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Original Research

An Evaluation of Education Methods Used to Train United States Air Force Air Medical Evacuation Crewmembers on Aircraft Systems

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A B S T R A C T

Objective: United States Air Force air medical evacuation crewmembers (AECMs) are responsible for the safe air medical evacuation of casualties in dynamic environments and must be highly proficient in the C-17, C-130H/J, and KC-135R/T aircraft. Current methods to train AECMs on their aircraft proficiency include computer-based simulation training (CBT) or instructor-based training (IBT) on an actual aircraft. This study compares the aircraft proficiency scores between AECMs who were trained via CBT and IBT methods.

Methods: An experimental prospective design was chosen, introducing the independent variable of CBT to the dependent variable of AECM aircraft system proficiency. Proficiency evaluation scores of the control group (n = 10) trained via IBT were compared against the scores of the intervention group (n = 10).

Results: A Mann-Whitney *U* test was conducted using a significance level of $\alpha = .05$ and a confidence interval of 95%. The test revealed an exact significance 2-tailed $P = .045 \leq .05$. AECMs trained via IBT had statistically higher aircraft proficiency evaluation scores than AECMs trained via CBT.

Conclusion: These findings show that using IBT and a real aircraft to train AECMs is a superior training method versus CBT.

Methods of air medical evacuation crewmember (AECM) training must be analyzed to determine evidence-based practice to best prepare the current and future generations of AECMs who have accepted the noble responsibility of ensuring the safe transport of America's wounded warriors. AECMs possess a unique skill set that involves specialized training and high levels of personal commitment. AECM's operate in disciplined teams that are typically comprised of 2 flight nurses and 3 flight medics and are responsible for the safe air medical evacuation of wartime casualties, victims of humanitarian disasters, and patients needing care from every medical discipline.[1]

In addition to medical care, all AECMs hold aeronautical qualifications and are responsible for converting 3 types of United States Air Force (USAF) aircraft into flying hospitals (C-17, C-130H/J, and KC-135R/T).[1] Additionally, select squadrons are responsible for additional aircraft, such as the C-12, C-21, C-20, and C-37. Each aircraft is vastly different in terms of air medical evacuation configuration, emergency egress procedures, patient enplaning/deplaning, emergency/therapeutic oxygen sources, and litter systems.

An AECM must prove his or her aircraft proficiency by passing a recurring flight evaluation. AECMs are "in phase" for their recurring flight evaluation 12 months after their last flight evaluation and must undergo mandatory refresher instruction on each aircraft, written examinations, emergency procedures evaluation, and a flight evaluation. The 2 methods to attain this aircraft refresher instruction are computer-based simulation training (CBT) or instructor-based training (IBT). CBT training is accomplished using computer software that takes the AECM through a series of simulations to refresh their proficiency on each aircraft. IBT is accomplished under the supervision of a qualified flight instructor on a real aircraft and involves the AECM actively using emergency egress procedures, emergency equipment, and tools for aircraft configuration. The CBT and IBT refresher training's purpose is to keep AECMs proficient, in addition to preparing them for their recurring flight evaluation. However, no studies have been accomplished to prove the effectiveness of CBT versus IBT training.

A comprehensive literature review revealed only 4 articles linking medical flight simulation training and AECM proficiency (Table 1). In an integrated literature review of simulation use in air medical

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Table 1
Literature Review

Citation	Description
Alfes and Christopher, 2014[3]	Describes the necessity and detail required to design a high-fidelity simulator
Fletcher and Wind, 2013[4]	Assesses the economic advantages and measures skill transfer frequency of medical simulation
O'Connell, 2014[2]	Integrated a literature review of simulation use in air medical evacuation training
Wright et al, 2006[5]	Assesses the cost, self-efficacy, and feasibility of performing high-fidelity medical simulation in the challenging helicopter environment

evacuation training, O'Connell et al[2] concluded that more research is required to assess the effectiveness of simulation to train AECMs. More research is necessary for the following 4 priority reasons: AECM training and skill proficiency is expensive to acquire and maintain; current defense budgetary environment forces innovation in cost-effective military readiness and training platforms; modern high-fidelity simulators have a large initial investment and daily operating costs to consider; high-fidelity simulation has not been proven as a superior training method for AECMs.

