Inter-Professional Team Objective Structured Clinical Examination (ITOSCE): teaching and assessment strategies of the inter professional approach

CrossMark

Atena Rahmati Najarkolai,[1] Fatemeh Keshmiri,[2*] Maryam Karbasi Motlagh,[2,3] Nazi Saljoughi[4]

ABSTRACT

Background: In the recent decades, Inter-Professional Team Objective Structured Clinical Examination (ITOSCE) has been considered as an efficient tool in evaluating the teamwork and the Inter-professional competences. The aim of this study was to review the literature related ITOSCE as educational tool.

Method: This narrative review study was conducted in 2015. Relevant literature was found by searching the databases such as: PubMed, Medline, CINAHL, Google Scholar, Science Direct, EBSCO, ProQuest. Title searching was performed in full English texts without time limitation using keywords including; Team, Inter professional Team, Group, Inter-disciplinary, Objective Structured Clinical Examination (TOSCE, ITOSCE, GOSCE).

Results: 19 studies met the inclusion criteria and were included in the analyses. In 13 studies, ITOSCE was used as an assessment tool, and in 6 studies as a learning tool. ITOSCE had been used in several fields such as: obstetrics, gynecology, emergency, palliative care with participating of a variety of disciplines, including: medicine, pharmacy, several trends of nursing, physiotherapy, occupational therapy and Social working.

Conclusion: Eventually, it can be noted that ITOSCE plays significant role as an educational and evaluation tool to improve inter-professional teamwork competences among the students. Further studies are needed to develop to examine the psychometric criteria of ITOSCE.

[1]Master in Medical Education, Firoozgar Hospital Education Development Office, Iran University of Medical Science, Tehran-ran.

[2]PhD candidate in Medical Education,Medical Education Department, School of Medicine, Tehran University of medical sciences, Tehran-Iran.

[3]Students' scientific research center (SSRC). Tehran University of medical sciences, Tehran-Iran.

[4]Medical student, Islamic Azad University, Tehran Medical Branch, Tehran, Iran

*Correspondence to: Fatemeh Keshmiri, PhD candidate in Medical Education, Medical Education Department, School of Medicine, Tehran University of medical sciences, Tehran-Iran
Tell: 09132733652
fkeshmiri1385@gmail.com

INTRODUCTION

Assessment of Competency-based education (CBE) has been considered as a popular topic and also as one of the major challenges in medical education.[1-2] Competency is defined as a collection of the required knowledge, attitude and skills that can act efficiently.[3] The aim of CBE is to improve the students' competencies in order to gain capability in their responsibilities and also prepare students for their future job.[4] Therefore, competency-based approaches require preparing comprehensive, and assessment and feedback systems.

CBE approach focuses on non-technical competencies, such as communication skills, professionalism and inter-professional collaboration, patient management and clinical competencies.[5-10] Recently, Inter-professional collaboration has been described as core competency in CBE. World health organization (2010) introduces inter-professional collaboration as the essential competencies of the health care professions to provide patient centered care.[11] Inter professional collaboration defines when various medical staff, patients and patient's family cooperate together to improve quality of care.[11-17] The result of various studies have shown that inter-professional collaboration of team members can efficiently improve patient safety and health outcomes.[11,13-17] As it was mentioned before, developing an appropriate assessment system that ensures the achievement of predefined objectives is important in competency based education.[2] Objective Structured Clinical Examination (OSCE) is a popular assessment tool in CBE.[18]

The OSCE was designed by Harden based on objective and standard assessment principals in 1975.[19,20] The OSCE evaluates the 'shows how' capability level of learn Miller pyramid in a simulated situation,[21,22] OSCE has been applied to assess different competencies such as communication skills, inter-professional collaboration[23-29] and professionalism competencies.[30-34] Recently, in order to assess teamwork and inter-professional collaboration competency, OSCE principles have been used as "Inter-Professional Team Objective Structured Clinical Examination (ITOSCE), Team Objective Structured Clinical Examination (TOSCE), and Group Structured Clinical Examination (GOSCE)",[35-43] in ITOSCE, the inter-professional team members (from various disciplines) cooperate with simulated team members to provide health care service.[44] The ITOSCE has been used as the appropriate summative and formative assessment and educational

tool.[35-43] The present study was conducted to review the application of ITOSCE

METHODS

The present study was systematically reviewed in 2015.

Review Objectives

This literature review aimed exploring the researches exist in the title of Inter-Professional Team Objective Structured Clinical Examination and to find out what the applications of ITOSCE are.

