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

Worksheet author(s)

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Clinical question.

EIT-011B - In ALS and PALS providers (P), are any specific intervals for update/retraining (I) compared with standard practice (ie. 12 or 24 monthly) (C) that increase outcomes (eg. skill aquisition and retention) (O)?

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

Conflict of interest specific to this question

None

Search strategy (including electronic databases searched).

Medline Keyword: ""advanced life support.mp. or exp Advanced Cardiac Life Support" OR "exp Advanced Cardiac Life Support or pediatric advanced life support.mp."" AND ""learn$.mp." OR "educat$.mp."" AND ""reten$.mp." OR "memor$.mp." OR "interval.mp." OR "skill acquisition.mp.""(36)
CINAHL Keyword: "Advanced Life Support" AND "learn" (11)
Keyword: "Advanced Life Support" AND "retention" (25)
Cochrane Keyword: "Advanced Life Support in **Title, Abstract or Keywords" AND "learn** in **Title, Abstract or Keywords"** in **Cochrane Central Register of Controlled Trials (19)**
Keyword: "Advanced Life Support in **Title, Abstract or Keywords" AND "retention** in **Title, Abstract or Keywords"** in **Cochrane Central Register of Controlled Trials (8)**
PudMed Keyword: "skill retention" AND "advanced life support" (14)
Searched 2010, Jan. 24

• State inclusion and exclusion criteria

Articles fulfilling above criteria with acceptable design and relevance to our clinical question were included. The following studies were excluded: review articles, trauma, abstract only studies, non-peer reviewed articles, and studies which did not directly answer the question (not relevant).

• Number of articles/sources meeting criteria for further review: 19 articles were under final review.

Summary of evidence

Evidence Supporting Clinical Question

Good				**Makker 1999 E**	
Fair	**Su 2000E(P)**			**Cooper 2007 E Curry 1987 E Gass 1983 E Kazcorowski, 1998E(P) Jensen, 2009E Lin 2000 E(P) O'Steen 1996 E Semerano 2003 E Smith 2008 E Stross 1983E Weeks 2008E(P)**	
Poor				**Young 2000 E**	
	1	**2**	**3**	**4**	**5**
Level of evidence					

A = Return of spontaneous circulation C = Survival to hospital discharge E = Other endpoint P=Pediatric

B = Survival of event D = Intact neurological survival *Italics = Animal studies*

Evidence Neutral to Clinical question

Good					
Fair				**Hammond 2000E Miotto 2008 E Schwid 1999 E Wayne 2006 E Wolfram 2003E (P)**	
Poor					
	1	**2**	**3**	**4**	**5**
Level of evidence					

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

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

For ALS/PALS providers to function effectively, knowledge and skills retention after training, and the ability to perform at emergencies are essential. Despite importance of scientific, educational and logistic implications of intervals of updates and retraining on the knowledge and skill retention, there were not many studies focusing on the issues. Most of the studies addressed adult advanced life support, and few examined pediatric training.

The studies reviewed varied widely with regard to the following areas:
1) Knowledge vs. skill retention as the target of assessment;
2) Intervals of knowledge and skill retention assessed;
3) Different levels of providers (physicians, nurses, paramedics) studied; and
4) Impacts of different education / training interventions on retention intervals.

For ALS providers, if no interventions were given, knowledge and skills deteriorated before the current recommended time for refresher course. Knowledge and skills deteriorated at different pace post initial training. Skills appear to decline at a faster rate than knowledge. Evidence showed that ALS providers were able to retain knowledge 6-12 months after training, but skills generally deteriorated by 6 months after training.

For ACLS providers :
#1 (Cooper 2007) A LOE 4 study examined the effect of ILS (Immediate Life Support) on retention of knowledge and skills of BLS, airway management, and defibrillation. Knowledge did not decline significantly by 6 months, but skills did via ILS course.

