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Systematic evaluation of cardiac life support skills training

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Psychomotor skills development through experiential learning has been shown to be an effective means of retaining skills and knowledge, both by action and practice, through the formative years of medical education through to internship. While skills performance may not be optimal during the training years, significant improvement occurs when opportunities are presented during the postgraduate years.[1] Basic life support including cardiac life support (CLS) is one of the many skills trainings in the medical curriculum.

WHO data published in 2020 shows 21.86 % i.e., 36,729 of all deaths in Malaysia were due to Coronary Heart Disease. Malaysia ranks 61 in the world with an age-adjusted mortality rate of 136.21 per 100,000 of the population. Apart from issues of health literacy and immediate access to health facilities, delay in initiation of CLS at the point of care, and transportation factors have been identified as areas of weakness in health delivery, in reducing preventable deaths due to coronary heart disease. Worldwide, there appears to be problems in effective delivery of CLS due to competency gaps and lack of formal training. Preparing health workers and the community in rendering effective and timely CLS are essential strategies. One center in a low-income country in Africa reported that only 18.4% of patients who had heart attacks received cardio-pulmonary resuscitation (CPR).[2]

Goal-oriented skills training in CLS and advanced basic life support need to be strengthened through programmed strategies at all levels in the health delivery system, including training of by-standers in communities and first responders. The aim of such CLS training is to develop sustained competencies in health care workers and the public.

In this issue of the IeJSME (Aug 2022) Thiruchelvi S. & Shahid Hassan, studied the impact of a cardiac life support course among 37 final year medical students at the International Medical University. The authors lament that though the skills training was effective when pre- and post-test evaluation were done, there was a need to re-strategize the learning methods, as 'decay' in knowledge was noted at the end of 6 months. The mandatory course in CLS, based on the American Heart Association Manual, adopts several strategies in its delivery, which include access to learning materials in the Learning Management System of the university, and formal conduct of the course prior to evaluation. The subjects were tasked to complete four stations i.e., airway devices, chest decompression, drugs and their delivery and mega-code hands-on training on human-patient simulators. Additionally, practice sessions on ECG interpretation for cardiac emergencies were included in the contents. Repeated measures of competencies showed a decline in knowledge, when evaluated at the end of six months. The authors of this paper have therefore suggested various strategies to improve the current training focusing on reinforcing memory and re-training. Similar findings among both undergraduate medicals students and postgraduates have been reported by others.[3-5]

Identifying gaps in training

Incorporating CLS training into the medical curriculum has been one of the strategies adopted by medical schools, worldwide. Clearly, the development of learning materials and its delivery

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to undergraduates contents are not issues to contend with. However, educators would like to see the impact of such training in authentic clinical situations; the 'return on investment' must be realized. The decline in knowledge and skills over time is of concern, as any form of skills training focuses on mastery and eventual readiness of the trainee for clinical practice. The problems of decline in knowledge and skills will need to be addressed employing effective strategies based on identification of the problems, to sustain the skills over long periods of time. Most certified courses in CLS require re-training every two years; the basis of the time period is difficult to justify if the root cause of the decline in knowledge and competencies are not critically evaluated.

Timing of the course within the medical curriculum is a point in contention. Junior students would need to be initiated in CLS as early as possible, as current strategies in basic life support extend to first aid basic life support (BLS) for by-standers and the community at large. Senior students could be incrementally exposed to hybrid learning to sustain clinical performance, as they mature and gain experience in clinical instructions. "Low-dose-spaced high frequency cardiac resuscitation' and high-fidelity simulation training has been suggested as a means to check the decline in knowledge over time. Additionally, other measures like short- duration-distributed CLS training have been suggested. While these options in conduct and delivery of learning are laudable, one needs to re-look at the reasons for decline of desired knowledge (and skills), rather than suggest alternative content delivery teaching methods.

Experiential and reflective learning cycles, shown in the Kolb's' learning theory,[6] clearly shows the importance of contextual learning, ensuring learners are seen to reflect on their learning to ensure sustenance of competencies in CLS and related skills training. While learning the fundamentals of cardio-pulmonary resuscitation and basic life-support in clinical skills lab and on e-learning platforms (learning management systems) are essential, contextual learning is required in current adult learning methods.

Vertical and horizontal integrated curriculum

In relation to timing of delivery of the CLS and other skills training in the medical curriculum, one needs to review the spiral MBBS curriculum and incorporate the value of vertical and horizontal integration of curriculum contents.[7] Extending this concept to CLS, low dose-spaced learning through the spiral curriculum will support meaningful learning. Horizontal integration in linking the fundamental principles of situational learning, as students rotate through the critical clinical areas, provides opportunities for application of principles of CLS and re-visits in real clinical environment (e.g., Emergency Department, Coronary Care Units) to appreciate the value of CLS and related skills. We are reminded of the vertical integration of clinical and basic science components throughout the five-year MBBS program. If the design of the course followed adult learning principles, vertical integration will ensure that the skills training course will relate to motivation and engagement by learners, at various stages of the program. A continuum of education will be seen with proper design of the course, as the student's transit through pre-clinical to clinical years to internship and beyond. Impact of skills training and medical education should extend to professional

identity formation and application of learnt principles in real situations, as students mature, engage, and participate in clinical situations (situated learning) when opportunities for learning arise outside the skills labs. Wijnen-Meijer, M., et al[7] summarise the concept of vertical integration in evaluating the 'outcome-based' curriculum as integral to professional education as 'knowledge-based engagement in practice with graduated responsibilities in patient care' will meet intended objectives of the training.