Search Methods

Our research covered eight databases; Web of Knowledge, Pub Med, CINAHL, Science Direct, EBSCO, ProQuest and Google scholar. The search keyword terms were Team, Inter-professional, Interdisciplinary, Group, Objective Structured Clinical Examination (TOSCE, ITOSCE, GOSCE). References lists of included articles were also reviewed to identify other articles meeting the inclusion criteria. We searched the databases in July 2015. Related studies were found without time limitation.

Inclusion Criteria

According to our research question, the inclusion criteria were the English language original articles that have used ITOSCE as an educational and assessment tool. The exclusion criteria were the non-related articles to the ITOSCE as an educational and assessment tools.

RESULTS

19 studies met the inclusion criteria and were included in the analysis. In 13 studies ITOSCE was used as an assessment tool, in 6 studies as a learning tool. Studies were done with various objectives

including: assessing inter-professional collabration competencies, determining the ITOSCE' validity and reliability and educational effectiveness.[37-46] ITOSCE was used in several fields such as obstetrics and gynecology, emergency, palliative care and mental health with the participation of various disciplines such as medicine, pharmacy, nursing, physiotherapy, occupational therapy, psychiatry, clinical psychology and social work.

ITOSCE as Assessment Tools

In the present study, the results of various studies analyzed based on indicators of systemic assessment of Baartman and Vander Vlutenstudies[47-49] Validity (Fit for purpose) and Reliability (Reproducibility of decisions) are two major criteria for evaluation system.

Validity

Validity evaluate whether the tests measure what they were intend to measure. Validity indicators include the assessment of the integrated knowledge, attitude and skill; apply multiple assessment format, summative and formative form and Compatibility with educational objectives.

Validity: Content and Face

The results of the Elliot's and Hall`s study to demonstrated that ITOSCE had acceptable validity for evaluating teamwork' skills.[40,45]

Content Validity: Topic of ITOSCE

For designing ITOSCE, determining the topic of scenario is crucial. Several studies were determined scenario topic and measurable skills through survey, Delphi and focus groups.[40,50,51] Simmons (2011) determined the content of ITOSCE through qualitative approach. 23 inter-professional managers of various faculties participated in three modified Delphi rounds. In the first Delphi round, five clinical scenarios were developed by participants. Each scenario has to involve five or more different health professionals in solving complex clinical problems in an inter-professional team. Eventually, a list of 80 scenarios has been developed and discussed in expert panels. Finally, a set of 20 main topics has been finalized. In the next rounds, the scenarios were prioritized and 10 top priorities of the scenario were determined.

The results of Delphi rounds indicated 10 assessment subject of ITOSCE, Including:

1. Inter professional challenges in the management of complex chronic diseases (hypertension, heart disease, diabetes and stroke).
2. Elderly care: (e.g. inter professional issues related to the discharge of hip fracture patients).
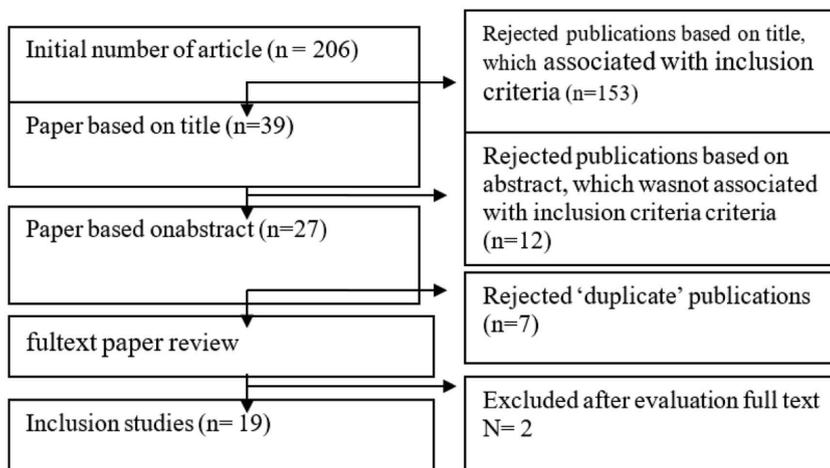
Figure 1 Search and journal selection methods

3. Stroke: planning for discharge and inter-professional collaboration

4. The team processes (e.g. conflicts, communication and planning for discharge), poor inter-professional communication conflict.

