Assessing Core Clinical Competencies Required of Medical Graduates in Taiwan

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Medical students are assumed to be competent to provide basic patient care independently on graduation. However, there is a gap between what students are expected to learn and what they have actually learned. This may be due to the lack of clearly defined learning objectives, well-organized curriculum, and properly administered assessment. In an attempt to tackle this problem, we conducted a three-step study. Firstly, we identified the core clinical competencies required of medical graduates in Taiwan. Secondly, we incorporated these clinical competencies into a new medical curriculum. Finally, we identified the most appropriate assessment methods for each clinical competency. In 2004, a set of minimally required clinical competencies for medical undergraduates in Taiwan was developed, which included 92 clinical skills, four communication skills, and seven kinds of attitudes. In order to prepare 3rd and 4th year medical students at Kaohsiung Medical University (KMU) for later clinical work, the medical curriculum committee integrated the teaching and assessment of the core clinical skills identified previously into relevant organ-system blocks of the new curriculum. To identify appropriate assessment methods for each clinical skill, a structured questionnaire of assessment methods based on the *Toolbox of Assessment Methods* (Accreditation Council for Graduate Medical Education) and *The Scottish Doctor* (Scottish Deans' Medical Curriculum Group) was developed and distributed to 40 senior clinical faculty members at KMU. Simulations and Models, Standardized Patient Examination (SP), and Objective Structured Clinical Examination (OSCE) were suggested to be most suitable to assess two-thirds of the core clinical skills. These assessment methods are commonly used in American and European medical schools. We believe that the implementation of the new curriculum at KMU accompanied by the use of Simulations and Models, SP, OSCE, and other teaching and assessment methods will help 3rd and 4th year students to prepare better for clinical practice in clerkships.

Key Words: assessment method, clinical competence, curriculum, medical education, medical students
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Although medical students ideally should have acquired sufficient knowledge and skills on graduation to work as junior doctors, researchers have found that not only do students' experience in clinical training vary, but also their skills fall short of faculty's expectations [1,2]. This may be due to the lack of a uniform standard and a set of clearly defined objectives in clinical training [3].

Insufficient competencies in basic patient care are a source of stress for fresh graduates [3]. Deficiency in essential clinical skills could jeopardize the safety of patients [4]. Acknowledging these problems, several institutes have developed documents that state

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the requirements for undergraduate medical education. In 1993, the UK General Medical Council issued their recommendations on undergraduate medical education, *Tomorrow's Doctors*, which set forth the knowledge, skills, and behaviors that should be achieved and assessed at the end of the medical course [5]. Likewise, the Association of American Medical Colleges published the Medical School Objectives Project in 1998, which identified the attributes, knowledge, skills, and attitudes that medical students should possess at the time of graduation [6]. Australia [7], Canada [8], and several European countries [9–11] have also defined national learning objectives for medical education.

Medical schools are expected to use these documents as a guide when reviewing their curricula, and to employ the learning objectives in their revised curricula [5,6,12]. A core curriculum based on a set of national learning objectives can ensure that the knowledge, skills, and attitudes required of medical graduates are actually taught, learned, and assessed.

In outcome-based education, the learning outcomes, i.e. (1) what the doctor is able to do, (2) how the doctor approaches their practice, and (3) the doctor as a professional, determine the curriculum contents, teaching methods, and assessments [11,13]. As assessment plays an important role in directing the focus of learning and ensuring the quality of graduates [13], it should be designed to encompass every facet of the learning objectives and to reflect the levels that students are expected to reach [14,15]. However, there is no single tool that can be used to assess all the learning objectives in terms of knowledge, skills, behaviors, and attitudes. Thus, it is essential to match the assessment methods with the competencies being learned [16].

Adopting the outcome-based approach, a set of minimally required clinical competencies for medical graduates in Taiwan was developed in 2004 [17]. The purposes of this study were to integrate this set of competencies into a new curriculum, and to identify the most appropriate assessment method for each clinical skill.

Materials and Methods

In a previous study [17], we identified a set of minimally required clinical competencies for medical graduates in Taiwan by conducting a survey followed by a meeting. We developed a questionnaire with a list of clinical skills compiled from European and American documents and curricula. We asked the deans and clinical faculties of all the medical schools in Taiwan whether they considered each skill to be a "required competency", i.e. something a medical graduate should be able to perform independently. Representatives from these schools then studied the results of the survey, identified and agreed on the basic clinical skills, communication skills, and attitudes for the undergraduate medical curriculum.

