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

Worksheet author(s)

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17 March, 2008 – Revised 18 March, 2009 – Revisions include formatting changes for references. Rewritten with prognosis LOE and question format.

Search and worksheet updated Feb. 8, 2010

Clinical question.

For students of advanced level Emergency Cardiovascular Care courses (such as ACLS and PALS) (P), does success in the written examination (I) predict success in completing the practical skills testing associated with the course or in cardiac arrest management performance in actual or simulated cardiac arrest events (O)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Prognosis
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?

Authors have conducted research in the domain and have a manuscript 'in-press'. No other relevant COI.

Search strategy (including electronic databases searched).

Independent searches were done by the worksheet authors. Results were compiled into a single document set which is presented in this worksheet.

Rodgers

Databases searched –PubMed, Academic Search Premier, AHA Education Database

Search combinations, all keyword searches in all fields (Searches conducted on Oct. 8, 2007):
ACLS & Test
PALS & Test
Written & Skill & Test
Advanced Life Support & Written & Test
Advanced Life Support & Written & Skill

Bhanji

Databases searched –PubMed, Embase (1980-), AHA Endnote Database, Cochrane library

Search combinations, all keyword searches in all fields (Searches conducted on Oct. 22nd and 23rd, 2007):
ACLS & Test
PALS & Test
Pediatric Advanced Life Support and Test
Paediatric Advanced Life Support and Test
Written & Skill & Test
Advanced Life Support & Written & Test
Advanced Life Support & Written & Skill
Advanced Cardiac Life Support and Test

the search was repeated on Jan 31st 2010 using the same search strategy

For both searches, bibliographies of significant articles were manually searched for potentially useful articles that were not identified through the primary search strategy.

- State inclusion and exclusion criteria

Direct data related to ACLS, PALS, or equivalent course test as a predictor for success in advanced resuscitation skills performance

Extrapolated data to include the use of written or oral knowledge tests as a predictor of clinician competence in skill performance in other advanced medical courses. Articles were excluded if there was a prolonged time delay (>6 months) between the written examination and the performance measure.

Exclusion criteria:

studies were excluded if:
-were published only in abstract form
-were not peer reviewed
-did not answer the worksheet question
-prolonged delay between written and performance tests (> 6 months)
-only reported the correlation between written and performance tests in BLS courses (topic of a previous ILCOR worksheet)

- Number of articles/sources meeting criteria for further review:

A combined 1910 articles were identified in the initial search. This number was reduced by elimination of all nonrelevant articles.
19 articles were found to meet the inclusion/exclusion criteria.

The repeat search strategy in 2010 identified another 181 articles
-of these 2 articles was relevant to the worksheet question

Total of 21 relevant articles found

Summary of evidence

Evidence Supporting Clinical Question

Good					Bishop (2001) 234 Gerrow (2003) 896[3] Jansen (1995) 247 Kramer (2002) 812 Ram (1999) 197 Remmen (2001) 29 Schwid (2002) 1434 Stillman (1991) 393 Verhoeven (2000) 525 Van der Vleuten (1989) 97 Willoughby (1979) 453
Fair					van Dalen (2002) 148
Poor					Caruthers (1991) 590 Hardy (1998) 582
	P1	**P2**	**P3**	**P4**	**P5**
Level of evidence					

E = Other endpoint

Evidence Neutral to Clinical question

Good					
Fair		Napier 2009 1034 White (1998) 1232			Stillman (1987) 1981
Poor					
	P1	**P2**	**P3**	**P4**	**P5**
Level of evidence					

E = Other endpoint

Evidence Opposing Clinical Question

Good					Jansen (1996) 339 Sivarajan (1984) 603
Fair		Rodgers (2010) in press Nadel (2000) 73			
Poor					
	P1	**P2**	**P3**	**P4**	**P5**
Level of evidence					

E = Other endpoint

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

Only two studies [Rodgers (2010) in press, Napier (2009) 1034] directly address the ILCOR question. In the study by Rodgers [Rodgers (2010) in press] looking at 34 senior nursing students enrolled in an Advanced Cardiac Life Support Course (ACLS) course, Spearman's rho correlation coefficient between the written test scores and practical skills performance was only 0.194 (significance = 0.272). Similarly the larger study (537 subjects) by Napier [Napier (2008) 1034] demonstrated a weak correlation between written tests and performance measures (the CASTest) of 0.269 and 0.336 depending on whether the assessments occurred before or after the course respectively

Nadel's article [Nadel (2000) 73] is useful in suggesting there is a lack of an association of the written questions, in advanced resuscitation courses, with respect to performance but this information was not directly reported as a correlation (LOE P2). Subjects, as a group, performed well on the standardized Pediatric Advanced Life Support course test but poorly on essential resuscitation skills indicating the two measures likely do not correlate well.