5. Patient safety: Teamwork related to elective surgery (e.g. Total knee replacement).

6. Ethics: consent, confidentiality and collaboration with patient (without the ability to provide consent).

7. Pain: teamwork related pain management/palliative care

8. Palliative Care: Collaboration in palliative care of patients with larynx/pharynx cancer.

9. Mental Health: communication for discharge of patients with clinical depression.

10. Diabetes management: Issues relating to the inter-professional management of diabetes type I and II.[50]

Solomo's study which was conducted to develop Mc Master-Ottawa Team Observed Structured Clinical Encounter (TOSCE), the measurable topics of ITOSCE station have reviewed in the first step of the study. In the study emphasis on issues related to primary care and inter-professional collaboration for the development of care plans based on the literature review and personal experience of clinical specialist team.[51] The team was formed by various health professionals including (doctors, nurses, pharmacists, social workers and physical therapy (41 members)). In his study a list of 13 prevention issues in primary care and their short scenarios have been developed. The topics of scenarios were related to diabetes, geriatrics, chronic disease, stroke, mental illness, heart disease, COPD, surgery, pediatrics and obesity. According to the characteristics of each scenario, the expert panel (including doctors, physiotherapists and nurses) determined the format (stimulus format and paper-based problem, video monologue, standardized patient).[51] In sum, the result of the studies suggested the ITOSCE topics such as chronic diseases; hypertension, heart disease, diabetes, stroke, mental illness and surgery.

Predict Validity

This criterion of ITOSCE provides the possibility of predicting the performance in the final test and also their future performance. In the Meagher`s study which was done with the aim of evaluating the ability to predict the final exam results through Team Objective Structured Bedside Assessment (TOBSA), the results indicated that TOBSA is valid tool for assessing students' clinical abilities and formative tests in actual environment. Moreover, TOSBA is a strong predictor of subsequent performance in the final examination because there was a significant relationship between TOSBA and final test results.[52]

Reliability Indicators

The reproducibility indicators consisted of the agreement between several times assessment, several assessors and several situations. Increasing the number of stations, and rater could be effective for improving the reliability of objective structure exams.[53] The other studies showed that with transparent objectives, developed standardized assessment checklist and proper rater training could be improved the ITOSCE reliability.[38-39,51-54] Reliability assess through the internal consistency, intra-rater in several situation and inter-rater agreement. The reliability of the objective structure exam depends on several factors such as the number of stations, assessment tools, inter-rater training and the assessment objective transparency.[21-30, 50-60]

Internal Consistency

One of the measures of reliability is the internal consistency of a test.[61] The internal consistency of checklist items in hall's study at three stations was determined as 0.725 to 0.865.[41] In Singleton`s study internal consistency of five clinical stations of ITOSCE reported 0.04-0.88. In his study Smear station had lower reliability due to unfit marking schedule.[62]

Inter-rater Agreement (Intra-rater and Inter-rater Reliability)

The result of various studies showed the type of assessment tool would affect by reliability indicators. There are a few studies of ITOSCE which address the affecting factors on reproducibility of ITOSCE. A reliability criterion consists of reproducibility has been assessed by multiple assessors with various backgrounds in different situations.[47]

Inter-rater reliability

Inter-rater reliability can be calculated by inter-raters agreement. Inter-rater reliability criteria includes between the range 0-1 and higher than the 0.7 is acceptable.[63] Morgan et al. used two assessment tools for ITOSCE; Global rating and Human Factors Rating Scale (HFRS) in his study 9 external evaluator have evaluated the ability of learners through video-tape. Single-rater reliability in HFRS assessment was ICC= 0.34 while Inter-rater reliability (9 rater reliability) HFRS was ICC= 0.823.In global tool, single rater reliability was = 0.446 and nine-rater Cronbach reliability was 0.879.[40] In line of the study result, in Hall study inter-rater reliability was 0.916.[41] The results of Elliot study were contrasted from the two previous studies. The results indicated that the reliability of the station was low and intra-class

correlation between the stations was 0.2 to 0.5. He stated that time constraints and limited number of stations are two major factors in low reliability.[45]

Reproducibility

The results showed there are favorable reliability indicators of ITOSCE.[41,42,62-64] In Morgan's study there was good agreement between the 9 external evaluators. However, ICC's reliability was not suitable for each rater (in two stages).[40] In contrast with the other studies results, the Elliot's study indicated that the reliability of ITOSCE was low (ICC 0.29, -0.05, 0.12).[45] In ITOSCE, it is essential to do future studies regarding effective factor on test reliability. The result of studies related to reliability assessment of ITOSCE have showed there are controversy subject in literature and more studies need to assess of reliability of this kind of OSCE.

