A conceptual model for practice-based learning and improvement competency in medicine

Arezou Faraj Pour¹, Shahram Yazdani², Somayeh Akbari Farmad²

¹Department of Education Development Center, Faculty of Medicine, Mashhad Medical Sciences, Islamic Azad University, Mashhad, Iran, ²Department of Medical Education, Virtual School of Medical Education and Management, Shahid Beheshti University of Medical Sciences, Tehran, Iran

ABSTRACT

Introduction: Quality improvement and performance evaluation have become today's mainstream medical issues, whereas in many areas of medical care, the quality of care services is less than desirable. Objective: To determine a conceptual model for practice-based learning and improvement (PBLI) competency in medicine. Methods: This study was conducted using Walker and Avant's theoretical synthesis method. Articles related to the concept of PBLI were searched using the keywords of practice-based learning and improvement, quality improvement, core competency, medical education, practice-based learning in English, separately and combined in google, google scholar, and Pubmed databases. After identifying the theoretical blocks and variables of each block and communicating them, a visual model of PBLI was presented. After a focused search for each block, a total of 229 full papers were studied and the PBLI model was developed in six conceptual blocks. Results: The visual model that presented in this study shows the relation among six theoretical blocks of PBLI including: Block of approach to PBLI, PBLI process triggers block, gap bridging solutions, PBLI infrastructure block, PBLI sub-competencies block, PBLI academic development block. Conclusions: Nowadays, PBLI is one of the inevitable qualities of medicine that ensures the quality of medical practice, which, in addition to individual requirements, requires a series of technical, strategic, structural, and cultural infrastructures. By utilizing this capability, a physician will be able to discover the knowledge, skills, and performance gaps, and will be able to cope up with their appropriate approaches, thereby improving the quality of their medicine and the care provided and the patient’s safety. It can provide satisfaction and trust in society. The model presented in this paper makes it easy to understand the relationships between the various components of this competency.

Keywords: PBLI, practice-based learning, quality of care services

Introduction

Accreditation Council for Graduate Medical Education (ACGME) recognizes the improvement of healthcare quality as one of its missions. Therefore, since 1999, with the goal of educating highly qualified residents, it introduced six core competencies as the requirements of the residential education program.¹,² There are a number of occupations that also require continuous professional competence maintenance and updating. In the aviation industry, pilots’ knowledge and technical skills are continually evaluated through written tests and flight simulators. Obviously, people do not accept a flight in which the pilot’s professional standard was not continuously assessed. The same standard, or even higher, should be applied to doctors. Quality improvement and performance evaluation have become today’s mainstream medical issues, whereas in many areas of medical care, the quality of care services is less than desirable.³

Doctors will spend the majority of their career in unsupervised practice after graduation from a graduate medical education
program, ideally pursuing a journey toward expertise, but some evidences suggest that physicians who do not engage in practice-based learning and improvement (PBLI) experience a decline in their knowledge and skills over time because the advances in the medical field are increasingly occurring and medical knowledge is easily expired. To overcome this challenge, physicians must gain competency in PBLI such as self-directed learning and informed self-assessment. In a systematic review done by Choudhry in 2005, it was concluded that a considerable number of older doctors who have years of experience may be less likely to adopt new evidence-based treatments and accept new standards of care.

ACGME states that residents, with regard to the PBLI competency, should be able to critically evaluate their care and medical practice, compare this care with scientific evidence, and improve their practice. PBLI has a range of sub-competencies and, due to its complex and abstract concepts, training programs have struggled to address PBLI comprehensively at any time in all aspects of curriculum. In 2016, new PBLI milestones were provided by ACGME to monitor its implementation in the Residential Education program. Of course, the development of a tool for evaluating this competency is also a well-known priority. The review of literature suggests that there is no comprehensive model for academic development and implementation of this skill after graduation and in the professional world. The aim of this study was to provide an overview of this competency and presenting a conceptual framework to highlight the relationship and interdependence between required sub competencies for PBLI and high quality of care.