Significant extrapolated data exists (LOE P5) from research conducted within health education, but outside the specific domain of resuscitation. The majority of these studies (12 out of 15 at the fair or good level) support the premise that a written or oral knowledge examination can correlate with actual performance, however the magnitude of the correlation varies widely (from 0.19 to 0.65 –see Table 1 of Kramer [Kramer (2002) 812]). Of particular interest was Ram's paper [Ram (1999) 197] that found a written test could predict actual clinical performance to the same degree as direct observation of subjects in a multiple station examination.

Given the single study demonstrating a lack of correlation between the written test and skill performance in the context of an Emergency Cardiovascular Care (ECC) advanced level courses, the additional LOE P2 study that did not appear to support the question, and the lack of a consistent conclusion in the broader medical education literature (LOE P5), the written examination in advanced level ECC courses should not be considered a substitute for demonstration of clinical skills performance. The written test however is objective, allows a wider range of subject matter to be assessed, is relatively easy to deliver and score, and therefore likely adds to the reliability of the of the resuscitation course assessment process. Further research is required to further clarify the 'ideal' testing process both in terms of assessment and driving student learning.

Acknowledgements:
None

Citation List

Bishop (2001) 234	Bishop, M. J., P. Michalowski, et al. (2001). "Recertification of respiratory therapists' intubation skills one year after initial training: an analysis of skill retention and retraining." Respiratory Care **46**(3): 234-7. Level of Evidence – P5 (Extrapolation) , Quality – Good, Supports Comments – Showed a very strong correlation of a 21 question written examination and skill proficiency at intubation in the OR setting. The higher the written test score, the less intubation attempts needed to demonstrate proficiency.
Caruthers (1991) 590	Caruthers, B. S. and K. J. Sheets (1991). "Development of a curriculum in colposcopy." Journal of Family Practice **32**(6): 590-7. Level of Evidence – P5 (Extrapolation), Quality – Poor (Data/statistical information not adequate), Supports Comments – Course concluded with a 20 item written test that showed mean of 19 of 20 correct with skills performance being conducted at 95% (checklist score) to 100% accuracy (visual recognition). No test of significance completed in comparison of written evaluation and practical evaluation.
Gerrow (2003) 896	Gerrow, Murphy, et al (2003). "Concurrent validity of written and OSCE components of the Canadian Dental certification examinations." Journal of Dental Education. **67**(8): 896-901. Level of Evidence – P5 (Extrapolation), Quality – Good, Supports Comments – written and OSCE correlated with each other ($r=0.54$, $p<0.001$) in this large scale study.

