Assessment of Saudi MEDs framework competence in performing clinical and practical skills by final-year medical students

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A R T I C L E   I N F O

A B S T R A C T

Clinical examinations and practical clinical skills are essential to guide diagnosis and treatment. Competency-based medical education (CBME) is high on today's medical education agenda, and competence has become the unit of medical education planning in many countries. With the rise of medical education in Saudi Arabia, The Saudi MEDs initiative began as a means of achieving national consensus and developing necessary learning outcomes for medical schools. The aim of this study is to evaluate the final-year medical students' core clinical competencies and identify the gaps between clinical skills in the Saudi MEDs framework and students' actual achievement. Online data collection from all fifth-year medical students, to assess their clinical and procedural skills by using Objective Structured Clinical Examination (OSCE) scores and using a self-administered questionnaire that has been developed based on the Saudi MEDs framework. Eight clinical competencies were chosen out of the 17 after consulting the experts in this field. OSCE scores were checked for correlation with their self-assessment scores. The total OSCE scores of 323 students were evaluated which showed 93% of students have passed all eight competencies. Also, 304 students responded to the self-administered questionnaire in the current Saudi MEDs competencies 323 (response rate=94.11). The students were confident in the majority of the eight clinical competencies of the Saudi MEDs framework. Saudi MEDs framework has ensured that Saudi medical or health care education adapted to changing demands, critical competencies are not overlooked, teaching and learning, and evaluation are appropriate at medical schools by implementing the competency framework.

1. Introduction

Clinical reasoning, decision-making, and other practical and clinical skills are fundamental to guiding medical professionals in diagnosing and treating any medical problem. Therefore, assessing of medical students' clinical competence is necessary to ensure that graduates can perform their duties in patient care properly and safely (Aiken et al., 2012; Feo and Kitson, 2016; Abdulrahman et al., 2021). However, several studies revealed that students do not get enough clinical exposure to medical problems and do not have the opportunity to learn the skills needed to be competent doctors (Fincher and Lewis, 1994; Abdulghani et al., 2021a). Although medical students can practice fundamental skills in the clinic on healthy and simulated patients, they cannot manage critical occurrences due to patient safety concerns. As a result, the educational experience is limited, and a great burden rests on the stakeholders to find creative and innovative ways of how medical students should be taught and be assessed to be clinically competent. Since Flexner's study in 1910, the recurrent call for change and creativity in how medical students are educated and evaluated has been a source of debate and, at times, controversy (Buja, 2019; Abdulghani et al., 2019; Ahmad et al., 2020). Global medical education has been through a major transition to overcome these challenges, where it became more focused on competency-based training and assessment rather than only content-based evaluation (Buja, 2019;

Shah et al., 2016). As a result, competency-based medical education (CBME) is rising to the top of today's medical education agenda and has become a central aspect of many countries' medical education plans (Frank et al., 2010; Abdulghani et al., 2021b). And with the rise of medical education in Saudi Arabia, a national call to define the competencies of medical graduates has been given a higher priority (Zaini et al., 2011; Alrashed et al., 2021; Abdulghani et al., 2022c). In response to this call, in 2011, the Saudi Deans' Committee developed a national competency-based framework called the Saudi MEDs Framework to ensure Saudi medical graduates have mastered core competencies (Fincher and Lewis, 1994; Zaini et al., 2011; Huenges et al., 2017).

Most Saudi undergraduate medical curricula provide a problem-based, integrated, community-oriented, and competency-based education. The Saudi MEDs initiative began to achieve national consensus among Saudi stakeholders on the concept of the "Saudi Future Physician" and the development of necessary learning outcomes for medical schools, which was carried out between 2005 and 2007 (Zaini et al., 2011). Seventeen core competencies make up the Saudi MEDs framework, which provides a competency-based framework that reflects the professional medical practices in Saudi Arabia. Also, the competencies specified in the Saudi MEDs framework do not differ significantly from those specified elsewhere in the world (Huenges et al., 2017). For example, in the USA framework of the Accreditation Council for Graduate Medical Education is used (ACGME) (Philibert, 2015). In Canada Can MEDs framework is used and in the UK General Medical Council (GMC) guidelines of Tomorrow's Doctors are implemented (Ologunde et al., 2014).

