Does Simulation Training Increase 9-1-1 Operator's Ability to Recognize the Need for Cardiopulmonary Resuscitation Instruction?

Barry Richard Morrison

A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Public Health

University of Washington

2017

Committee:

Hendrika W. Meischke

Ian S. Painter

Program Authorized to Offer Degree:

School of Public Health

University of Washington

Abstract

Does Simulation Training Increase 9-1-1 Operator's Ability to Recognize the Need for Cardiopulmonary Resuscitation Instruction?

Barry Richard Morrison

Chair of the Supervisory Committee:
Professor Hendrika W. Meischke
Department of Health Services

Purpose: The purpose of this thesis paper is to analyze if there is a dose-response effect of a simulation training of 9-1-1 operators on improved recognition and timing of the need for telephone-assisted cardiopulmonary resuscitation (CPR). T-CPR is an important tool for 9-1-1 operators, as cardiac arrest survival rates have been shown to improve, when T-CPR is provided without delay. The ability to timely recognize and therefore initiate T-CPR protocols is critical in sudden cardiac arrest events.

Methods/Design: Analysis was conducted on dispatchers from thirteen call centers who were randomized to receive mock caller scenarios, as part of a randomized controlled study of the use of simulation for training 9-1-1 operators in recognition of cardiac arrest. The simulation consisted on an actor acting in the capacity of a 9-1-1 caller, calling in with a simulated scenario, with the 9-1-1 dispatcher reacting per their protocols for a cardiac event. Each 9-1-1 dispatcher was subject to 4 sessions, with 3 training calls each, and received a brief feedback after the session was over from an instructor who listened in on the calls. All participants' sessions were recorded and abstracted for time to start of call to recognition of the need for T-CPR, and appropriate inquiry of consciousness and breathing status of the patient.

Analysis: The analysis focuses on whether or not the training simulations indicated if the dispatchers improved as they progressed through the training sessions. Mixed effects linear regressions were used with fixed effects for the main variables. A separate, secondary analysis was conducted to compare rates of recognition between those dispatchers with < 2 years of experience, and dispatchers with > 2 years of experience.

Results: The does-response analysis indicated a statistically significant effect, in that the more trainings received: 1) recognition of cardiac arrest, and 2) time to start CPR instructions decreased. However, when looking at the effect of years of experience, there was no statistically significant result.

Discussion: This thesis paper illustrated that as the number of simulated training increases, dispatcher's time to recognize the need for T-CPR instructions decreases, which can lead to the start of T-CPR sooner. 9-1-1 dispatch call centers should look at incorporating simulated training into their operations. Recognition of the need for T-CPR in sudden cardiac arrest events, is critical to achieving positive outcomes.

Significance/Introduction

Bystander-initiated cardiopulmonary resuscitation is crucial in improving chances of survival in sudden cardiac events. [1] The initiation of cardiopulmonary resuscitation (CPR) is both important and can be a challenge. The Centers for Disease Control and Prevention, citing the US Department of Health and Human Services, indicates that heart disease is the leading cause of death in America. [2] Furthermore, the out-of-hospital cardiac arrest (OHCA) incidence rate is >350,000, with bystander-CPR only occurring in about forty-six (46%) percent of those cases, and the survivor rate at twelve (12%) percent. [3] Increasing bystander-CPR rates is critical for improving survival rates for those experiencing sudden cardiac arrest.