	Study done in the dental population thereby posing a risk to transferability.
Hardy (1998) 582	Hardy, Demos, et al. (1998). "Undergraduate surgical examinations: an appraisal of the clinical orals." Medical Education **32**(6): 582-589. Level of Evidence – P5 (Extrapolation) , Quality – Poor (weak extrapolation to current question), Supports Comments – Mixed results in this study. Several correlations were examined. The Short Case test included an oral examination that covered a broad range of material. This test had a reasonably strong correlation with other measures judging surgical skill. However, the long case correlation with surgical skill was not as strong.
Jansen (1996) 339	Jansen, J. J., A. J. Scherpbier, et al. (1996). "Performance-based assessment in continuing medical education for general practitioners: construct validity." Medical Education **30**(5): 339-44. Level of Evidence – P5 (Extrapolation) , Quality – Good, Opposes Comments – Although some measures showed small positive correlations (3 of the 8), the authors concluded "Knowledge of a skill was not a reliable predictor of proficiency for that specific technical skill as knowledge predicted only a very small part of the variance on the performance-based test for the different skills."
Jansen (1995) 247	Jansen, J. J., L. H. Tan, et al. (1995). "Assessment of competence in technical clinical skills of general practitioners." Medical Education **29**(3): 247-53. Level of Evidence – P5 (Extrapolation) , Quality – Good, Supports Comments – Concluded "a written test of skills can predict performance on these skills to some extent, if developed according to the same blueprint." The correlation was 0.54 between the complete written test score and the performance measure. This correlation increased to 0.77 when the scores on the subset of written questions linked to the content of the performance measure was correlated with the performance measure.
Kramer (2002) 812	Kramer, A. W. M., J. J. M. Jansen, et al. (2002). "Predictive validity of a written knowledge test of skills for an OSCE in postgraduate training for general practice." Medical Education **36**(9): 812-819. Level of Evidence – P5 (Extrapolation), Quality – Good, Supports Comments – Fair-good correlation between knowledge test of skills and the OSCE (based approx. 50% on skills), but a weak correlation between a general knowledge test and OSCE. The authors appropriately conclude that written testing of knowledge cannot replace assessment of skills with an OSCE but it can be used as an instrument to estimate the level of clinical skills (particularly when done at the group rather than individual level)
Nadel (2000) 73	Nadel, F. M., J. M. Lavelle, et al. (2000). "Assessing pediatric senior residents' training in resuscitation: fund of knowledge, technical skills, and perception of confidence." Pediatric Emergency Care **16**(2): 73-6. Level of Evidence – P2, Quality – Fair (No statistical correlation between written and skills tests), Opposes Comments – Focused on skills (basic airway, advanced airway, central line, and IO). Did not address overall resuscitation management. No statistical test of significance for written versus skills test, but reported means were dramatically different.
Napier (2009) 1034	Napier F, Davies RP, Baldock C, Stevens H, Lockey AS, Bullock I, Perkins GD. Validation for a scoring system of the ALS cardiac arrest simulation test (CASTest). Resuscitation. 2009 Sep;80(9):1034-8. Epub 2009 Jun 13. Level of Evidence – P2, Quality – Fair. Large study with includes one paragraph on the correlations between written and performance-based tests in resuscitation. Correlation of 0.269 when the written and performace test were compared before the course and 0.336 when the written test was compared to a performance test after the course.

Ram (1999) 197	Ram, P., C. v. d. Vleuten, et al. (1999). "Assessment in general practice: the predictive value of written-knowledge tests and a multiple-station examination for actual medical performance in daily practice." Medical Education **33**(3): 197-203. Level of Evidence – P5 (Extrapolation), Quality – Good, Supports Comments – A good extrapolation with a knowledge test being compared against a series of skill stations. Showed a strong correlation between written test scores and skills station performance.
Remmen (2001) 29	Remmen, R., A. Scherpbier, et al. (2001). "Correlation of a written test of skills and a performance based test: a study in two traditional medical schools." Medical Teacher **23**(1): 29-32. Level of Evidence – P5 (Extrapolation), Quality – Good, Supports Comments – A good extrapolation with a skills and knowledge test being compared against an OSCE station. Showed a strong correlation between written test scores and OSCE station performance.
Rodgers (2010) in press	Rodgers, D. L., Bhanji, F., & McKee, B. R. (2010) "Written Evaluation is not a Predictor for Skills Performance in an Advanced Cardiovascular Life Support Course." Resuscitation (In press). http://dx.doi.org/10.1016/j.resuscitation.2009.12.018 Level of Evidence – P2, Quality – Fair, Supports Comments – small study in a population of nurses.
Schwid (2002) 1434	Schwid, H. A., G. A. Rooke, et al. (2002). "Evaluation of anesthesia residents using mannequin-based simulation: a multiinstitutional study." Anesthesiology **97**(6): 1434-44. Level of Evidence – P5 (Extrapolation) , Quality – Good, Supports Comments – Excellent extrapolation that comes close to ECC content. Moderate but significant correlations of test scores (written and oral) with skill performance.
Sivarajan (1984) 603	Sivarajan, M., E. Miller, et al. (1984). "Objective evaluation of clinical performance and correlation with knowledge." Anesthesia and Analgesia **63**(6): 603-7. Level of Evidence – P5 (Extrapolation), Quality – Good, Opposes Comments – Despite high scores (mean = 90 +/- 7.4) on the skills test, written scores were much lower (mean = 61 +/- 12.3). This was statistically significant (P < .005). The correlation between the skills test and the written test was weak (r = .19).
Stillman (1991) 393	Stillman, P., D. Swanson, et al. (1991). "Assessment of clinical skills of residents utilizing standardized patients. A follow-up study and recommendations for application." Annals of Internal Medicine **114**(5): 393-401. Level of Evidence – P5 (Extrapolation), Quality – Good, Supports Comments – Multiple areas were tested to compare an OSCE station series with several other measures of student performance including a MCQ written examination derived from the ABIM research item bank. Results showed low positive correlation across four dimensions: Content (0.28, P < .001), Interviewing (0.29, P < .001), Physical findings (0.12, P < ,05), and Differential diagnosis (0.28, P < .001).
Stillman (1987) 1981	Stillman, P. L., M. B. Regan, et al. (1987). "A diagnostic fourth-year performance assessment." Archives of Internal Medicine **147**(11): 1981-5. Level of Evidence – P5 (Extrapolation), Quality – Fair (mixed results), Neutral Comments – Part of this study compared performance based testing against Parts 1 and 2 of the National Board. Showed low to moderate correlations between performance stations (0.09 to 0.29 across 9 dimensions with 0.19 correlation in aggregate for Part 1; 0.11 to 0.32 across 9 dimensions with 0.27 correlation in aggregate for Part 2). Showed higher correlations with non-patient based written tests (0.54 for Part 1 and 0.58 for Part 2).
van Dalen (2002) 148	van Dalen, J., E. Kerkhofs, et al. (2002). "Predicting communication skills with a paper-and-pencil test."