This set of core clinical competencies included 34 examination skills, five image interpretation skills, eight laboratory and interpretation skills, 25 procedural skills, 20 therapeutic skills, four basic clinical communication skills, and seven kinds of basic clinical attitudes.

In 2005, Kaohsiung Medical University (KMU) implemented a new 3rd and 4th year (M3–M4) curriculum composed of 15 organ-system blocks. To prepare 3rd and 4th year students for later clinical work, the medical curriculum committee integrated the core clinical skills identified previously into related blocks.

To identify the most appropriate assessment method for each clinical skill, we developed a questionnaire with a list of assessment tools based on the *Toolbox of Assessment Methods* [18] and *The Scottish Doctor* [14]. The 13 tools of assessment included: 360° Global Rating, Chart Stimulated Recall Oral Examination, Checklist, Global Rating, Objective Structured Clinical Examination (OSCE), Oral Examination, Patient Survey, Portfolios, Procedure or Case Logs, Record Review, Simulations and Models, Standardized Patient Examination (SP), and Written Examination (multiple choice questions). Forty senior clinical faculty members involved in the development of the new curriculum were asked to identify the tool most suitable to assess each clinical skill. Before the survey, copies of *Toolbox of Assessment Methods* [18] and *The Scottish Doctor* [14] were distributed to those faculty members for reading, and then all assessment tools were demonstrated by the author and discussed in a conference on June 21, 2005 to reach a general consensus.

Results

In 2005, KMU implemented a completely new M3–M4 curriculum. The new M3–M4 curriculum comprised 15 organ-system blocks: Block 1, Introduction; Block 2,

Development and Homeostasis; Block 3, Hematology and Neoplasia; Block 4, Cardiovascular System; Block 5, Infection and Host Response; Block 6, Nervous System; Block 7, Musculoskeletal System; Block 8, Renal System; Block 9, Respiratory System; Block 10, Gastrointestinal System; Block 11, Endocrine System; Block 12, Human Reproduction and Sexuality; Block 13, Mind; Block 14, Public Health; and Block 15, Special Senses. Unlike the old curriculum that was departmentally controlled and lecture-dominated, the new one fully integrated basic and clinical medical science and used a variety of learning activities, such as problem-based learning and e-learning.

In our previous study [17], 92 skills, which included 34 examination, five image interpretation, eight laboratory and interpretation, 25 procedural, and 20 therapeutic skills, were identified as core clinical skills required of medical graduates in Taiwan. To help 3rd and 4th year students become acquainted with these skills before their clerkships, the teaching and assessment of these skills were designed to link with relevant blocks. Among the 92 core clinical skills, 67 were integrated into 13 blocks, with the exception of blocks 1 and 14 (Table). Several clinical skills were added to each block by the medical curriculum committee based on national internship guidelines [19] to supplement the core clinical skills. Twenty-five core clinical skills, either irrelevant to the learning objectives of the 15 blocks or too difficult for 3rd and 4th year students to perform, were taught in clerkships and therefore not included in the next step of this study.

Forty senior clinical faculty members who had previously participated in curriculum development identified the tool most suitable to assess each clinical skill. The core clinical skills and their most appropriate assessment methods in each block are shown in the Table. For some skills, there was more than one suitable method to assess them. Among the 13 tools of assessment listed in the questionnaire, Simulations and Models, SP, and OSCE were identified as the most suitable methods to assess two-thirds of the core clinical skills.

Discussion

The content as well as the method of assessment should reflect the learning outcomes to be assessed [20]. Following the strategy of the Scottish Deans' Medical Curriculum Group [14,20], we first developed a set of core clinical competencies for medical graduates, and then identified the assessment methods for these competencies.

Most of the core clinical skills identified in our previous study are similar to those defined in European and American curricula [17], indicating that these skills are universally set out as basic competencies that newly qualified doctors should master. This set of skills has been incorporated into the national internship guidelines [19] that are used as core learning outcomes by all medical schools and teaching hospitals, to ensure that medical students in Taiwan receive sufficient training in basic clinical skills.

