

Assessing Medical Students' Performance in Core Competencies Using Multiple Admission Programs for Colleges and Universities: from the Perspective of Multi-source Feedback

Ji-Tseng Fang¹, Yu-Shien Ko², Chu-Chun Chien³, Kuang-Hui Yu⁴

Background: Since 1994, Taiwanese medical universities have employed the multiple application method comprising “recommendations and screening” and “admission application.” The purpose of this study is to examine whether medical students admitted using different admission programs gave different performances.

Methods: To evaluate the six core competencies for medical students proposed by Accreditation Council for Graduate Medical Education (ACGME), this study employed various assessment tools, including student opinion feedback, multi-source feedback (MSF), course grades, and examination results. MSF contains self-assessment scale, peer assessment scale, nursing staff assessment scale, visiting staff assessment scale, and chief resident assessment scale. In the subscales, the Cronbach’s alpha were higher than 0.90, indicating good reliability. Research participants consisted of 182 students from the School of Medicine at Chang Gung University.

Results: Regarding students’ average grade for the medical ethics course, the performance of students who were enrolled through school recommendations exceeded that of students who were enrolled through the National College University Entrance Examination (NCUEE) $p = 0.011$, and all considered “teamwork” as the most important. Different entry pipelines of students in the “communication,” “work attitude,” “medical knowledge,” and “teamwork” assessment scales showed no significant difference. The improvement rate of the students who were enrolled through the school recommendations was better than that of the students who were enrolled through the NCUEE in the “professional skills,” “medical core competencies,” “communication,” and “teamwork” projects of self-assessment and peer assessment scales. However, the students who were enrolled through the NCUEE were better in the “professional skills,” “medical core competencies,” “communication,” and “teamwork” projects of the visiting staff assessment scale and the chief resident assessment scale.

Conclusion: Collectively, the performance of the students enrolled through recommendations was slightly better than that of the students enrolled through the NCUEE, although statistical significance was found in certain parts of the grades only.
(*Biomed J* 2013;36:188-197)

At a Glance Commentary

Scientific background of the subject

This study is to examine whether medical students admitted using different admission programs gave different performances. According to the statistical data, the performance of the students who were enrolled through recommendations was slightly better than that of the students who were enrolled through the National College University Entrance Examination.

What this study adds to the field

The results of this study will provide the Ministry of Education with a reference for improving medical educational policies, assisting domestic medical schools in determining the number of students admitted through each method and developing course feedback, and enhance the teachers’ teaching abilities and the counselors’ counseling abilities.

Key words: admission through recommendation and screening, core competency, multi-source feedback

From the ¹School of Medicine, College of Medicine, Chang Gung University, Taoyuan, Taiwan; ²School of Traditional Chinese Medicine, College of Medicine, Chang Gung University, Taoyuan, Taiwan; ³Division of Nephrology, Chang Gung Memorial Hospital at Linkou, Chang Gung University College of Medicine, Taoyuan, Taiwan; ⁴Division of Rheumatology, Allergy and Immunology, Chang Gung Memorial Hospital at Linkou, Chang Gung University College of Medicine, Taoyuan, Taiwan
Received: Dec. 16, 2011; Accepted: Aug. 14, 2012

Correspondence to: Dr. Ji-Tseng Fang, School of Medicine, College of Medicine, Chang Gung University, 259 Wenhua 1st Rd., Gueishan, Taoyuan 333, Taiwan (R.O.C.). Tel: 886-3-2118800, ext. 3700; Fax: 886-3-2118800, ext. 5108; E-mail: fangjits@adm.cgmh.org.tw

DOI: 10.4103/2319-4170.113856

Because of the specialty and complexity of medical care, professional physicians must have extensive medical knowledge, possess interpersonal and communication skills for interacting with medical teams and patients, exhibit empathy for humanity,^[1] and continuously improve their professional abilities to retain a current knowledge of evolving medical technologies.^[2] The US Accreditation Council for Graduate Medical Education (ACGME) proposed the following six core competencies for physicians: Patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and system-based practice.^[3] Nurturing these core competencies requires a substantial amount of resources, including hardworking students, improved education from medical schools, and government and social support. If medical schools can employ advanced methods to screen potential students with the appropriate characteristics and who conform to social expectations of the physicians, they can reduce the cost of nurturing physicians and achieve better outcomes, which is beneficial for social health and welfare.

Since 1994, Taiwanese medical universities and colleges have employed the multiple application method comprising “recommendations and screening” and “admission application.” Regarding the fairness of the program, most schools select students by having several examiners interview each potential candidate.^[4-6] During the interview, the examiners assess the traits of the potential candidate, including their intelligence, motive for studying medicine, maturity, honesty, conscience, teamworking skills, desire to help people, spontaneity, ability to handle anxiety, and empathy.^[7] Through this process, medical schools expect the admission interviews to effectively select students with the appropriate characteristics, abilities, and motives of a physician to train physicians that fulfill the social and national expectations.

According to international studies, the academic performance of medical students in the primary period was positively correlated with the admission methods and students' academic backgrounds.^[8-12] However, the results of domestic studies indicated that no significant difference in academic performance was found between students selected using the multiple admission program and those selected using the National College University Entrance Examination (NCUEE).^[13-15] Domestic studies only compared the results of paper and pencil tests without considering other crucial core competencies.

Before the 1950s, only a few tools existed for assessing the practical abilities of medical students and physicians. Additionally, the assessment content centered around concrete professional medical knowledge and several clinical communication skills. However, societies and nations have different expectations of physicians. As shown by the six

core competencies developed by ACGME, the tools for assessing learning efficiency should be increased. When comparing the academic performance of medical students through various admission methods, researchers should consider their learning efficiency in the core competencies, as well as their medical knowledge and exam results.

