specific knowledge of the candidate, the content areas of MCAT also include applied subjects such as psychology and sociology. From April 2015, the revised version of MCAT assesses the candidate in domain-specific areas of biological and biochemical foundations of living systems, chemical and physical foundations of biological systems and psychological, social and biological foundations of behaviour.²⁶ The BMAT conducted by the University of Cambridge is essential for candidates who wish to pursue a course in Medicine, Veterinary Medicine, Biomedical Science or Dentistry among 10 universities in the UK and 1 in Singapore.²⁷ It ascertains application of the knowledge of science and mathematics based on school-level curriculum. The NEET-UG in India, the AIIMS (New Delhi), and the JIPMER examinations ascertain knowledge as identified by the ‘core syllabus’ which includes physics, chemistry and biology as prescribed for the higher secondary stage.²⁸⁻³¹

However, Powis³² has questioned the relevance of testing knowledge of these subjects for those pursuing a graduate course in medicine. If a correlation exists between these 2 aspects, the achievement of the candidate in these science subjects should denote future success in the medical course.

Cognitive aptitude

Cognitive ability is the ‘ability of an individual to perform the various mental activities most closely associated with learning and problem-solving. Examples include verbal, spatial, psychomotor and processing speed ability’.¹⁰ Aptitude tests have been defined ‘to measure intellectual capabilities for thinking and reasoning, particularly logical and analytical reasoning abilities’.³³ Powis *et al.*³⁴ suggested possession of adequate intellectual and reasoning skills in a medical aspirant to be a prerequisite for assessment which involves an individual’s style of manipulating concepts and information along with applying creativity, problem-solving and logical reasoning.

Among the different skills of cognitive aptitude being assessed, the skill of reasoning is assessed by 5 standardized tests worldwide (Table II). Logical, verbal, quantitative, abstract and non-verbal are the various skills under reasoning being analysed in an objective manner. The GAMSAT aims to evaluate the level of

skills acquired through experience and acquisition such as problem-solving and critical thinking skills, perceived to be essential prerequisites in modern medical courses.³⁵ These have been incorporated in the assessment of reasoning in humanities, social sciences, biological and physical sciences. The BMAT has identified reasons for assessing the aptitude and skills of the pre-medical student with an intention that they must possess the ability to understand, provide arguments for reasons, arrive at logical inferences, use a critical approach to arrive at decisions and consider alternatives.³⁶ The UKCAT also lays emphasis on assessing the most pertinent psychological skills and attitudes required in the medical science. Skills exclusively assessed by the UKCAT include those of decision-making and situational judgement, apart from skills in reasoning. Decision-making evaluates the potential of the student to use the available information to arrive at meaningful decisions while situational judgement ascertains the ability to display appropriate behaviour with respect to real-life situations by assessing the ‘integrity, perspective taking, team involvement, resilience and adaptability of the individual’.²⁴

The UMAT is designed to assess abilities gained through experience and skills such as critical thinking and problem-solving and abstract non-verbal reasoning. The need to ascertain logical reasoning and problem-solving skills of the candidate is justified to understand and arrive at conclusions by identifying relevant facts through evaluation of available information while non-verbal reasoning assesses one’s ability to reason with the abstract.²⁵ These skills have been identified by UMAT as being pivotal for all professions in health sciences. In India, JIPMER and AIIMS assess cognitive skills and aptitude required for the medical professional. However, NEET-UG does not assess any of these cognitive parameters, despite it being the sole mode of admission into the medical profession in India.

Linguistics and communication skills

The GMC, UK has highlighted the need to developing adequate communication skills.³⁷ Future doctors ought to learn to communicate as a patient advocate, teacher, manager or improvement leader. This entails communicating effectively by

