

REVIEW ARTICLE



Speaking the same language in health professions education

Manoharan P. S¹, Sethuraman K.R², Adkoli B.V³, Saravana Kumar R⁴

¹Department of Prosthodontics and Crown and Bridge, Indira Gandhi Institute of Dental Sciences, Sri Balaji Vidyapeeth, Puducherry, India, ²Vice Chancellor, Sri Balaji Vidyapeeth, Puducherry, India, ³Medical Education Unit, Sri Balaji Vidyapeeth, Puducherry, India, ⁴Principal, Indira Gandhi Institute of Dental Sciences, Sri Balaji Vidyapeeth, Puducherry, India

Key words:

Assessment, competence, evaluation, outcome, quality control

Correspondence:

Dr. P. S. Manoharan, Department of Prosthodontics and Crown & Bridge, Indira Gandhi Institute of Dental Sciences, Sri Balaji Vidyapeeth, Puducherry, India.
Phone: +91-9865019673.
E-mail: manodent_2000@yahoo.com

Received: 11 September 2017;

Accepted: 20 November 2017

doi: 10.15713/ins.jcri.189

Abstract

A common understanding of the terms used in the field is very important, especially in the field of science. In health professions education, the inadvertent use of terms in inappropriate context can lead to deleterious effects. The use of wrongly conveyed terms in planning, teaching-learning activity, or evaluation can cause ambiguity, confusion, and misinterpretation. Reform in any field gets initiated and progress only if the shared knowledge is well defined. In health professions education, many terms are been loosely used without realizing the impact it could cause to the field. The paper is intended to unravel some of the commonly misused and misinterpreted terms. The collection of terms presented in the paper is based on extensive experience and encounters in various educational settings rather than what is documented in the literature.

Practice Points

- All health professions educators are mandated to be familiar with the terms used in Health Professions Education and practice correct usage.
- Correct usage would prevent inadvertent gross errors in planning, process and assessment.
- The intention of any planned activity would be clear to the other working units of the organization, thereby preventing misconception and misinterpretation.
- Compulsory faculty development programmes in education for all facilitators in the organization with emphasis on these ambiguous terms.
- Correct understanding and usage of these terms in scientific literature should be strictly viewed for transmission of wrong ideas and concepts.

Introduction

A common understanding of the terms used in any field is the key to effective communication, especially in science. The use of common terminology helps in better understanding,

comparison, and standardization of practice in any field of knowledge. In health professions education, we come across many terms such as competencies, assessment, and evaluation which are being used extensively, often loosely thereby causing a communication gap among the faculty, students, and the public. It is a well-known fact that the syllabus compilations go through review by experienced personnel and passed to the faculty for implementation. It is, therefore, important for all to understand these concepts and use them appropriately and effectively. It helps to maintain uniformity in curriculum and eliminate ambiguity, distortion, and confusion. Reform in education can be brought as a first step by defining a shared knowledge.^[1] It would enable the professionals to relate to each other. Evidence in literature has proved that a lack of common language could affect their implementation.^[2,3] The paper would endeavor to discuss some of the misused, misinterpreted, and conflated terms and unravel common misconceptions in health professions education. The misuse of these terms is based on our extensive experience and encounter with a variety of educational settings, rather than what has been documented in the literature.

Theory of Learning, Educational Philosophy, and Teaching Philosophy

A theory of learning explains how the learning is facilitated or hindered by external and internal factors. On the other hand, a philosophy of education guides the schools to design their curriculum in a particular manner. Learning theories explain how the individual absorbs, processes, and retains information. There is no single theory to explain various types learning among different individuals across the board. Learning theories are used by the teachers to understand the psychology of students to cater to their learning styles. Educators should therefore draw sound principles of learning based on different theories.