The Saudi Dean committee agreed that all Saudi medical colleges review and modify their curricula according to the Saudi MEDs framework competency and apply it in their teaching. learning and assessment of their graduates (Alrehaily et al., 2022). Based on an extensive literature review, we did not find any study which has evaluated the impact of the Saudi MEDs competency framework implementation on the students, clinical skills achievements.

Assessing medical students' competency performance during their final year is related to their performance as medical practitioners (Prediger et al., 2020; ul Haq et al., 2022; Abdulghani et al., 2022a). Therefore, this present study is designed to estimate the level of achievements of the core clinical and procedural skills competencies of the final year medical students at King Saud University in 2019-2020 and 2020-2021 based on the Saudi MEDs competencies Framework.

2. Method

2.1. Study design, setting, and participants

It is a cross-sectional study conducted at the College of Medicine, King Saud University, Riyadh.

Saudi Arabia. All final-year male and female students were included in the study from the academic year 2019-2020 and 2020-2021.

2.2. Study context

As mentioned earlier, Saudi MEDs is a framework that ensures Saudi medical students graduate with the knowledge of the core competencies of medical practice. It has 17 competencies covering all three domains of knowledge, skills, and attitudes (Appendix A). Also, the framework contains twenty-six diagnostic and procedural skills (Appendix B).

After consulting experts in the field, eight competencies were chosen out of the 17 core clinical competencies which were as follows: (1) Ability to demonstrate the essential clinical skills, (2) Use of clinical reasoning, decision-making, and problem-solving skills in medical practice, (3) Manage patients with a life-threatening medical condition, (4) Manage patients with a common medical problem, (5) Place patients' needs and safety at the center of the care process, (6) Support health promotion and disease prevention, (7) Effectively communicate with the patient, their families, colleagues, and other health professionals, and (8) Adhere to professional attitude and behaviors of physicians. The 28 diagnostic and procedural skills were selected, such as "Performing arterial puncture for blood gas, Performing capillary blood sampling, Performing an electrocardiograph, Performing basic respiratory function tests, Performing eye irrigation, etc."

The eight core clinical competencies were assessed by Objective Structured Clinical Examination (OSCE) scores in the final graduation examination of the two batches. Also, these competencies were self-assessed by the self-administered questionnaire. In addition, the 28 diagnostic and procedural skills were assessed by the self-administered questionnaire that was developed based on these 28 competencies of the Saudi MEDs framework. The self-administered questionnaire was developed to evaluate their self-assessment competency on a 5-point Likert scale from zero to a score of four. The zero scale means that the candidate has not come across a given skill at all. The number 1 scale means that the student has been taught the skill but did not understand it well. The number 2 scale means that the student has been taught and understood but never practiced. The number 3 scale means that the student has been taught, understood, and practiced well. The number 4 scale means that the student is competent enough to practice it professionally.

2.3. Data collection/data source tools

The students' scores of their assessment of the clinical competencies based on the Objective Structure Clinical examination (OSCE) results were included. There were 10 OSCE based on the eight competencies, and they are blueprinted and aligned

with the eight clinical competencies from the Saudi MEDs framework. Data was collected online via a self-assessment questionnaire measuring clinical competencies and procedural skills.

2.4. Statistical analysis

The collected data were entered in Microsoft Excel and analyzed by using SPSS version 24.0 as statistical software. Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to describe the qualitative and categorical variables. Bivariate statistical analysis was carried out using appropriate statistical tests based on the types of outcome variables, to find the correlation between students' actual assessment scores and Saudi MEDs framework competencies. According to the structure coefficients pertaining to the first Saudi MEDs framework, eight competencies from the self-assessed clinical competencies set were meaningfully correlated, using a cut-off correlation of 0.3 (Lambert and Durand, 1975). A *p*-value of <0.05 and 95% was used to report the statistical significance and precision of the results.