TABLE II. Assessment of cognitive aptitude with weightage per section

Test	Sections of assessment in cognitive aptitude	Weightage per section (%)
Medical College Admission Test	Critical analysis and reasoning skills	23
Graduate Medical School Admissions Test	Reasoning in humanities and social sciences	40
	Reasoning in biological and physical sciences	58
Biomedical Admissions Test	Problem-solving skills	20
	Understanding arguments	15.87
	Data analysis and inferential abilities	19
United Kingdom Clinical Aptitude Test	Verbal reasoning	18.96
	Quantitative reasoning	12.5
	Abstract reasoning	15.5
	Decision analysis	23.7
	Situational judgement abilities	29.3
Health Professions Admission Test-Ireland	Logical reasoning and problem-solving	39.2
	Non-verbal reasoning	26.7
Undergraduate Medicine and Health Sciences Admission Test	Logical reasoning and problem-solving	35.2
	Non-verbal reasoning	30.88
NEET-UG, India	Nil	—
AIIMS, New Delhi, India	Aptitude and logical thinking	5
JIPMER, Puducherry, India	Logical and quantitative thinking	5

NEET-UG National Eligibility-cum-Entrance Test Undergraduate Institute of Postgraduate Medical Education and Research AIIMS All India Institute of Medical Sciences JIPMER Jawaharlal

listening, sharing and responding with patients and colleagues in the medical context. The importance of non-verbal communication in the context of consultation through cues of body language of the patient has also been stressed by the GMC.

Padmanabhan *et al.*³⁸ have highlighted that the medical student should be able to reasonably understand the English language apart from being competent in communication. Powis³² has questioned the extent of verbal and written communication skills required for the medical aspirant—demonstration of sound understanding and logical accuracy in writing. However, only 4 of the existing standardized tests, namely the GAMSAT, BMAT, HPAT-Ireland and JIPMER (Table III) assess this component.

While GAMSAT assesses written communication of the candidate to assimilate and convey thoughts in a rational and effective manner,³⁵ the BMAT and HPAT-Ireland use the task of writing to ascertain the ability of the candidate to scrutinize and organize ideas with an intention to communicate effectively.^{27,39} However, JIPMER, analyses the English language and comprehension ability of the candidate through multiple-choice items rather than a written task.³¹

Interpersonal understanding

Hippocrates of Kos—the ‘Father of Clinical Medicine’⁴⁰—and the MCI in its Professional Conduct, Etiquette and Ethics Regulations, 2002,⁴¹ have stressed that physicians must be concerned about the well-being of the sick by conducting oneself with utmost professionalism. A proper understanding of the doctor–patient relationship has been put forth by Morgan⁴² to be transparent communication, which requires the doctor to understand the perspective of the patient. Powis *et al.*³⁴ also suggest that sound interpersonal skills are essential for building a smooth rapport in the doctor–patient communication process (Table IV).

Despite these being pivotal skills to be assessed in doctors-to-be, ironically only 2 agencies have been assessing them worldwide. The HPAT-Ireland assesses interpersonal understanding in the candidate to assess the ability to understand, identify, infer thoughts, feelings and interactions of people.³⁹ The UMAT evaluates the ability to understand how people feel and think as ‘Understanding people’ with objectives similar to HPAT-Ireland.⁴³

TABLE III. Assessment of linguistics and communication skills in different tests

Test	Assessment of linguistics and communication skills with weightage (%)
Medical College Admission Test	Nil
Graduate Medical School Admissions Test	Written communication (2%)
Biomedical Admissions Test	Writing task
United Kingdom Clinical Aptitude Test	Nil
Health Professions Admission Test-Ireland	Written English task (1%)
UMAT	Nil
NEET-UG, India	Nil
AIIMS, New Delhi, India	Nil
Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India	English language and comprehension (5%)

UMAT Undergraduate Medicine and Health Sciences Admission Test
 NEET-UG National Eligibility-cum-Entrance Test Undergraduate
 AIIMS All India Institute of Medical Sciences

The PQA, in one of its sections, assesses the interpersonal values, which reflects the candidate’s personal values, and interpersonal traits, which allows the candidate to understand the way in which individuals think.⁴⁴