For several years, medical education emphasized the essence of medical knowledge and clinical diagnosis technology, and the resulting medical care was the only evaluation indicator. However, with the evolution of medical education and patient autonomy, the public not only expect physicians to restore patients' health and life quality but also require the respect of medical staff when receiving medical assistance. This allows patients to undergo therapies that conform to health care quality regulations under an acceptable risk. The development of medical education to provide the public with comprehensive medical services is the first step in cultivating excellent physicians who satisfy public expectations. A study by Papadakis reported a significant correlation between the behavior of medical students during study and the punishment for violating regulations when practicing medicine. He found that physicians who were punished for violating medical regulations when practicing medicine had significant negative behavior, such as being unwilling to accept feedback and unnecessarily interrupting courses, recorded in their course learning evaluation scales, recommendation letters written by instructors, and school administration records when studying in medical school. His study also found that professionalism was the most crucial competency medical students must master before graduation.^[16] Papadakis also explored the negative impact of unprofessional behavior on practicing physicians. The results indicated that medical students who exhibited a low sense of responsibility, unreliability, and no spontaneous improvement and adjustment when studying in medical schools and during their resident internship had a high possibility of violating medical regulations and being punished when practicing medicine.^[17-21]

The materiality of doctor–patient relationships is recognized by most medical professionals. A good doctor–patient relationship enables patients to develop trust in physicians, which allows physicians to work with enthusiasm, thereby improving therapy results.^[22] Previous studies proved that physicians with inferior communication skills are related to low patient satisfaction and high complaint rates. Moreover, the corresponding exam results also reflect the practical communication skills of physicians.^[23] Inferior communication skills may influence patients' trust in the professional ability of physicians. ACGME proposed that communication skills are the most required core competency for medical school graduates. Regarding communication skills, ACGME proposed that “physicians must be capable to demonstrate

interpersonal and communication skills that result in effectively obtaining patient history, exchanging information with related medical staff, and cooperating in medical teams." The aim of interpersonal and communication skills is to create and sustain a relationship with patients and work effectively with medical teams using effective listening skills. In the US and Canada, communication skills have become a core competency for medical residents and professionals; physicians must undergo a regular assessment of their communication skills to retain their license to practice.^[24,25]

Professionalism remains a core competency of physicians in today's world.^[26] Although the definition of professionalism is ambiguous, most people believe professionalism includes ethical principles, sensitivity to patients, reliable and effective abilities, concern for humanity, and altruism.^[27-29]

METHODS

Admission methods of the School of Medicine at Chang Gung University include recommendations from schools, individual application, the NCUEE, international students, children of dispatched personnel, International Olympiad winners, and students transferring from other departments at Chang Gung University. The purpose of this study is to explore differences in performance of the core competencies among the medical students enrolled through recommendation and through the NCUEE. However, considering the different screening conditions of several admission methods and the limited number of students admitted through recommendations, the study results may have no statistical significance. Therefore, the participants of this study were 182 medical students of the School of Medicine at Chang Gung University, who were admitted through school recommendations or the NCUEE between 2003 and 2004. Among these students, 44 were admitted through school recommendations and 138 were admitted through the NCUEE. Because individual application was not available between 2003 and 2004, this study compared the performance of students admitted through school recommendation with that of students admitted through the NCUEE.

To evaluate the six core competencies for medical students proposed by ACGME, this study employed various assessment tools, including student opinion feedback, multi-source feedback (MSF), course grades, and examination results.

MSF or 360-degree feedback refers to the questionnaire through their own joint assessment with peers, nursing staff, instructors, and patients with multiple angle performance of a method of physician professional, to assess patient satisfaction, the interaction between medical personnel and medical services, etc., This method is derived from the industrial sector management of the use, based on the concepts of "total quality tubes management," "organization development,"

"staff development feedback," "performance assessment," "multi-assessment volume of the system," etc., according to the parties' performance to conduct all-round assessment of volume and give feedback after the assessment. MSF, when compared with the Mini-clinical Evaluation Exercise (Mini CEX), Objective Structured Clinical Examination (OSCE), and Direct Observation of Procedural Skills (DOPS) assessment methods, has the following two advantages:

1. Assessment conducted by a number of assessment to prevent the specific assessment of the arbitrary or bias and, therefore, the evaluation is more objective
2. By comparison of self-assessment and the assessment of others, the appraisee has more self-awareness and enhanced self-efficacy, and a basis for improvement through feedback.

In this study, self-assessment scale, peer assessment scale, nursing staff (NS) assessment scale, visiting staff (VS) assessment scale, and chief resident (CR) assessment scale were used as a research tool. This was to understand the physician clinical learning outcomes through assessment and questionnaire survey. The scales were developed by modifying our hospital physicians' Monthly Evaluation Form (MEF) and Alberta, Canada Provincial physician rating scale. The self-assessment scale or peer assessment scale contains communication skills (5 items), professional skills (8 items), teamwork (4 items), and emotional management (2 items); the NS assessment scale contains work attitudes (3 items), communication skills (4 items), and teamwork (4 items); the VS assessment scale or CR assessment scale contains medical core competence (5 items), work attitude (3 items), and the quality of medical records (3 items). The questionnaire was rated on a 9-point scale ranging from 9 (strongly agree) to 1 (strongly disagree). In the "communication," "work attitude," "medical knowledge," and "teamwork" subscales, the Cronbach's alpha values were higher than 0.90, indicating good reliability [Table 1].

Below we present a detailed explanation of the core competencies and the corresponding assessment tools.