Some of the leading schools of learning are behaviorism, cognitive psychology, constructivism, social constructivism, experiential learning, multiple intelligence, situational learning, and community of practice. All these theories have been developed from carefully crafted lessons based on the years of experience and inquiry.^[4] Educational philosophies are either student centered or teacher centered. Perennialism, idealism, pragmatism, positivism, behaviorism, and essentialism are teacher-centered educational philosophies. Here, the teacher decides the course of curriculum with minimal consideration from the student. Progressivism, constructivism, reconstructionism, and humanism are student-centered educational philosophies, wherein the student plays an important role in the planning and pacing the curriculum. Teaching philosophy, on the other hand, is more personal to a teacher. It is described in the form of a statement. The statement is based on the educational philosophy which he or she personally believes and what principles of learning theories he or she wishes to apply in his approach to teaching. It helps others to visualize the overall teaching style of a teacher. This statement becomes an integral part in teacher's portfolio. Writing down a teaching statement also reinforces and clarifies teacher's own beliefs. It can even reveal inconsistencies which would facilitate change for a positive development.^[5]

Vision, Mission, and Core Values

A vision statement refers to what an institution wants to do or achieve in a realistic time frame, whereas the Mission statements indicate the ways in which the vision can be materialized. The accomplishment of vision and mission are expected to be guided by a set of core values. For instance, a research institution may have a vision of becoming a Center of Excellence in "research." Its mission can be through the "pursuit of basic research, clinical research, translational research, etc." The core values can be ethical behavior, team approach, autonomy, etc. Vision, mission, and core values are fairly stable entities which do not change frequently. They guide all the activities of the institution. It is imperative that these are decided collectively and communicated extensively to achieve "buy in" and active participation from every member of the organization. Such awareness is found to be important for the working units to demonstrate qualities such as responsibility, accountability, ownership, and commitment.^[6]

Goals and Objectives and Outcomes

Goals refer to the intended end products of a program. Outcomes are actually what turned out after the process. In general, both the process and the outcomes are important because a systematic process is likely to bring out better outcome.^[7] The objectives are the means to achieve the goals. To cite an example, one of the main goals of an MBBS program may be to develop competent doctors. This can be achieved by fixing objectives at various levels, namely, institutional, departmental, and teaching session. Institutional objectives are the statements to define what an MBBS graduate should be able to do at the end of the course. Departmental objectives indicate what the students should be able to do in a department to which he/she is posted. Specific instructional objectives are the statements which describe what a learner should be able to do at the end of a teaching session. A trend in education is to achieve SMART objectives, namely, objectives which are specific, measurable, achievable, relevant, and time bound. Spelling out the objectives clearly and precisely helps the learners to learn more effectively and helps the teacher to plan the teaching, assessment in a meticulous way.^[8,9] Harden in his editorial has mentioned the importance of outcomes for the current generation. He has mentioned to include important aspects like communication skills and attitudes which were neglected in the past. It helps the teacher to comprehend what to teach and the learner to understand the scope of his learning.^[8]

Skill, Competency, and Entrustable Professional Activity

Knowledge, skills, and attitudes form the main essential domains called cognitive, psychomotor, and affective domains, respectively. The skill may be psychomotor skill or perceptual skill. The psychomotor skill pertains to a pure kinesthetic activity. While applying a bandage is a purely psychomotor skill, interpretation of radiograph involves perception and use of cognitive domain. The term competency is used to denote ability to perform a task with a certain degree of precision. Competency is defined as "the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values, and reflection in daily practice for the benefit of the individuals and communities being served."^[10] The Accreditation Council for Graduate Medical Education (ACGME) of the USA has identified six core competencies: Medical knowledge, systems-based practice, practice-based learning, patient care and procedural skills, interpersonal and communication skills, and professionalism.

Another term which is becoming popular is Entrustable Professional Activity (EPA), which focuses on a measurable activity, rather than bits and pieces of competencies that are involved in learners' journey. Each EPA may involve several competencies such as medical knowledge, communication, and professionalism. For example, giving immunization involves medical knowledge about the vaccine and right dosage, skill in administering injection, and attitude to maintain cold chain.

Competency-based approach also involves delineation of various levels of proficiency to be reached, for example, mere observation, doing under strict supervision, doing under loose supervision, doing independently, and teaching others. The milestones to be reached during various points of training are also defined clearly to guide the training process.

Each EPA can be mapped for the competencies the student should demonstrate during the course.^[11] A paradigm shift from Flexner’s to competency model has opened the eyes of many, to view the outcomes as not just knowledge or skills, but with an activity with various dimensions, involving different competencies.^[12]

An example from a dental institution for the EPA and the grid showing competency weightage based on ACGME guidelines is seen in Table 1. In 1999, the ACGME has selected and provided six competencies which define a particular foundational skill of a medical graduate. This is used to develop the competencies in the student and help to assess them for improvement and certification.