3. Results

The total number of students who have entered the final clinical examination and their OSCE scores were available for 323 students. 168 (52%) were male and 155 (48%) were female. After the final examination and before announcing the OSCE results of the students, the self-administered questionnaire was distributed to all students. Out of 323 students, only 304 students completed the self-administered questionnaire with a response rate of 94.11%. The male responses were higher with a frequency of 165 (54.3%), while female responses were 139 (45.7%).

Table 1 summarizes the students' self-assessed level with Saudi MEDs clinical competencies. For competency number-1: Demonstrating essential clinical skills, students have shown very good knowledge and competency. As 19.1% of students reported they were competent enough to practice professionally, and 69.7 % of students reported they have learned and practiced. For competency number-2: Usage of clinical reasoning, decision-making, and problem-solving skills in medical practice, most of the students in the current study were very well aware of this competency. As 14.8% of students were competent enough to practice professionally and 67.8% of students learned and practiced. For competency number-3: Management of patients with life-threatening medical conditions, about 10.9% of students were competent enough to practice professionally, 26.3% reported they learned and practiced how to manage any patients from life-threatening conditions, and most of the students (58.9%) learned but never practiced. Similarly, for competency number-4: The formulation and implement appropriate management plans for common medical conditions, 9.2% of students were competent enough to practice professionally. And 31.6% of students learned and practiced.

Moreover, for competency number-5: Keeping patients' needs and safety at the center of the care process. 11.8 % of students were very competent, and 21.7% of students have learned and practiced. Furthermore, for competency number-6: Health promotion and disease prevention, there were a good number of students (12.8%) who were competent enough to practice professionally, and 40.5% have learned and practiced well. For competency number-7: Communication skills 10.2% were competent enough to practice professionally and 47% have learned and practiced well. Finally, for competency number-8: Demonstration of professional attitudes and ethical behaviors, 28.3% of students were competent enough to practice professionally and 35.9% of students learned and practiced well.

Table 1: Level of the self-assessed student's clinical competencies

Items	Phrase	Mean (SD)	Degree of approval				
			I	II	III	IV	V
Demonstration of the essential clinical skills	a	4.06(0.58)	58(19.1)	212(69.7)	30(9.9)	4(1.3)	0(0.0)
Usage of clinical reasoning, decision-making, and problem-solving skills in medical practice	b	3.95(0.60)	45(14.8)	206(67.8)	48(15.8)	5(1.6)	0(0)
Management of patients with life-threatening medical conditions	c	3.44(0.73)	33(10.9)	80(26.3)	179(58.9)	12(3.9)	0(0.0)
Formulation and implement appropriate management plans for patients with common medical problems	d	3.43(0.75)	28(9.2)	96(31.6)	162(53.3)	16(5.3)	2(0.7)
Keeping patients' needs and safety at the center of the care process	f	3.20(1.00)	36(11.8)	66(21.7)	142(46.7)	43(14.1)	17(5.6)
Application of health promotion and disease prevention in clinical practice	g	3.64(0.72)	39(12.8)	123(40.5)	136(44.7)	6(2.0)	0(0.0)
Communication with patients, their families, colleagues, and other health professionals both verbally and in writing	h	3.59(0.78)	31(10.2)	143(47.0)	110(36.2)	17(5.6)	3(1.0)
Demonstration of professional attitudes and ethical behaviors of physicians	i	3.86(0.89)	86(28.3)	109(35.9)	94(30.9)	13(4.3)	2(0.7)