1. Patient care: The assessment items of work attitude in MSF; student grades for the OSCE of the School of Medicine at Chang Gung University.
2. Medical knowledge: The assessment items of professional technologies and medical core competencies in MSF.
3. Practice-based learning and improvement: Student grades for the evidence-based medicine course, undertaken during their sixth year at the School of Medicine at Chang Gung University; items related to evidence-based medicine in the pre-test of the Internal Medical OSCE in 2010.
4. Interpersonal and communication skills: The assessment items of communication skills in MSF.

Table 1: MSF scale reliability statistics

	Items	Cronbach's α
Communication		
Self	5	0.938
Peer	5	0.982
NS	4	0.971
Work attitude		
CR	3	0.926
VS	3	0.901
NS	3	0.967
Medical knowledge		
Self	8	0.973
Peer	8	0.984
CR	5	0.936
VS	5	0.931
Teamwork		
Self	4	0.966
Peer	4	0.987
NS	4	0.973

Abbreviations: CR: Chief resident; VS: Visiting staff; NS: Nursing staff

To understand whether medical students have fully mastered communication skills, besides using MSF, the course design referenced international education and the requirements of domestic education to design doctor–patient relationship courses. The course design included the basic manner for interviewing, starting a conversation, respect for patient privacy, and obtaining agreement. The advanced course included explaining legal disputes, presenting bad news, and discussing the termination of medical care. Students were divided into groups and they performed role play exercises to understand the essence of communication. The course also hosted group debates regarding current medical disputes and distributed course feedback questionnaires. However, because of the limited research period, we considered only the course grades without assessing the impact of the following course.

5. Professionalism: Students' grade for and feedback regarding the medical ethics course undertaken in their sixth year at the School of Medicine at Chang Gung University.

To ensure that medical students understand the essence of ethics, apply knowledge to analyze problems and make ethical medical decisions, and adopt the necessary procedures to improve the status quo, students are required to undertake the medical ethics course in their sixth year at the School of Medicine at Chang Gung University. The goal of the medical ethics course is to help medical students understand the ethical challenges, maintain patient rights, improve medical quality, facilitate doctor–patient relationships, and cultivate professional physicians. Using ethics-oriented issues as the instruction principles, the course included conferences, speeches, and debates, and the topics included basic medical ethics concepts, the historical and

cultural perspectives of medical ethics, students' ability to inform, agree, and make decisions, involving children in medical decision-making, patient rights and obligations, ethical dilemmas related to pregnant women and infants, research ethics, organ transplant and resource distribution, ethics in the post-genome era, ethics in psychiatry, doctor–manufacturer relationships, punishment systems, ethics in hospice care, and ethics in senior citizen care. These topics were expected to provide medical students with comprehensive trainings in the basic concepts of medical ethics. We also distributed course feedback questionnaires with 18 items for professionalism among students at the end of the semester. Based on the questionnaire results, we determined which five aspects of professionalism were believed to be most vital by the medical students admitted through various admission methods. Medical ethics course feedback sheet was prepared through literature analysis and examined by seven experts. It has good content validity.

6. System-based practice: The assessment items of teamwork in MSF; student grade for OSCE.

After this study had been implemented for 1 year, repeated assessments could not be conducted on a number of items because of the required courses. Using students' general grades as the assessment item made it difficult for researchers to identify whether the students' excellent performance was the result of learning and improvement. Therefore, for the sub-items of the continuously learning improvement dimension, this study referenced the MSF employed for several years by Canadian medical schools and Chang Gung University as the assessment tool, and conducted a 1-year repeat assessment. Because of the teaching and administration requirements of Chang Gung Memorial Hospital, the study participants were students admitted in the 2003 school year. Each participant completed self-evaluation and peer evaluation questionnaires once in every 3 months. Chief residents and visiting medical staff assessed the clinical performance of the participants once in every 2 weeks. Nurses who had close cooperative relationships with intern doctors also assessed the participants' performance once in every 2 weeks. By implementing a 1-year repeat assessment, we could assess the continued improvement of medical students admitted through different methods.

The collected data were analyzed using the SPSS software and descriptive statistical tests (mean, standard deviation, absolute and relative frequency); Chi-square test was used for analyzing the student distribution. The two-sample *t*-test was used for comparing the performance of recommendation-admitted students and NCUEE-admitted students.

RESULTS

The study participants consisted of 182 medical students [Table 2], comprising 44 students enrolled through rec-

ommendations and 138 enrolled through the NCUEE. There was significant difference between genders with regard to the recommendations and the NCUEE groups ($p < 0.001$). There was also significant difference between grades with regard to the recommendations and the NCUEE groups ($p < 0.05$). Regarding the students enrolled in the medical ethics course, 72 questionnaires were retrieved; 23 questionnaires were retrieved from students enrolled through recommendations and 49 from students enrolled through the NCUEE. According to the survey results, more than half the participants (41 students) believed that teamwork was the most crucial aspect of professionalism, followed by competence, care and compassion, and insight. However, the least important of professionalism was confidentiality. Regarding the students who were enrolled through school recommendations, the majority chose teamwork as the most crucial aspect, followed by competence and openness; whereas the students who enrolled through the NCUEE primarily selected teamwork, followed by care and compassion, and insight [Table 3]. Obtained from the school system, regarding students' average grade for the medical ethics course, the performance of students enrolled through school recommendations (85.43 ± 2.14) exceeded that of students enrolled through the NCUEE (83.64 ± 2.36) ($p = 0.011$).

The experiment period was from June 2009 to May 2010. This study collaborated with teaching units at the Linkou Branch of Chang Gung Memorial Hospital to develop MSF, which comprised assessment items for communication skills, professional technologies, teamwork, emotion management, core medical competencies, work attitudes, and the quality of historical cases. Different questionnaires were applied according to the scorers, who included seventh grade medical students from the School of Medicine at Chang Gung University, visiting medical staff and residents, nurses, and patients.