For survival rates from cardiac arrest to improve, access to early interventions are required. [1] When it comes to cardiac arrest, early initiation of the emergency response system, and immediate initiation of resuscitation efforts are paramount, this is what is termed the "Chain of Survival". [4] Providing Telephone-assisted CPR (T-CPR) instructions over the phone to the caller is part of the 9-1-1 dispatcher's toolbox, and requires training and subsequent quality improvement through which to improve cardiac arrest recognition rates and initiation of T-CPR in appropriate events. [5] The ability of 9-1-1 dispatchers to assist bystanders in initiation of and support through T-CPR can be a struggle, especially as it relates to nonrecognition of the symptoms of sudden cardiac arrest, which in turn delays delivery of chest compressions to the victim. [6] The lack of recognition is a challenge for the caller as well as the dispatcher, who must interpret the information they are being given. [6] Caller clarity and consistency are further obstacles for dispatchers, when they are asking callers to explain the situation they are in. [6]

Barriers

Though first-aid is taught in communities, not every caller witnessing a sudden cardiac arrest knows how to determine if someone is not conscious and not breathing normally, and therefore in need of CPR. [7] There can be a false impression by the caller that a victim is exhibiting what are called “signs of life”, wherein callers believe the victim is still breathing and therefore not in need for CPR. [8] A main barrier in recognizing the need for T-CPR is agonal breathing, defined as: a brainstem reflex characterized by gasping, labored breathing, accompanied by strange vocalizations and myoclonus, in that a caller is not able to properly describe the victim’s breathing, and the dispatcher is delayed in recognizing a cardiac arrest event. [9, 11] Agonal breathing can make it challenging to determine if the call is for a true cardiac arrest event. [10] Bystanders will often describe agonal breathing as the victim is: “…wheezing, groaning, snorting, weak breathing, occasional breathing, irregular breathing, and poor breathing.” [12]

9-1-1 dispatchers are trained to follow a set of guidelines for querying callers on patient status to determine if a patient is not conscious and not breathing normally. 9-1-1 dispatchers do not experience cardiac arrest calls as often as other emergency medical scenarios, this can make it more difficult for dispatchers to gain enough practice to navigate communication barriers with callers. [13] Some aspects of nonrecognition stem from the caller not knowing how to effectively communicate to the dispatcher, caller not being near the victim, and the dispatcher not asking formal and systematic questions, which can lead the caller to properly identify symptoms. [13] Continued and ongoing training for 9-1-1 dispatchers is paramount to improve dispatcher recognition of challenging barriers.

Training on T-CPR

The American Heart Association (AHA) recognizes the need for 9-1-1 dispatchers to be trained and provide T-CPR instructions, the AHA further emphasizes the need for continuing education for dispatchers in order that they will be able to address new scenarios as they present during sudden cardiac arrest events. [14, 15] A study done in France, indicated that the cost of training its dispatchers was neither costly, nor time-consuming. [16]

Training includes direct feedback to dispatchers, in order that both recognition and performance are evaluated, and can illuminate both good performance and performance that requires attention. [7] Training for dispatchers has usually taken place after the fact, after analyzing previous cardiac arrest calls, and then taking from those calls the positives and negatives, to develop training solutions for which improvement is sought. [17] Such training can include dedicated in-person sessions, where the dispatchers work on recognizing the signs of a cardiac arrest event and learning proper delivery of T-CPR instructions. [18] Furthermore, other trainings include sessions on recognizing agonal breathing (as done with Stockholm dispatchers) and e-learning courses (i.e., conducted in King County, Washington EMS). [18] Here in the United States, there are no national performance standards which can allow for targeted benchmarks in training. [6] Furthermore, along with the desire to have performance standards be uniform, teaching CPR providers how to recognize barriers like agonal breathing as being a "…sign of cardiac arrest…" will also decrease time to recognition. [19] As the literature shows, training dispatchers in proper delivery of T-CPR instructions to lay callers can achieve positive results for those suffering from a sudden cardiac arrest event.

Simulation Training

Simulated training can help 9-1-1 dispatchers develop their skills while in an educational setting, where standardized patients (these are actors who have been trained to portray the various complaints and issues a live patient may present with) allow dispatchers to practice their call processing skills, which then can be evaluated and scored. [20] Continuing education is key to promoting improved performance. [21] Simulated training has been shown to work in other medical education scenarios, where the participants receiving the training were able to realize positive outcomes. [22] Much as nursing students, and other medical professionals can and do achieve positive results from simulated training scenarios, so can this technique be used for 9-1-1 dispatchers, in improving recognition of sudden cardiac arrest events. The objective of this thesis is to analyze how simulation training can affect and improve upon how quickly dispatchers recognize sudden cardiac arrest scenarios, and therefore improve their time to start T-CPR instructions.

