WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care

Worksheet author(s)

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Clinical question.

In ALS/ PALS providers (P), are there any specific training interventions (eg. duration of session, interactive computer programmes/e-learning, video self-instruction etc) (I) compared with traditional lecture/practice sessions (C) that increase outcomes (eg. skill aquisition and retention) (O)? (Have excluded leadership skills, and high fidelity simulation as these are addressed in other worksheets)

Is this question addressing an intervention/therapy, prognosis or diagnosis? Intervention (but for education)
State if this is a proposed new topic or revision of existing worksheet: New topic

Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

Search strategy (including electronic databases searched).

Bhanji search strategy

PUBMED search on Nov 2nd 2009

Cardiopulmonary Resuscitation (MeSH term) AND Education (MeSH term)

EMBASE search on Nov 2nd 2009 (EMBASE classic + EMBASE – reflecting all publications in EMBASE from 1947 to Oct 30th 2009)

Resuscitation (keyword) AND Education (keyword)

AHA Master Library of June 2007 – searched for keyword 'education'.

Bibliographies of significant articles were manually searched for potentially useful articles that were not identified through the primary search strategy.

Alternate search strategy:

An alternate search strategy was initially proposed and conducted prior to the feedback of the Evidence Evaluation Experts. It was performed in PUBMED on Oct 1st 2008 using the following search strategy:

(Advanced Life Support OR Pediatric Advanced Life Support OR Paediatric Advanced Life Support) AND (Education OR training OR retention)

1902 articles were found and screened in the manner described above – several of the articles found were not reflected in the final formal search.

Barelli search strategy

Pubmed: search "Cardiopulmonary resuscitation" [Mesh] AND "Education" [Mesh]
Cochrane: search "Cardiopulmonary resuscitation" [Mesh] AND "Education" [Mesh]
Embase: search "Resuscitation" as Subject heading AND "Education" as Subject heading

• State inclusion and exclusion criteria

Bhanji

Inclusion of all comparison studies looking at the conventional versus alternate forms of instruction (e.g. video-assisted, computer-assisted instruction, etc) in Advanced Life Support education (including Trauma). Review articles related to Advanced Life Support education were analyzed for potentially useful research articles that were not identified using the primary search strategy (or through the references of the 'included articles').

Studies focused on simulation based instruction and refreshers to advanced life support courses were excluded as these topics will be covered in alternate EIT ILCOR worksheets. Studies comparing two different refresher strategies that subsequently compared learning/retention were not withdrawn.

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Inclusion criteria were:

Papers dealing with adult training and education in courses dealing with adult and pediatric emergencies

Papers assessing candidates knowledge/skill acquisition and retention

Result: 93 Hits

Exclusion criteria were:

1 - Papers assessing knowledge/skill acquisition and retention not related to any specific training intervention

2 - Papers not comparing traditional and innovative training interventions

3 - Reviews (not trial) or comments about papers

4 - Not ALS nor PALS courses

Result: 86 Hits

• **Number of articles/sources meeting criteria for further review:**

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1021 'hits' of potentially useful articles through PUBMED

356 'hits' of potentially useful articles through EMBASE

1048 'hits' using keyword of 'education' in AHA library

Identified 1 further article, not identified in initial search strategy

Summary of evidence

Evidence Supporting Clinical Question

Good	**Schwid, 1999 E** computer vs. textbook		**Perkins, 2008 E** 'old' vs. 'new' guidelines		**Ali, 2002 E** effect of actual experience on retention
Fair			**Farah, 2007 E** surprise resuscitation drills – change in performance over time		
Poor		**Herrin, 1980 E** modular vs. 'traditional' course			
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation   C = Survival to hospital discharge   E = Other endpoint
B = Survival of event   D = Intact neurological survival   *Italics = Animal studies*

Evidence Neutral to Clinical question

Good		**Christenson, 1998 E** multimedia vs. standard training			
Fair	**Kim, 2002 E** studied computer based instruction to text based instruction **Su, 2000 E** mock code and/or written test refresher vs. control group **Weeks, 2008 E** video based vs. traditional refresher course	**Gerard, 2006 E** compared combine multi-media + on-site skills testing to traditional training **Miotto, 2008 E** live actors vs. traditional course			
Poor			**Polglase, 1989 E** PBL vs. Conventional		
	1	**2**	**3**	**4**	**5**
	Level of evidence				

A = Return of spontaneous circulation   C = Survival to hospital discharge   E = Other endpoint
B = Survival of event   D = Intact neurological survival   *Italics = Animal studies*

