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Simulation Technology enhances Doctor of Pharmacy candidates' retention of rhythms and medications used in advanced cardiac life support

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Abstract

Aims: Simulation technology is currently being employed to enhance traditional didactic teaching in both nursing and medicine. We plan to assess the difference between simulation-based and didactic-based methods when teaching Advanced Cardiac Life Support to Doctor of Pharmacy candidates.

Methods: A prospective, parallel designed study comparing didactic lecture with written scenarios versus didactic lecture plus simulation-based scenarios. Both groups completed a one-hundred point examination two weeks prior to lecture, immediately after lecture, and two weeks post lecture to assess material retention.

Results: Twenty-one subjects were enrolled and participated in the study. The immediate post-lecture assessment average score for the didactic and simulation group was 80.2±12 and 85.6±8 respectively (p=0.262). Retention test scores differed significantly in favour of the simulation group versus didactic group (79.6 and 64.8 respectively; p=0.031).

Conclusions: The use of simulation based training in addition to traditional didactic lecture significantly improves students' retention of Advanced Cardiac Life Support rhythms and medications.

Keywords: *Simulation, Pharmacy, ACLS*

Introduction

During cardiopulmonary resuscitation timely and appropriate medication selection is critical. Pharmacist involvement on a code team has shown to improve compliance with Advanced Cardiac Life Support (ACLS) guidelines. (Draper *et al*., 2008) Unfortunately ACLS training for pharmacy students is limited throughout the curriculum. Simulation Based Training (SBT) is an appealing option to fill the ACLS training gap.

Simulation training has deep historical military roots from the use of chess to simulate a battle field to modern computerized aviation simulation (Bradley, 2006). Simulators were originally used in medicine in 1960 with the development of the Sim One mannequin by Abrahamson and Denson (Bradley, 2006). SBT failed to gain acceptance at that time and it was not until 1994 that the first mannequin simulation course was offered to medical students in Copenhagen (Seybert *et al*., 2006). Simulation has since been accepted as an effective training technique in many areas of medicine.

In a retrospective case control study (Wayne *et al*., 2008) compliance with ACLS guidelines was assessed in medical residents trained via simulation or a traditional education program. The simulator-trained group had significantly higher adherence to American Heart Association (AHA) standards (68% v 44%, p<0.001). Also, the simulator group was seven times more likely to follow ACLS guidelines than the traditional group (95% CI, 1.8-28.6). Another study conducted (Wayne *et al*., 2006) found SBT to be well received by medical residents. SBT is a mainstay in nurse training, especially in areas of patient safety, communication, and team building. SBT gives nurses a chance to learn clinical skills through multiple scenarios when these opportunities may be limited in the actual setting due to limited resources, higher patient acuity, and staff shortage (Mckeon *et al*., 2009).

David Grant Medical Center's (DGMC) simulation centre is utilised regularly for medical resident training. Although pharmacy students are not routinely trained at the simulation centre, the American Council for Pharmacy Education (ACPE) recommends use of education technologies that involve various modes of education delivery and technology (Seybert *et al*., 2008).

Unlike previous pharmaceutical education trials (Seybert *et al*., 2006; Tokunaga *et al*., 2008; Fernandez *et al*., 2007) investigating simulation technology, our study is the first to

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compare SBT to traditional didactic training. We aimed to quantify whether simulation technology plus didactic training is superior to didactic training alone in improvement of pharmacy students understanding and retention of ACLS material.

Methods

Study Design

This was a prospective, parallel study design approved by the DGMC Institutional Review Board. Doctor of Pharmacy (Pharm.D.) candidates in their final year of pharmacy school were recruited for participation in the study. For consistency purposes all students were selected from the same school of pharmacy and were three months away from graduation. Exclusion criteria included students who had participated in an Advanced Cardiac Life Support situation previously, were ACLS certified, not in their final year of school or unwilling to participate.

Students were assigned to either the traditional didactic group or simulation group based on their geographical location. The didactic group received a 50 minute lecture presented by an ACLS trained pharmacist followed by 10 minutes of PowerPoint patient cases. The simulation group received the same lecture by the same pharmacist followed by patient cases using a Laerdal ALS® simulator, LIFEPAK®, and a crash cart. A 25 question examination was administered on three separate occasions, two weeks prior to intervention (baseline), immediately post intervention, and two weeks following the intervention (retention).

The exam questions were created specifically for this study and ranged from medication dosing to case-based ECG reading.