Can interpersonal understanding be considered as an aptitude skill to be reviewed under the construct of medical aptitude? This draws parallel with the purview of EI. EI was defined by Salovey and Mayer as a ‘type of social intelligence that involves the ability to monitor one’s own and others’ emotions, to discriminate among them, and to use the information to guide one’s thinking and actions’.⁴⁵ Mayer and Salovey⁴⁶ later increased the scope of EI as ‘verbal and nonverbal appraisal and expression of emotion, the regulation of emotion in the self and others and the utilization of emotional content in problem-solving’. Elam brought out the need to differentiate EI from the other skills of communication, verbal reasoning and interpersonal understanding. It is evident that EI is an intelligence that over time, on conscious development by the individual, becomes an essential aptitude or skill to be possessed. Bejjani⁴⁷ has also stressed that EI is a quality that improves and strengthens by introspection, practice and supervision. Elam has pointed out the significance of displaying sound EI in physicians. The ability to discern patient’s emotional response and to infer it as a guide for future thinking and action is yet another skill in strengthening the doctor–patient relationship. Bejjani insists that both medical students and physicians must develop and control EI. Carrothers *et al.*⁴⁸ first used EI to assess medical applicants as a pilot study. They assessed 5 dimensions of maturity, compassion, morality, sociability and calm disposition. The instrument was reliable in demonstrating the ability to assess appropriate intra- and interpersonal skills in prospective medical applicants.

APTITUDE ASSESSMENT

McManus *et al.*¹² have discussed that, unlike examinations which purport to measure academic mastery and achievement based on the latest educational experience, aptitude tests assess cognitive ability by means acquired through non-formal and informal means of education. These tests of intelligence portray the stability and sustenance of the skills depicted by the individual throughout life. McManus has described the objective of these intellectual aptitude tests as wanting to measure both fluid and crystallized intelligence. While fluid intelligence measures logical reasoning

TABLE IV. Assessment of interpersonal understanding in different tests

Test	Assessment with weightage per section (%)
Medical College Admission Test	Nil
Graduate Medical School Admissions Test	Nil
Biomedical Admissions Test	Nil
United Kingdom Clinical Aptitude Test	Nil
Health Professions Admission Test-Ireland	Interpersonal understanding (32.1)
Undergraduate Medicine and Health Sciences Admission Test	Understanding people (32.4)
NEET-UG, India	Nil
AIIMS, New Delhi, India	Nil
Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India	Nil

NEET-UG National Eligibility-cum-Entrance Test Undergraduate
 AIIMS All India Institute of Medical Sciences

and critical reasoning, crystallized intelligence assesses knowledge acquired culturally through vocabulary and geography. On the flip side, Powis *et al.*³⁴ stated that possession of adequate intellectual and reasoning skills is broadly orthogonal to academic achievement.

However, McManus has pointed out that intellectual aptitude tests fail to evaluate the scientific knowledge required to study medicine, nor the motivation and personality traits for it. Pure intellectual aptitude tests assess only fluid intelligence (like the UKCAT), which is not a strong predictor of performance, as only cognitive skills are considered. Powis *et al.*³⁴ stressed that intellectual and reasoning skills are vital for developing a professional approach by the student to practice medicine. Powis³² ascertained the importance of using logical reasoning, problem-solving and critical reasoning as areas of assessment for admittance to the medical course, provided tests were purposefully designed to identify these essential cognitive skills. Cognitive aptitude skills cannot be ruled out in the modern-day medical curriculum as pointed out by GAMSAT. Verma *et al.*⁴⁹ and other studies⁵⁰⁻⁵² have shown that, despite Indian medical graduates possessing essential knowledge of medical science, they are often found to be lacking in skills such as problem-solving. Apart from problem-solving skills, skills in decision-making and independent thinking also need to be developed in medical graduates.³⁸

The aptitudes of candidates may vary from the time of admittance in the course to as they progress through the course. The marked variation in differences in aptitude required for the profession of medical science was studied in a cohort of medical students by Salpekar and Mujawar.⁵³ They did a cross-sectional study to evaluate aptitude among the first- and final-year MBBS students in a medical college in Nagpur. The Differential Aptitude Test Battery was used which assessed the students in verbal and abstract reasoning, numerical ability, space relations and use of language. They found that only 38% of students possessed a sound aptitude as they had scored high in the section of abstract reasoning. More than half the final-year students (51.3%) showed sound aptitude required for the profession while a little more than a quarter (26.6%) of the freshers showed aptitude for the profession. This could be attributed to the fact that the senior students over the course of their studies have progressed in developing judgement skills. Salpekar and Mujawar ascertained that no structured programme exists in India which allows adolescents to assess themselves when making an informed choice about choosing a profession. They also state that the results of an aptitude test can determine how well an individual applies the acquired knowledge and skills in real-life situations, thereby predicting the fitness of a person for a job, not just by the educational qualification and work experience.