Type of Assessment Tools

The type of the assessment tool of ITOSCE is a controversial subject in the literature. The result of Hall and Morgan studies showed the rater agreement in global scores were higher in comparison with others tools.[40,41] Hodges' study stated utilizing rating scale is preferred over using checklist in OSCE.[65] On the other hand, Taghva's study recommended to use checklist in stations in order to reach assessing students' scores with higher objectivity[66] some studies, mentioned the usage of global rating scale is preferred to checklist because global rating scales scores have more reliability, construct and concurrent validity in OSCE.[67,68,69]

Acceptability and Feasibility

These criteria emphasize on practicality, realistically, acceptability, authenticity and credibility of the test from the perspective of stake holders.[70] Acceptability is an important indicator in assessment system. Acceptability indicators are consisted of the acceptation of criteria and procedure by the teachers, learners and employers.[47] Acceptability and feasibility are major topics in ITOSCE. The Hall's results indicated students and assessors who participated ITOSCE as an acceptable and applicable tool.[41] In line with this results, other studies confirmed acceptability and feasibility of ITOSCE.[40-42,62-64] Therefore, it has been believed that, the implementation of inter-professional education and its evaluation through ITOSCE is achievable; although it requires financial support and specialized human resources.[42]

Cost-effectiveness

One of the ITOSCE issues is cost-effectiveness and time-consuming examination. The ability to assess students' clinical and inter-professional skills in simulated team[42] has an efficient role to reduce the time and cost of conducting exam. The Elliot study mentioned ITOSCE cost was lower than the OSCE. In ITOSCE a large number of students were examined without spending time and cost to assess individually.[45] In other words, one of the positive features of ITOSCE is the potentiality to run the examination to evaluate various skills in a large number of students.[45] Regarding, One study addressed this matter,[45] economic research related to education's economic such as determining the cost–effectiveness and Opportunity-Cost analysis of ITOSCE can help educational managers in making effective decision.

The Educational impact

This criteria defined as the effect of the assessment of how learners and teachers understand the learning objectives and regulate their learning tasks consequently.[48] The educational impact indicators include providing stimulated learning processes by giving the formative and summative feedback and positive effect on students and teachers.[47]

One of the purposes of the inter-professional approach is creating collaborative climate in training and evaluation with participating of different professions. This allows students to be familiar with their role in real setting and to obtain required skills for playing role in future occupation.[41] The result of Sharma's study showed applying ITOSCE with feedback has promoted team skills (understanding role of other team members, shared decision making, problem solving, handling unexpected events, giving feedback and closure) and interview skills (e.g. communication skill with patient, professionalism principal such as confidentiality, consent, reflection, encourage participation).[46]

Burn study (2013) was explained benefits and challenges of using inter-professional team in ITOSCE as a formative assessment tool. Learning objectives include inter-professional collaboration competencies to team consensus, understanding own role during the interaction and patient-centered caring. The participants were senior students of nursing physiotherapy, medicine who voluntarily participated in ITOSCE. The three focus group meetings were run to explore the benefits and challenges of involving the Standardized Patient (SP) during the debriefing by participation of students (N=5), (SP) (N=3), faculty (N=4). The results have showed the usage of SP in ITOSCE was beneficial and it is the proper method to teach cooperation skills, inter-professional coordination and team-based education at simulation situation in non-acute care and patient-centered environment.[36]

To implement ITOSCE, the training of the specialized personnel is required in order to perform multiple roles, such as individual and team performance assessment, playing role in standardized teams (doctors, nurses, other health care staff and simulated patient). Thus, it is essential to provide continuing programs for training the simulated team members.

ITOSCE as a Teaching Tool

In some studies ITOSCE has been used as a teaching tool in which individuals experience inter-professional work, by performing in different teams and playing different roles. Cullen in his study used ITOSCE strategy for training inter-professional skills in midwifery and medical students, the results declared that ITOSCE is impressive strategy for teaching and learning in order to improve communication and teamwork. Midwifery, medical students and facilitators who participated in the study had consensus about teamwork and understanding of roles which can improve service delivery.[39]

In Symonds's study in order to improve knowledge related to professional`s role in inter-professional team, and also the ability to manage the service delivery as well, they used ITOSCE as a learning tool. In this study the team consisted of medicals and midwifery students' enrolled current events of stations in the clinical sections. The station format were role playing, problem solving and solving structured questions in which all members needed to have the active participation.