The lectures were reviewed by a team of healthcare professionals (two hospital pharmacists and one faculty member from the school of pharmacy) to ensure content and presentation consistency between the groups. The same team also validated the exam questions for level and appropriateness. In addition to exam scores, the research team also collected general demographics (age, gender, previous degree, GPA), and level of student confidence in ECG identification with each intervention. The latter was assessed by asking the question "How confident are you in your ability to interpret a basic electrocardiogram?," and graded on a scale of 1 to 5 with 1 being not confident and 5 being very confident.

Simulator

The simulator used was the Laerdal ALS® or Laerdal Advanced Life Support. The simulator was a mannequin located near a crash cart and LIFEPAK® machine. The instructor controlled the heart rhythm of the mannequin creating case based scenarios (ALS, 2010).

Analytic Plan

With an alpha of 0.05, power of 80%, and assessment test difference of 12 ±8%, the calculated sample size was 18 students distributed equally assuming no subject dropout. Examination scores were considered as a continuous variable and analyzed using an unpaired *t*-test. Fisher's Exact test was utilized for categorical data.

Results

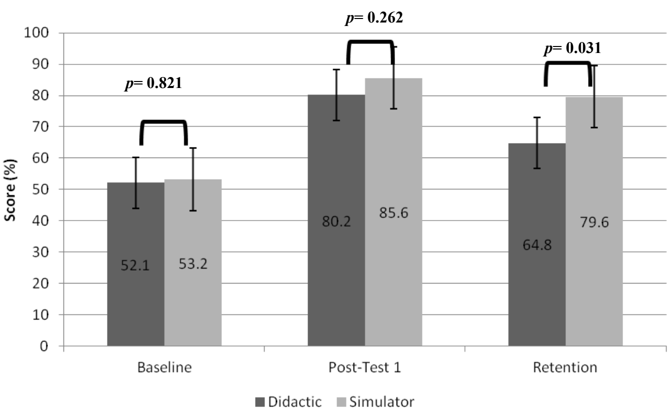
We enrolled 21 Pharm.D. students from the Northern California area, 12 in the didactic group and 9 in the simulation group. Table I describes the baseline characteristics of the didactic and simulation groups. The groups were similar at baseline with no significant differences (all p values for 2x2 table >0.3).

Table I. Student demographics at Baseline

Baseline Characteristics			
		Didactic Group	Simulation Group
		N=12	N=9
Gender			
	Male	6 (50%)	5 (56%)
	Female	6 (50%)	4 (44%)
Age (years)			
	≤25	10 (83%)	7 (78%)
	>25	2 (17%)	2 (22%)
Prior Degree			
	Yes	7 (58%)	6 (67%)
	No	5 (42%)	3 (33%)
GPA			
	<3.5	6 (50%)	6 (67%)
	≥3.5	6 (50%)	3 (33%)

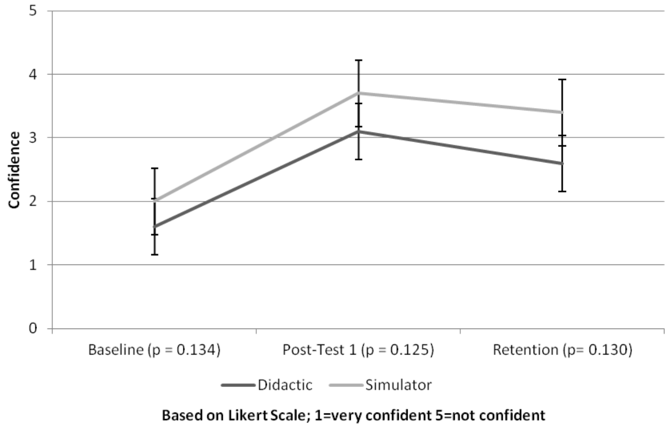
Both the didactic and simulation lectures significantly improved scores when comparing baseline and immediately post-intervention test results (examination scores increased from 52.1±12 to 80.2±12 in didactic group (p<0.001) and from 53.2±11 to 85.6±8 within the simulation group (p<0.001)). When the didactic and simulation groups were compared at different time points there were no differences except at two weeks post intervention where the simulation group scored significantly higher than the didactic group (p=0.031) (Figure 1).