This study used the MSF results of the self-evaluation, peer evaluation, and NS evaluation to assess students' interpersonal and communication skills, as defined by ACGME, using a total score of 9. Some scorers gave the students more

than 9 points for extremely excellent performances. To present the differences in students' practical performance, this study also adopts a score scale greater than 9.

Analysis using two-sample *t*-test revealed that the assessment scales correspond to the ACGME core competencies of communication, work attitude, medical knowledge, and teamwork. The pipeline of students of different entries in the competence indicators showed no significant difference [Table 4]. Maybe the object of study are seven grade medical students. They had received 7 years of the same medical education, so the abilities in different aspects of the medical would not differ. The use of MSF assessment of the way and each rating scale was no significant difference; the greater certainty of admission is not caused by the impact factor of the Department of Medicine seventh grade student performance differences.

Regarding the advanced OSCE examination held in the second semester of 2009, the test results of seventh grade medical students who were enrolled through recommendations and through NCUEE were similar at 81 and 80, respectively. For the OSCE examination taken by fifth grade students in 2010, the average score of students who enrolled through the NCUEE was 78, which was slightly lower than that of the students who enrolled through recommendations (80). Regarding the pre-test conducted before the OSCE examination (for a total score of 5), the average scores of the students who enrolled through the NCUEE and through recommendations were 2.6 and 2.5, respectively.

To improve the health service and quality of health care, the assessment item of practice-based learning and improvement examined whether medical students can engage in lifelong self-directed learning, absorb scientific empirical information, and judge the reliability and adaptability of the data, to further improve the medical care of patients and aim at the core competency of medical quality improvement. The assessment indicator was the students' grade for the evidence-based medicine course, which was a selective course, at the School of Medicine at Chang Gung University. Among the students who took this course, 6 had

Table 2: Research subjects

	Students admitted via recommendations <i>n</i> (%)	Students admitted via (NCUEE) <i>n</i> (%)	Total <i>n</i> (%)	χ^2
Grade				
Admitted in 2003	15 (17.00)	73 (83.00)	88 (100.00)	4.726*
Admitted in 2004	29 (30.90)	65 (69.10)	94 (100.00)	
Total	44 (24.20)	138 (75.80)	182 (100.00)	
Gender				
Male	21 (15.90)	111 (84.10)	132 (100.00)	17.912****
Female	23 (46.00)	27 (54.00)	50 (100.00)	
Total	44 (24.20)	138 (75.80)	182 (100.00)	

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; Abbreviation: NCUEE: National college university entrance examination

Table 3: Preference of professionalism

Professionalism	Students via recommendations		Students via NCUEE		Total	
	<i>N</i>	%	<i>n</i>	%	<i>n</i>	%
Altruism	5	4.46	9	3.77	14	3.99
Autonomy	1	0.89	12	5.02	13	3.70
Caring and compassion	7	6.25	22	9.21	29	8.26
Commitment	2	1.79	8	3.35	10	2.85
Competence	13	11.61	18	7.53	31	8.83
Confidentiality	2	1.79	3	1.26	5	1.42
Insight	8	7.14	21	8.79	29	8.26
Integrity and honesty	5	4.46	19	7.95	24	6.84
Morality and ethical conduct	2	1.79	10	4.18	12	3.42
Trustworthiness	9	8.04	10	4.18	19	5.41
Openness	11	9.82	15	6.28	26	7.41
Presence	5	4.46	2	0.84	7	1.99
Respect for the healing function	3	2.68	6	2.51	9	2.56
Respect patient dignity and autonomy	8	7.14	17	7.11	25	7.12
Responsibility to the profession	9	8.04	17	7.11	26	7.41
Responsibility to society	4	3.57	10	4.18	14	3.99
Self-regulation	3	2.68	14	5.86	17	4.84
Teamwork	15	13.39	26	10.88	41	11.68
Total	112	100.00	239	100.00	351	100.00

Abbreviation: NCUEE: National college university entrance examination

Table 4: Differences between the performance of recommendation-admitted students and NCUEE-admitted students for the MSF

	Students via recommendations			Students via NCUEE			<i>t</i> value	<i>p</i> value
	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD		
Communication								
Self	11	8.21	0.71	58	8.29	0.62	-0.370	0.712
Peer	11	8.60	0.54	58	8.32	0.43	-1.964	0.054
NS	11	7.54	0.58	58	7.62	0.47	-0.504	0.616
Work attitude								
CR	11	8.63	0.23	58	8.57	0.27	0.682	0.497
VS	11	8.49	0.21	58	8.39	0.20	1.515	0.134
NS	11	7.40	0.67	58	7.59	0.57	-1.002	0.320
Medical knowledge								
Self	11	7.98	0.89	58	7.99	0.84	-0.031	0.975
Peer	11	8.63	0.53	58	8.36	0.42	1.888	0.063
CR	11	8.54	0.23	58	8.44	0.26	1.243	0.218
VS	11	8.30	0.18	58	8.22	0.19	1.341	0.184
Teamwork								
Self	11	8.33	0.61	58	8.43	0.69	-0.444	0.658
Peer	11	8.62	0.58	58	8.45	0.46	1.111	0.270
NS	11	7.60	0.71	57	7.73	0.53	-0.684	0.496

Abbreviations: CR: Chief resident; VS: Visiting staff; NS: Nursing staff; NCUEE: National college university entrance examination; MSF: Multi-source feedback

enrolled through school recommendations and 15 through the NCUEE. The average score of the students who enrolled through school recommendation was 90, which was higher than that of the students who enrolled through the NCUEE (88). In the OSCE pre-test taken by fifth grade

students in 2010 (for a total score of 5), the average scores of the students who enrolled through recommendations and through the NCUEE were 2.1 and 2.5, respectively.