Medical knowledge is trained through didactic or non-didactic method with the intention to impart the scientific basis for any foundational activity. It is assessed by examinations, end of posting evaluation through oral examination, or tests. Patient care includes the treatment or care to the patient offered by the student. The step-by-step systematic approach of the student in handling the patient is expected to be observed by the facilitator and feedback to the student given for improvement. Practice-based learning and improvement includes the demonstrable behavior such as gathering information accurately, documenting, follow-up care, and time management skills. Interpersonal and communication skills include a demonstrable better treatment outcome with effective interpersonal or communication skills which is evaluated best with 360° assessment or multisource feedback. Systems-based practice includes the involvement of the student by recognizing himself as a part of the system/unit or organization. It would help the trainee to realize his/her role for contribution for betterment and improvement of the system. It also means how the student is able to deliver his best to the patient by understanding the complexities of the system. Professionalism, on the other hand, is best instructed to the student through a demonstrable invisible work culture by the faculty and by the student observing it. The student

Table 1: Mapping of skill to competencies

Entrustable professional activity/skills	MK	PC	PBLI	SBP	P	ICS
Ability to identify common medical emergencies in dental office such as bleeding, syncope, seizure, hypoglycemic episode, hyperventilation, and anaphylaxis, to manage the same within the scope of a dental surgeon and also realize the need for early medical intervention	++	++	+++	++	+	++

MK: Medical knowledge, PC: Patient care, PBLI: Practice-based learning and improvement, SBP: Systems-based practice, P: Professionalism, ICS: Interpersonal and communication skills

imbibes qualities such as respect, empathy, discipline, astute responsiveness, integrity, accountability, practice of ethics, and commitment.

Pedagogy, Andragogy, Heutagogy, and Microteaching

Microteaching can be described as a teaching exercise to practice one teaching skill component at a time in a controlled setting. A teacher plans a small teaching session (5–10 min) and practices a skill (e.g., questioning, narration, and use of audiovisual aid). A checklist is used by the observers, often students, and peers, who will give detailed feedback to the teacher following latter’s presentation and self-reflection. At the end, the supervisor summarizes the feedback and asks the teacher to replan and reteach. This enables to develop some of the classroom behavior of the teacher and develop the art of teaching at ease.^[13] Sometimes, a playback of the recording of a video of the teaching activity is also used as an effective feedback.

Pedagogy refers to the theory and practice of teaching as applicable to children. This emphasizes the overall control exercised by the teacher. The teacher decides what should be taught and how should it be taught to the students who are expected to absorb from the teacher.

Andragogy, in the literal sense, means “leading the man.” In education, this term is used for adult learners. In health professions education, it is interesting to note that Pedagogy is the common mode of delivery of instruction when the learners are all adults. This may be a reason why difficulties are encountered to make the undergraduate or postgraduate learn through a routine pedagogical training. Andragogy is based on adult learning principles where the learner engages in self-directed learning, motivated by challenging task, and works at his own pace towards mastery.

Heutagogy is one step ahead where the adult learner and the facilitator blend in their approach to plan, deliver, assimilate, and evaluate the learning process. In higher education, doctoral, postdoctoral, and residential learning this method may prove effective. It is more self-directed. The learner decides what to learn and how to learn. The facilitator’s role is limited to provide resources and a congenial environment. The learner’s capability is exploited well and made to evolve beyond learning boundaries. This may be effective in adult learners who are motivated to learning exists already due to career choices. Heutagogical approach can be best used to induct life-long learning and self-directed learning which are the key attributes of professionalism.^[14,15]

E-learning, Media-Based Learning, Online Learning

E-learning involves learning of an individual using electronic media. It can be inclusive of media-based learning, web-based learning, or online learning. Media-based learning involves the use of CD-ROMs, AV teaching aids, and PowerPoint

presentations. Online or web-based learning involves the use of internet to create distance learning opportunities in a synchronous mode (all learners are connected with “live” interaction) or asynchronous mode (learners’ access, download, and respond individually at their convenient time). Podcasts, online courses, and webinars are some of the web-based or online learning tools. Telemedicine is the application technology for facilitating outreach consultation. Many educational institutions have started adapting e-learning strategy to save time, improve the efficacy of delivery of instruction, and enhance the ease of assessment. E-learning has withstood a lot of criticism that it is “sub-standard” or “superficial,” and it cannot be totally brushed away, as it has potential to reach learners any time (24 × 7) and anywhere. To overcome the pitfalls and blended learning, a transformative mode of learning is practised in the recent years, which combines formal classroom learning and online-based learning.^[16] Apart from the learning strategy, learning style was also found to have an impact on the quality of learning which occurs.^[17]

