

Evaluation of Manikin Practice and Instruction Modality on C-CPR in high school students

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INTRODUCTION

Ohio's House Bill 113 updated, in 2016, the first aid and cardiopulmonary resuscitation (CPR) curriculum requirement under Ohio Revised Code 3313.60 to include psychomotor skills and automated external defibrillator (AED) use, based on a national curriculum or current Emergency Cardiovascular Care (ECC) guidelines (131st Ohio General Assembly, 2016). Substantial to the success of learning outcomes is the use of adjuncts to allow skill demonstration (aka motor skills) of chest compressions. The cost of commercial manikins range from about \$40 (USD) for home teaching (AHA 2015 Adult/Child CPR Anytime) to \$1,200 for a manikin that provides comprehensive feedback to learner and educator (Brayden Pro CPR Training Manikin). The American Red Cross provides manufactures with minimum features of adult CPR manikins that includes realistically representing the size and shape of an adult, ability to perform airway, breathing and circulation skills (American Red Cross, n.d.).

This research questions the learning outcomes of skill practice on various manikins and instructional modalities, using a Compression-only Cardiopulmonary Resuscitation (CCPR) approach within a high school age population. The four manikin treatments included:

- Laerdal American Red Cross (ARC) Annie©,
- a foam compression practice tool,
- a foam compression practice tool, plus a cutout intended to be anthropomorphically similar to an adult,
- a control who does not practice the CCPR.

The two instructional modalities included one of two standardized training methods, either a self-guided video or instructor-led skills session both developed and commercially available by the ARC. Through an experimental approach, the CCPR outcomes could be assessed objectively to help school administrators or other make informed choices as to the training devices purchased and methodological approach. Our central hypothesis is that there will not be a statistical difference in CCPR assessment indices across manikins and modality for high school students receiving standard training. However, we expect that the presence of CCPR practice compared to control with no practice will yield an improvement in skill assessment of the learner.

Methodology

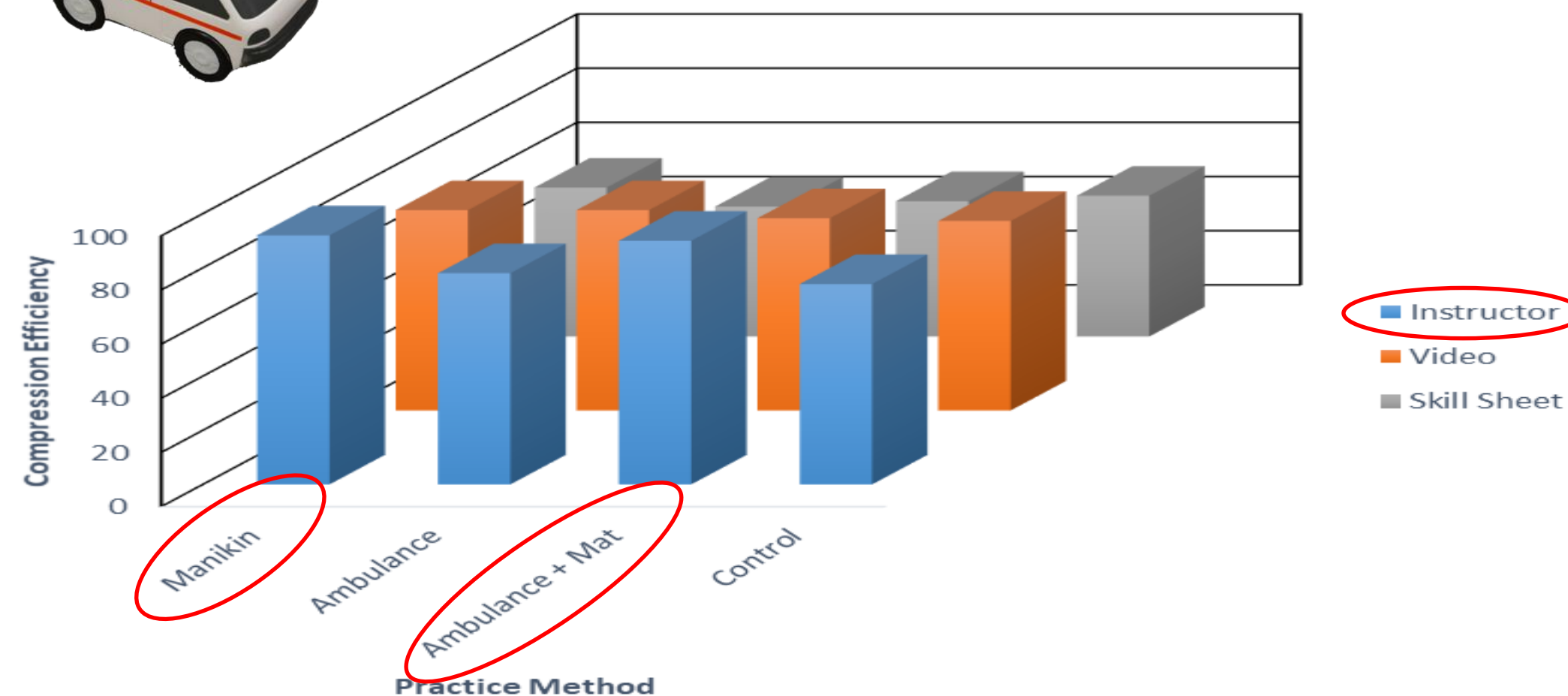
This investigation employed a post-test only experimental design using a 3x4 two factor complete randomized design. The two factors included the treatments, manikin and modality, see Table 1, with 1 student randomly assigned to 12 manikins by mode conditions across two classes. We used analysis of variance techniques, *post hoc* pairwise comparisons (method to method across modality), and contrast to compare instructor lead instruction to the self-instruction of skill sheet and app-based learning; as well as CPR practice to no CPR practice if significance in the global *F*-test was reached ($p \leq 0.05$).