#2 (Curry 1987) A LOE4 cohort study determined the rate of deterioration of knowledge and skills in cardiopulmonary resuscitation (CPR) among physicians and nurses at 6 and 12 months after training. Skills deteriorated among physicians and nurses at 6 months. Knowledge deteriorated for physicians at 6 months, but retained for nurses at 12 months.

#3 (Gass 1983). A LOE 4 before-after study (Physicians and nurses in a community hospital) that assessed the knowledge and skill retention after CPR training. The assessment tool was perceptions of their knowledge of and skill in CPR. By 12 months after training the scores in both groups were similar to the pretraining scores.

#4 (Hammond 2000). A LOE 4 study on knowledge remained at an equivalent level over the 18 month timeframe. However, 18 months after successfully completing an ALS course, only 75 per cent (n = 30) of participants passed the practical skill assessment components, with the 25 per cent (n = 10) requiring a second attempt to pass.

#5 (Jensen 2009). A LOE 4 prospective single blinded randomized controlled study to determine whether half a year of clinical experience before participation in an Advanced Life Support (ALS) course increases the immediate learning outcome and retention of learning. The main outcome measurement was a composite MCQ- and CASTest score. Either intervention (82%) or control group (78%) declined in skills and knowledge in six months.

#6 (Makker 1995) A LOE 4 observational study to assess residents' CPR error after completing ACLS. The error rates during actual CPR for 180 cardiac arrests directed by physicians increased from 5.1% at 6 months to 21.6% at 12 months. However, there was no impact on actual survival rate.

#7 (Miotto 2008) A LOE 4 study examined whether adding live actor to increase the reality of the scenario improves knowledge retention in Advanced Cardiac Life Support (ACLS) Courses. The results showed that live actors made no difference in performance, and both physicians and nurses were able to retain knowledge at 6 month.

#8 (O'Steen 1996). A LOE 4 case series to assess the retention of ACLS of registered nurses over time. Assessment tools were written examination and mega code scenario. Knowledge and written score decays and need refreshing 6-12 months.

#9 (Schwid 1999) A LOE4 randomized, controlled study on 45 anesthesia residents and faculty to determine whether an advanced cardiac life support (ACLS) computer simulation program improves retention of ACLS guidelines more effectively than textbook review 10 to 11 months later. It was found that a a refresher course after 10-11 months using computerized simulation program improves retention than textbook review. There is no report of baseline skill retention.

#10 (Semerano 2006). A LOE4 case series to examine the retention of ALS knowledge and skills among 47 anesthesiologists (23 consultants and 24 residents). Compared to the results at the end of the ALS course, there was significant decay of both knowledge and skills at 6 months.

#11 (Smith 2008) A LOE 4 using repeated-measure, quasi-experimental design to examine nurses' retention of BLS and ACLS knowledge and skills evaluated 3, 6, 9, or 12 months. Nurses could retain BLS skills up to 6 months, but ACLS skills deteriorated rapidly at 3 months. Only 30% passed ACLS skills at 3 months and 14% at 12 months.

#12 (Stross 1983) A LOE 4 study compared the effect of providing reinforcement (quarterly mailed reprints vs. patient treatment problems), on the knowledge and skills retention 12 months after ACLS. For the control group, knowledge retention was about ½ and skills retention 1/3 one year after ACLS. Compared to controls, providers with reinforcement after continuing medical education may enhance knowledge retention, but does not maintain motor skills at one year.

#13 (Wayne 2006)A LOE 4 study examined if adding four 2-hour simulation-based training improve skills retention among internal medicine residents at 6-months and 14 months after traditional ACLS. The results showed that a training program using a medical simulator, small-group teaching and deliberate practice helps internal medicine residents maintain skills for 14 months. However, there was no comparison group without these interventions.

#14 (Young 2000). A LOE 4 study that identified modest increase in ALS theoretical knowledge and a decrease in practical skill performance between 6 and 12 weeks.

For PALS providers:

#15 (Lin 2000) A LOE 4 cohort before-after study (129 participant, 82 responders, 75 from medical center) to assess knowledge retention 1 year after PALS course. The participants receiving the 1-day PALS training showed a significant decline in their knowledge after 1 year.