The results declared that most of the students agreed with formative ITOSCE as a learning tool. They believed that the interactive nature of sections leads to deep learning and the feedback enhances the knowledge, problem solving skill and their attitude. Furthermore, sharing learning among inter-professional team members had a significant role in the growth and development of students' clinical skills.[55] Results of another study which used ITOSCE for continuing professional development indicated 60% of students were capable of teamwork and 83% of them were aware of their weaknesses in team work. The average of usefulness, enjoying and relevance of ITOSCE were 4 of 5 which was desirable. So the results confirmed that ITOSCE is a practical tool for teaching teamwork skills in inter-professional environment of graduated students.[37]

In another study which was conducted at the University of Washington, the study content was establishing inter-professional training among pharmacy students. The ITOSCE has been used as appropriate assessment and mutual tool (learning and assessment) in which training was conducted

in the simulation. Indeed, during ITOSCE learner performance was assessed. The results indicated team leadership skills, commitment and inter-professional collaboration of students who enrolled in inter-professional training of the Center for Health Sciences Inter-professional Education (CHSIE) was improved.[71] It can conclude using ITOSCE as a teaching strategy provides the commitment for learners as well as consider course content and inter professional competencies.[64] So, this causes improving students' perception of team benefits and the different roles of the team members in various professions and deemed to creating safe environment for clinical simulation skills for all learners.[72] The results of another study demonstrated that ITOSCE has been favorable learning experience.[62]

One of the advantages in using the ITOSCE strategy is providing a safe simulated environment by the presence of inter-professional teams that causes ideal teaching experience for students and leads them to consider teamwork and inter-professional collaboration competencies along with clinical skills. One of the remarkable issues in ITOSCE is its educational impact that would be achievable through feedback. In most studies it has been emphasized on immediate feedback after performing the ITOSCE stations by internal raters and standardized patients,[40,45,52,73] likewise feedback by external raters and students reflection are other strategy to improve students' efficient learning which has been used in some studies.[40,73] Thus, using feedback and reflection can enhance students learning and could help them through determining their strengths and weaknesses. Similarly it effectively could improve students' performance so this leads to deep learning. Therefore, it is imperative to teach the principles of giving feedback to raters and educating reflection principles to students to facilitate learning in designing programs and preparation of raters and students for ITOSCE.

CONCLUSION

ITOSCE as a teaching and evaluating tool can play an effective role in improving the inter-professional competencies and teamwork among students and staff. However, there are a few studies have been conducted to assess the psychometric indicators of ITOSCE. Therefore, it is essential to conduct further studies on the psychometric and economic indicators of ITOSCE.

REFERENCES

1. Frank J, Mungroo R, Ahmad Y, Wang M, De Rossi S, Horsley T. Toward a definition of competency-based education in medicine: a systematic review of published definitions. Medical teacher. 2010;32 (8):631-7.

2. Holmboe E, Sherbino J, Long D, Swing S, Frank J. The role of assessment in competency-based medical education. Medical Teacher. 2010;32(8):676-82.

3. Shasti S. Competency based education. Iranian Journal of Educational Strategies. 2010;3(2):77-80.

4. Frank J, Snell L, Cate O, Holmboe E, Carraccio C, Swing S, et al. Competency-based medical education: theory to practice. Medical Teacher. 2010; 32(8):638-45.

5. Smith S, Dollase R. Amee guide No. 14: Outcome-based education: Part 2: Planning, implementing and evaluating a competency-based curriculum. Medical Teacher. 1999;21(1):15-22.

6. Frank JR, Deborah D. The CanMEDS initiative: implementing an outcomes-based framework of physician competencies. Medical Teacher. 2007 Sep;29(7):642 - 7.

7. Frank JR, Snell L, Sherbino J. The Draft CanMEDS. Physician Competency Framework. 2014, Royal College of Physicians and Surgeons of Canada. 2015.

8. Harden RM. Outcome-Based Education: the future is today. Medical Teacher. 2007 Sep;29(7):625-9.

9. Swing SR. The ACGME outcome project: retrospective and prospective. Medical Teacher. 2007 Sep;29(7):648-54.

10. Swing SR. Assessing the ACGME general competencies: general considerations and assessment methods. Acad Emerg Med. 2002 Nov;9(11):1278-88.