	Medical Education **36**(2): 148. Level of Evidence – P5 (Extrapolation) , Quality – Fair (weak extrapolation to current question), Supports Comments – Focus was on communication skills. While correlation between written test of knowledge and practical demonstration of communication skills was strong, authors noted strength of correlation was not as high as other studies that focused on clinical skills.
Van der Vleuten (1989) 97	Van der Vleuten, C. P., S. J. Van Luyk, et al. (1989). "A written test as an alternative to performance testing." Med Educ **23**(1): 97-107. Level of Evidence – P5 (Extrapolation) , Quality – Good, Supports Comments – Correlation between a knowledge test of skills and the skills test increased from 0.03, in first year students, to 0.72 in 6th year (final year) students. The disattenuated coefficients were 0.04 to 0.89 for the same student subgroups. The study concluded '…the written test on knowledge of skills is able to predict achievements in performance tests, except for students in low proficiency regions such as the first and second year.'
Verhoeven (2000) 525	Verhoeven, B. H., J. G. H. C. Hamers, et al. (2000). "The effect on reliability of adding a separate written assessment component to an objective structured clinical examination." Medical Education **34**(7): 525-529. Level of Evidence – P5 (Extrapolation) , Quality – Good, Supports Comments – Showed a high correlation between written test of skills knowledge and skills performance as demonstrated in an OSCE.
White (1998) 1232	White, J.R.M. Shugerman, R. et al. (1998). "Performance of advanced resuscitation skills by pediatric housestaff". Arch Pediatr Adolesc Med **152**: 1232-35. Level of Evidence - P4 Quality – Fair, Neutral Comments – students performed well on the cognitive domain (written test) and were able to achieve the defined skill endpoints, but they frequently omitted or incorrectly performed key subcomponents of each skill.
Willoughby (1979) 453	Willoughby, T. L., L. C. Gammon, et al. (1979). "Correlates of clinical performance during medical school." Journal of Medical Education **54**(6): 453-60. Level of Evidence – P5 (Extrapolation) , Quality – Good, Supports Comments – Mixed results with some aspects of clinical performance being correlated to cognitive tests while other aspects showed no correlation.. I had initially thought of excluding this article but I can't exactly remember the reason (may have been timing b/w written and performance measures). Will re-look at it to see if it might be relevant. The Pearson correlation between clinical performance examinations and written tests was 0.43 for the internally developed comprehensive Quaterly Profile Examinations (QPE) and 0.46 for the National Board of Medical Examiners test. The exact time interval between written and performance scores is not provided but assumed to be short as 6th (final) year February QPE scores were compared to clinical block scores (likely completed in the immediately preceding months). The authors concluded 'the results indicate clinical performance to be moderately related with examination scores'