Syllabus and Curriculum

Syllabus is a list of topics or content areas with the working hours which are provided by the regulatory bodies of a course. Curriculum is a wider term which includes a statement of objectives, content or syllabus, time schedule, and plan of assessment. The planning of curriculum should ideally be done considering the views of all stakeholders management, faculty, students, patients, and representatives from a social body.^[18] The curriculum document should indicate the weightage to various topics and the working hours allotted by the regulatory guidelines. Within the flexibility offered by the regulations, the curriculum planners have the option to stretch even beyond the boundaries to offer value-added innovations in teaching learning and assessment. The role of administrators, faculty from the technology of education, and the facilitators are vital in forming and reforming curriculum which is unique to every institution.^[15]

Assessment and Evaluation

Assessment is done to judge the performance of participants. While formative assessment is continuous and focuses on the improvement, summative assessment is terminal and focuses on certification (pass/fail decision) or grading of learners.

In assessment, we follow many tools and techniques of measurement to arrive at the definite score. Tests, examinations (theory, practical, and viva), checklists, rating scales (self-rating/peer rating scales), observation schedules, rubrics, questionnaires, portfolio, and multisource feedback (360 assessment) are all tools of assessment. The result of assessment is scoring.

Score can be a raw score or the actual score or relative like percentile and standardized score. Based on the score and the method of assessment, we evaluate the learning strategy,

teaching-learning methods, assessment methods, and student cohort. The purpose of scoring after the assessment is to certify or grade a student for pass or progress. Last but not the least, the measurement tool which is used for assessment and scoring can also lead to problems which may defeat. Assessment refers to the measurement aspect of student performance. Evaluation is a term used to describe overall value judgment based on measurement of a quantity as well as quality to take a decision. American literature generally uses the term assessment to refer to “student assessment.” The purpose of evaluation is to give a value judgment to decide whether the subject meets preset standards of norm or criteria.^[15] The purpose of evaluation is to judge student performance and to improve the system, redefine objectives, and identify potential problems. In education, evaluation of a theory or practical examination can be through post-validation. The evaluation of students can be criteria based (against set standards) or norm based (comparing among the group). The choice of evaluation is to give a value judgment to decide whether the subject meets preset standards of norm or criteria.^[19]

Feedback and Reflection

Feedback and reflections play a vital role in the formative assessment for correction and improvement.^[20] Feedback can be either from the student to teacher or from the teacher to student regarding the learning activity. Feedback involves meticulous observation of an activity (or performance) and reporting strengths and limitations of the participant for bringing improvement in the learner. Feedback is given at the end of the activity based on observations made by the facilitator. It can be a formal or an informal feedback. Such feedbacks play a crucial role in formative assessment.

Reflections are careful recording of the experiences by the learner in a written or digital format. Reflections are expected to be comprehensive about the learning activity with supportive pictures and other documents. It integrates the knowledge, skills, and attitude in the cognitive framework of the individual.^[16] Reflections are exercised during and after completion and much more after completion of the activity. The facilitator plays an important role in helping the student to pen down the experiences as reflections. The teacher can plant leading questions in the mind of the student such as “What did we see today?” “In what way was this activity different from the last time?” “What actually happened?” “Why did it happen like that?” “What could have been done?” and “What will you do next time if this episode repeats?” These endeavors by the faculty can be taken as hidden curriculum and best practice for the institution.^[21] In Kolb’s learning cycle, reflection forms an integral part of all learning. Where the learning understands abstract concepts starting from experiences, reflective observation forms the connecting link, where the learner reviews and introspects on the experience encountered.^[22] The reflections are captured through maintenance of portfolio in printed or electronic form

(e-portfolio). Trainers in the unit should value the importance of reflections. Otherwise, this would be considered as a strenuous task and a cumbersome documentation.

Quality Control, Quality Assurance, and Quality Improvement

In quality management plan of an organization, quality control, quality assurance, and quality improvement form an integral part.