Primary/Secondary Research Question

STAT-911 Protocol for Parent Study

The data to be analyzed stems from the STAT-911 study. [23] This simulation study focused on evaluating phone-based simulated training to improve identification for the need of T-CPR, and reduce time to start of T-CPR instructions. Since cardiac arrest events are infrequent, exposure to simulated scenarios might assist dispatchers in handling these calls effectively. The primary aim of the STAT-911 study was to determine if there were differences in performance between intervention and control participants after exposure to four T-CPR simulated training sessions. Secondary aims of the study were: 1) was there an effect on actual cardiac arrest calls, 2) were

there any differences in call processing skills evident during the simulated testing, 3) were dispatcher's self-confidence impacted because of the simulated training, and 4) discussion about cost and cost-effectiveness of the study intervention. Results of the STAT-911 study indicated that training reduced the time interval from call onset to identification of the need for T-CPR and improved call processing skills of the participants during a simulated cardiac arrest call.

This thesis paper seeks to determine if one training session, two training sessions, or up to four training sessions were needed to achieve increased rates of recognition and reductions in time delays. Taking dispatchers off the floor for training sessions of up to 30 minutes can be a challenge for call centers, so it is important to take advantage of this time to understand how many sessions are necessary to get improvement in call processing for cardiac arrest calls. The analysis investigates if improvements occur over the four sessions in the primary communication skill: not getting distracted by the caller's attempt at diagnosing the situation ("label") and the time-intervals for transitioning to and beginning of CPR instructions. The secondary research question will look at years of experience, in relation to the simulated training, to determine if such experience plays a role in improved recognition of the need for T-CPR.

Methods

The STAT-911 parent study was a randomized control trial to determine if simulation training improved call processing of cardiac arrest events. The thesis paper will analyze if there is a dose-response effect of the training.

In the parent study participants were recruited from 13 call centers in the United States. Participants were randomized into control and intervention groups. This thesis only reviewed and analyzed the simulation training calls from the intervention group. The intervention group was subject to four simulated training sessions over a 6-8-month period, wherein during each session the dispatcher took part in three simulated calls of equal or increasing complexity. [23] Once a session was completed, the instructor listening in on the session would provide a debriefing. Each call had a "standardized caller" who acted the part of a 9-1-1 caller. There were four scenarios which all began with a "label" (i.e. lay diagnosis provided by the caller such as "my mother fell") that the dispatchers had to make decisions based on the information provided by the call actors. The "label" was the immediate medical emergency that the caller described. Each scenario was based on communication behaviors observed in real cardiac arrest calls, which could hinder accurate and efficient identification of a cardiac arrest scenario. The STAT-911 study trained on 4 specific components, which if handled properly, would facilitate effective dispatch, identification, and prompt T-CPR instructions. These points were: 1) managing initial description of the event (label), 2) consciousness inquiry, 3) breathing inquiry, and 4) beginning T-CPR. Common challenges in each call component were: possible, but generally inaccurate descriptions of the event; ambiguous or inaccurate answer to whether or not the victim was conscious; ambiguous or inaccurate answer to whether or not the victim was breathing normally; and the dispatcher being able to promptly begin T-CPR instructions. [23] Each dispatcher was graded on how they handled the scenarios presented, and if handled skillfully, would show they could: manage the caller's initial description of the medical emergency, inquire about consciousness and breathing, and start T-CPR instructions.