**Methods**

This study was conducted using Walker and Avant’s theoretical synthesis method. In this strategy, the theoretician collects information about a phenomenon and organizes concepts and statements in a network, called synthesized theory that consists of three steps:

1. Determining the focal concepts or a framework of concepts as an anchor for the synthesis of theory.
2. Reviewing the texts in order to identify factors related to focal concepts and specifying the nature of relationships.
3. Organizing concepts and statements in an integrated manner so that they become a useful display for the desired phenomenon.

In the first step, we put the ACGME guidelines into our conceptual framework. In the second stage, we conducted an extensive literature search. Initially, articles related to the concept of PBLI were searched using the keywords of PBLI, quality improvement, core competency, medical education, practice-based learning in English, separately and combined in google, google scholar, and Pubmed databases, then articles with good conceptual richness that helped shape our model were identified and the full text of available 120 articles were studied. One of the mechanisms for organizing the concepts and statements is “theoretical blocks.” Subsequently, researchers selectively incorporated concepts that, in their view, were more relevant to the concept of PBLI, and supported this communication. In the third step, finally, after identifying the blocks and variables of each block and communicating with them, a visual model of PBLI was presented. After a focused search for each block, a total of 229 full papers were studied and the PBLI model was developed in six conceptual blocks.

**Findings**

1- Block of approach to PBLI

In the daily life, humans, sometimes reactively, seek information to solve a problem, but sometimes proactively seek the subjects as well as the construction of a concept of the problem. In traditional medical education, learning is too often passive and reactive, but modern medicine is seeking to develop proactive approaches. Individuals at the top professional level usually adopt a proactive stance; these people are fundamentally provocative and inventive.

2- PBLI Process Triggers Block

A. Identifying the knowledge gap

Medical knowledge is constantly expanding and changing. Sometimes solving a clinical problem requires a knowledge that we do not have, and awareness of this ignorance causes the psychological-emotional response of cognitive dissonance to confront what we do not know and need to know. These gaps occur in certain clinical situations such as uncertainty and difficulty, management of a complex and difficult clinical situation, conflicting clinical outcomes with expectations, dealing with a contradiction with previous experiences, the inability to explain and interpret an event, and clinical decision-making. Occasionally, the knowledge gap is manifested through external feedbacks and outcomes of external evaluations. In some cases, also proactively, the physician seeks knowledge based on intrinsic interest, the usefulness of the subject or the attraction of the subject matter, keeping up with the advancements in the clinical medicine, and reviewing and enhancing the prior knowledge.

B. Identifying the skill gap

In some cases, the person becomes aware of his inability and skill gaps through metacognitive awareness and self-reflection. According to the theory of cognitive dissonance, when there is a discrepancy between what one wants to do and what is actually done, the discrepancy is uncomfortable, and this contradiction is the stimulus of change. According to cognitive psychology and feedback-learning model, when the doctors receive feedback on the success or failure of their interventions, their skill gaps are identified and learned.

C) Identifying the performance gap

Sometimes, in professional groups or fields, the individual compares his skills and performances with his superior counterparts, which is called internal benchmarking. Through benchmarking, doctors can identify structures and processes that will help them achieve their goals and outcomes. In a competitive environment despite the lack of a real gap, the
physician may proactively seek improvement and promotion where the competitive benchmarking is created so an effort is made to provide better and more efficient services.\cite{22,23,26} And, getting feedback from external sources such as patients, colleagues, and so on may put the doctor in a competitive environment and (s) he may engage the competitive benchmarking.\cite{22,21,27-34}

### 3. Gap bridging solutions

After identifying the knowledge, skills, and performance gaps in individual medicine, through internal or external, proactive or reactive resources, solutions and programs need to be addressed to resolve these gaps.

#### A. Bridging the knowledge gaps

To overcome the knowledge gaps in responding to clinical questions and foreground knowledge, implementation of an evidence-based practice strategy is applicable.\cite{35} Evidence-based medicine provides a framework for doctors to confront their clinical challenges and problems.\cite{2,23} To overcome the perceived knowledge gaps in background knowledge, self-directed learning approaches and personal studies as well as CME courses should be used. Effective participation in physician CME courses, effective intervention of supervising organizations, and the development of self-directed learning is necessary for medical professionals who are confronted with the ever-changing body of medical knowledge and increased use of technology.\cite{36-41}

#### B. Bridging the skills gap

To eliminate skills gaps, attending fields and professional communities, passing CPD courses are recommended.