Quality control checks whether the units of the management fulfil the requirement of the organization in terms of the quality of the output. Quality control involves assessments at planned points to monitor and check quality. There have been attempts to develop instruments to measure quality such as defect rate and error rate, but none of these have been directly related to actual quality. Quality control measures alone do not signify quality management. Quality assurance and maintenance are more essential components of quality management.^[23]

Quality assurance is a much wider concept. It defines the standards against benchmarks to be fulfilled by the organization to check whether the products are fit for the purpose. Applying QA to education, it rests on three pillars, namely, defining standards, self-assessment, and peer/external assessment or accreditation. To put up a QA system, an educational institute should first define the benchmarks and select performance indicators to chase. It should then develop a robust institutional mechanism to monitor progress through self-assessment.

Quality assurance activities include planning, inspecting, testing of plans, identify defects, and training people for the processes. The pivotal role of the quality assurance personnel can be appreciated in his demonstration of their exemplary communication skills to maintain peace, harmony, and productive working units. In education, it includes activities such as review of quarterly and annual reports, student surveys, exit surveys, alumni/employees' survey, and reports of external examiners/assessors, besides student performance and faculty output.

Quality assurance can be considered as a strategy for prevention (verification), whereas quality control can be used as a strategy for detection (validation), though both work toward a common goal, their focus or approach is different.

Quality improvement is the primary goal of the institution which is aimed to raise the quality of the process or product. The conception of improvement finally reached as a result of the review was to define improvement as better patient experience and outcomes achieved through changing provider behavior and organization through using a systematic change method and strategies.^[24] Quality assurance forms the first step for quality improvement. For quality improvement, there is a need to revisit the vision and mission. Comparison of goals with global benchmarks should be done prior to resetting realistic vision and mission statements. It requires a cultural change, transparency, and commitment of the working units to achieve the new goal

in a given time. Sometimes, this may seem radical, and there are threats which can be anticipated such as increasing bureaucracy, negative competition, loss of diversity, time management, and work imbalance.

All the mentioned above form part of quality assessment system. The system mainly is aimed to improve the existing state of the process and also is accountable to the external world about the resources provided and the quality of teaching at this end.

Multidisciplinary, Interdisciplinary, Interprofessional, and Transdisciplinary

The term multidisciplinary involves working in separate units without much of interaction. Interdisciplinary describes that various disciplines work in providing a coordinated and collaborative health care. Interprofessional can be described as in-depth collaboration and coordination and joint intellectual effort of the individuals in the team to their fullest effort. The collaboration involves shared knowledge of healthcare providers, work toward the best in their joint decision-making which should synergistically influence to promote the patient care provided. In transdisciplinary training, the boundaries merge and the professionals understand and practice the role of the other professionals. The individuals become more flexible with the roles and responsibilities.^[25]

Conclusion

The educational terms described above are just a handful of terms within the scope of this paper. There are other terms scattered around, which are misused and abused by practising health professionals.^[26] The paper does not intend to provide definitions. Problems with the applications, in spite of definitions made available in glossaries, can cause severe damage. "Bad terminology is the enemy of good thinking" - Warren Buffet. In education, a good thought process can be hampered with inappropriate use of terms and concepts. Wrong perpetuation of knowledge through confusion in the body of terms can cause damage to the field. Ill effects caused can be reduced or eliminated by training of faculty and proper guidance, especially in educational organizations. We recommend that the curriculum planners and trainers should be cautious in choosing the terms, otherwise, the end users of the system, namely, students are likely to be the victims for no fault on their part. We this will trigger and stimulate further discussions among educators to evolve a better consensus.

References

1. Bashook PG, Parboosingh J. Continuing medical education: Recertification and the maintenance of competence. *Br Med J* 1998;316:545-8.
2. Mazurek B. Strategies for overcoming barriers in implementing evidence-based practice. *Pediatr Nur* 2002;28:159-61.