Audio taped sessions were abstracted for one call from each training session in the intervention group using a standardized format. Each training session included 3 calls, and one of those calls was a cardiac arrest event designed to be of medium difficulty, which were the calls abstracted. A total of 12 'scripts' were used for the 12 calls, with the order of the 4 designated medium scripts randomized per individual over the 4 training sessions. Two of the variables examined required a Pass/Fail assessment: 1) did the dispatcher recognize the scenario as a cardiac arrest event; and 2) did the dispatcher get distracted by irrelevant information from the caller. Furthermore, consciousness and breathing inquiries required a Yes/No/Not Asked assessment. Lastly, time stamps were created for when the dispatchers transitioned into T-CPR instructions, and the beginning of such instructions. Upon completing of the abstractions, the scores and demographic information for the intervention group were inputted into an Excel spreadsheet for use in Stata 14 statistical software for all statistical analyses.

Methods for Thesis Study

All the audio files provided by the STAT911 parent study were all sufficient quality to allow for complete transcription and analysis of the caller/dispatcher interactions. Descriptive statistics were used to describe the characteristics of the intervention group. [See Table 1] A dose-response analysis of time to recognition of need for CPR and time to first instruction was conducted using mixed effects linear regressions, with fixed effects for the number of trainings, script number and actor, and a random intercept term for the participant. Chi-square analyses were used to determine the bivariate associations between the variables for Script, Actor, and Call.

Results

The 9-1-1 dispatchers who participated were from a wide-ranging geographical set, wherein 9-1-1 emergency call centers ranged from Alaska (Anchorage), down the west coast of the U.S. and into Arizona. The majority of participants were female (75.8%), with the majority of age groups for the participants being between the age of 30 to 44. [See Table 1] Years of experience averaged about 9.3 years. The intervention group completed the 4 simulated training call session over a period of 6-8 months.

The variables for Call, Script, and Actor were approximately evenly distributed between the training sessions (Table 2). In Table 3, although the scripts were designed to be of similar difficulty, statistically significant differences were observed in scenario (Label) pass rates between the 4 scripts ($p < 0.001$), with Script 2 having the highest pass rate (100%) and Script 4 having the lowest (77%). There were no statistically significant differences between pass rates and the 3 standardized callers (Actor).

Consistent with a dose-response hypothesis, scenario pass rates progressively improved over number of trainings (Table 3), wherein the first training call achieved an 82% pass rate, the last training call achieved a 95% pass rate. After adjusting for effects by Script and Actor, after each additional training call the odds of recognizing a cardiac arrest event for what it is increases 98% (95% CI 21-224%, $p < 0.001$). A strong dose-response was also evident when analyzing the transition and instruction times (Table 4). As each training session progressed, both transition and instruction times decreased, by 4.6 (95% CI 2.4-6.7 seconds, $p < 0.001$) and 5.1 seconds (95% CI 2.9-7.4 seconds, $p < 0.001$) respectively.

The next analysis centered around the question of whether or not experience played a role in a dispatcher being able to recognize a cardiac arrest event. Table 5 does show a small (6%) increased rate of recognition for those dispatchers with more than 2 years of experience being a 9-1-1 dispatcher, and an increase for those who have spent more than 2 years at their call center (8%). These differences in rate of recognition were not statistically significant ($p = 0.100$ and 0.154 respectively). However, given that there are high rates of missing data for this question, there is not enough data to show that experience plays a role.

Discussion

The primary research question for this thesis, was to determine if 9-1-1 dispatchers increase their ability to recognize a cardiac event scenario through simulated training sessions. As shown in the Results section, there is a clear indication that a positive dose-response for increased recognition of the need of T-CPR instruction has been achieved through the simulation training provided to the study intervention group. The time to recognize the cardiac arrest event, and then transitioning to T-CPR instruction was clearly decreased the more training sessions the dispatchers went through.

