Impact of High Fidelity Simulation Training on the Quality of Cardiopulmonary Resuscitation Performance among Emergency Medical Services (EMS) Professionals in Pune, India

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Abstract

Introduction: The provision of high quality cardio pulmonary resuscitation (CPR) is a key modifiable factor associated with survival in cardiac arrest. Management of a patient with cardiac arrest is a dynamic and high-pressure challenge requiring critical decision making in a short period of time. Numerous studies emphasize that quality of chest compressions directly influences survival rate from cardiac arrest. Hence, improving CPR quality is of paramount importance. This can be achieved by accurate measurement of various CPR metrics and provision of real time feedback to the rescuer.

Objective: The study aims to assess impact of high fidelity simulation training on quality of CPR performance of EMS Professionals.

Methods: A high fidelity manikin was utilized to create four unique healthcare simulation scenarios based on cardiac arrest. The manikin software was capable of capturing real-time CPR data and measured parameters like chest compression depth (CCD), chest compression rate (CCR), chest recoil (CR) and chest compression fraction (CCF). The participants were initially taught the assessment and management of cardiac arrest. The participants underwent a pre-intervention test conducted on high fidelity manikin. The CPR metrics were recorded during the session. The participants were then imparted training with real time CPR feedback for a period of two months. This was followed by a post-intervention test and the CPR metrics of both tests were compared.

Discussion: The participants showed improvement in chest compression depth and chest compression rate but the chest recoil frequency and chest compression fraction decreased after the two-month intervention period. The overemphasis on achieving target depth and rate led to ignorance of the other two parameters affecting overall quality of CPR.

Conclusion: Maintaining adequate attention on all aspects of CPR metrics is a complex challenge even for trained professionals. Utilizing technology for real-time feedback is a reliable method to gauge improvement in quality of CPR during training sessions of EMS professionals.

***Keywords**: Cardio Pulmonary Resuscitation(CPR), Chest compression rate (CCR), chest compression fraction (CCF), Emergency Medical Services Professionals.*

Introduction

The provision of high quality cardio pulmonary resuscitation (CPR) is a key modifiable factor associated with survival in cardiac arrest. Despite its significance, the sustained delivery of high quality CPR is not achieved in regular clinical practice.[1] Management of a patient with cardiac arrest is a dynamic and high-pressure challenge requiring critical decision making in a short period of time. A study conducted to evaluate the impact of comprehensive effort to improve trauma care through multidisciplinary education showed that improvements in team performance using innovative technology can translate into more efficient care with fewer errors.[2] There has been an increased focus on high quality of CPR with greater emphasis on the quality of chest compressions.[3] Numerous studies emphasize that quality of chest compressions directly influences survival rate from cardiac arrest.[4-7] The various parameters in CPR associated with improved survival include greater CPR fraction, greater depth of compression, optimum compression rate and briefer peri-shock pauses.[8-12] Hence, improving CPR quality is of paramount importance. This can be achieved by accurate measurement of various CPR metrics and provision of real time feedback to the rescuer.[13-14]

Current systems used to train, assess and provide performance feedback reveal poor performance in CPR.[15-18] Very few studies have focused on improving CPR quality using high fidelity simulation and real time feedback.[19] Yet, distributed CPR training with real time feedback has shown to improve compliance to American Heart Association (AHA) guidelines of quality of CPR.[20]

Objective: To assess impact of high fidelity simulation training on quality of CPR performance among EMS Professionals.