Evidence Opposing Clinical Question

Good					
Fair					
Poor					
	1	**2**	**3**	**4**	**5**
	Level of evidence				

A = Return of spontaneous circulation   C = Survival to hospital discharge   E = Other endpoint
B = Survival of event   D = Intact neurological survival   *Italics = Animal studies*

REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

There is limited evidence available on specific interventions that may enhance learning and retention from Advanced Life Support courses. The literature suggests that computer based simulation is at least as effective as text-based learning. One LOE I study of good quality (Schwid, 1999 821) compared computer-based simulation refreshers following an advanced life support course to printed material and found significantly improved performance on a Mega-code test for the computer simulation group. In one further LOE 1 study of fair quality (Kim, 2002, 395) text-based learning and a computer-based learning of arrhythmias produced similar learning outcomes. In this study the immediate learning outcomes favoured the textbook method of instruction but this difference was not apparent at one week after the training (this could have been a type II error as the mean score of the textbook group was higher but not statistically significantly different). It is important to note that the 'one size fits all' approach to resuscitation instruction may actually not be appropriate as experience may play an important role in knowledge and skills retention, at least for trauma resuscitation (Ali, 2002, 142).

One LOE 2 study comparing multi-media instruction to a standard advanced life support course, in final year medical students, did not demonstrate better results in acquisition of knowledge or skills for the multi-media program (Christenson, 1998, 702). The standard course learners actually scored slightly higher on the video-taped mock-code evaluations (14.4 compared to 13.1 out of 20) but the authors did not believe this was educationally relevant. 47% of the mock code group required multiple attempts to pass the mock code while this was true for only 24% of the standard group.

One LOE 3 study demonstrated that the simplification of the treatment algorithms in 2005 (Perkins, 2008, 69) has helped improve compression rate but not overcome all of the 'educational barriers' to allow providers to successfully perform quality CPR.

One LOE 2 study using live actors in simulation stations, compared to standard manikins, during an advanced life support course did not result in any significant improvement of knowledge retention (Miotto, 2008, 76).

Finally, one LOE 1 study comparing results of retraining via either videoconferencing or through traditional refresher courses (Weeks, 2008, 109) did not demonstrate any difference in knowledge or skill retention. Generalization from this study may be somewhat limited as there was a loss to follow-up of 21 out of 73 subjects.

Given the clear evidence that advanced life support skills deteriorate over time, along with the 'well accepted principle' that the quality of resuscitation does affect patient outcome, further research into the optimization of learning and retention of knowledge/skills is needed.

Acknowledgements:

Citation List

Ali J, Howard M, Williams J. Is attrition of advanced trauma life support acquired skills affected by trauma patient volume? *Am J Surg*. 2002;**183**:142-145.

- Study of ATLS retention of knowledge retention (MCQ) + performance on an OSCE
- Also looked at 'organized approach' and 'adherence to priorities'
- Compared high volume to low volume trauma physicians
- Found that high volume trauma physicians outperformed low volume physicians on the knowledge test (MCQ) and OSCE 2 years or greater after taking the ATLS course (not in the initial or 6 month post course evaluations).
- Both groups did show decline in MCQ scores and OSCE but the change was greater for the low trauma volume physicians

- No difference in 'organized approach' and 'adherence to priorities'
- LOE 5 (not directly cardiac life support but a very closely related field), quality *good*
- Supports (i.e. Trauma volume affects knowledge and skills retention)

Christenson J, Parrish K, Barabe S, et al. A comparison of multimedia and standard advanced cardiac life support learning. *Acad Emerg Med*. 1998;**5**:702-708.

- Convenience (non-randomized) study of multi-media (2/3 of subjects) vs. standard course (1/3 of subjects) in final year medical students (n=113).
- Learners evaluated by MCQ test, on-site mock arrest and a video tape of the mock arrest sent to a blinded evaluator
- Both groups performed equally well on MCQ exam and on-site mock arrest evaluation. The scores of the video-taped were 13.1 (out of 20) for the multimedia vs. 14.4 (out of 20) for the standard course – authors did not view this as educationally relevant (<10% difference).
- 47% of multimedia students vs. 24% of standard students required multiple attempts to pass the mock arrest.
- LOE 2. Graded as 'good'
- Evidence neutral (at best equivalent but does not favour computer assisted learning)

Farah R, Stiner E, Zohar Z, Zveibil F, Eisenman A. Cardiopulmonary resuscitation surprise drills for assessing, improving and maintaining cardiopulmonary resuscitation skills of hospital personnel. *Eur J Emerg Med*. 2007;**14**:332-336.