When medical attention, specifically CPR in a cardiac event, is not given within a reasonable time frame, the chances for positive outcomes decrease sharply. [23] Though there have been studies which indicate that experience handling cardiac arrest scenarios can show an increased rate of recognition, there have been no studies about how simulated training would impact this metric. [23] Along with using simulated scenarios, the use of standardized callers is also another

aspect which has not been utilized until now. Going forward, 9-1-1 call centers should consider using simulated training to improve their dispatcher's ability to recognize cardiac arrest events.

Effects on Dispatcher Experience on Performance

The secondary questions within this thesis were to examine the effects of experience as a 9-1-1 dispatcher on recognition of CPR. When analyzing the first question (how many years spent as a dispatcher), there is an increased rate of recognition (6%), but under statistical analysis this increase was not found to be significant. The same goes for the second issue (how many years at the call center as of the time of study), where there is an increased rate of recognition (8%) but again the increase was not found to be statistically significant. Though from a descriptive analysis viewpoint, there is an indication that experience can help with rate of recognition, this must be tempered with the fact that there were missing data points and that not all call centers provide their dispatchers with the same type of training which can lead to a predictive analysis. Some call centers required their dispatchers to ask questions which could play a role in rate of recognition, which other call centers would not be able to account for. This does not directly indicate that experience does not play a role in cardiac event recognition, but does illustrate that not all 9-1-1 dispatchers are given the same experience and trainings, and thus just analyzing experience as a metric, without taking other issues into account, clouds the ability to properly measure and analyze this question.

Limitations

Simulated training can have its advantages and disadvantages. [24] Though effectiveness of T-CPR is not a question for this thesis, nor specifically the STAT-911 parent study, knowing and

understanding outcome effectiveness would be a desired result, thus study is limited in not being able to address this issue. Being able to learn from previous experiences can allow for training to be modified, in order that effectiveness can be measured. Further, the characteristics of the caller, victim, and dispatcher could factor into the quality of T-CPR delivered, outside of simulated training scenarios. Other limitations could stem from the differences between the various call centers involved in the STAT-911 parent study. Oregon call centers dictated that their dispatchers were to ask about whether the caller had access to an AED (Automated External Defibrillator), and furthermore these call centers also asked callers if the event was because of an overdose, hanging, or drowning. These additional inquiries could possibly skew the data as to the rate of recognition for beginning T-CPR instruction. The concern here would be that when one call center requires its dispatchers to ask additional questions of callers, versus another call center which does not require such inquiries, time to start T-CPR instructions could be impacted.

Conclusion

The simulated training analyzed and discussed in this thesis has shown that the more training dispatchers receive, the better able they are to recognize a sudden cardiac arrest event and begin T-CPR instructions.

Reference Section:

[1] Huu Tam Truong, Li Shien Low, Karl B. Kern. Current Approaches to Cardiopulmonary Resuscitation. Curr Probl Cardiol. 2015 Jul;40(7):275-313. doi: 10.1016/j.cpcardiol.2015.01.007. Epub 2015 Jan 23. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0146280615000080

[2] National Center for Health Statistics. Citing: Health, United States, 2015. CDC [Web site] Last updated: March 17, 2017. Available at: https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm .

[3] CPR & First Aid Emergency Cardiovascular Care, American Heart Association [Web site] Statistical Update: 2016. © 2017 American Heart Association, Inc. Available at: http://cpr.heart.org/AHAECC/CPRAndECC/General/UCM_477263_Cardiac-Arrest-Statistics.jsp .

[4] Richard O. Cummins, Joseph P. Ornato, William Theis, Paul E. Pepe. Improving survival from sudden cardiac arrest: the "chain of survival" concept. A statement for health professionals from the Advanced Cardiac Life Support Subcommittee and the Emergency Cardiac Care Committee, American Heart Association. Circulation. 1991 May;83(5):1832-47. Available at: http://circ.ahajournals.org.offcampus.lib.washington.edu/content/83/5/1832.long .