To understand the practical conditions of learning and improvement, this study conducted repeated assessments

to compare the scores for one item obtained during different quarters. Regarding the assessment item of teamwork, the improvement of students who enrolled through school recommendations for the self-evaluation and peer evaluation was less than 2%, which exceeds the negative growth of the students who enrolled through the NCUEE. In the NS evaluation, regardless of the admission methods, students' scores for teamwork did not show a positive increase [Figure 1]. Students who enrolled through school recommendations showed no improvements in their communication skills in the self-evaluation and peer evaluation; their scores changed

by 0.31 and 0.56%, respectively. However, these results are higher than the 5% change of the students who enrolled through the NCUEE [Figure 2]. Students who enrolled through school recommendation had higher scores for continual improvement of medical technology knowledge in the self-evaluation and peer evaluation, with an average improvement rate of 0.5-1.5%. However, according to the results of the VS and resident evaluations, the improvement made by the students who enrolled through the NCUEE was superior to that of students who enrolled through school recommendations. Additionally, the professional

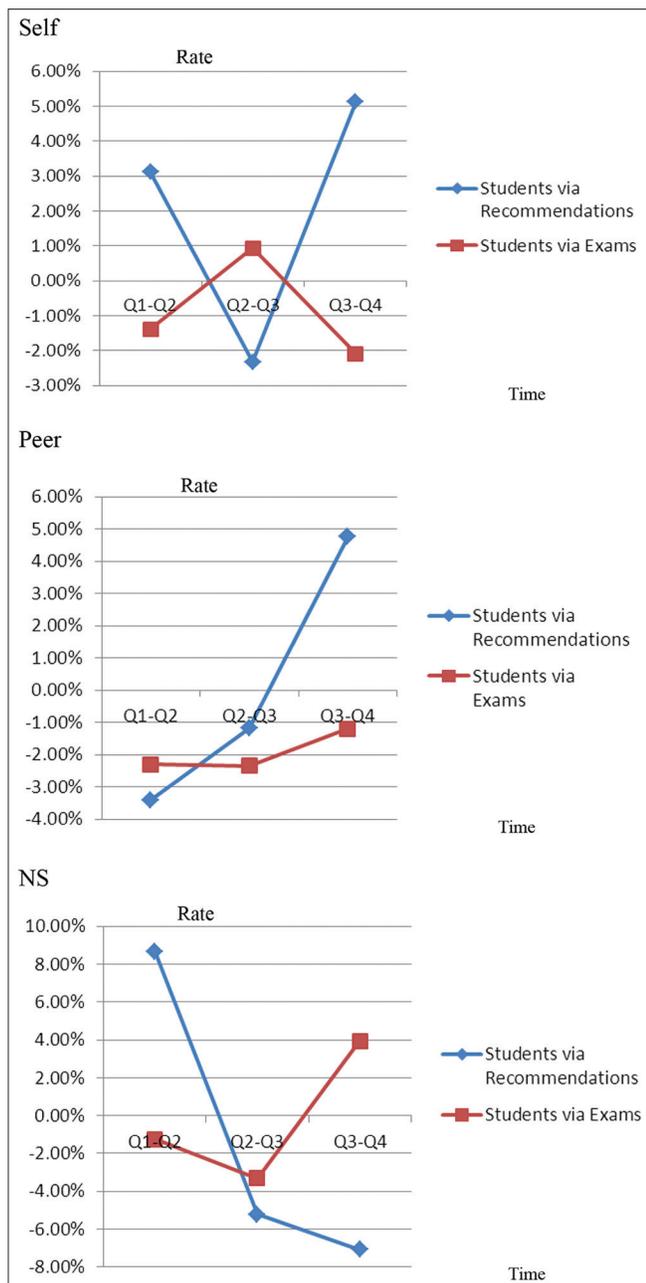


Figure 1: Practice-based learning and improvement: Teamwork

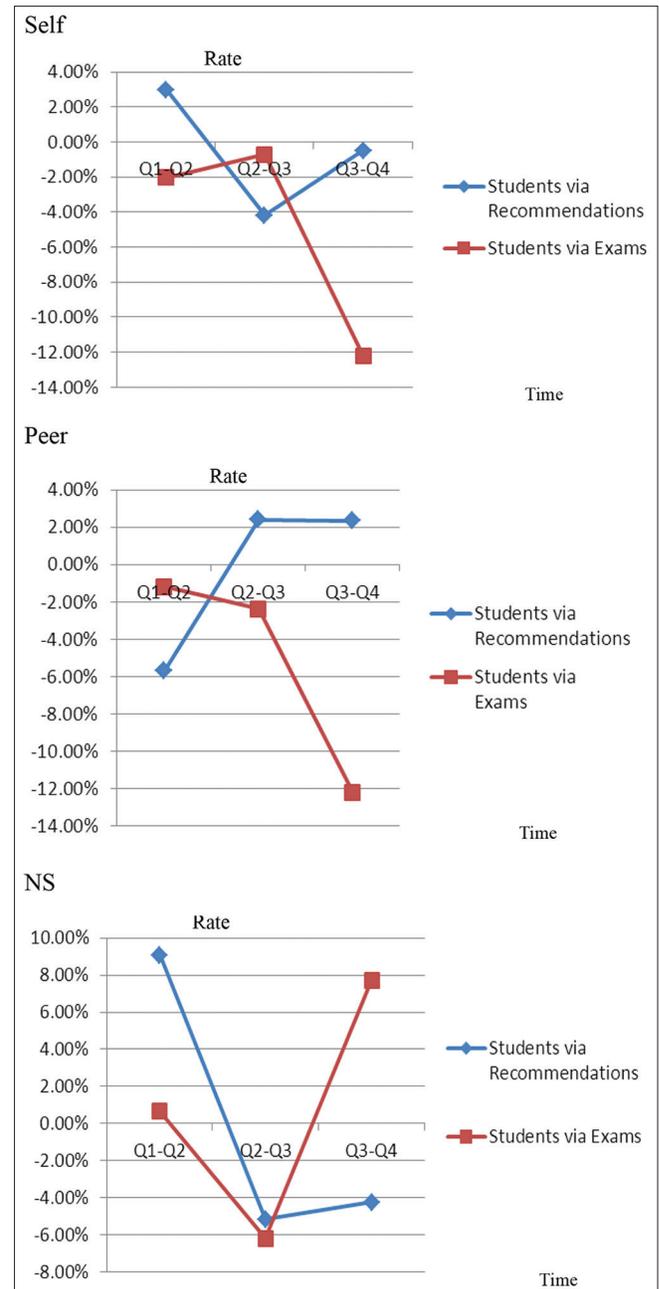


Figure 2: Practice-based learning and improvement: Communication

medical technology score for students who enrolled through school recommendations in the VS evaluation decreased by 4.26% [Figure 3]. For work attitude, in the VS, resident, and NS evaluations, the scores of the students who enrolled through the NCUEE were better than those of the students who enrolled through school recommendations; the students'

VS evaluation scores differed substantially. The difference in the VS evaluation scores for students enrolled using these two admission methods was more than 4% [Figure 4].

DISCUSSION

Patient care

For the assessment items of patient care, we expected medical students to exhibit affection, concern, and empathy toward patients and provide appropriate and effective medical service to resolve health problems. Statistics show that among the students of admission, there was no significant difference in the indicators of the ability to "work attitude" by the MSF. The performance of students of different channels showed little difference. Regarding the clinical care of patients to study and improve the situation, in terms of VS, CR, NS as-