a: Take a focused history. Conduct a complete physical examination of any system. Critically analyze clinical data obtained through history, physical examination, and investigation. Perform essential procedural skills (Appendix A); b: Formulate and prioritize a differential diagnosis using reasoning skills, and a management plan based on clinical reasoning; c: Recognize, diagnose, and manage common medical emergencies; d: Select appropriate diagnostic/lab procedures, write prescriptions, and formulate management plans with patients in all acute and chronic conditions; f: Demonstrate appropriate knowledge and skills in the areas related to patient safety e.g. Root-cause analyses, safe prescription, and procedures, and demonstrate reflection and learning from errors; g: Apply basic principles of disease prevention (e.g. Screening, the impact of chronic diseases on health), and preventive strategies for common chronic and infectious diseases (e.g. Obesity, diabetes, smoking, etc.); h: Demonstrate basic and advanced communication skills with patients during taking history, breaking bad news, counseling skills, quit smoking advice; i: Place the patient's interests above one's own, recognize conflict of interest, maintain patient confidentiality, recognize own limitations, and conduct self-evaluation; I: Very competent, n(%); II: Learned and practiced, n(%); III: Learned but never practice, n(%); IV: Taught, but did not learn, n(%); V: Not aware at all, n(%)

Table 2 shows that the student's actual achievement in the clinical skills examination (OSCE) score and the self-assessment of the Saudi MEDs framework scores were summarized and illustrated

with a correlation between their clinical exam scores and Saudi MEDs framework scores. There was an almost identical overall mean score for male students in the OSCE exam (Mean=24.3) and Saudi MED framework (Mean=25). Furthermore, female students' overall OSCE exam score (25.61) achievement was slightly higher than their self-assessment (24.35). The correlation between male students'' actual scores (OSCE) and Saudi MEDs achievement scores.

In Table 3, there is a strong correlation (r=0.64; p=0.0001) between the mean score of the OSCE and the Saudi MEDS "Ability to demonstrate the essential clinical skills" score. Similarly, there was a significant correlation between the mean score of the OSCE and the Saudi MEDs framework score "Use clinical reasoning, decision making, and problem-solving skills in medical practice" (r=0.60; p=0.001) found in

the current study. However, the male students OSCE results had a weak correlation with Place patients' needs and safety at the center of the care process (r=0.29; p=0.01)" and "Support health promotion and disease prevention (r=0.38; p=0.07)" scores. Furthermore, the female actual mean score (OSCE) had a very strong correlation with the Saudi MEDs framework score "Use clinical reasoning, decision making, and problem-solving skills in medical practice (r=69; p=0.0001). Similarly, a significant correlation was shown with another SaudiMED framework score, such as "Use clinical reasoning, decision making, and problem-solving skills in medical practice" (r=0.70; p=0.000); "Manage patients with life-threatening medical conditions" (r=74; p=0.000); "Manage patients with common medical problems" (r=0.53; p=0.07).

Table 2: Students actual achievement in the OSCE and Saudi MEDs framework score

Items	categories	Saudi MEDs competencies scoured	Actual OSCE Scores
Male group	Mean (SD)	24.3 (2.77)	25(2.29)
	Maximum	30	29.62
	Minimum	16.67	16.5
Female group	Mean (SD)	24.35(3.01)	25.61(1.86)
	Maximum	29.16	30
	Minimum	15.9	19.6