Evaluating the design and development of skills training courses

In evaluating the design and development of skills courses like CLS, three components need to be addressed:

i. The audience and conditions for learning
ii. Applying 'Instructional Design' principles
iii. Evaluating the final product after implementation

Incorporation of skills training, which includes cognition and affective domains, need to be evaluated in a systematic way employing time-tested approaches like the ADDIE model.[8] The ADDIE framework, a popular model among others, is used in 'Instructional Design' of instructional courses. It adopts a sequential approach, though not necessarily linear. Thiruchelvi S and Shahid Hassan and other researchers,[3-5] who lament on the predictable decline in knowledge and skills over time, make little reference to 'analysing the situation (CLS course) and reviewing the conditions of learning, before customizing a course that will be engaging and motivate learners to meet the intended goals i.e., to be competent in applying the skills in the clinical context of cardiac resuscitation.

Adopting available course materials, designed, and developed elsewhere, without considering the current learners' capacity and learning needs (audience) may be reasons for not meeting the objectives of the course completely. The focus of the 'analysis' phase in the ADDIE model, is to explore what the student already knows (prior knowledge) and what is to be learned (learning objectives) at the end of the course. The training course constructors are better placed if they determined the audience and conditions of learning before implementing the training program.

The design of the course needs to be thoroughly thought-through, with feedback from learners and peers, to pitch the course objectives to the level of maturity and experience of the learner. The aim of training is aligned to the scope and depth of the curriculum, as the BLS is for undergraduates, who will re-visit the skills at a later stage of their training. The design stage in ADDIE focuses on learning objectives, and learning materials, which should be analysed prior to incorporation into the course. A lesson plan should be developed with sufficient formative assessment tools at all stages of the course. The design and development of the course are two distinct steps in good models (of ADDIE) which require good planning. Andragogic principles of adult learning will need to be incorporated in the development of the course, as adult learners come with a background of prior knowledge, own experience and have differing learning styles.

The constructors of the CLS course will review the format and plan of the course, as it needs to reflect on the concepts that are to be learned in meeting the learning objectives. The 'audience' or learner is the focus of the design and development of this phase of

ADDIE - it must be aligned to the curriculum and be acceptable to the audience to produce meaningful learning. Engaging Instructional Designers is helpful, as media and presentation of learning materials need to be appealing to meet the functional criteria of a good course, especially when delivered as a blended or entirely on-line asynchronous mode. Most educators are encouraged to develop a prototype of the course, which then undergoes quality check based on feedback from all stakeholders. Testing and re-testing the course material based on timely feedback, will lend to quality assurance. If the analysis and design phases were developed well, the development phase will be well streamlined with the storyboard. The planning would also include the method of delivery of the course that best fits learner's learning style and needs. This could be traditional face to face for practical sessions, supplemented by blended learning employing on-line learning taken at the learners' own time and pace, in line with adult learning preferences.

The delivery of the completed skills training course will consider these aspects of learning before a decision is made about delivery methods. This could be face to face for practical skills with portions of the course being better delivered in a blended asynchronous method.

Evaluation of skills training course

Although statistical methods have been often used to determine criterion for passing, mastery learning is encouraged in skills development. Formative assessment with progressive learning requires thoughtful input from course constructors based on feedback from learners. Evaluating the course continuously has advantages for both trainers and learners for improvement in the design and development of the course. The Kirkpatrick model is a common framework for evaluation of training.[9]

The four levels of evaluation in the Kirkpatrick framework i.e., reaction, learning, behavior, and results, can be comprehensively employed to evaluate all aspects of training. Leaners can reflect on the learning materials and teaching styles in an objective way (reaction). Learning reflects on the degree the subjects acquire knowledge, skills and attitude based on learning outcomes. It should also reflect on engagement and commitment in extending their learning to contextual learning. Assessing the third level of behavior requires long term observation using tools like case encounters and portfolio of real cases seen in the clinical context. All courses have objectives in determining if learners have achieved the learning objectives. This should be the basis of the first three levels in assessment.

The fourth level is an overall assessment of the impact of the skills training which reflects on 'return on investment'. A more comprehensive assessment tool is required to assess all aspects of the course apart from staff requirement and learning materials. The Kirkpatrick's model of assessment is time consuming, especially the fourth level.[9] However, it is worthwhile, as skills training are dynamic and investments are high. Evaluating the 'results' of training has huge implications. Business models of training include a fifth level, rightfully so i.e., ROI-return on investment!

Conclusion

Long term retention of learning appears to be reduced after CLS and skills development courses in medical

education curricula. Using criterion references in evaluating competence in skills development would not be sufficient a measure in determining impact of such courses. The return on investment and being 'industry-ready' are two elements not factored in evaluating such courses. It is necessary for educationists to adopt instructional design steps in construct of skills training courses based on andragogy and design and development of such courses. Mastery training requires appropriate formative assessment tools. Feedback from learners, as the course is being designed and developed, will ensure quality products that lend to meaningful learning. Educational courses need to be evaluated based on well-developed frameworks like the Kirkpatrick's model.

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