There have been concerns about the difficulty of learning all 92 core clinical skills in the year of internship, and the possible shortage of staff, time, and resources needed to teach and assess them. To address these concerns, an organized and systematic approach to teach these skills using facilities in a clinical skills center should be developed. The new M3–M4 curriculum at KMU gives such an example for the implementation of innovative curriculum, OSCE, and SP programs; all financial, personal, technical and instrumental resources were fully supported by administrators of both the university and hospital.

In the new M3–M4 curriculum, the core clinical skills are integrated into the 15 organ-system blocks where it is relevant. Some of the skills are considered to be invasive or not related to the learning objectives of the blocks, and therefore excluded in the M3–M4 curriculum and taught in higher grades. Unlike the clinical skills sessions in the old M4 curriculum, which were not organized to run in parallel with other 4th year courses, the clinical skills sessions in the new M3–M4 curriculum are carefully designed to combine clinical experience with knowledge. The new clinical skills sessions were implemented in August 2005 and are expected to not only help students understand the underlying basic and clinical medical sciences, but also motivate their learning, as proved in another study [21].

In some blocks of KMU's new curricula, several clinical skills appeared repeatedly, e.g. the clinical skill of history taking is listed in all blocks, and the clinical skill of interpreting skull, skeletal, chest and abdominal radiographs is listed in blocks 2, 4, 5, 6, 9, and 10. History taking was included in every block because it was deemed to be very important. As to the

Table. Core clinical skills and their most appropriate assessment methods in each block

Block*/Clinical skill†	Assessment method
I. Block 2—Development and Homeostasis	
1. Measurement and plotting of height and weight (calculate body mass index)	OSCE
2. Ability to approach and examine a child	OSCE
3. Neonate examination	Checklist, OSCE
4. Developmental assessment	Checklist
5. Establish drug dose for a child	Exam MCQ
6. Ability of differential diagnosis‡	Exam Oral
7. Microbilirubin‡	Simulations and Models, Exam Oral
8. Interpret arterial blood gas analysis and acid-base balance‡	Exam MCQ
9. Throat swab	Simulations and Models
10. Venepuncture	Simulations and Models
11. Otoscopy	Simulations and Models
12. Interpret an electrocardiogram	Exam MCQ
13. Interpret chest, abdominal, and skeletal radiography	Exam Oral
14. Interpret a skin test	Exam Oral
15. History taking‡	Record Review, OSCE
II. Block 3—Hematology and Neoplasia	
1. Blood smear	Exam Oral
2. Manage a blood transfusion	Simulations and Models, Exam Oral
3. Interpret blood routine, biochemical, and electrolyte examination‡	Exam MCQ
4. History taking‡	Record Review, OSCE
III. Block 4—Cardiovascular System	
1. Blood pressure measurement	SP
2. Cardiovascular system examination	OSCE
3. Interpret an electrocardiogram	Exam Oral
4. Perform an electrocardiogram (12 lead)	SP, OSCE
5. Measurement of height and weight	OSCE
6. Respiratory rate‡	OSCE
7. Pulse rate‡	OSCE
8. Body temperature measurement	OSCE
9. History taking‡	Record Review, OSCE
IV. Block 5—Infection and Host Response	
1. Safe handling of blood specimens	Simulations and Models
2. Label specimens	Simulations and Models
3. Specimen storage	Procedure or Case Logs
4. Put on sterile gloves and gown	OSCE
5. Venepuncture, including blood culture	Simulations and Models
6. Gram stain	Simulations and Models
7. Skin test	Simulations and Models
8. Aseptic technique‡	OSCE
9. Acid fast stain‡	Simulations and Models, Procedure/Case Logs
10. Sampling‡	Simulations and Models, OSCE
11. History taking‡	Record Review, OSCE
V. Block 6—Nervous System	
1. Conscious level assessment	OSCE
2. Interpret a brain computed tomogram	Exam MCQ
3. Examination of the nervous system	SP
4. Confirmation of death	Exam Oral
5. Treat pain appropriately	Exam Oral
6. Interpret skull X-ray‡	Exam MCQ
7. History taking‡	Record Review, OSCE

(Continued)

Table. (Continued)