11. Framework for Action on Inter-professional Education& Collaborative Practice " This publication isproduced by the Health Professions Network Nursing and Midwifery Office within the Department of Human Resources for Health. 2010. This publication is available on the Internet at: http:// www.who.int/hrh/nursing_midwifery/en/

12. Inter-professional Education Collaborative Expert Panel. Core competencies for inter-professional collaborative practice: Report of an expert panel. Washington, D.C.: Inter-professional Education Collaborative. 2011: Available from: www.aacn.nche.edu/education-resources/ipecreport.pdf.

13. Accreditation Council for Graduate Medical Education. ACGME Outcome Project.2005. www.acgme.org/Outcomes.

14. Reeves S, Perrier L, Goldman J, Freeth D, Zwarenstein M. Inter-professional education: effects on professional practice and healthcare outcomes (update). Cochrane Database Syst Rev. 2013;3:1-5.

15. Reeves S. A systematic review of the effects of inter-professional educationon staff involved in the care of adults with mental health problems. Journal of Psychiatric and Mental Health Nursing. 2001; 8(6):533-42.

16. A national inter-professional competency framework. Canadian Inter-professional Health Collaborative. Retrieved from http://www.cihc.ca 2010.

17. Lo L. Teamwork and Communication in Healthcare:a Literature Review. The Canadian Patient Safety Institute. This publication is available as a free download from:www.patientsafetyinstitute.ca.2011.

18. Chan C. Is OSCE valid for evaluation of the six ACGME general competencies?. Journal of the Chinese Medical Association. 2011; 74(5):193-4.

19. Boulet JR, De Champlain AF, McKinley DW. Setting defensible performance standards on OSCEs and standardized patient examinations. Medical Teacher. 2003;25(3):245-9.

20. Rushforth HE. Objective structured clinical examination (OSCE): review of literature and implications for nursing education. Nurse Education Today. 2007;27(5):481-90.

21. Kamran Z, Ramachandran S, Gaun K, Pushkar P. The Objective Structured Clinical Examination (OSCE): AMEE Guide No. 81. Part I: An historical.and theoretical perspective. Medical Teacher. 2013; 35(9): e1437-e46.

22. Khan KZ, Gaunt K, Ramachandran S, Pushkar P. The Objective Structured Clinical Examination.(Osce): Amee Guide No. 81. Part Ii:Organisation & Administration. Medical Teacher. 2013;35(9):E1447-E63.

23. Casey PM, Goepfert AR, Espey EL, Hammoud MM, Kaczmarczyk JM, Katz NT, et al. Association of Professors of Gynecology and Obstetrics Undergraduate Medical Education Committee. To the point: reviews in medical education-the Objective Structured Clinical Examination. Am J Obstet Gynecol. 2009;200(1):25-34.

24. Simon SR, Bui A, Day S, Berti D, Volkan K. The relationship between secondyear medical students' OSCE scores and USMLE Step 2 scores. J Eval Clin Pract. 2007;13(6):901-5.

25. Tervo RC, Dimitrievich E, Trujillo AL, Whittle K, Redinius P, Wellman L. The Objective Structured Clinical Examination (OSCE) in the clinical clerkship:an overview. S D J Med. 1997;50(5):153-6.

26. Yudkowsky R, Alseidi A, Cintron J. Beyond fulfilling the core competencies: an objective structured clinical examination to assess communication and interpersonal skills in a surgical residency. curr Surg. 2004;61(5):499-503.

27. Joekes K, Sedgwick P, Hall A. Assessment of risk communication by objective structured clinical examination. Med Educ. 2009;43(5):484.

28. O'Sullivan P, Chao S, Russell M, Levine S, Fabiny A. Development and implementation of an objective structured clinical examination to provide formative feedback on communication and interpersonal skills in geriatric training. J Am Geriatr Soc. 2008;56(9):1730-5.

29. Ishikawa H, Hashimoto H, Kinoshita M, Fujimori S, Shimizu T, Yano E. Evaluating medical students' non-verbal communication during the objective structured clinical examination. Med Educ. 2006 40(12):1180-7.

30. Dwyer T, GloverTakahashi S, Kennedy Hynes M, Herold J, Wasserstein D, Nousiainen M, et al. How to assess communication, professionalism, collaboration and the other intrinsic CanMEDS roles in orthopedic residents: use of an objective structured clinical examination (OSCE). Can J Surg. 2014;57(4):230-6.

31. Erfanian F, Khadivzadeh T. Evaluation of midwifery students' competency in providing intrauterine device services using objective structured clinical examination. J Nurs Midwifery Res Iran. 2011;16(3):191-6.

32. Wallenstein J, Heron S, Santen S, Shayne P, Ander D. A core competency-based objective structured clinical examination (OSCE) can predict future resident performance. Acad Emerg Med. 2010;2:67-71.