#16 (Kaczorowski 1998) A LOE 4 study that evaluate retention of knowledge and skills following NRP training. Knowledge and skills deteriorate over time significantly (6-8 months). The retention of psychomotor skills is substantially lower than the retention of the NRP knowledge. Boostering by hands-on or video at 3-5 months do not seem to have an impact on the retention of knowledge or lifesaving skills.

#17 (Su 2000) A LOE 1 randomized controlled study to assess retention of knowledge after PALS course for 43 paramedics . Pediatric clinical knowledge (as measured by KE) rose sharply immediately after the course but returned to baseline levels within six months.

#18 (Weeks 2008) A LOE 4 study that examined the effect of videoconferencing vs. traditional instruction on knowledge and skills retention for PALS. No significant difference were detected among delivery methods for knowledge and psychomotor skill performance. Both groups showed a significant decline in knowledge and skill at 1 year.

#19 (Wolfram 2003) A LOE4 study showed that 25% of paramedics achieved a minimum passing score on a PALS retest at an average of 21months post initial training. Another 40% scored within one standard deviation below.

The retention of knowledge and skills for ACLS and PALS in previous studies is summarized in the following table:

	Target Population	**Intervention other than standard ACLS**	**Evaluation Methods**	**Knowledge Retention**	**Skills Retention**
Cooper 2007 Support	173 health care providers	Immediate Life Support Training	MCQs ILS skills tests	→ @ 6 mo	↓@ 6 mo
Curry 1987 Support	31 MDs 54 RNs	None (ACLS)	MCQs, ResusciAnne	MD↓@ 6 mo RN → @12 mo	MD ↓@ 6 mo RN ↓@ 6 mo
Gass 1983 Support	MDs & RNs	None (ACLS)	Skill test	↓@ 12 mo	↓@ 12 mo
Hammond 2000 Neurtral	40 RNs (critical care)	None (ALS)	Written test, Skill station	→ @ 18 mo	↓@ 18 mo
Jensen 2009 Support	117 newly graduated doctors	half year of clinical work before an ALS course	composite MCQ- and CASTest score	Around 80% in six months (composition of knowledge and skills)	Around 80% in six months (composition of knowledge and skills)
Makker 1995	225 Pts undergoing CPR	None (ACLS)	Treatment errors		Error rate 5.1%@

Support					6mo; 21.6%@ 12 mo
Miotto 2008 Neutral	225 health care providers	Live actors in ACLS courses	MCQs	→ @ 6 mo	N/A
O'steen 1996 Support	40 RNs	None (ACLS)	Written tests Mega code	↓@ 12 mo	↓@ 12 mo
Schwid 1999 Neutral	45 MDs (Anesthesia)	Computer simulation vs. textbook	Megacode		↓(29.2 out of 47 point)@ 10-11 mo
Semeraro 2006 Support	43 MD Anestesia	None (ALS)	MCQs Scenarios	↓@ 6 mo	↓@ 6 mo
Smith 2008 Support	133 RNs	None (ACLS)	ACLS scenarios with checklists	N/A	↓(30%)@3mo ↓(14%)@12mo
Stross 1983 Support	132 MDs	Quarterly mailed reprints vs. pt treatment problems	Mock arrests, Ventilation Compression	↓(1/2) @12 mo	↓(1 /3)@12mo
Wayne 2006 Neutral	38 MDs (residents)	Four 2-hour simulation	ACLS scenarios with check lists	N/A	→ @ 6 mo → @ 14mo
Young 2000 Support	10 RN	None (ALS)	Skills	→ @ 4 mo	↓@ 4 mo
	Target Population	**Intervention other than standard PALS**	**Evaluation Methods**	**Knowledge Retention**	**Skills Retention**
Lin 2000 Support	129 health care providers	None (PALS)	Written test	↓@ 12 mo	
Kaczorowski 1998 Support	10 family practice residents	"booster" course by video *vs.* hands on *vs.* control after NRP	NRP written test, performance checklists	↓@ 6-8 mo	↓@ 6-8 mo
Su 2000 Support	43 paramedics	Knowledge ex Mock Scenario	Knowledge exam	↓@ 6 mo	
Weeks 2008 Support	73 Health care providers	Videoconferencing	PALS written test, Skills checklists	↓@ 12 mo	↓@ 12 mo
Wolfram 2003 Neutral	99 Paramedics	None (PALS)	PALS written test	↓(25% passing rate) @ 21 mo	