Block*/Clinical skill†	Assessment method
VI. Block 7—Musculoskeletal System	
1. Interpret a skeletal radiograph	Exam Oral
2. Locomotor examination	OSCE
3. Fracture immobilization	OSCE
4. Back examination‡	OSCE
5. Examination of extremities‡	OSCE
6. Examination of bones and joints‡	OSCE
7. History taking‡	Record Review, OSCE
VII. Block 8—Renal System	
1. Male genital organs examination‡	Simulations and Models
2. Female urethral catheterization	Simulations and Models
3. Assessment of hydration/volume (body fluid status)	Exam MCQ
4. Male urethral catheterization	Simulations and Models
5. Prescribe intravenous fluids	Exam Oral
6. Interpret urine analysis	Exam Oral
7. History taking‡	Record Review, OSCE
VIII. Block 9—Respiratory System	
1. Respiratory system examination	SP
2. Interpret a chest radiograph	Exam Oral
3. Basic airway management	Simulations and Models
4. Perform endotracheal tube intubation	Simulations and Models
5. Measure peak flow	Simulations and Models
6. Use a bronchodilator inhaler	Exam MCQ, Exam Oral
7. Use a nebulizer	Simulations and Models
8. Interpret arterial blood gas analysis and acid-base balance‡	Exam MCQ
9. History taking‡	Record Review, OSCE
IX. Block 10—Gastrointestinal System	
1. Abdominal examination	SP, OSCE
2. Interpret an abdominal radiograph	Exam Oral
3. Inguinal examination	Simulations and Models
4. Rectal examination	Simulations and Models
5. Lymph node examination	Simulations and Models
6. Treat stool impaction/treat constipation appropriately	Exam MCQ
7. Interpret stool examination	Simulations and Models
8. History taking‡	Record Review, OSCE
X. Block 11—Endocrine System	
1. Near patient blood glucose measurement	Simulations and Models
2. History taking‡	Record Review, OSCE
XI. Block 12—Human Reproduction and Sexuality	
1. Delivering a baby	Simulations and Models
2. Follow patient through labor and delivery	Exam Oral
3. Perform cervical smear and take swabs	Simulations Models
4. Take swabs from cervix, urethra and vagina	Simulations and Models
5. Breast examination	Simulations and Models
6. Assessment of stages of labor	Exam MCQ
7. Examination of the pregnant abdomen	Simulations and Models
8. Pelvic examination‡	Simulations and Models
9. History taking‡	Record Review, OSCE
XII. Block 13—Mind	
1. Cognitive assessment	Chart Stim. Recall
2. Mental state examination	SP
3. Assessment of functional status/ADLs	Chart Stim. Recall, SP, Exam Oral

(Continued)

Table. (Continued)

Block*/Clinical skill†	Assessment method
4. Communication skills	SP
5. History taking‡	Record Review, OSCE
XIII. Block 15—Special Senses	
1. Skin examination	SP
2. Neck examination including thyroid gland	SP
3. Eye examination	SP
4. Oropharyngeal examination	SP
5. Ear examination	SP
6. Ophthalmoscopy (fundoscopy)	SP
7. Otoscopy	SP, OSCE
8. Throat swab	SP, Simulations and Models
9. Head and face examination‡	SP, OSCE
10. Nose and oral cavity examination‡	SP
11. History taking‡	Record Review, OSCE

*No clinical skills were integrated into Block 1—Introduction and Block 14—Public Health; †core clinical skills taught in clerkships were not included in this study. These skills included: administer a local anesthetic, arterial puncture, assist theater, basic life support, change and dress a wound, examination of seriously ill patient, give an intravenous drug injection, give first aid, intramuscular and intravenous injections, measurement and recording of pain, monitor medication levels, nasogastric tube intubation, observe lumbar puncture, obtain written informed consent, sedate a patient, set up and care for a venous infusion, set up and operate a syringe pump, subcutaneous injection, suture a wound, venous cannulation, wound assessment, write a discharge letter (including discharge medication), write a prescription, and write a referral letter and a consultation form; ‡skills added by medical curriculum committee.
Chart Stim. Recall = Chart Stimulated Recall Oral Examination; OSCE = Objective Structured Clinical Examination; Exam MCQ = Written Examination (multiple-choice questions); SP = Standardized Patient Examination; ADLs = activities of daily living.

interpretation of radiographs being listed in several blocks, it was due to the reasoning that the radiograph skill in block 2 pertains to infants, and those in blocks 4, 5, 6, 9 pertains to adults, and are required in different blocks.