Recent advances in the design, planning and implementation of new methods for the further effectiveness of continuing medical education have led to the emergence of a new paradigm for continuing professional development (CPD) and PBLI. It has several features focusing on lifelong learning based on the needs of the individual encompassing inclusive learning methods.\cite{42-44}

#### C) Fixing performance gaps

To eliminate identified performance gaps, it is recommended to use the root cause analysis of error and quality improvement techniques.

The use of QI methods and their tools has been growing in the health sector now for decades. Various models of quality improvement approaches have been introduced.\cite{44-46} Despite the different models, the general principles are the same.\cite{46} [Figure 1].

### 4- Practice-Based Learning and Improvement Infrastructure block

The block provided in the previous section was PBLI operational, but implementation of these programs requires the development of infrastructures such as the Knowledge Management system, regulatory bodies, information technology, clinical policymakers,
and continuing medical education centers and professional communities. Evidence-based practice should underpin a “National Evidence-based Healthcare System.” Thus, the national system of evidence-based healthcare helps to ensure generating, storing, publishing, using, sharing, and ultimately monitoring and evaluating the best evidence for providing effective and safe services in a systematic process and in accordance with the needs of different stakeholders.

**Practice-based evidence generating research system:** Practice-based evidence is a naturalistic view of medical treatments based on data that is readily available from medical documentation and other sources. Therefore, in addition to planning for the production of evidence-based practice, a mechanism should be considered for using evidence and implementing a practice-based evidence approach from multiple sources.

**Evidence-Based Clinical Decision-Making System:** The main objective of information retrieval systems is user support in all domains of search behaviors. Healthcare providers need to quickly retrieve information. The tools designed for evidence-based intervention at the moment of clinical care are POCs. To address this need, the tool should be able to provide synthesized and high-quality information at the shortest time possible for clinical decision making.

**Regulatory bodies:** Studies on the ability of regulatory and accreditation bodies show their influence on the implementation of physicians’ standards and clinical guidelines. Adherence to the guidelines and standards can be the basis for extending the license of activity. Governments and regulatory organizations can affect the performance of health institutions primarily through positive and negative financial incentives, relicensing requirements, and support for activities to enhance performance.

**Intersectional coordination:** The availability of evidence-based guidelines and their implementation requires them to be tailored to the needs of patients, facilities, and conditions of health centers, meaning that strategic, cultural, structural, and technical infrastructure is operational for the program. Moreover, inter-sectional interaction and co-operation are needed; so its successful implementation depends on a national trend and stewardship commitment in this regard.

**Community of practice:** We must not forget that the other potential of clinical environments is education in which individuals must learn, promote, specialize, and help others when needed. It seems that the development of communities of practice is essential for capacity building for sustainable development and being a hot topic in many countries.

**Information and communication Technology:** Information technology is used for information management, access to online medical information, increase the efficiency of health services, use of information for self-education, use of knowledge related to the design of studies and statistical methods for critically evaluating articles and information on the therapeutic and diagnostic effectiveness. Today, IT seems to be a prelude to individual PBLI qualifications [Figure 2].

![Figure 2: PBLI supporting and infrastructures](image-url)
5. Practice-based learning and improvement sub competencies block

In order for a person to exploit infrastructure and to start and run the PBLI process, there must be a series of individual competencies.