Knowledge Gap:

1. What domains of knowledge and skills retention examined were not clarified in most studies
2. No studies were designed to examine the best intervals or strategies for refresher courses
3. What levels of knowledge / skill deterioration are tolerable before refresher course
4. Correlation between knowledge and skill competencies and patient survival is lacking.
5. The economy of shorter intervals for retraining has not been well calculated.
6. Modalities to increase knowledge / skill retention (clinical exposure, simulation, video learning) need to be addressed

Acknowledgements:

Citation List

#1 Cooper, 2007, 92. Immediate life support (ILS) training Impact in a primary care setting? Resuscitation (2007) 72, 92-99

LOE 4 (study using concurrent control without randomization), poor, supportive. Two group cohort before-after study (29 ILS vs 25 BLS) to examine the effect of ILS on retention of knowledge and skills. Assessment tool were standard ILS skill tests for BLS, airway management and defibrillation, and 12 item multiple choice questionnaire (MCQ) for knowledge. *Major weakness of study design: no blinding, and no withdrawal and drop-outs report. → Knowledge did not decline significantly by 6 months but skills did via ILS course.*

#2 Curry, 1987, 137. Effects of training in cardiopulmonary resuscitation on competence and patient outcome. CMAJ (1987) 137: 491-496.

LOE 4, poor, supportive. One group cohort before-after study (2 nonteaching hospital, 31 physicians and 54 nurses, pre-test, post-test, 6 months later, and 12 months later) to determine the rate of deterioration of knowledge and skills in cardiopulmonary resuscitation (CPR) among physicians and nurses. Assessment tools were100MCQs for knowledge and ResusciAnne for skills. Major weakness of study design: no blinding, and no withdrawal and drop-outs report. → Skills deteriorated among physicians and nurses at 6 months. Knowledge deteriorated for physicians at 6 months, but retained for nurses at 12 months.

#3 Gass, 1983, 550. Physicians' and nurses' retention of knowledge and skill after training in cardiopulmonary resuscitation. Canadian Medical Association Journal. 128(5):550-1, 1983 Mar 1.

LOE 4, supportive. One group cohort before-after study (Physicians and nurses in a community hospital) to assess the knowledge and skill retention after CPR training. The assessment tool was perceptions of their knowledge of and skill in CPR. → By 12 months after training the scores in both groups were similar to the pretraining scores.

#4 Hammond, 2000, 99. Advanced life support: retention of registered nurses' knowledge 18 months after initial training. Australian Critical Care. 13(3):99-104, 2000 Aug.

LOE 4, neutral. Participant's theoretical knowledge remained at an equivalent level over the 18 month timeframe. However, 18 months after successfully completing an ALS course, only 75 per cent (n = 30) of participants passed the practical skill assessment components, with the 25 per cent (n = 10) requiring a second attempt to pass.

#5 Kazcorowski,1998,705. Retention of neonatal resuscitation skills and knowledge: a randomized controlled trial. Family Medicine. 30(10):705-11, 1998 Nov-Dec.

LOE 4, fair, supportive. A randomized controlled study to evaluate retention of knowledge and skills following NRP training. → Knowledge and skills deteriorate over time significantly (6-8 months). The retention of psychomotor skills is substantially lower than the retention of the NRP knowledge. Boostering by hands-on or video at 3-5 months do not seem to have an impact on the retention of knowledge or lifesaving skills.