THE COMPREHENSIVE CONSTRUCT OF MEDICAL APTITUDE

A literature review of the construct of medical aptitude is seldom available. McGaghie made one of the earliest attempts to define the construct of medical aptitude.⁷ McGaghie described the construct with special reference to the evolution of MCAT over a period of decades. The definition of medical aptitude has undergone several revisions over the years as each version embodied different components.

The definition of medical aptitude has a 'consistent core with many peripheral variations' (p.1090).⁷ The core consists of the knowledge about the principles of physical, chemical and biological sciences. The peripheral content includes assessing the candidate

with respect to the scientific principles of verbal ability and verbal reasoning; reading ability; writing skills; general information about social sciences; discerning and formulating relationships and problem-solving skills. However, the inclusion and exclusion of components of the peripheral content could not allow a fixed definition of medical aptitude but has been constructed socially. Stalnaker agreed that 'aptitude for medicine is complex, difficult to define, to establish and difficult to measure' (pp.196-97).⁹ A comprehensive definition of medical aptitude, based on the reviews and version of the MCAT, encompasses the knowledge of 'set of core, consensual principles from the Biological and Physical Sciences' (p. 1090) along with the assessment of skills in problem-solving; verbal reasoning and discerning and formulating relationships.⁷

This consistent core is what ascertains the domain-specific knowledge of the medical aspirant in areas of the pure sciences. Most assessments worldwide assess the medical aspirant with respect to this core of pure sciences, except for the UKCAT, which exclusively focuses on cognitive aptitude. With respect to crystallized intelligence, where learnt knowledge and skills are assessed, it gives room to access information from one's memory. The physical, chemical and biological sciences form the fundamentals of pure sciences. Though the anatomy and physiology of human life in the biological sciences is what medical science is, the other 2 branches have their fair contribution in the same. The interdisciplinary branches of biophysics and biochemistry form a part of medical curricula where the scientific basis of physiological processes can be explained and understood.²¹ The peripheral content relies on assessing that aspect of medical aptitude where the fluid intelligence of the individual is assessed. It focuses on cognitive aptitude skills that include problem-solving, and verbal and logical reasoning.

If the consistent core and peripheral content have acquired status to define them, where does assessment of communication skills and interpersonal understanding or EI of the individual find place in the construct of medical aptitude? Literature reviews^{34,42,48} that have ascertained the foundation of a trustworthy doctor-patient relationship to be based on open communication and possession of interpersonal understanding or adequate EI on the part of the medical student and the future physician suggest that these 2 areas must not be ignored during assessment of the pre-medical student and have been termed the 'scaffold'. Assessing these in the pre-medical student should focus on evaluating the existing communication skills and level of interpersonal understanding of the admitted candidates and should not be taken as a criterion for selection in the profession. The Vision 2015 document, published by the Board of Governors, MCI has incorporated new teaching elements in undergraduate medical education with an objective to develop existing standards of medical education throughout the country.⁵⁴ A foundation course of 2-months has been introduced aimed at preparing students for the profession effectively. The modules in this course, among many, include those related to learning communication skills and sociology of health and demographics.

Based on the 3 dimensions of the construct of medical aptitude, one can relook at the present assessment tests and the dimensions these assess, the methodology of the test (test pattern) and the weightage per section (Table V).