Methods

A high fidelity manikin was utilized to create four unique healthcare simulation scenarios based on cardiac arrest i.e. Ventricular Fibrillation (VF), pulseless Ventricular Tachycardia (pVT), Asystole, Pulseless Electrical Activity (PEA). The manikin software was capable of capturing real-time CPR data and measured parameters like chest compression depth (CCD), chest compression rate (CCR), chest recoil (CR) and chest compression fraction (CCF) using sensors and potentiometer present in manikin chest. The scenarios were dry run by facilitators before the student sessions. 50 EMS professionals participated in the study. The participants were initially taught the assessment and management of cardiac arrest through didactic lecture method and case study discussions. For the pre-intervention test, the participants were divided into four groups and prebriefed on the features of high fidelity simulation manikin and the background of their respective cases. Informed consent was taken from participants to record the sessions. Each simulation session lasted for approximately 10 minutes followed by structured debriefing lasting for 20 minutes. The CPR metrics were recorded for the sessions. Over the next 8 weeks, participants were trained on various cardiac arrest scenarios using High fidelity simulation. Each simulation training session lasted for four hours and the participants were provided real time feedback on their performance on various CPR metrics. At the end of 8 week period, the participants underwent post intervention test structured in the same format as the pre-intervention test. CPR metrics were again recorded for the 4 case scenarios during the test. The pre-intervention vs post-intervention data was tabulated and analyzed for difference in means.

Results

The study focused on major four key metrics to determine the quality of CPR i.e. chest compression depth, chest compression rate, chest recoil and chest compression fraction.

The pre and post intervention values have been tabulated below:

Table 1: Mean CPR Metrics (Pre-intervention vs Post-intervention)

Parameters	Pre-intervention Means	Post-intervention Means
CCD (% of time)	55.25	61
CCR (per min)	95.77	112.50
CR (% of time)	94.75	91.25
CCF (% of time)	56.75	51.50

Discussion

Chest compressions create blood flow by increasing intrathoracic pressure and directly compressing the heart which in turn results in critical blood flow and oxygen delivery to the heart and brain. Sufficient chest compression depth (about 5cm as per AHA 2015 guidelines) is essential for effective CPR. The participants could achieve optimal chest compression depth for only 55% of time during the CPR in the pre-intervention test. This improved to 61% in the post intervention test. Although reasonable improvement was recorded, yet the values show that greater practice is required to reach optimal compression depths which can be sustained throughout the CPR process.

Apart from depth of compression, AHA 2015 guidelines recommend maintaining a steady chest compression rate of atleast 100-120/minute is crucial for the effectiveness of CPR. The participants achieved a mean rate of 95.77/min during the pre-intervention test which improved significantly to 112.50/min i.e. ideal range in the post intervention phase.

Chest compression recoil is vital during CPR as it allows for maximum possible output with each compression during CPR. Interestingly, the chest recoil was achieved for 94.75 % of the time in the pre intervention phase but it reduced to 91.25 % of the time in the post intervention phase. This finding lays emphasis on conveying the significance of complete chest recoil during training. The participants are pre – occupied with achieving target chest compression rates thereby, not fulfilling requirement of complete chest recoil during all compressions.

Chest compression fraction is the percentage of time in which chest compression are done by rescuers during a cardiac arrest. An increased CCF is independently predictive of better survival. The AHA 2015 guidelines recommend that the CCF should be maintained at atleast 60%. In the pre-intervention phase, the recorded fraction was 56.75% which surprisingly decreased to 51.50 % in post intervention phase. This could be attributed to greater time spent in checking pulse and rhythm analysis during the scenario. This could have occurred due to greater awareness of the medical conditions learnt during the intervention leading to more inquisitiveness on the cause and diagnosis during the scenario.

The study shows that greater focus and attention is paid to CCD and CCR whereas CR and CCF are ignored, thereby affecting the overall quality of CPR. A wholesome approach on all metrics during training can help tide over this problem.

Technology allows for real-time monitoring recording and feedback on CPR performance metrics. This data can be used during debriefing after resuscitation to improve the quality of CPR among EMS Professionals.

Conclusion

Maintaining adequate attention on all aspects of CPR metrics is a complex challenge even for trained professionals. Utilizing technology for real-time feedback is a reliable method to gauge improvement in quality of CPR during training sessions of EMS professionals. The study is limited by its sample size and short intervention period, yet throws light on importance of key CPR performance metrics through objective data.

Source of Funding: Self

Conflict of Interest: Nil

Ethical Clearance: Taken from IEC, SIU

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