Hypothesis Formulation

Through scientific observation, the research author formulated a researchable and answerable question in the following hypotheses:

1. Null hypothesis: there *is no statistical difference* between aircraft proficiency evaluation median scores between AECMs who have received CBT or IBT training.
2. Hypothesis 1: there *is a statistical difference* between aircraft proficiency evaluation median scores between AECMs who have received CBT or IBT training.

Methods

Population and Sample Selection

The population of the 86th Aeromedical Evacuation Squadron consists of approximately 30 flight nurses and 50 flight medics and was the only location from which the sample was selected. The research author was a flight nurse who was pursuing his master of science in nursing degree, and this research study was his research capstone. He received research approval from the Clarkson College Institutional Review Board, Omaha, NE, and his commander to pursue this research as a process improvement initiative. Recruitment for the study occurred during the squadron chief nurse's professional development meeting that requires mandatory attendance by all AECMs. The research author gave a PowerPoint (Microsoft, Redmond, WA) presentation explaining the study's purpose, risks, benefits, and informed consent. A total of 30 AECMs volunteered for the study and filled out a study survey. The study survey asked each research participant the following 3 questions (Appendix 1):

1. How many years have you been an AECM (0-5 years, 6-10 years, 11-15 years, or 6-20 years)?
2. Have you ever used high-fidelity computer simulations to assist in your learning (yes or no)?
3. What is your preferred method of accomplishing aircraft systems training (CBT or IBT)?

A total of 20 AECMs were selected to participate in the study via a convenience sample. In order to be selected for the study, the study participant's schedule availability had to align with C-17 aircraft and researcher availability. The C-17 aircraft was selected as the research setting because of its availability at Ramstein Air Base, Ramstein-Miesenbach, Germany. The researcher used scheduling software to determine individual AECM availability and the C-17 operations center for aircraft availability. The researcher approached the study participant once AECM and aircraft availability were confirmed and provided a refresh brief on the study's purpose and reconfirmed consent before taking the participant out to the C-17 for the research evaluation.

AECMs were placed into either the control group or the intervention group based on their most recent training method on the C-17. AECMs who were trained via computer simulation were placed into the intervention group, and AECMs who were trained by IBT were placed into the control group. Once placed into either the control or intervention group, AECMs were not allowed to undergo any additional C-17 training until they completed the study's evaluation of their training.

Research Design

A prospective experimental design was chosen, introducing the independent variable of CBT to the dependent variable of AECM aircraft system proficiency. The intervention group completed CBT and then received an aircraft walk-around evaluation to measure their aircraft proficiency. Scores were calculated on the evaluation worksheet by a flight evaluator.

The control group completed no simulation training and attended IBT. IBT training consists of a flight instructor taking the student out to the aircraft and covering each aircraft system using the teaching principles of guided discussion and demonstration performance. The control group received an aircraft walk-around evaluation to measure their aircraft proficiency. Scores were calculated on the evaluation worksheet by the flight evaluator. Differences between the control group and the intervention group evaluation worksheet median scores were analyzed using a nonparametric independent sample Mann-Whitney *U* test.

Research Study Setting

The research was conducted on a USAF C-17 aircraft. The C-17 is a large, long-range, 4-engine–powered transport aircraft capable of moving cargo and troops and air medical evacuation. The C-17's maximum litter capacity using litter stanchions is 36 patients, and up to 60 litter patients can be loaded on the aircraft floor during contingencies. Every C-17 used in the research study was configured for air medical evacuation.

Description of Measurements

A USAF supplemental evaluation worksheet (Air Force Form 3862) was used to document each research participant's completion of aircraft proficiency (Supplementary Table S1). The Air Force Form 3862 is a standardized measurement tool that requires a certified USAF flight examiner to observe AECMs and document their proficiency on the worksheet. The worksheet collects data at the interval level. The supplemental evaluation worksheet is a standardized evaluation and measurement tool that squadron commanders often use to direct their flight evaluators to collect data on specific flight performance objectives to identify training trends.

AECMs were graded on a total of 35 training objectives on the C-17 using the following 3-tiered grading system: qualified (Q), qualified with discrepancies (Q minus), and unsatisfactory (U). The first grade of Q states that the AECM is proficient and can do the respective task correctly, in the proper order, and immediately. The second grade of Q minus states that the AECM is not proficient in the respective task but accomplished it in a satisfactory manner. Common causes of a Q minus grade are doing the task procedures out of order, a deficiency in the established procedure, and/or a delay in accomplishing the task. The third grade of U states that the AECM