3. Mitchell GJ. Evidence-based practice: Critique and alternative view. *Nurs Sci Q* 1999;12:30-5.
4. Wilson SM, Peterson PL. Theories of Teaching and Learning: What do They Mean for Educators. Working Paper. Best Practices. ED 495823. National Education Organization; 2006.
5. Schönwetter DJ, Sokal L, Friesen M, Taylor KL. Teaching philosophies reconsidered: A conceptual model for the development and evaluation of teaching philosophy statements. *Int J Acad Dev* 2002;7:83-97.
6. Darbi WP. Of mission and vision statements and their potential impact on employee behaviour and attitudes: The case of a public but profit-oriented tertiary institution. *Int J of Bus Soc Sci* 2012;14:95-109.
7. Harden RM. Learning outcomes and instructional Objectives: Is there a difference? *Med Teacher* 2002;24:151-5.
8. Harden RM. Developments in outcome-based education. *Med Teacher* 2002;4:117-20.
9. Jenkins A, Unwin D. How to Write Learning Outcomes; 2005. Available from: <http://www.ncgia.ucsb.edu/education/curricula/giscc/units/format/outcomes.html>. [Last accessed on 2001 Nov 16].
10. Epstein RM, Hundert EM. Defining and assessing professional competence. *JAMA* 2002;287:226-35.
11. Krupat E. Critical Thoughts about the core entrustable professional activities in undergraduate medical education. *Acad Med* 2017. DOI: 10.1097/ACM.0000000000001865.
12. Carraccio C, Wolfsthal SD, Englander R, Ferentz K, Martin C. Shifting paradigms: From Flexner to competencies. *Acad Med* 2002;77:361-7.
13. Remesh A. Microteaching, an efficient technique for learning effective teaching. *J Res Med Sci* 2013;18:158-63.
14. Canning N. Playing with heutagogy. Exploring strategies to empower mature learners in higher education. *J Further High Educ* 2010;34:59-71.
15. Blaschke LM. Heutagogy and lifelong learning: A review of heutagogical practice and self-determined learning. *Int Rev Res Open Distance Learn* 2012;13:56-71.
16. Wang KH, Wang TH, Wang WL, Huang SC. Learning styles and formative assessment strategy: Enhancing student achievement in web-based learning. *J Comp Assisted Learn* 2006;22:207-17.
17. Garrison DR, Kanuka H. Blended learning: Uncovering its transformative potential in higher education. *Internet High Educ* 2004;7:95-105.
18. Stenhouse LA. Curriculum research and development in action. *J Curriculum Studies* 1980;12:371-6.
19. Kizilk B. Measurement, Assessment and Evaluation. Available from: <http://www.adprima.com/measurement.htm>. [Last cited on 2012 Jan 04].
20. Branch WT, Paranjape A. Feedback and reflections. Teaching methods for clinical settings. *Acad Med* 2002;77:1185-8.
21. Hafferty FW. Beyond curriculum reform: Confronting medicine's hidden curriculum. *Acad Med* 1998;73:403-7.
22. Stice JE. Using Kolb's learning cycle to improve student's learning. *Eng Educ* 1987;77:291-6.
23. Saraph JV, Benson PG, Schroeder RG. An instrument for measuring critical factors of quality management. *Decis Sci J Innov Educ* 1989;20:810-29.
24. Ovretveit J. Does improving Quality Saves Money? A Review of Evidence of which Improvements to Quality Reduce Cost to Health Service Providers. London: The Health Foundation. Available from: http://www.health.org.uk/sites/health/files/DoesImprovingQualitySaveMoney_Evidence.pdf. [Last accessed on 2009 Sep 11].
25. Stone J. Interprofessional and Collaborative Practice [IPCP] – Definitions and Terminology: Attempting to Speak the Same Language. Interprofessional Learning Coordinator. Canberra: ACT Health; 2009. p. 1-7.
26. Glossary of Curriculum Terminology. UNESCO International Bureau of Education. Available from: http://www.ibe.unesco.org/fileadmin/user_upload/Publications/IBE_GlossaryCurriculumTerminology2013_eng.pdf@UNESCO-IBE 2013 IBE/2013/KPM/PI/0.1 [Last accessed on 2009 Sep 11].

How to cite this article: Manoharan PS, Sethuraman KR, Adkoli BV, Kumar RS. Speaking the same language in health professions education. *J Adv Clin Res Insights* 2017; 4:181-186.

This work is licensed under a Creative Commons Attribution 4.0 International License. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in the credit line; if the material is not included under the Creative Commons license, users will need to obtain permission from the license holder to reproduce the material. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/> © Manoharan PS, Sethuraman KR, Adkoli BV, Kumar RS. 2017