[5] Fabrice Dami, Eric Heymann, et al. Time to identify cardiac arrest and provide dispatch-assisted cardio-pulmonary resuscitation in a criteria-based dispatch system. Resuscitation. 2015 Dec;97:27-33. doi: 10.1016/j.resuscitation.2015.09.390. Epub 2015 Oct 1. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0300957215008047

[6] Miranda Lewis, Benjamin Stubbs, Mickey Eisenberg. Dispatcher-Assisted Cardiopulmonary Resuscitation Time to Identify Cardiac Arrest and Deliver Chest Compression Instructions. Circulation. 2013 Oct 1;128(14):1522-30. doi: 10.1161/CIRCULATIONAHA.113.002627. Epub 2013 Aug 27. Available at: http://circ.ahajournals.org.offcampus.lib.washington.edu/content/128/14/1522.long

[7] E. Brook Lerner, Thomas D Rea, et al. Emergency medical service dispatch cardiopulmonary resuscitation prearrival instructions to improve survival from out-of-hospital cardiac arrest: a scientific statement from the American Heart Association. Circulation. 2012 Jan 31;125(4):648-55. doi: 10.1161/CIR.0b013e31823ee5fc. Epub 2012 Jan 9. Available at: http://circ.ahajournals.org.offcampus.lib.washington.edu/content/125/4/648.long

[8] Mickey S. Eisenberg. Incidence and significance of gasping or agonal respirations in cardiac arrest patients. Curr Opin Crit Care. 2006 Jun;12(3):204-6. doi: 10.1097/01.ccx.0000224862.48087.66. Available at: https://insights-ovid-com.offcampus.lib.washington.edu/pubmed?pmid=15928464

[9] Camilla Hardeland, Kjetil Sunde, et al. Factors impacting upon timely and adequate allocation of prehospital medical assistance and resources to cardiac arrest patients. Resuscitation. 2016 Dec;109:56-63. doi: 10.1016/j.resuscitation.2016.09.027. Epub 2016 Oct 18. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0300957216304981

[10] Hidetada Fukushima, Masami Imanishi, et al. Abnormal breathing of sudden cardiac arrest victims described by laypersons and its association with emergency medical service dispatcher-assisted cardiopulmonary resuscitation instruction. Emerg Med J. 2015 Apr;32(4):314-7. doi: 10.1136/emermed-2013-203112. Epub 2014 Jan 8. Available at: https://www-ncbi-nlm-nih-gov.offcampus.lib.washington.edu/pmc/articles/PMC4392227/

[11] Martha Wolfskeil, Maxim Vanwulpen, et al. Detection and quantification of gasping during resuscitation for out-of-hospital cardiac arrest. Resuscitation. 2017 Jun 3;117:40-45. doi: 10.1016/j.resuscitation.2017.05.031. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0300957217302423

[12] Jacek Smereka, et al. Are physicians able to recognition ineffective (agonal) breathing as element of cardiac arrest? Am J Emerg Med. 2016 Jun;34(6):1165. doi: 10.1016/j.ajem.2016.03.002. Epub 2016 Mar 4. Available at:

http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0735675716001844?via%3Dihub

[13] Travers S, Jost D, et al. Out-of-hospital cardiac arrest phone detection: Those who most need chest compressions are the most difficult to recognize. Resuscitation. 2014 Dec;85(12):1720-5. doi: 10.1016/j.resuscitation.2014.09.020. Epub 2014 Oct 2. Available from: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S030095721400762X

[14] American Heart Association Recommends Standards to Improve Dispatcher-Assisted CPR. Sept. 26, 2016 Available at: http://www.jems.com/articles/2016/09/american-heart-association-recommends-standards-to-improve-dispatcher-assisted-cpr.html

[15] Jerry P Nolan, Jasmeet Soar, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 1. Executive Summary. Resuscitation. 2010 Oct;81(10):1219-76. doi: 10.1016/j.resuscitation.2010.08.021. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0300957210004478