A comprehensive view throws light on the fact that the NEET-UG is the only test—among those discussed—that ascertains the consistent core, exclusively giving absolutely no weightage to the other 2 dimensions of medical aptitude. AIIMS (New Delhi) and

TABLE V. Dimensions of assessment of medical aptitude of standardized tests

Test	Dimensions assessed with weightage per dimension (%)			
	Consistent core	Peripheral content	Scaffold	Methodology of test
MCAT	77	23	0	Passage-based sets of questions and independent questions
GAMSAT	0	98	2	Passage-based multiple-choice type questions
BMAT	42	55	1	Multiple-choice type questions
UKCAT	0	100	0	Multiple-choice type questions
HPAT-Ireland	0	33.9	66	Multiple-choice type questions
UMAT	0	66.1	32.35	Multiple-choice type questions
NEET-UG, India	100	0	0	Objective-type questions (multiple-choice questions)
AIIMS, New Delhi, India	90	10	0	Objective-type questions (multiple-choice questions)
JIPMER, Puducherry, India	90	5	5	Single best response-type questions (multiple-choice questions)

MCAT Medical College Admission Test GAMSAT Graduate Medical School Admissions Test BMAT Biomedical Admissions Test UKCAT United Kingdom Clinical Aptitude Test HPAT-Ireland Health Professions Admission Test-Ireland UMAT Undergraduate Medicine and Health Sciences Admission Test
 NEET-UG National Eligibility-cum-Entrance Test Undergraduate AIIMS All India Institute of Medical Sciences JIPMER Jawaharlal Institute of Postgraduate Medical Education and Research

JIPMER are next in allotting a higher weightage (about 90%) to this consistent core. However, unlike NEET, the peripheral content is assessed by the latter tests while communication is solely assessed by JIPMER. Among the tests conducted worldwide, MCAT follows in ascertaining the core by giving importance not just to the branches of pure sciences but also to psychology and social sciences of behaviour. However, BMAT ascertains school-level knowledge of science and mathematics, with a weightage of 42% for the consistent core.

With respect to the peripheral content, all tests discussed in this article—except NEET-UG—assess this dimension of medical aptitude. The UKCAT is the sole test that exclusively ascertains this dimension for admittance into the profession with no weightage for assessing the consistent core and communication. The substantiation lies in the fact that the UKCAT lays focus to assess the most pertinent psychological skills and attitudes required for sustenance in the profession of medical science.²³ The GAMSAT, UMAT, BMAT and the HPAT follow suit in descending order with respect to the weightage allotted for this dimension of the construct of medical aptitude. The GAMSAT identifies the skills in the peripheral content as being essential prerequisites in modern medical curricula for which the assessment of reasoning in biological and physical sciences along with humanities and social sciences has been given prominence rather than content knowledge of these sciences.³⁵ The UMAT and the HPAT-Ireland echo the above thought in assessing skills identified in the peripheral content in being essential for professionals entering the health sciences and allied courses, when compared to academic knowledge.²⁵ BMAT has acknowledged the possession of aptitude and skills as qualities to be assessed with respect to the handling of data in the form of number and communication for the pre-medical aspirant.³⁶ However, BMAT clarifies that their test is solely an assessment of a candidate's potential for an academically inclined undergraduate degree in medicine and not their fitness to practice the profession. In India, AIIMS and JIPMER assess this peripheral content in their entrance test with a weightage of 10% and 5%, respectively, of the total. It is ironical that the single entrance window test of the NEET-UG fails to assess this dimension of medical aptitude.

Unlike the weightages allotted to the dimensions of the consistent core and the peripheral content, the weightage allotted in assessing the dimension of the scaffold in standardized tests is meagre. While BMAT, GAMSAT and one section of the HPAT-Ireland employ written tasks of communication for the same, the

JIPMER, UMAT and another part of the HPAT-Ireland assess this through questions analysing interpersonal understanding. In fact, the HPAT-Ireland assesses 66% of its medical aptitude under the scaffold when compared to the weightage allotted to its peripheral content (33.9%). However, it is alarming that the MCAT, UKCAT, NEET-UG, and AIIMS have no room to assess this scaffold—despite it being recognized as the edifice of a healthy doctor-patient relationship.^{34,42,48}

CONCLUSION

The construct of medical aptitude has been socially conceptualized, as quoted by McGaghie, with the definition of the construct being complex. Medical aptitude, thus, is a comprehensive and multifaceted term that encompasses 3 dimensions under it which includes a consistent core, a peripheral content and the support of a scaffold. Each of these dimensions have their importance and specific objectives in being assessed in the pre-medical student. No specific dimension outweighs the other 2. A perfect intertwining of these 3 dimensions can prove beneficial in assessing individuals to be fit for the profession of medical science.

Conflicts of interest. None declared

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