The AMEE guide reminds medical educators that "implementation of a new curriculum without changes to the approach to assessment may result in little or no change at all" [13]. Assessment drives learning [16]. Expecting medical students to acquire the core clinical skills without providing them with essential training and appropriate assessment would be unrealistic. Schuwirth noted that, "If the examinations match the curriculum goals well, studying for the examination is the same as studying to become a better doctor" [22]. Since assessment affects what students learn and how they learn, a properly designed and implemented assessment protocol can improve their performance [22–24].

Our faculty has suggested Simulations and Models, SP, or OSCE as the most suitable methods to assess more than two-thirds of the core clinical skills. Simulations and Models [25–27], SP [13,25,28], and OSCE [13,24,25,29] have been widely used in teaching and assessing clinical skills. These methods are applied to mimic real patients, anatomical regions, clinical situations and tasks, and clinical settings as accurately as possible, thus providing a safe simulated environment where students can perform skills without risking the safety of real patients [13,25]. Although other assessment tools such as portfolios can also be used to assess clinical skills performance, the three tools suggested in this study are more appropriate to assess 3rd and 4th year students who have limited access to real patients.

The next step is to study the strengths and weakness of those assessment tools that are applied to our students by collecting information and responses from faculty and students. In addition, the difficulty in implementing the new curriculum, such as the extra loading of clinical teachers and their original responsibility of upholding the quality of patient care in the hospital as well as the strategies for solving such problems should also be investigated.

Conclusion

A set of learning objectives is essential to guarantee the tight overlap between what is taught, learned, and assessed [10]. Therefore, we attempted to identify the core clinical skills that every medical student must be

able to perform on graduation, and then integrated these skills into preclinical medical curriculum for early exposure to clinical knowledge and skills, and suggested the most suitable tools to assess them.

As Tekian commented, "A well-planned curriculum must provide the students not only with explicit objectives, but also with structured opportunities for practicing the required clinical skills, timely feedback about their mastery of skills, and opportunities for remediation" [4]. At KMU, the integrated curriculum was implemented in August 2005. We believe that the implementation of the new M3–M4 curriculum at KMU accompanied by the use of Simulations and Models, SP, OSCE, and other teaching and assessment methods will help 3rd and 4th year students to prepare better for clinical practice in clerkships.

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醫學生核心臨床能力的評量方法

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醫學生在畢業時理應具備獨立提供基本病人照護的能力，然而，他們應該學習的能力與實際學到的能力之間確實有落差。這可能是因為缺乏明確定義的學習目標、仔細規劃的課程、以及適當實施的評量所致。本研究以三階段的方式來處裡這個問題：首先訂定醫學生畢業時必須具備的核心臨床能力，接著將這些能力整合到新課程當中，最後找出評量每一種臨床能力的最適當方式。我們在 2004 年訂定出一套醫學生必須具備的基本臨床能力，當中包括 92 項臨床技巧，4 項溝通技巧、與 7 項態度。為了讓三、四年級學生能及早熟悉未來的臨床工作，醫學系課程委員會將核心臨床技巧的教學與評量整合進新課程中相關的器官系統學組。為了找出評量每一種臨床能力的最適當方式，我們以美國畢業後醫學教育評鑑委員會出版的 ***Toolbox of Assessment Methods*** 以及 Scottish Deans' Medical Curriculum Group 出版的 ***The Scottish Doctor*** 所提出的評量工具為基礎來設計問卷，並且以 40 位臨床教師為對象進行調查。研究結果顯示模擬與模型測驗、標準化病人測驗、以及客觀結構式臨床測驗適用於評量三分之二的核心臨床技巧，這些評量方法目前亦廣用於歐美醫學院。我們認為本校所實施的新課程，以及伴隨使用上述評量工具與其他新的教學和評量方式，將有助於讓醫學生為未來的臨床工作做好準備。

關鍵詞：評量方法，臨床能力，課程，醫學教育，醫學生

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