33. Carraccio C, Englander R. The objective structured clinical examination: a step in the direction of competency-based evaluation. Arch Pediatr Adolesc Med. 2000;154(7):736.

34. Fan JY, Wang YH, Chao LF, Jane SW, Hsu LL. Performance evaluation of nursing students following competency-based education. Nurse Educ Today. 2015; 35(1):97-103.

35. Singleton A, Smith F, Harris T, Ross-Harper R, Hilton S. An evaluation of the Team Objective Structured Clinical Examination (TOSCE). Medical Education. 1999;33:34-41.

36. Burn C, Nestel D, Gachoud D, Reeves S. Program Innovations Abstract Simulated Patient as Co-Facilitators: Benefits and Challenges of the Inter-professional Team OSCE. (Abstracts). Journal of the Society for Simulation in Healthcare. 2013;8(6):455-6.

37. Gordon M, Uppal E, Holt K, Lythgoe J, Mitchell A, Hollins-Martin C. Application of the team objective structured clinical encounter (TOSCE) for continuing professional development amongst postgraduate health professionals. Journal of Inter-professional Care. 2013;27(2):191-3.

38. Curran V, Casimiro L, Banfield V, Hall P, Lackie K, Simmons B, et al. Research for Inter - professional Competency - Based Evaluation (RICE). Journal of Inter-professional care 2009;23(3):297-300.

39. Cullen L, Fraser D, Symonds I. Strategies for inter-professional education: the Inter-professional Team Objective Structured Clinical Examination for midwifery and medical students. Nurse Educ Today. 2003;23(6):427-33.

40. Morgan P, Pittini R, Regehr G, Marrs C, Haley M. Evaluating Teamwork in a Simulated Obstetric Environment. Anesthesiology. 2007;106(5):907-15.

41. Hall P, Marshall D, Weaver L, Boyle A, Taniguchi A. A Method to Enhance Student Teams in Palliative Care:Piloting the McMaster-Ottawa Team Observed Structured Clinical Encounter. Journal of Palliative Medicine. 2011; 14(6):744-51.

42. Quandt M, Schmidt A, Segarra L, Beetz-Leipold C, Degirmenci Ü, Kornhuber J, et al. Teamwork elective: Results of a German pilot project on inter-professional and interdisciplinary education with formative team OSCE(abstract). GMS Z Med Ausbild. 2010;27(4):1-7.

43. Amini M, Moghadami M, Kojuri J, Abbasi H, Abadi AA, Molaee NA, et al. Using TOSCE (Team Objective Structured Clinical Examination) in the second national medical sciences olympiad in Iran Journal of Research in Medical Sciences. 2012;17(10):975-8.

44. Raynor M, Marshall J, Sullivan A. Decision-Making in Midwifery Practice.Edinburgh: Churchill Livingstone-Elsevier. 2005.

45. Elliot D, Fields A, Keenen T, Jsffe A, Toffler W. Use of a Group Objective structured clinical examination with first-year medical student. Academic Medicine. 1994;69(12):990-2.

46. Sharma MK, Chandra PS, SK C. Team OSCE: A Teaching Modality for Promotion of Multidisciplinary Work in Mental Health Settings. Indian Journal of Psychological Medicine. 2015;37 (3):327-30.

47. Baartman LJ, Prins FJ, Kirschner PA, Van der Vleuten C. Self-evaluation of assessment programs: A cross-case analysis. Evaluation and Program Planning. 2011;34(3):206-16.

48. Baartman LJ, Bastiaens TJ, Kirschner pA, Van der Vleuten C. The wheel of competency assessment: presenting quality criteria for competency assessment programs. Studies in Educational Evaluation. 2006;32(2):153-70.

49. Van Der Vleuten C. The assessment of professional competence: Developments, research and practical implications. Adv Health Sci Educ Theory Pract. 1996 1(1):41-67.

50. Simmons B, Egan-Lee E, Wagner S, Esdaile M, Baker L, Reeves S. Assessment of inter-professional learning: the design of an inter-professional objective structured clinical examination (iOSCE) approach. Journal of Inter-professional Care. 2011; 25(1):73-4.

51. Solomo P, Marshall D, Boyle A, Burns S, Casimiro L, Hall P, et al. Establishing face and content validity of the McMaster-Ottawa team observed structured clinical encounter (TOSCE). Journal of Inter-professional Care. 2011; 25(4):302-4.