Table 3: Correlation of students actual OSCE score and Saudi MEDs framework

Items	categories	Actual achievement (OSCE)	1*	2*	3*	4*	5*	6*	7*	8*
Male group	Mean (SD)	25(2.29)	0.647 (0.0001)	0.605 (0.001)	0.72 (0.000)	0.60 (0.001)	0.29 (0.019)	0.38 (0.072)	0.48 (0.006)	0.40 (0.08)
	Maximum	29.62	0.762 (0.000)	0.561 (0.008)	0.65 (0.001)	0.56 (0.009)	0.31 (0.013)	0.55 (0.021)	0.59 (0.000)	0.49 (0.003)
	Minimum	16.5	0.31 (0.08)	0.493 (0.06)	0.57 (0.008)	0.49 (0.08)	0.46 (0.010)	0.17 (0.16)	0.27 (0.092)	0.21 (0.11)
Female group	Mean (SD)	25.61(1.86)	0.692 (0.0001)	0.700 (0.000)	0.74 (0.000)	0.53 (0.07)	0.49 (0.009)	0.40 (0.02)	0.51 (0.001)	0.42 (0.009)
	Maximum	30	0.78 (0.000)	0.778 (0.000)	0.69 (0.001)	0.71 (0.000)	0.61 (0.000)	0.63 (0.009)	0.64 (0.000)	0.53 (0.000)
	Minimum	19.6	0.35 (0.003)	0.525 (0.008)	0.53 (0.004)	0.62 (0.009)	0.25 (0.027)	0.23 (0.07)	0.33 (0.067)	0.24 (0.09)

*Saudi MEDs competencies (Appendix A); P<0.01

Table 4 shows the comparison of female clinical skills (OSCE) students' scores and Saudi MEDs framework students' scores. Those students with high scores in the clinical exam have a strong and positive correlation with the Saudi MEDs framework compared to others. In the competence of demonstration of the essential clinical skills, those students who have a high score in the clinical exam have a high correlation (r=0.38; p=0.001) with the framework. However, usage of clinical reasoning, decision-making, and problem-solving skills in medical practices, showed a low correlation between all three scores (16-20; r=0.02(0.72); 21-25 r=0.07(0.18); 26-30 r=0.19(0.21)). Moreover, high-score students have a good correlation (r=0.17,

p=0.48) with the management plan for patients with life-threatening medical conditions. Competency in formulating and implementing appropriate management plans for patients has a low correlation with students' test scores. Also, a good correlation (r=0.23, p=0.69) showed with higher scores students in keeping patients' needs and safety. Highly significant association was found (r=0.54, p=0.000) between good students' scores with health promotion and disease prevention. Similarly, communication with patients and their family competency also highly significant correlation (r=0.48, p=0.000) with high-grade students' scores (Table 4).

Table 4: Association with clinical skills achievement (OSCE) score and SaudiMED competencies (correlation)

I	II	III	IV	V	VI	VII	VIII	IX
16 - 20	0.032(0.58)	0.020(0.72)	-0.05(0.35)	0.033(0.56)	0.12(0.025)	0.004(0.94)	-0.012(0.83)	0.042(0.46)
21- 25	0.021(0.72)	0.071(0.18)	-0.06(0.30)	0.062(0.23)	0.041(0.69)	0.052(0.31)	0.050(0.30)	0.42(0.09)
26-30	0.38(0.009)	0.19(0.21)	0.17(0.27)	0.064(0.26)	0.023(0.69)	0.54(0.000)	0.056(0.33)	0.48(0.000)

I: Students Score (OCSE); II: Demonstration of the essential clinical skills; III: Usage of clinical reasoning, decision-making, and problem-solving skills in medical practice; IV: Management of patients with life-threatening medical conditions; V: Formulation and implement appropriate management plans for patients with common medical problems; VI: Keeping patients' needs and safety at the center of the care process; VII: Application of health promotion and disease prevention in clinical practice; VIII: Communication with patients, their families, colleagues, and other health professionals both verbally and in writing; IX: Demonstration of professional attitudes and ethical behaviors of physicians

Table 5 summarizes the students' self-assessed level with the Saudi MEDs diagnostic and procedural

skills. Only 2.6% of students reported that they were very competent and 10.9% of students learned and

practiced performing arterial puncture for blood gas, but most students (44.7%) have learned but never practiced. Regarding the skills of performing capillary blood sampling 4.6% of students were very competent. More than 57% of students reported they have learned but never practice performing an electrocardiogram. About one-third of the students (33.6%) learned but never practiced irrigating the external auditory canal. Moreover, advising patients on how to obtain a sample of urine, 10.2% of students reported being very competent, 7.2% of

students reported learning and practicing, and most of the students 48.7% of students reported that they learned but never practiced. Regarding the Testing of blood groups skill, the students have competent (15.1%) to do so and practiced (41.8%). Furthermore, observing lumbar puncture skills a good number (47.4%) of students have observed lumbar puncture skill. Similarly, performing the PAP smear test, most (52.6%) of students were competent and practiced.