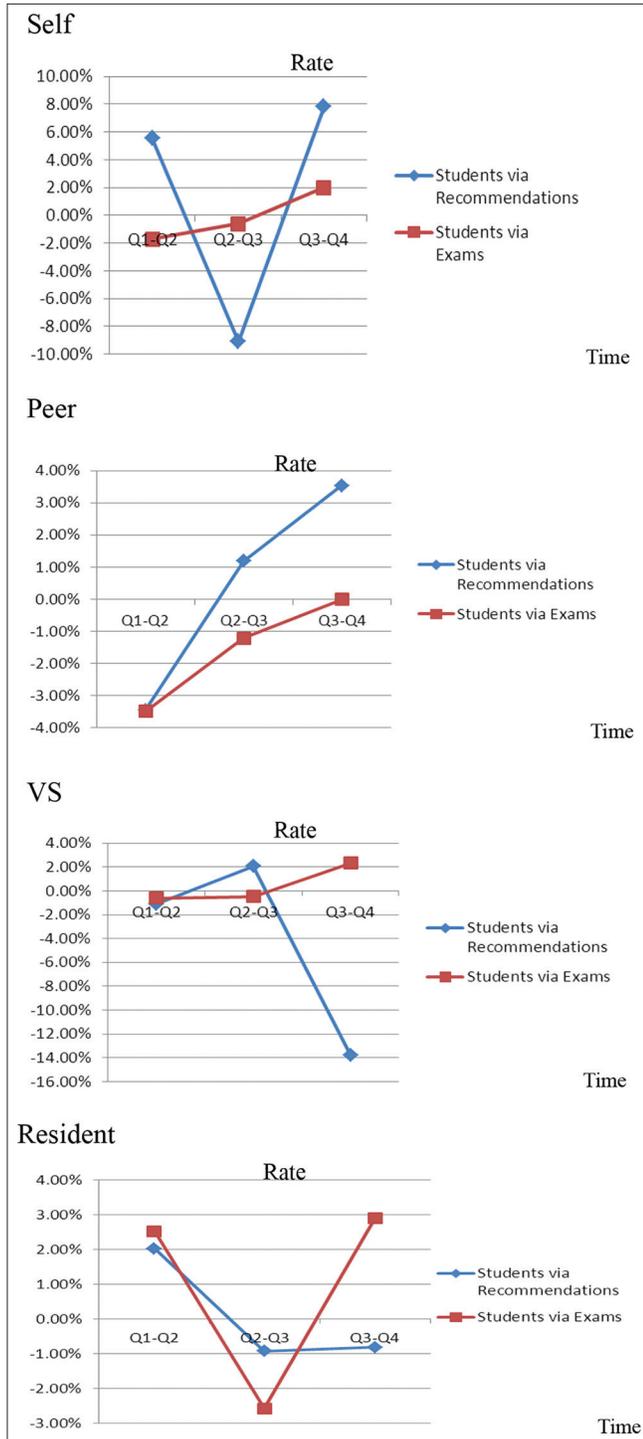


Figure 3: Practice-based learning and improvement: Medical knowledge

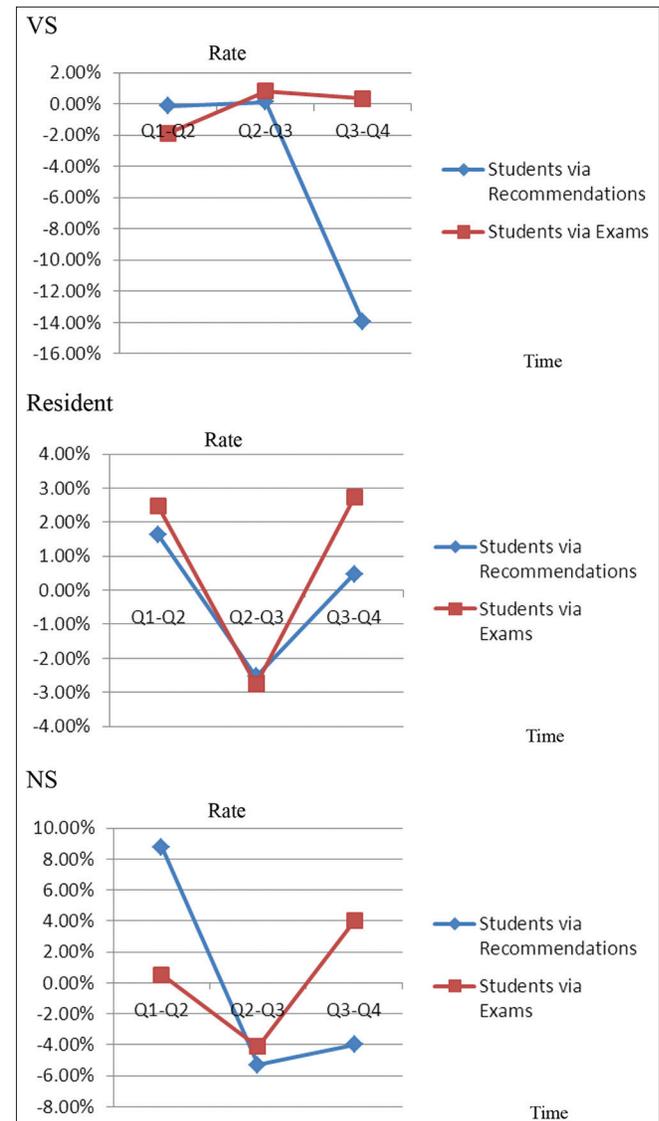


Figure 4: Practice-based learning and improvement: Work attitude

assessment, the scores of the students who enrolled through the NCUEE were better than those of the students who enrolled through school recommendations. The results of this study are different from those of other studies.^[13,14,30-33] May be the object of study for the seven-year medical students receive the same medical training in this regard, after several years, so not much different due to different entrance channels.

Medical knowledge

The assessment items of medical knowledge examined whether medical students understand and apply knowledge of biology, psychology, sociology, ethnics, culture, and health, and whether they know how to use professional basic and clinical medical knowledge to handle, analyze, and investigate patients' questions. Statistics show that the pipeline of students of different entries in the "professional skills" and "medical core competencies" indicators showed no significant difference. However, student achievements differed significantly according to the admission method used; this result was different from the research results of Yue-Joe Lee *et al.*^[13,15,30,34] The improvement rate of the students who enrolled through the school recommendations was better than that of the students who enrolled through the NCUEE in the self-assessment scale and peer assessment scale. However, the students who enrolled through the NCUEE were better in the VS scale and CR scale.

Practice-based learning and improvement

In this respect, the results show only slight differences in those recommended for admission and those admitted through entrance examination. The pipeline of different entries did not affect the practice-based learning and improvement.

Interpersonal and communication skills

Statistics show that among the students of admission, there was no significant difference in the indicators of "communication skills." The improvement rate of the students who enrolled through the school recommendations was better than that of the students who enrolled through the NCUEE in the self-assessment scale and peer assessment scale. The recommendation process emphasizes on the communication skills of the students. The recommendation-admitted students needed to go through the interview. Therefore, the students who enrolled through the school recommendations were better.

Professionalism