1.5 Self-regulation and self-monitoring skills

Self-monitoring means that the physician is aware of his own activity from moment to moment and, based on this intuitive awareness, may modify or change its performance. Reflection is of two types: Reflection on action where individuals think and contemplate about past events, and Reflection in action where people are aware of and reflect about what is happening right now.\cite{61-64}

2.5 Self-directed learning competency (SDLC)

The concept of self-directed learning has been suggested as a way of eliminating the need for physicians to maintain current information and the need to maintain and update the continuing competencies of today’s practitioners for practice in today’s changing world. They determine their learning goals, identify physical and human resources for learning, select and implement appropriate learning strategies, and evaluate their learning outcomes.\cite{65-67}

3.5 Continuous quality improvement

Indicators used to improve quality measure the achievement of goals. These indicators can be the basis for achieving goals as numbers, ratios or averages that are used by physicians, organizations and planners in quality improvement programs and for overall measurement of the structure, process, and outcomes.\cite{60,68} The issue of quality in health services is the concern of all governments and communities, and everyone agrees on the implementation of quality management.

4.5 Evidence-based practice

Today, the searchable clinical question and the acquisition of robust information search skills is one of the basic cornerstones of medical knowledge and clinical skills. Evidence-based practice is the daily application of EBM skills in the practice of physicians, which requires integration of evidence and personal motivation at the point of decision-making.\cite{2,33}

5.5 Performance measurement and output evaluation skill

Improvement and promotion of performance in healthcare is highly needed, but through Aggregate data. Aggregated data are data that can be traced by time, organization, patient population, and other variables. Various issues such as data availability, data formats, as well as its management and definition make it difficult...
to collect aggregated data. Also, the processes for determining Trending are complex and its comparison with a standard is complicated.\cite{65,70} The relations between blocks was illustrated in Figure 3.

6.5 The root-cause analysis
The health system should avoid the current “Blame and Shame” culture, which prevents accepting errors and thus prevents learning from errors. Promoting safety requires that the health system has access to information that will support the learning from experiences.\cite{71}

6. PBLI Academic Development Block
Reviewing the literature and recommendations of experts suggests that acquiring and applying knowledge and skills related to PBLI is better than entering the medical school until completion of residency training. After determining the main goals of training in PBLI through academic development, the depth of knowledge and skill utilization should be gradually increased for learners according to the Dreyfus professional skills acquisition model.\cite{72,73} Many of these curriculum are a combination of didactic training and experiential learning to bring significant improvements in learner knowledge and clinical processes. It is also important to use milestones and developmental and contextual assessments to assess the extent to which learners are accessing this capability.\cite{74}

Conclusions
Nowadays, PBLI is one of the inevitable qualities of medicine that ensures the quality of medical practice, which, in addition to individual requirements, requires a series of technical, strategic, structural, and cultural infrastructures. By utilizing this capability, a physician will be able to discover the knowledge, skills, and performance gaps, and will be able to cope up with their appropriate approaches, thereby improving the quality of their medicine and the care provided and the patient's safety. It can provide satisfaction and trust in society. The model presented in this paper makes it easy to understand the relationships between the various components of this competency.