Table 5: Level of the self-assessed student's diagnostic procedural skills

Phrase	Mean (SD)	Very Competent, n(%)	Learned and practiced, n(%)	Learned but never practice, n(%)	Taught, but did not learn, n(%)	Not aware at all, n(%)
Performing arterial puncture for blood gas	2.50(1.05)	8(2.6)	33(10.9)	136(44.7)	54(17.8)	73(24.0)
Performing capillary blood sampling	2.72(1.15)	14(4.6)	61(20.1)	124(40.8)	36(11.8)	69(22.7)
Performing an electrocardiograph	3.12(0.83)	12(3.9)	77(25.3)	167(54.9)	33(10.9)	15(4.9)
Performing basic respiratory function tests	2.92(0.87)	7(2.3)	56(18.4)	176(57.9)	37(12.2)	28(9.2)
Performing eye irrigation	2.33(1.05)	7(2.3)	22(7.2)	128(42.1)	55(18.1)	92(30.3)
Irrigating external auditory canal	2.11(0.97)	2(0.7)	16(5.3)	102(33.6)	78(25.7)	106(34.9)
Performing removal of corneal foreign body	2.16(0.89)	2(0.7)	1(0.3)	135(44.4)	73(24.0)	93(30.6)
Inserting anterior nasal pack	2.21(0.98)	3(1.0)	13(4.3)	130(42.8)	58(19.1)	100(32.9)
Advising patients on how to obtain a sample of urine	2.74(1.15)	31(10.2)	22(7.2)	148(48.7)	44(14.5)	59(19.4)
Drawing venous blood, venous access	3.49(0.86)	22(7.2)	149(49.0)	102(33.6)	20(6.6)	11(3.6)
Testing blood groups	3.54(0.99)	46(15.1)	127(41.8)	91(29.9)	27(8.9)	13(4.3)
Performing throat swab	2.52(0.92)	7(2.3)	13(4.3)	171(56.3)	54(17.8)	59(19.4)
Collection of samples for occult blood in feces	2.11(0.95)	3(1.0)	11(3.6)	106(34.9)	81(26.6)	103(33.9)
Performing pregnancy testing	2.45(0.91)	7(2.3)	9(3.0)	158(52.0)	70(23.0)	60(19.7)
Observing lumbar puncture	3.31(1.12)	40(13.2)	104(34.2)	106(34.9)	21(6.9)	33(10.9)
Observing peritoneocentesis (ascetic tap)	2.22(0.98)	3(1.0)	15(4.9)	126(41.4)	64(21.1)	96(31.6)
Performing peak flow measurement	3.161(1.00)	20(6.6)	96(31.6)	126(41.4)	37(12.2)	25(8.2)
Performing PAP smear	3.49(0.90)	32(10.5)	128(42.1)	111(36.5)	23(7.6)	10(3.3)
Performing PPD	2.43(0.96)	4(1.3)	17(5.6)	161(53.0)	47(15.5)	75(24.7)
Using a microscope and noting observations	2.82(1.14)	15(4.9)	82(27.0)	91(29.9)	67(22.0)	49(16.1)
Observing bleeding and clotting time	2.57(1.04)	6(2.0)	47(15.5)	126(41.4)	63(20.7)	62(20.4)
Urinalysis (by dipstick) and urine microscopic examination	3.73(0.80)	39(12.8)	167(54.9)	81(26.6)	11(3.6)	6(2.0)
Measuring blood sugar by glucometer	3.79(1.15)	99(32.6)	100(32.9)	70(23.0)	14(4.6)	21(6.9)
Taking samples for cultures (throat, urine, blood, cervix, etc.)	2.72(0.96)	7(2.3)	43(14.1)	160(52.6)	47(15.5)	47(15.5)
Managing blood samples	2.50(1.0)	8(2.6)	39(12.8)	132(43.4)	44(14.5)	81(26.6)
Taking blood cultures	2.33(0.98)	5(1.6)	14(4.6)	144(47.4)	57(18.8)	84(27.6)