Returned questionnaires were assessed by the students of medical ethics course. Regarding the students who were enrolled through school recommendations and the

NUCEE, the majority chose teamwork as the most crucial aspect, but others were different. Obtained from the school system, regarding students' average grade for the medical ethics course, the performance of students enrolled through school recommendations exceeded that of students enrolled through the NUCEE ($p = 0.011$). Therefore, different entry pipeline students may show such a significant difference in performance in the professionalism due to different characteristics and both ethics courses. Future research will further explore the real reason. That would benefit to select students in the interview.

System-based practice

The assessment items of system-based practice examined whether medical students can understand the health care system and its operation and foundations to effectively integrate sources to provide appropriate medical services, respect patient safety and avoid systematic errors, review medical decisions and operational content, and assess system resource content. Statistics show that among the students of admission, there was no significant difference in the indicators of "teamwork." The improvement rate of the students who enrolled through the school recommendations was better than that of the students who enrolled through the NCUEE in the self-assessment scale and peer assessment scale. Results of this study and previous studies are the same.^[14] It allows the reference number of Audition admission.

According to the indicators, statistical data, and the MSF results, the performance of the students who were enrolled through school recommendations was slightly better than that of the students who were enrolled through the NCUEE. Regarding professionalism, all the medical students agreed that teamwork was the most vital aspect of professionalism.

We expect that the results of this study will provide the Ministry of Education with a reference for improving medical educational policies, assisting domestic medical schools in determining the number of students admitted through each method and developing course feedback, and enhance the clinical teachers' and tutors' teaching abilities and the lecturers' and counselors' counseling abilities.

Acknowledgment

The authors are grateful to the National Science Council for the support received (Grant No. NSC98-2511-S-182A-001).

REFERENCES

1. Institute of Medicine. Crossing the quality chasm: A new health system for the 21st century. Washington, DC: National Academy Press; 2001. p. 11-2.
2. Wojtczak A, Schwarz MR. Minimum Medical Education. 2000.