Acknowledgment
We express our appreciation to Professor Eric Holmboe for giving valuable comments and guidance on earlier versions of this manuscript. This project was funded by the national agency for Strategic Research in Medical Education, Tehran, Iran, Grant No. 960188.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References
1. Webb TP, Merkley T, Wade TJ, Simpson D, Yudkovsky R, Harris I. Assessing competency in practice-based learning: A foundation for milestones in learning portfolio entries. J Surg Educ 2014;71:472-9.
2. Widge AS, Hunt J, Servis M. Systems-based practice and practice-based learning for the general psychiatrist: Old competencies, new emphasis. Acad Psychiatry 2014;38:288-93.
3. O’Connor ES, Mahvi DM, Foley EF, Lund D, McDonald R. Developing a practice-based learning and improvement curriculum for an academic general surgery residency. J Am Coll Surg 2010;210:411-7.
4. Morrison LJ, Headrick LA. Teaching residents about practice-based learning and improvement. The joint commission J Qual Patient Saf 2008;34:453-9.
5. Beliveau ME, Nishimura RA, O’Gara P. Physician competence: A perspective from the practicing cardiologist. Methodist DeBakey Cardiovasc J 2014;10:50-2.
6. Choudhry NK, Fletcher RH, Soumerai SB. Systematic review: The relationship between clinical experience and quality of health care. Ann Intern Med 2005;142:260-73.
7. ACGME. Advancing Education in Practice-based Learning & Improvement: An educational resource from the ACGME Outcome Project. 2005. Available from: Available from: http://www.acgme.org/outcome/implement/complete_PBLIBooklet.pdf.
8. ACGME-approved focused revision; June 13, 2021; Available from: https://www.acgme.org/globalassets/PROGRAMSsets/ProgramRequirements/CPRResidency_2022_TCC.pdf. [Last accessed on 2022 Jul 01].
9. Hamstra SJ, Edgar L, Yamazaki K, Holmboe S. Milestones Annual Report 2016. Education ACTIGM, editor. USA: Accreditation Council for Graduate Medical Education; 2016.
10. Walker LO, Avant KC. Strategies for theory construction in nursing. Upper Saddle River, NJ: Pearson/Prentice Hall; 2005.
11. Mathers N, Challis M, Howe A, Field N. Portfolios in continuing medical education—effective and efficient? Med Educ 1999;33:521-30.
12. Evensen DH, Salisbury-Glennon JD, Glenn J. A qualitative study of six medical students in a problem-based curriculum: Toward a situated model of self-regulation. J Educ Psychol 2001;93:659.
13. Miller JP, Seller W. Curriculum: Perspectives and Practice. New York, NY, USA: Longman; 1990.
14. Gruen RL, Pearson SD, Brennan TA. Physician-citizens—public roles and professional obligations. JAMA 2004;291:94-8.
15. Reinle GG. The specialist and his obligation to the profession. Cal State J Med 1922;20:48-9.
16. Afshar MD, Rashidi MD, Mirzatoleuei MD. Information Seeking Behavior of Iranian Orthopaedic Surgeons in Information Seeking Behavior of Iranian Orthopaedic Surgeons in. Iranian Journal of Orthopaedic Surgery 2009;7:121-5.
17. Baker R, Bala M, Czabanowska K, Dubas K, Eriksson T, Gudynicki-Dwirko M, et al. Guidebook on implementation of Quality Improvement in General Practice: The College of Family Physicians in Poland; 2012.
18. Belkin NJ. Interaction with texts: Information retrieval as
information seeking behavior. Inf Retr 1993;93:55-66.
19. Saptya J, Riemer M, Bickman L. Feedback to clinicians: Theory, research, and practice. J Clin Psychol 2005;61:145-53.
20. Aronson, E. Dissonance, hypocrisy, and the self-concept. In E. Harmon-Jones & J. Mills (Eds.), Cognitive dissonance: Progress on a pivotal theory in social psychology. American Psychological Association 1999; p. 103-6.
21. Camp RC, Tweet AG. Benchmarking applied to health care. Jt Comm J Qual Improv 1994;20:229-38.
22. Plsek P. Section I: Evidence-based quality improvement, principles, and perspectives. Pediatrics 1999;103:203-14.
23. Burstin HR, Conn A, Setnik G, Rucker DW, Cleary PD, O'Neil AC, et al. Benchmarking and quality improvement: The Harvard emergency department quality study. Am J Med 1999;107:437-49.
24. Ellis J. Sharing the evidence: Clinical practice benchmarking to improve continuously the quality of care. J Adv Nurs 2000;32:215-25.
25. Pryor LS. Benchmarking: A self-improvement strategy. J Bus Strategy 1989;10:28-32.
26. Comm CL, Mathaisel DF. A paradigm for benchmarking lean initiatives for quality improvement. Benchmarking Int J 2000;7:118-28.
27. Templeman D. How to get the most out of your orthopaedic fellowship: Thinking about practice-based learning. J Orthop Trauma 2012;26:S3-S5.