[16] Emmanuel Besnier, Credric Damm, et al. Dispatcher-assisted cardiopulmonary resuscitation protocol improves diagnosis and resuscitation recommendations for out-of-hospital cardiac arrest. Emerg Med Australas. 2015 Dec;27(6):590-596. doi: 10.1111/1742-6723.12493. Epub 2015 Oct 9. Available at: http://onlinelibrary.wiley.com.offcampus.lib.washington.edu/doi/10.1111/1742-6723.12493/abstract;jsessionid=C5D2233E91DAA48A05F7A4CA5148DF37.f02t03

[17] Gareth R. Clegg, Richard M Lyon, et al. Dispatcher-assisted CPR: where are the hold-ups during calls to emergency dispatchers? A preliminary analysis of caller-dispatcher interactions during out-of-hospital cardiac arrest using a novel call transcription technique. Resuscitation. 2014 Jan;85(1):49-52. doi: 10.1016/j.resuscitation.2013.08.018. Epub 2013 Sep 1. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0300957213004516

[18] Tonje S. Birkenes, et al. HOW to train for telephone-CPR. *Trends in Anaesthesia and Critical Care*, vol 5, no. 5, pp. 124-129. DOI: 10.1016/j.tacc.2015.07.003 Available at: http://www.trendsanaesthesiacriticalcare.com/article/S2210-8440(15)30006-X/pdf

[19] Gavin D. Perkins, et al. Teaching recognition of agonal breathing improved accuracy of diagnosing cardiac arrest. Resuscitation. 2006 Sep;70(3):432-7. Epub 2006 Jul 10. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0300957206000517?via%3Dihub

[20] William C. McGaghie, Viva J. Siddall, Paul E. Mazmanian, Janet Myers, and FCCP. Lessons for continuing medical education from simulation research in undergraduate and graduate medical education: effectiveness of continuing medical education: American College of Chest Physicians Evidence-Based Educational Guidelines. Chest. 2009 Mar;135(3 Suppl):62S-68S. doi: 10.1378/chest.08-2521. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0012369209601768?via%3Dihub

[21] Kevin M O'Neil, FCCP, Doreen J Addrizzo-Harris, and FCCP. Continuing medical education effect on physician knowledge application and psychomotor skills: effectiveness of continuing medical education: American College of Chest Physicians Evidence-Based Educational Guidelines. Chest. 2009 Mar;135(3 Suppl):37S-41S. doi: 10.1378/chest.08-2516. Available at: http://www.sciencedirect.com.offcampus.lib.washington.edu/science/article/pii/S0012369209601720?via%3Dihub

[22] Loai I Tawalbeh. Effect of Simulation on the Confidence of University Nursing Students in Applying Cardiopulmonary Assessment Skills: A Randomized Controlled Trial. J Nurs Res. 2017 Aug;25(4):289-295. doi: 10.1097/JNR.0000000000000170. Available at: https://insights-ovid-com.offcampus.lib.washington.edu/pubmed?pmid=28683017

[23] Hendrika Meischke, Ian Painter, Anne M. Turner, Marcia R. Weaver, Carol E. Fahrenbruch, Brooke R. Ike, Scott Stangenes. Protocol: simulation training to improve 9-1-1 dispatcher identification of cardiac arrest. BMC Emerg Med. 2016 Feb 1;16:9. doi: 10.1186/s12873-016-0073-6. Available at: https://www-ncbi-nlm-nih-gov.offcampus.lib.washington.edu/pmc/articles/PMC4736553/

[24] Brooks N, Moriarty A, Welyczko N. Implementing simulated practice learning for nursing students. Nurs Stand. 2010 Jan 20-26;24(20):41-5. doi: 10.7748/ns2010.01.20.24.20.41.c7454 Available at: http://eds.b.ebscohost.com.offcampus.lib.washington.edu/ehost/pdfviewer/pdfviewer?vid=1&sid=b01b81ff-2c4e-407c-99f2-db55db0c147a%40sessionmgr104

Appendix of Tables

Table 1 – Demographics of the Intervention Group.