Figure 1: Test Results Across Different Time Points



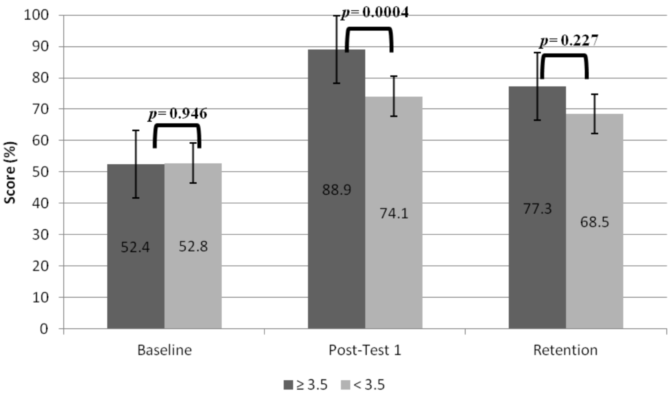
There was a significant increase in student confidence after the didactic and SBT interventions (*p*<0.002 for both groups). However the difference between the groups at any time point was not significant. As such, this difference appeared to get wider with increasing time (Figure 2).

Figure 2: Student Confidence Scores Across Different Time Points



A subgroup analysis was conducted based on grade point average (Figure 3). Students with higher GPAs scored significantly higher immediately after the intervention, but this effect was not sustained over time.

Figure 3. GPA subgroup analysis



Discussion

The results of our study suggest the use of simulation training in addition to traditional didactic lecture improves student retention of subject material compared to the didactic lecture alone. The University Of Pittsburgh School Of Pharmacy utilized SBT in their Introduction to Critical Care for their second year pharmacy students. (Seybert *et al*., 2006) The Pittsburgh students presented to the simulation center as if they were attending team rounds in a hospital setting for a patient with an acute myocardial infarction. The SBT effectiveness was assessed with a student survey indicating significant enhancement in students' knowledge of critical care. However, the authors conceded that a comparison of SBT to didactic training was needed in order to truly assess SBT's effectiveness.

There have been other studies validating the findings of the Pittsburgh study. A Japanese study at Kyushu University of Health and Welfare trained pharmacy students in various emergency situations using simulators (Tokunaga *et al*., 2008). Students' understanding of the material significantly increased following simulation-based training (*p*<0.01). A similar study at Eugene Applebaum College of Pharmacy and Health Sciences found that 90% of the students felt they learned clinical patient care better when using the simulator (Fernandez *et al*., 2007). Again, these results were self reported and lacked direct comparison to traditional learning.

Simulator training does not come without its drawbacks. An obvious drawback to SBT is the cost. To warrant the high expense, its usefulness and effectiveness must be measured (Hofmann, 2009). A review (Salas *et al*., 2008) of SBT warns that simulation training can actually divert attention away from other important aspects, such as teamwork and communication, due to its technology. Distraction from the "bells and whistles" of a simulator can affect the students' ability to focus on the content of the training. Simulation training comes in many forms other than mannequin SBT.

Not all simulation used in education is technologically advanced, in fact, most simulation used in health care training today utilizes little technology (Bradley, 2006). The use of patient actors to train pharmacy students in patient counselling techniques is a form of low technology simulation. Pharmacy students respond positively to this form of simulation, recognizing its value in teaching clinical and pharmaceutical skills (Austin *et al*., 2006). Another form of simulation technology that is a less costly alternative to mannequin SBT is computer-based simulation. Computer-based simulation has been shown to be as effective a learning strategy as mannequin SBT, with the benefit of needing less faculty hours to administer the training (Mckeon *et al*., 2009). Our study shows students improve their retention with mannequin SBT as well as increasing their confidence after the intervention.

Our study has several limitations. The students were not randomized into either group since they were allocated by geographical area. Randomization would have decreased the risk of geographical biases. Our retention examination was given with-in two weeks of the intervention and the long term retention remains to be determined. The same questions were used at each examination which could have led to easier student recall. However, the students were not given the correct answers and asked not to seek out correct answers which would limit this potential study weakness. While the pharmacist who gave the didactic lecture avoided variability between the two groups, he did not use a recording which would have mitigated this risk. Post-hoc analysis reveals this study to be underpowered however the effect sizes are compelling enough to warrant further investigation. While students having participated in a code were excluded, differences in APPE (Advanced Pharmacy Practice Experience) training were not accounted for. We also did not formally validate our test questions.

Our study is important because to our knowledge, this is the first comparison of SBT versus traditional training in pharmacy students. Our results warrant further studies in larger sample sizes to investigate if SBT translates into better clinically trained pharmacists. As such, there are very few studies showing direct improvements in clinical outcomes from the use of SBT in medical or nursing students (Okuda *et al*., 2009).

Conclusion

The use of simulation training in addition to traditional didactic lecture improves student retention of ACLS rhythms and medications compared to traditional didactic lecture alone. SBT has a promising future in pharmacy education, but still needs to be investigated further for cost effectiveness and clinical outcome translation.

Acknowledgements

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