- Studied change in performance in resuscitation drills over time (2003-2005) with a surprise drills program
- Unclear how many surprise drills in each department (total of 131 surprise skills in 30 clinical departments)
- Significant improvements found in resuscitation parameters (mixed BLS and ALS skills)
- LOE 3. Graded as 'fair' for question. Favours intervention

Gerard JM, Scalzo AJ, Laffey SP, Sinks G, Fendya D, Seratti P. Evaluation of a novel Web-based pediatric advanced life support course. *Arch Pediatr Adolesc Med*. 2006;**160**:649-655.

- Compared a combined web-based (1 day) + on-site skills/testing (1 day) course to their traditional Pediatric Advanced Life Support course (a 3 day course which included cardiorespiratory support combined with trauma life support and surgical, neurosurgical and toxicologic emergencies).
- Subjects were not randomized and 2 subjects in the web-based course were not included in the data analysis (1 did not fill out data on self-confidence correctly and the other did not complete web-based modules but was inadvertently allowed into the on-site component of the course).
- Although not statistically significant a higher percentage in the web-based course had taken previous PALS courses (73% vs. 57%)
- Students of the web-based course scored slightly lower than traditional course students on the written test (95.4% vs. 97.1%) but all students passed the written exam on the first attempt
- Videotape recordings of the subjects performing various skills (rapid cardiopulmonary assessment, bag-valve mask ventilation, intubation, intraosseous needle insertion and rhythm assessment/defibrillation) were reviewed by expert blinded reviewers.
- Mean overall scores were similar between web-based course students (75%) and traditional course students (73%)

- LOE 2. Graded as 'fair' as there was no attempt to compare performance of subjects in 'full mock codes' rather they only assessed procedural skills. Neutral to question.

Herrin TJ, Norman PF, Hill C, Crosby R. Modular approach to CPR training. *South Med J*. 1980;**73**:742-744.

- Compared a modular self-teaching ACLS course to the traditional course at that time (poorly described in the paper)
- Students in the modular group were more likely to pass the course (appears to be 85-96% versus 74% on the 'postgraduate course') with an average instructor to student time of 2 to 2.5 hours versus 9.4 hours. Written exam scores were comparable (93% for modular vs. 92% for usual course).
- LOE 2. Graded as 'poor' to current question. Unclear if comparison group was equivalent to 'treatment' group. Current ACLS teaching is modular so the results of this study cannot be applied to the current training context. Favours modular course.

Kim JH, Kim WO, Min KT, Yang JY, Nam YT. Learning by computer simulation does not lead to better test performance than textbook study in the diagnosis and treatment of dysrhythmias. *J Clin Anesth*. 2002;**14**:395-400.

- Compared learning from a computer assisted program to text-based learning in medical students.
- 57 total subjects randomized into the two groups.
- Identical training times for each group (150 min)
- Computer based learning of arrhythmias was similar to learning from a traditional textbook based on a 20 question multiple choice test. Groups were similar in knowledge at baseline but initial post-course testing favoured the textbook format with one week post-course training showing similar results between the two groups (may have been a slight advantage of textbook group with a type II error - mean score for textbook 11.1 (+/- 2.4) and for computer based instruction 9.9 (+/- 2.5))
- LOE 1. Graded as 'fair'. Neutral to question

Miotto HC, Couto BR, Goulart EM, Amaral CF, Moreira Mda C. Advanced Cardiac Life Support Courses: live actors do not improve training results compared with conventional manikins. *Resuscitation*. 2008;**76**:244-248.

- Compared retention of knowledge (based on an MCQ test) to determine if subjects learning with a live actor (but invasive maneuvers done on manikins) were equivalent to subjects learning with a conventional manikin. Tested pre, post and 6 months following ACLS course.
- Very large drop out (follow-up of 225 out of 435 subjects)
- Groups found to be equivalent in terms of knowledge retention
- LOE 2 (seems like they were randomized by ACLS course not individual, although I am not certain and it could potentially be a LOE 1 i.e. randomized by individual). Graded as 'fair' as the method of evaluation is not congruent with factors felt to be important to resuscitation (MCQs assess knowledge and can assess theoretical application but not actual performance which is the outcome of concern). Neutral to question

Perkins GD, Boyle W, Bridgestock H, et al. Quality of CPR during advanced resuscitation training. *Resuscitation*. 2008;**77**:69-74.