- Available from: <http://http://www.iime.org>. [Last accessed on 2008 Nov 01].
3. Accreditation Council for Graduate Medical Education, ACGME. Available from: <http://www.acgme.org/acWebsite/home/home.asp>. [Last accessed on 2008 Dec 01].
 4. Lin CC, Ye BH. U.S. computerized tests and investigation report of e-government test. Ministry of Examination 2004:15-6 (In Chinese).
 5. Hong YS. Enhance the quality of physician examination papers of the national research project. Ministry of Examination 2004:25-8. (In Chinese).
 6. Huang KY, Lai CW. White paper on medical education- improvements to the direction of medical education in Taiwan. Medical education committee of Ministry of Education 2003:10-20 (In Chinese).
 7. Liu KM, Yang YH, Liu M, Yeh JL, Lai CS, Huang CH. Using a multiple mini-interview approach to select graduate entry medical students. *J Med Educ* 2007;11:22-35.
 8. Andriole DA, Jeffe DB, Hageman HL, Whelan AJ. What predicts USMLE step 3 performance? *Acad Med* 2005;80 (10 suppl):S21-4.
 9. Basco WT, Gilbert GE, Chessman AW, Blue AV. The ability of a medical school admission process to predict clinical performance and patients' satisfaction. *Acad Med* 2000;75:724-43.
 10. Craig PL, Gordon JJ, Clark RM, Langendyk V. Prior academic background and student performance in assessment in a graduate entry programme. *Med Educ* 2004;38:1164-8.
 11. Armstrong A, Chimene D, William H. Predictors of Performance on the National Board of Medical Examiners Obstetrics and Gynecology Subject Examination. *Obs Gyn* 1998;91: 1021-2.
 12. Lai CW. Completes each step. How to select medical students. Taipei: Andrew T. Huang Medical Education Foundation; 2003. p. 8-9 (In Chinese).
 13. Lee YJ, Lee MB, Lue BH, Hou SM, Hsieh BS. A Preliminary study of the academic achievements and group learning response in medical students admitted via recommendations and screening. *J Med Educ* 1998;2:36-42.
 14. Pan JY, Lai MI. Effectiveness of Recommended Admission Policy in the Department of Medicine at Tzu Chi University. *J Med Educ* 2005;9: 46-59.
 15. Yen CF, Liu HW, Liu KM, Lai CS, Huang CH, Huang IT. Comparison of Academic Achievements among Medical Students from Four College Entrance Systems Who Were Experiencing Educational Reformation. *J Med Educ* 2006;10:225-31.
 16. Papadakis MA, Hodgson CS, Teherani A, Kohatsu ND. Unprofessional behavior in medical school is associated with subsequent disciplinary action by a state medical board. *Acad Med* 2004;3:244-9.
 17. Teherani A, Hodgson CS, Banach M, Papadakis MA. Domains of unprofessional behavior during medical school associated with future disciplinary action by a state medical board. *Acad Med* 2005;80 (10 Suppl):S17-20.
 18. Papadakis MA, Arnold GK, Blank LL, Holmboe ES, Lipner RS. Performance during internal medicine residency training and subsequent disciplinary action by state licensing boards. *Ann Intern Med* 2008;11:869-76.
 19. Papadakis MA, Teherani A, Banach MA, Knetter TR, Rattner SL, Stern DT, *et al.* Disciplinary action by medical boards and prior behavior in medical school. *N Engl J Med* 2005;25:2673-82.
 20. Stern DT, Papadakis M. The developing physician-becoming a professional. *N Engl J Med* 2006;17:1794-9.
 21. Papadakis MA. The Step 2 Clinical-Skills Examination. *N Engl J Med* 2004;17:1703-5.
 22. Interpersonal and Communication Skills- Assessment Approaches. Available from: <http://www.acgme.org/acWebsite/home/home.asp>. Last accessed on 2008 Dec 01].
 23. Tamblyn R, Abrahamowicz M, Dauphinee D, Wenghofer E, Jacques A, Klass D, *et al.* Physician scores on a national clinical skills examination as predictors of complaints to medical regulatory authorities. *JAMA* 2007;298:993-1001.
 24. Mazor KM, Ockene JK, Rogers HJ, Carlin MM, Quirk ME. The relationship between checklist scores on a communication OSCE and analogue patients' perceptions of communication. *Adv Health Sci Educ Theory Pract* 2005;10:37-51.
 25. Singer PA, Robb AK. The ETHICS OSCE: Standardized Patient Scenarios for Teaching and Evaluating Bioethics. Available from: <http://wings.buffalo.edu/faculty/research/bioethics/osce.html> [Last accessed on 2008 Dec 01].
 26. American Board of Internal Medicine. Project Professionalism. Philadelphia: ABIM; 1995. p. 22-38.
 27. Swick HM. Toward a normative definition of professionalism. *Acad Med* 2000;75:612-6.
 28. Hafferty FW. Definitions of professionalism: A search for meaning and identity. *Clin Orthop Relat Res* 2006;449:193-204.
 29. Buyx A, Maxwell B, Schoene-Seifert B. Challenges of educating for medical professionalism: Who should step up to the plate. *Med Educ* 2008;42:758-64.
 30. Wei SL, Hou SM, Yang MC. Academic performance of National Taiwan University medical students from diversified college entrance systems. *J Med Educ* 2005;9:262-71.
 31. Liao SC, Lee MB, Lee YJ, Hou SM, Hsieh BS. The correlation between candidate personality traits and acceptance for admission to medical school by recommendation. *J Med Educ* 2001;5:135-45.
 32. Cheng YC, Lee MC, Lee HS, Lin LY, Lan CT, Tsao CY, *et al.* A retrospective study of performance comparing medical students at Chung Shan Medical University recruited by recommendation and by joint entrance examination. *J Med Educ* 2006;10:301-12.
 33. Kao MY, Chen HJ, Lue BH. Medical Students' Attitudes Toward Patient-Centered Care. *J Med Educ* 2009;13:275-86.
 34. Ho ST, Hsu CP, Wang CJ, Shieh JY, Chen CH, Lin CH, *et al.* Future direction of medical education reform in Taiwan. *J Med Educ* 2004;8:18-30.