#6 Jensen, 2009, 238. The significance of clinical experience on learning outcome from resuscitation training—A randomised controlled study Resuscitation 80 (2009) 238–243.

LOE 4, fair, supportive. A prospective single blinded randomized controlled study to determine whether half a year of clinical experience before participation in an Advanced Life Support (ALS) course increases the immediate learning outcome and retention of learning. Either intervention (82%) or control group (78%) declined in skills and knowledge in six months.

#7 Lin, 2000, 205. The follow-up on the training course of pediatric advanced life support. Acta Paediatrica Taiwanica. 41(4):205-10, 2000 Jul-Aug.

LOE 4, fair, supportive. One group cohort before-after study (129 participant, 82 responders, 75 from medical center) to assess knowledge retention 1 year after PALS course. The major weakness were blinding and selection bias. → The participants receiving the 1-day PALS training showed a significant decline in their knowledge after 1 year.

#8 Makker, 1995, 116. Evaluation of advanced cardiac life support in a community teaching hospital by use of actual cardiac arrests. Heart & Lung. 24(2):116-20, 1995 Mar-Apr.

LOE 4,good, supportive. An observation study to assess residents' CPR error. Assessment tool was observation of record. The error rate in the first 6 months after ACLS completion among residents was 5.1%, as compared with 21.6% in the next 6 months, with no impact on actual survival rate. (P=0.033)

#9 Miotto, 2008, 244. Advanced Cardiac Life Support Courses: Live actors do not improve training results compared with conventional manikins. Resuscitation (2008) 76, 244-248

LOE 4, poor, neutral. RCT (N=225, 111 vs. 114) to determine whether using live actors to increase the reality of the scenario improves knowledge retention in Advanced Cardiac Life Support (ACLS) Courses. Assessment tool was 33 MCQs. Major weakness of study design: no blinding, and confounders (age and education). → Live actors made no difference in performance. MDs and RNs were able to retain knowledge at 6 month.

#10 O'Steen, 1996, 66. The retention of advanced cardiac life support knowledge among registered nurses." Journal of Nursing Staff Development. Journal of Nursing Staff Development. 12(2):66-72, 1996 Mar-Apr.

LOE 4, fair, supportive. A case series to assess the retention of ACLS of registered nurses over time. Assessment tools were written examination and mega code scenario. Major weakness of study design: no report of blinding and selection bias? (only less then half RN asked and then elected to participate). Knowledge and written score decays and need refreshing 6-12 months.

 # 11 Schwid, 1999, 821. Use of a computerized advanced cardiac life support simulator improves retention of advanced cardiac life support guidelines better than a textbook review. Critical Care Med 1999; 27(4): 821-824

LOE4, fair, neutral. Randomized, controlled *study (*Forty-five anesthesia residents and faculty tested 10 to 11 months later*) to* determine whether an advanced cardiac life support (ACLS) computer simulation program

improves retention of ACLS guidelines more effectively than textbook review. *Assessment tool was* performance on a standardized Mega Code examination with a written list of 47 single-point items. *Major weakness of study design: no report of confounders. → A refresher course after 10-11 months using computerized simulation program improves retention than textbook review.*

Or supportive?

#12 Semeraro, 2006, 101. Retention of CPR performance in anaesthetists. Resuscitation 68:101-108, 2006

LOE4, poor, supportive. A prospective study that examined the retention of ALS knowledge and skills among 47 anesthesiologists. Assessment Tools: Knowledge by MCQs, and skills by CAStest. Compared to the results at the end of the ALS course, there was significant decay of both knowledge and skills at 6 months.

#13 Smith, 2008, 59. Evaluation of staff's retention of ACLS and BLS skills. Resuscitation (2008) 78, 59-65

LOE 4, poor, supportive. One group cohort before-after study (133 RN, randomized to one of four groups for final testing (evaluated 3, 6, 9, or 12 months after training))to examine nurses' retention of BLS and ACLS knowledge and skills. Assessment tool was AHA BLS and ACLS checklists. Major weakness of study design: no blinding, and no withdrawal and drop-outs report. → Nurses could retain BLS skills up to 6 months, but ACLS skills deteriorated rapidly at 3 months. skills degrade: BLS 63% at 3 months and 58% at 12 months ACLS 30% at 3 months and 14% at 12 months.