52. Meagher F, Butler M, Miller S, Costello R, Conroy R. Predictive validity of measurements of clinical competence using the team objective structured bedside assessment (TOSBA): assessing the clinical competence of final year medical Students. Medical teacher. 2009;31(11):545-50.

53. Brannick MT, Korkmaz HE, Prewett MA. Systematic review of the reliability of objective structured clinical examination scores. Medical Education. 2011;45:1181-9.

54. Fraser DM, Symonds I, Cullen L. Multi professional or inter professional education in obstetrics and gynecology. The Obstetrician & Gynaecologist. 2005;7(4):271-5.

55. Symonds I, Cullen L, Fraser D. Evaluation of a formative inter-professional team objective structured clinical examination (ITOSCE): a method of shared learning in maternity education. Medical Teacher. 2003; 25(1):38-41.

56. Shirazi M, Labaf A, Monjazebi F, Jalili M, Mirzazadeh M, Ponzer S, et al. Assessing medical students' communication skills by the use of standardized patients: emphasizing standardized patients' quality assurance. Acad Psychiatry. 2014 ;38(3):354-60.

57. Yang YY, Lee FY, Hsu HC, Lee WS, Chuang CL, Chang CC, et al. Validation of the behavior and concept based assessment of professionalism competence in postgraduate first-year residents. J Chin Med Assoc. 2013;76(4):186-94.

58. Sellu DH, Davis RE, Vincent CA. Assessment of blood administration competencies using objective structured clinical examination. Transfus Med. 2012; 22(6):409-17.

59. Hecker KG, Adams CL, Coe JB. Assessment of first-year veterinary students' communication skills using an objective structured clinical examination: the importance of context. J Vet Med Educ. 2012; 39(3):304-10.

60. Pell G, Fuller R, Homer M, Roberts T. International Association for Medical Education.How To Measure The Quality Of The Osce: A Review Of Metrics - Amee Guide No. 49. Medical Teacher. 2010; 32(10): 802-11.

61. JA, Harden R. A P Crtical Guide For Medical Teachers. Second edition. 2005.

62. Singleton A, Smith F, Harris T, Ross-Harper R, Hilton S. An evaluation of the Team Objective Structured Clinical Examination (TOSCE).Medical Education. 1999;33:34-41.

63. Zubair Amin (Author), Chong Yap Seng (Author), Khoo Hoon Eng. Practical Guide to Medical Student Assessment. 1 ed: World Scientific Publishing Co. Pte. Ltd.; 2006.

64. Marshall D, Hall P, Taniguchi A. A Team OSCEs: evaluation methodology or educational encounter. Medical Education. 2008;42(11):1129-30.

65. Hodges B, McIlroy J. Analytic global OSCE ratings are sensitive to level of training. Medical Education. 2003;37(11):1012-6.

66. Taghva A, Panaghi L, Rasoulian M, Bolhari J, Zarghami M, Esfahani M. Evaluation of reliability and validity of the psychiatry OSCE in Iran. Academic Psychiatry. 2010; 34 (2):154-7.

67. Hodges B, Regehr G, Hanson M, McNaughton N. Validation of an objective structured clinical examination in psychiatry. Academic medicine. 1998;73(8):910-2.

68. Park RS, Chibnall JT, Blaskiewicz RJ, Furman GE, Powell JK, Mohr MC. Construct validity of an objective structured clinical examination (OSCE) in psychiatry: associations with the clinical skills examination and other indicators. Academic Psychiatry. 2004;28(2):122-8.

69. Regehr G, MacRae H, Reznick RK, Szalay D. Comparing the psychometric properties of checklists and global rating scales for assessing performance on an OSCE-format examination. Academic Medicine. 1998;73(9):993-7.

70. Norcini J, Anderson B, Bollela V, Burch V, Costa MJ, Duvivier R, et al. Criteria for good assessment: Consensus statement and recommendations from the Ottawa 2010 Conference. Medical Teacher. 2011;33(3):206-14.

71. Odegard P, Robins L, Murphy N, Belza B, Brock D, Gallagher TH, et al. Inter-professional Initiatives at the University of Washington. American Journal of Pharmaceutical Education. 2009;73 (4):63.

72. Williams J, Terry SJ. A Team objective structured clinical examination for obstetric emergencies. British Journal of Midwifery. 2010;18(12):808-13.

73. Huang Y, Liu M, Huang C, Liu K. Implementation of an OSCE at Kaohsiung Medical University. Kaohsiung J Med Sci. 2007;23(4):161-9.