- Studied compared performance of ALS before and after implementation of the 2005 guidelines (greater emphasis on compressions – with change of compression to ventilation ratio from 15:2 to 30:2 and change from 3 stacked shocks for defibrillation to single shocks).
- Groups similar at baseline

- Studied 94 simulations (46 before 2005 guidelines and 48 after changes made)
- Although the post 2005 group provided more chest compressions - 103 compressions/min vs. 75 compressions/min - (and less 'no flow' time) the quality of compressions was no different (majority too shallow)
- Post 2005 group still had major delays in initiating CPR and defibrillation, as well as interruptions to CPR.
- The pre-shock pause for ventricular fibrillation was longer in the 'Guidelines 2000' group (statistically significant) and time to defibrillation trended longer (2.1 vs. 1.6 min; $p=0.06$) but was not statistically significant
- LOE 3. Graded as 'good'. Evidence favours Guidelines 2005

Polglase RF, Parish DC, Buckley RL, Smith RW, Joiner TA. Problem-based ACLS instruction: a model approach for undergraduate emergency medical education. *Ann Emerg Med*. 1989;**18**:997-1000.

- PBL group was not comparable to standard care group in that they were more junior students (2nd year vs. senior medical students, interns and residents), their course had clearly defined objectives and that the course was longitudinal not 'massed' instruction.
- The ACLS course at that time was described as lecture-based so the findings of this study are likely not transferable to the current era
- Does not appear to be any attempt to blind observers
- High drop-out rate in 'treatment' group (3 out of 14 subjects)
- Seems the 'treatment' group had more hours (29 hours) of instruction than the conventional group (16 hours).
- Not analyzed statistically: PBL group had comparable written scores to senior medical students (86.8 vs. 82.9%) but had significantly higher megacode pass rates (90.9% vs. 50%) and overall course pass rates (100% vs. 61.1%)
- LOE 3. Graded as 'poor' in relation to current research question. Difficult to make conclusions as in is unclear which factor improved performance – longer preparation time? Longitudinal training? PBL? Use of objectives to define learning? Lack of blinded evaluators? etc. Will report as neutral to question as it can not be applied to today's 'standard' of highly interactive ALS courses.

Schwid, H. A., G. A. Rooke, et al. (1999). "Use of a computerized advanced cardiac life support simulator improves retention of advanced cardiac life support guidelines better than a textbook review." Crit Care Med **27**(4): 821-4.

- Compared performance of subjects receiving an ACLS refresher program via a printed material to those undertaking the ACLS simulator (computer based simulation).
- Refreshers were provided 1-2 months prior to a Mega-Code test (performed 10-11 months following the initial ACLS course)
- Subjects were free to use as much time as they required to review material.
- Mega-Codes were video-recorded prior to being evaluated by two ACLS certified instructors using a 47 single-point item score (validation of scale not provided in study). Evaluators were blinded to intervention group.
- Groups were similar at baseline based on residency clinical skills ratings. Small sample size (total of 45 subjects)
- ACLS simulator group performed better on Mega Code test (34.9 +/- 5.0 vs. 29.2 +/- 4.9 $p<0.001$). 58/69 in ACLS simulator group passed the test compared to 35/66 for the textbook group.

- LOE 1. Graded as 'good' quality. Favours use of computer based simulation to promote retention of skills.

Su E, Schmidt TA, Mann NC, Zechnich AD. A randomized controlled trial to assess decay in acquired knowledge among paramedics completing a pediatric resuscitation course. *Acad Emerg Med*. 2000;**7**:779-786.

- Randomized controlled trial (factorial design) assessing the impact of a knowledge exam, mock resuscitation (2 cases), both or neither (at 6 months) on the long term retention (12 months) of knowledge retention of paramedics in the Oregon Pediatric Prehospital Critical Care (OPC) course (meeting requirements of PALS certification).
- Small number of subjects (45 subjects with 2 lost to follow-up)
- Did not use intention to treat analysis in study design but do comment that results were not different on an intention to treat analysis (4 patients 're-randomized' when they did not come to complete f/u exam at appropriate time)
- Significant reduction in 12 month knowledge scores towards pre-course levels irrespective of which group subjects were randomized to. No significant difference between treatment groups.
- LOE 1. Graded as 'fair' as they assessed knowledge rather than a performance measure of retention. Neutral to question.
- May be removable from worksheet – discuss at New Orleans presentation

Weeks DL, Molsberry DM. Pediatric advanced life support re-training by videoconferencing compared to face-to-face instruction: A planned non-inferiority trial. *Resuscitation*. 2008;**79**:109-117.

- A non-inferiority Randomized Controlled Trial that studied whether live videoconferencing could perform as well as a traditional course in retraining of PALS knowledge and skills.
- Outcomes were assessed at the conclusion of the course and 1 year following training
- Significant loss to follow-up of 21 out of 73 subjects
- Significant decrease in knowledge and skills from immediate post-test 1 year follow-up.
- No difference in performance immediately or one year after follow-up in the traditional vs. the videoconferencing groups.
- LOE 1. Graded as 'fair'. Neutral to question