28. Cole JG. Practice-based, Guided Self-assessment for Improved Patient Care: Performance Improvement CME Jefferson Medical College. Available from: http://jdc.jefferson.edu/cgi/viewcontent.cgi?article=1523&context=hpn. [Last accessed on 2016 Jun 10].
29. Davis DA, Mazmanian P, Fordis M, Van Harrison RT, Thorpe KE, Perrier L. Accuracy of physician self-assessment compared with observed measures of competence: A systematic review. JAMA 2006;296:1094-102.
30. Lipstein EA, Kronman MP, Richmond C, White KN, Shugerman RP, McPhillips HA. Addressing core competencies through hospital quality improvement activities: Attitudes and engagement. J Grad Med Educ 2011;3:315-9.
31. Salzman DH, Franzen DS, Leone KA, Kessler CS. Assessing practice-based learning and improvement. Acad Emerg Med 2012;19:1403-10.
32. Falcone JL, Lee KKW, Billiar TR, Hamad GG. Practice-based learning and improvement: A two-year experience with the reporting of morbidity and mortality cases by general surgery residents. J Surg Educ 2012;69:385-92.
33. Farajpour A, Amini M, Pishbin E, Mostafavian Z, Farmad SA. Using modified Direct Observation of Procedural Skills (DOPS) to assess undergraduate medical students. Journal of Advances in Medical Education & Professionalism. 2018;6:130.
34. Lynn J, Baily MA, Bottrell M, Jennings B, Levine RJ, Davidoff F, et al. The ethics of using quality improvement methods in health care. Ann Intern Med 2007;146:666-73.
35. Rosenberg W, Donald A. Evidence based medicine: An approach to clinical problem-solving. BMJ 1995;310:1122-6.
36. Yazdani S, Farajpour A, Shakerian S. Practice-Based Learning and Improvement (PBLI) from the Perspective of Iranian Medical Education Experts: A Thematic Content Analysis. Iranian Red Crescent Medical Journal 2017;19:1-10.
37. Shirke RP, Rawat A, Chandar V, Walia J, Wasim S, Bhat NK. Evaluation of the self-directed learning readiness of medical undergraduates in pediatrics department: A study from medical college in Uttarakhand state of India. Int J 2016;5:2610.
38. Dweck CS. Self-Theories: Their Role in Motivation, Personality, and Development. Philadelphia: Psychology Press; 2000.
39. Madigosky WS, Linda A. Headrick, Kathryn Nelson, Karen R. Cox, and Timothy Anderson. Changing and sustaining medical students' knowledge, skills, and attitudes about patient safety and medical fallibility. Acad Med 2006;81:94-101.
40. Sargeant J, Arms H, Chesluk B, Dornan T, Eva K, Holmboe E, et al. The processes and dimensions of informed self-assessment: A conceptual model. Acad Med 2010;85:1212-20.
41. Arno Jr AR, Hemmer PA, Durning SJ. Using self-regulated learning theory to understand the beliefs, emotions, and behaviors of struggling medical students. Acad Med 2011;86:335-8.
42. Nissen SE. Reforming the continuing medical education system. JAMA 2015;313:1813-4.
43. Sachdeva AK. The new paradigm of continuing education in surgery. Arch Surg 2005;140:264-9.
44. Sachdeva AK, Blair PG, Lupton J. Education and training to address specific needs during the career progression of surgeons. Surg Clin North Am 2016;96:115-28.
45. Nicolay CR, Purkayastha S, Greenhalgh A, Benn J, Chaturvedi S, Phillips N, et al. Systematic review of the application of quality improvement methodologies from the manufacturing industry to surgical healthcare. Br J Surg 2012;99:324-35.
46. Shortell SM, O'Brien JL, Carmen JM, Foster RW, Hughes EF, Boerstler H, et al. Assessing the impact of continuous quality improvement/total quality management: Concept versus implementation. Health Serv Res 1995;30:377-401.
47. Kortekaas M, Barteltink M, Zuithoff N, van der Heijden G, de Boerstler H, et al. Teamwork and behaviors of struggling medical students. Acad Med 2011;86:S35-8.
48. Whelan CT, Podrazik P, Johnson JK. A case-based approach to teaching practice-based learning and improvement on the wards. Hosp Physician 2005;41:34.
49. Davis DA, Taylor-Vaisey A. Translating guidelines into practice: A systematic review of theoretic concepts, practical experience and research evidence in the adoption of clinical practice guidelines. Can Med Assoc J 1997;157:408-16.
50. Varkey P, Karlapudi S, Rose S, Nelson R, Warner M. A systems approach for implementing practice-based learning and improvement and systems-based practice in graduate medical education. Acad Med 2009;84:335-9.
51. Rayamajhi S, Bouknight. Curriculum on practice-based learning and improvement Msu internal medicine residency program. (March 2015).
52. Shurtz S, Foster MJ. Developing and using a rubric for evaluating evidence-based medicine point-of-care tools. J Med Libr Assoc 2011;99:247-54.
practice guidelines. Can Med Assoc J 1997;157:408-16.