4. Discussion

According to our knowledge, this is the first local study that investigates Saudi MEDs competencies achieved by undergraduate final-year medical students. The capacity to perform clinical and practical skills is operationally defined as self-perception of competence in this article. Individual self-perceptions of competence were measured, as well as the overall self-perception of competence for all eight Saudi-Med framework clinical and practical procedures. Expanding the clinical exam by including students' scores, those students who have good scores in the OSCE have a good correlation with the Saudi MEDs competencies frameworks. This finding matches with previously published studies (Coberly and Goldenhar, 2007; Ologunde et al., 2014). The current study shows students with good clinical competencies in every eight domains of Saudi MEDs. Barbosa and colleagues (2011) revealed that clinical skills in Angola and Portugal obtained low competencies in a study evaluating the self-perceived competence of medical students in three

distinct countries: Portugal, Angola, and Mozambique (Lai et al., 2007). In the current study, medical students' recall of essential clinical skills can be improved by simulation-based mastery learning, and purposeful practice of clinical skills under the supervision of an engaged instructor is a critical component of the Saudi MEDs framework. Other studies with medical and other health professional students have shown similar reports (Ericsson, 2004; Sahu et al., 2019; AlAjmi et al., 2013). Clinical reasoning, decision-making, and problem-solving are the most important framework of any medical curriculum and crucial concepts for medical students (Shin, 2019; Sattar et al., 2017). In the twenty-first century, communicate, evaluate medical information, and understand therapeutic approaches. The current study shows that medical students have a good knowledge of life-threatening medical conditions. During medical teaching and learning, students had regular training in basic life support (BLS), ECG interpretation, and cardiac life support. The current study shows that the medical students were good at practicing different Saudi MEDs frameworks

competencies, such as taking focused history which is one of the cornerstones for medical students and physicians. A positive study finding was that all students had moderate to high levels of correlation with Saudi MEDs frameworks competencies. Essential clinical skills have strong correlations with that problem-solving skills, management plans, and life-threatening conditions. In the domains of professional attitudes and ethical behaviors, they were very competent and have learned and practiced. Furthermore, we found a negative correlation (r -0.05; -0.06 and -0.012) between Saudi MEDs competencies (such as managing life-threatening medical conditions and communicating with patients) for students with low scores on the OSCE exam, and these findings were in contrast with the previously published study (Katowa-Mukwato and Banda, 2014; Abdulghani et al., 2022b; Abdulghani et al., 2018; Abdulghani et al., 2021c; Khan, 2018). Our results support the international findings that medical professionals should be capable of managing and implementing patient care plans professionally (Smith et al., 2017; Kassab et al., 2019; Alrashed et al., 2021). In addition to dealing with life-threatening conditions of patients, medical professionals also display professional behaviors and attitudes toward them (Torabi et al., 2018; Smith et al., 2017; Ahmad et al., 2022). Self-assessed students' diagnostic and procedural skills, the results indicated that the students have learned all the procedures and practiced some of them such as measuring blood glucose, drawing venous blood, establishing venous access, performing a urinalysis, and urine microscopic examination. However, most of the other procedures mentioned in Table 3 were learned but never practiced by the students. Therefore, it demonstrates that there is a lack of acquisition of competency among most of the students as they never practiced these procedures. Probably, this is due to fear of the students about making mistakes and inadequate opportunities to practice these procedures throughout their graduation. This part draws attention to the importance of clinical training during the education process (Barbosa et al., 2011; Shaik et al., 2017; Tekian and Al Ahwal, 2015) The study found that the majority of students were either moderately or highly confident in their abilities in the areas of intravenous arterial puncture for blood gas, blood sampling, removal of corneal foreign body. Apparently, the four procedures (electrocardiograph, lumbar puncture, performing PAP smear, and performing PPD) in consecutive order were performed many times. Even with the COVID-19 pandemic the two batches(2019-2020 and 2020-2021 academic years) on which the study was conducted, had faced some difficulties during the 2nd half of the 2019-2020 academic year and the whole 2020-2021 academic year. This is due to cause by COVID-19 pandemic and the accompanying quarantine. Thus, it had affected their acquisition of clinical skills and their attendance at the university hospital to see cases and apply the to real patients, and perhaps if the study had been conducted on the batches that preceded them, the results would have been better than the current one.