PARTICIPANTS

The population of participants included two high school math classes ($N = 48$) at a large U.S. Midwestern public high school. Inclusion criteria for the analysis included first-time CPR learners based on controlling for previous CCPR instruction and experience. Other students were included in the instruction and random assignment to the treatment combinations to allow for full class instruction to persist. The minimum sample size for the analysis within each class was set based on the instructor to learner ratio recommended by the ARC of a 1:12 for CCPR teaching. Following completion of the informed consent, students were assigned to one of 12 treatment combinations using computer generated random assignment (Minitab 17 Statistical Software 2016, State College, PA) recorded via adhesive tag to be worn on visible clothing and matched with their objective CCPR assessment data. Although two classes were planned for use, technological issues did not result in viable data for the first class, thus the blocking factor of class was excluded and the final sample, $n = 12$ was derived from the second class of $N = 24$ students.

Table 1: Modes and Practice

Factor	Treatment	Mean	SE	SD	Min	Max	Range	Skewness
Mode	Instructor	83.5	4.4	8.9	74.0	92.0	18.0	-0.1
	Skills Sheet	56.3	5.5	10.9	48.0	72.0	24.0	1.6
	Video	72.3	1.0	2.1	70.0	74.0	4.0	-0.2
Practice	Compression Tool	66.7	9.4	16.3	48.0	78.0	30.0	-1.6
	Compression tool + Mat	70.0	11.5	20.0	50.0	90.0	40.0	0.0
	Manikin	73.7	10.7	18.5	55.0	92.0	37.0	-0.1
	Control	72.3	0.9	1.5	71.0	74.0	3.0	0.9



RESULTS

Mode of Instruction

There was a significant effect of the Mode treatment on CPR Effectiveness, $F(2,6) = 8.66$, $p = 0.017$. Based on the Tukey's HSD post hoc comparison (HSD = 16.1), the learners in the instructor-led modality ($M = 83.5$) performed statistically better than the learners in the skills sheet modality ($M = 56.3$). The video modality ($M = 72.3$) was not statistically different from the instructor or skill sheet modalities. See Figure 2 for display multiple comparisons test. The contrast of instructor-led instruction compared to video and skill sheet instruction did not reach statistical significance $F(1,6) = 5.04$, $p = 0.07$. Although not significant the contrast, indicating that CPR Effectiveness for learners receiving instruction from an instructor who is able to provide feedback during practice outperforms the self-taught modes of video and skill sheets, warrants further investigation. Based on a randomization test of 34,650 possible random combinations of observations, the probability due random assignment change was $p = 2.9 \times 10^{-5}$.

Mode of Practice

Based on practice method, there was not a significant effect on CPR Effectiveness, $F(3, 6) = 0.33$, $p = 0.807$. This indicates that the CPR Effectiveness in the post instruction assessment did not statistically vary.

MODE OF INSTRUCTION	PRACTICE METHOD					Mode Mean
	Manikin	Ambulance	Ambulance + Mat	Control	Mode Mean	
Instructor	92	78	90	74	83.50	
Video	74	74	71	70	72.25	
Skill Sheet	55	48	50	52	56.25	
Practice Mean	73.67	66.67	70	72.33	70.67	

IMPLICATIONS

Instructor participation in the learning process demonstrated the highest outcomes for CCPR, compared to video or skill sheet use. The Ohio House Bill 113, and pursuant Ohio Revised Code 3313.6021 only requires certified instructors when students receive certification in CPR/AED. The Revised Code allows for non-certified, but licensed educator, to facilitate, provide, or oversee CPR/AED education if that education is from an "instructional program that is nationally recognized and based on the most current national, evidence-based emergency cardiovascular care guidelines" for CPR/AED (131st Ohio General Assembly, 2016). Administrators and other stakeholders might consider how programs outside of the ARC or AHA train and maintain quality standards of instructors before committing to alternatives to instructors (self-paced learning or video driven).

The opportunity to use lower cost compression practice tools (approx. \$5) compared to more realistic manikins that are 20x that amount, could improve access to CPR training beyond isolated experiences to fulfill a graduation requirement. Teaching across the entire chain of survival behaviors (International Federation of Red Cross Red Crescent Societies, 2016) could influence many different ages and curriculum for which learners could build and maintain psychomotor skills.

REFERENCES

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DISCLOSURES

Both authors voluntarily serve on the American Red Cross' national Scientific Advisory Council: Education Sub-council. All research was conducted independently.

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