54. Ogrinc G, Headrick LA, Morrison LJ, Foster T. Teaching and assessing resident competence in practice-based learning and improvement. J Gen Intern Med 2004;19:496-500.

55. Teunissen PW. Experience, trajectories, and reifications: An emerging framework of practice-based learning in healthcare workplaces. Adv Health Sci Educ 2015;20:843-56.

56. Wenger-Trayner, Etienne, and Beverly Wenger-Trayner. "Communities of practice: A brief introduction." (2015): 1. Pdf. Available from: http://hdl.handle.net/1794/11736.

57. Hanrahan LP, Foldy S, Barthell EN, Wood S. Medical informatics in population health: Building Wisconsin's strategic framework for health information technology. WMJ 2006;105:16-20.

58. Farkhondeh Asadi ZM. Challenges of using information technology in hospitals affiliated to Shaheed Beheshti University of Medical Sciences, 2009. Q Iran J Surg 2012;20:18-26.

59. Bohmer RM. The hard work of health care transformation. N Engl J Med 2016;375:709-11.

60. Mainz J. Defining and classifying clinical indicators for quality improvement. Int J Qual Health Care 2003;15:523-30.

61. Schön DA. The Reflective Practitioner: How Professionals Think in Action. 1st ed. London: Routledge; 2017. p. 384.

62. Eva KW, Regehr G. Self-assessment in the health professions: A reformulation and research agenda. Acad Med 2005;80:S46-54.

63. Larsen DP, London DA, Emke AR. Using reflection to influence practice: Student perceptions of daily reflection in clinical education. Perspect Med Educ 2016;5:285-91.

64. Archer JC. State of the science in health professional education: Effective feedback. Med Educ 2010;44:101-8.

65. Monroe KS. The relationship between assessment methods and self-directed learning readiness in medical education. Int J Med Educ 2016;7:73.

66. Smith SJ, Kakarala RR, Talluri SK, Sud P, Parboosingh J. Internal medicine residents' acceptance of self-directed learning plans at the point of care. J Grad Med Educ 2011;3:425-8.

67. Brook RH. Continuing medical education: Let the guessing begin. JAMA 2010;303:359-60.

68. Nelson EC, Batalden PB, Lazar JS. Practice based learning and improvement: A clinical improvement action guide. 3rd edition. USA: Joint Commission Resources; 2013.

69. Ryan SA, Thompson C, editors. The use of aggregate data for measuring practice improvement. Semin Nurse Manag 2002;10:90-4.

70. Lambert MJ, Whipple JL, Hawkins EJ, Vermeersch DA, Nielsen SL, Smart DW. Is it time for clinicians to routinely track patient outcome? A meta-analysis. Clin Psychol Sci Pract 2003;10:288-301.

71. Nieva V, Sorra J. Safety culture assessment: A tool for improving patient safety in healthcare organizations. Qual Saf Health Care 2003;12(Suppl 2):i17-23.

72. Tomolo AM, Lawrence RH, Watts B, Augustine S, Aron DC, Singh MK. Pilot study evaluating a practice-based learning and improvement curriculum focusing on the development of system-level quality improvement skills. J Grad Med Educ 2011;3:49-58.

73. Ogrinc G, Headrick LA, Mutha S, Coleman MT, O'Donnell J, Miles PV. A framework for teaching medical students and residents about practice-based learning and improvement, synthesized from a literature review. Acad Med 2003;78:748-56.

74. Wong BM, Etchells EE, Kuper A, Levinson W, Shojania KG. Teaching quality improvement and patient safety to trainees: A systematic review. Acad Med 2010;85:1425-39.