5. Conclusion

Implementing the Saudi MEDs competency framework has allowed medical education in the Kingdom to adapt to changing needs, prevent critical competencies from being overlooked, and ensure that the learning experiences and evaluation procedures in medical schools are modern and up-to-date. The framework will also assist in evaluating curricula and tracking educational progress in the Kingdom. Furthermore, the framework enables a smooth transition from the undergraduate to graduate phases of medical education and defines the postgraduate curriculum.

Appendix A. 17 Saudi MEDs outcome

1. Integrate basic, clinical, behavioral, and social sciences in medical practice
2. Practice evidence-based health care
3. Demonstrate the essential clinical skills
4. Use clinical reasoning, decision-making, and problem-solving skills in medical practice
5. Manage patients with life-threatening medical conditions
6. Manage patients with common medical problems
7. Place patients' needs and safety at the center of the care process
8. Describe and utilize the healthcare system in Saudi Arabia
9. Advocate health promotion and disease prevention
10. Effectively communicate with patients, colleagues, and other health professionals
11. Practice teamwork and inter-professional collaboration
12. Utilize medical informatics in the healthcare system effectively
13. Adhere to the professional attitudes and behaviors of physicians
14. Apply Islamic, legal, and ethical principles in professional practice
15. Exhibit commitment to personal and professional development
16. Demonstrate basic research skills
17. Demonstrate Scholarly behaviors

Appendix B. 26 Saudi MED outcome

1. Performing arterial puncture for blood gas
2. Performing capillary blood sampling
3. Performing an electrocardiograph
4. Performing basic respiratory function tests
5. Performing eye irrigation
6. Irrigating external auditory canal
7. Performing removal of corneal foreign body
8. Inserting anterior nasal pack
9. Advising patients on how to obtain a sample of urine
10. Drawing venous blood, venous access
11. Testing blood groups
12. Performing throat swabs
13. Collection of samples for occult blood in feces
14. Performing pregnancy testing
15. Observing lumbar puncture
16. Observing peritoneocentesis (ascetic tap)
17. Performing peak flow measurement
18. Performing PAP smear
19. Performing PPD
20. Using a microscope and noting observations
21. Observing bleeding and clotting time
22. Urinalysis (by dipstick) and urine microscopic examination
23. Measuring blood sugar by glucometer

24	Taking samples for cultures (throat, urine, blood, cervix, etc.)
25	Managing blood samples
26	Taking blood cultures

Acknowledgment

Compliance with ethical standards

Ethical approval and consent to participate

The Institutional Review Board (IRB) provided ethical approval for the study from King Saud University (KSU) in Riyadh, Saudi Arabia. All participants signed a consent form prior to participation. Participation was voluntary and informed consent was obtained from all participants prior to data collection. All methods were carried out in accordance with relevant guidelines and regulations. The consent forms were signed by all participants prior to participation, and all participants consented to participate and be published.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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