#14 Stross, 1983, 3339. Maintaining competency in advanced cardiac life support skills. JAMA. 249(24):3339-41, 1983 Jun 24.

LOE 4, fair, supportive. RCT(132 physicians, 42 control, 45 group 1 (quarterly mailed reprints),45 group 2 (patient treatment problems), pre-test, post-test, knowledge (mock-arrest performance) and skills (ventilation and compression) 12 months later) to clarify the effect of providing reinforcement on the knowledge and skills retention. Assessment tools were mock-arrest performance for knowledge and ventilation and compression for skills. Major weakness of study design: no blinding. → Reinforcement after continuing medical education may enhance knowledge retention, but does not maintain motor skills. Control group: 1-year ventilation 33%, compression 40%, mock-arrest performance 52.3 ; Group1: 1-year ventilation 40%, compression 49%, mock-arrest performance 75.4 ; Group2: 1-year ventilation 44%, compression 51%, mock-arrest performance 81.9. (For control group, knowledge retention was about one-half and skills retention was about one-third 1 year after ACLS training.)

#15 Su, 2000, 779. A randomized controlled trial to assess decay in acquired knowledge among paramedics completing a pediatric resuscitation course. Academic Emergency Medicine. 7(7):779-86, 2000 Jul.

LOE 1, good, supportive. A randomized controlled study to assess retention of knowledge after PALS course. → Pediatric clinical knowledge (as measured by KE) rose sharply immediately after the course but returned to baseline levels within six months.

#16 Wayne, 2006, 9. A Longitudinal Study of Internal Medicine Residents' Retention of Advanced Cardiac Life Support Skills. Academic Medicine 81(10 Suppl):S9-S12, 2006 Oct.

LOE 4, poor, opposite. One group cohort before-after study (38 residents, traditional ACLS + 2 hours x 4 simulation (HPS) sessions, evaluated 6-month and 14-month later)to see if adding simulation-based training improve skills retention. Assessment tool was observational checklist. Major weakness of study design: no blinding, and no withdrawal and drop-outs report. →A training program using a medical simulator, small-group teaching and deliberate practice helps internal medicine residents maintain skills for 14 months.

Secondary training (after initial training) vs. initial training

#17 Weeks, 2008, 109. Pediatric advanced life support re-training by videoconferencing compared to face-to-face instruction: A planned non-inferiority trial. **Resuscitation (2008) 79, 109—117**

LOE4, fair, support. A prospective study that examined the effect of videoconferencing vs. traditional instruction on knowledge and skills retention for PALS. No significant difference was detected among delivery methods for knowledge and psychomotor skill performance. Both groups showed a significant decline in knowledge and skill at 1 year.

#18 Wolfram, 2003, 475. Retention of pediatric advanced life support (PALS) course concept. JEM 25(4):475-79, 2003

LOE4, fair, neutral. A case series to assess knowledge retention of 99 pediatric advanced life support for paramedics over an average of 21 months after last PALS. The assessment tool was 70-item MCQs nested from individual's previous PALS tests. Three-quarters of subjects failed to achieve a passing score on the retest. 65% scored a passing grade or within one standard deviation of passing at the retest. Level of clinical exposure to pediatric patients was low, and not relevant to retest scores. Major weakness of study design: Additional MCQs in retests infuenced the retest scores.

#19 Young, 2000, 7. An evaluation of knowledge and skill retention following an in-house advanced life support course. Nursing in Critical Care. 5(1):7-14, 2000 Jan-Feb.

LOE 4, poor, supportive. A modest increase in ALS theoretical knowledge and a decrease in practical skill performance between 6 and 12 weeks were identified.