Intervention Group	N(66)	%
Gender		
Female	50	75.8
Male	16	24.2
Missing	0	
Ethnicity		
Not Hispanic/Latino	56	87.5
Hispanic/Latino	8	12.5
Missing	2	
Race		
Non-White	0	0

White	63	100
Missing	3	
Age		
<25	4	6.1
26-29	8	12.1
30-34	14	21.2
35-39	8	12.1
40-44	17	25.8
45-49	4	6.1
50-54	7	10.6
55-59	2	3
60-64	2	3
64+	0	0
Missing	0	
Years of Experience Mean (SD)	9.3	(7.9)

Table 2 – Script*/Actor details by call

			Script 1		Script 2		Script 3		Script 4	
Call number**	N calls		N	(%)	N	(%)	N	(%)	N	(%)
1	66		17	(26)	16	(24)	17	(26)	16	(24)
2	66		15	(23)	18	(27)	16	(24)	17	(26)
3	66		18	(27)	15	(23)	16	(24)	17	(26)
4	66		16	(24)	17	(26)	17	(26)	16	(24)

			Actor***					
			Actor D		Actor E		Actor J	
Call number	N calls		N	(%)	N	(%)	N	(%)
1	66		26	(39)	25	(38)	15	(23)
2	66		19	(29)	29	(44)	18	(27)
3	66		22	(33)	24	(36)	20	(30)
4	66		14	(21)	32	(48)	20	(30)

* Script – Refers to the specific scenario each Dispatcher participated in, with each script becoming progressively more difficult.
** Call number – Refers to each of the four (4) simulated training sessions each dispatcher participated in.
*** Actor – Refers to the Standardized Caller used for each scenario the Dispatcher participated in.

Table 3 – Fail/Pass rates by call characteristics

	N	N Pass	% Pass
All calls	259	231	89%
Script*			
1	66	63	95%
2	66	66	100%
3	65	54	83%
4	62	48	77%
p-value			0.000****
Actor**			
D	81	68	84%
E	105	96	91%
J	73	67	92%
p-value			0.186****

Call***			
1	66	54	82
2	65	55	85
3	62	59	95
4	66	63	95
p-value			0.018****

* Script – Refers to the specific scenario each Dispatcher participated in, with each script becoming progressively more difficult.
** Actor – Refers to the Standardized Caller used for each scenario the Dispatcher participated in.
*** Call – Refers to each of the four (4) simulated training sessions each dispatcher participated in.
**** Chi-square Test

Table 4 – Transition and Instruction Times

	N calls with need identified	Median – Transition Time(seconds)	Mean – Transition Time(seconds)	(sd)	Range (Min – Max)
Call*					
1	54	71	74.646	27.0174	32 – 145
2	55	70	70.969	22.947	33 – 132
3	59	62	66.597	22.921	30 – 151
4	63	61.5	61.818	15.804	27 – 92
		Median – Instruction Time(Seconds)	Mean – Instruction Time(Seconds)		
1	54	76	84.631	32.548	36 – 152
2	55	79.5	81.203	25.789	35 – 135
3	59	71.5	75.403	25.249	36 – 157
4	63	69	71.015	20.703	36 – 128

* Call – Refers to each simulated call session that the Actors and Dispatchers participated in.

Table 5 – Results of Years of Experience, Fail/Pass based on Label*.

	Fail(%)	Pass(%)	N
# of years as a 9-1-1 Dispatcher.			
<2 years of experience	15(15)	88(85)	103**
>2 years of experience	13(9)	125(91)	138**
# of years at 9-1-1 communications center, at time of study.			
<2 years of experience	14(17)	69(83)	83**
>2 years of experience	14(9)	147(91)	161**

* Label – Refers to the scenarios that each Dispatcher participated in. A total of 4 call scenarios were used.

** Missing data/observations can be contributed to possible lack of an answer from some of the dispatchers who participated in the study.