



Before First Two Minutes: A Quality Improvement Project Aimed at Decreasing the Time to Defibrillation for In-patients at High Risk of Having a Cardiac Arrest

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Abstract: The time from cardiac arrest to the administration of Cardio Pulmonary Resuscitation (CPR) and defibrillation have been shown to influence the outcome of a cardiac arrest in the hospital setting. Both the time to defibrillation and the start of CPR could be influenced by several factors including patient's physical environment, system based problems, promptness to calling for help, the availability of the code equipment and patient readiness for a CPR or Advance Cardiac Life Support (ACLS). In order to cut down on these barriers to a successful code, a pre-code readiness training was administered to hospital staff with various background and level of responsibilities. The goal of the program was to reduce the response time to in-hospital cardiac arrest by focusing on the factors which have been reported to increase the response time such as lack of a vascular access, equipment malfunction or even discrepancies in alerting hospital-wide resuscitation response. Twelve questions were prepared to address the main aspects that could reduce the time to defibrillation to below 2 minutes and contribute to the success of a code. A total of 125 volunteers were trained. First they completed a questionnaire with 12 questions on how to prepare both the patient and their environment to a possible emergent medical intervention or a cardiac arrest. Next, they received training on how they could assist in preparing a deteriorating patient or patient at a high risk of having a cardiac arrest during that admission. After the training, they were invited into the simulation center where there was a deteriorating virtual patient and a typical patient room environment was simulated, and a real life situation was simulated. There was a statistically significant difference in the before and after training response to each of the questions. Prior to the training, 968 answers to these questions were correct. After the training, 1484 answers were correct (Value is < 0.00001). The difference in the correct answers before and after the training was statistically significant for each of the questions. Most code situations are disorganized and the hypothesis is that recognizing a patient at a high risk of having a cardiac arrest and preparing the patient and his environment to a cardiac arrest may lead to a better outcome. This training program covered the most common patient related factors, environmental aspects and equipment related factors that could contribute to rapid intervention and consequently to a successful code.

Keywords: Response Time, Equipment Malfunction, Preparing High Risk Patients, Deteriorating Patient

1. Introduction

An estimated 200,000- 750,000 hospitalized patients have an in-hospital cardiac arrest each year in the United States [1, 2] and less than 25% of these patients survive to hospital discharge. [3, 4] This high incidence of cardiac arrest represents a major public health concern. [5] In the past 40 to 50 years, several attempts have been made to improve the

survival rate in patients with in-hospital cardiac arrest, but not much improvement has been noted. To the best of our knowledge, very few studies have examined trends in survival after in-hospital cardiac arrest. One main study showed no significant change in survival to discharge among hospitalized Medicare patients undergoing Cardiopulmonary Resuscitation (CPR) from 1992 through 2005. [6] From 2012 to 2016, survival rates for in-hospital cardiac arrest ranged

from 22.7 to 25.5, and there was no consistent improvement in the survival rates. [7] There was no significant improvement in the trend of survival in the in-hospital Cardiac arrest from 2012 to 2016. A report of 14,720 cardiac arrests from the National Registry of Cardiopulmonary Resuscitation on Cardiopulmonary Resuscitation of adults in the hospital revealed that only 17% of all adult arrest patients survive to hospital discharge. [8] In hospital cardiac arrest is usually caused by underlying cardiac conditions and patients have demonstrable deterioration prior to the event. [3, 5] Response time to in-hospital cardiac arrest which is the time from onset to Return of Spontaneous Circulation (ROSC) may reduce the severity of post cardiac arrest syndrome. Outcomes for in-hospital cardiac arrest vary greatly across institutions with risk adjustment survival rates ranging from 12.4 percent in the bottom decile of hospitals to 22.7 percent in the top hospitals. [1] Differences in hospital characteristics can account for some of the differences, but there are really no consistent, clear and reliable data that can be used to inform changes.

Cardiac arrest is largely unpredictable and the outcome depends on rapid diagnosis and intervention. There are major differences in how in-hospital cardiac arrest situations are managed throughout the United States and there is room for improvement in this area of medicine. In a study conducted by Chan et al. in 2008, they determined that defibrillation provided more than two minutes after the initial arrest occurred in 30 percent of patients and this was associated with a significantly lower probability of surviving to hospital discharge after multivariate risk adjustment. [9] Some other studies reported adjusted rates of delay in time to defibrillation ranging from 2 to 51 percent, across hospitals for patients with ventricular fibrillation and pulseless ventricular tachycardia related cardiac arrest. [10] These almost 25 fold delays are likely due to differences in hospital related factors. Another study reported adjusted rates of delays in time to defibrillation that was nearly 25-fold (delayed defibrillation rates ranging from 2 to 51 percent) across hospitals for patients with ventricular fibrillation and paroxysmal ventricular tachycardia cardiac arrests, likely because of differences in hospital-level factors [11, 12] System based errors have also been identified as contributing factors to the delay in time to defibrillation. 13 Some of the errors identified include: lack of a vascular access, protocol deficiencies equipment malfunction, discrepancies in alerting hospital wide resuscitation response, medications, airway management and quality of CPR. [13, 14, 15] Certain periarrest factors pose risk for poorer neurologic and functional outcomes. Time to defibrillation is a key determinant. Patients for whom defibrillation time is greater than two minutes have a significantly higher risk of permanent disability following cardiac arrest. [9]

Our training program was focus on improving some of these component that have been shown to lead to an increase time to defibrillation and subsequently to poor patient outcome.

2. Aim

The goal of our program was to reduce the response time to in-hospital cardiac arrest by focusing on the factors which have been reported to increase the response time such as lack of a vascular access, equipment malfunction or even discrepancies in alerting hospital wide resuscitation response.

Secondly, the program was aimed at creating awareness on how any hospital staff even staff not involved in a particular patient care could contribute towards decreasing the time from cardiac arrest to defibrillation and thus contributing to the success of a possible cardiac arrest.

3. Methods

A questionnaire with twelve questions including aspects that have been identified as barriers to prompt defibrillation and consequently to a successful code was created. These questions were validated by patient care members with different levels of expertise. Hospital personnel were randomly invited to participate in the training, and based on their availability, 125 hospital personnel participated in the training. First they completed a questionnaire with 12 questions on how to prepare both the patient and their environment to a possible emergent medical intervention or a cardiac arrest. The questions were totally anonymously answered. After then, they received training on how they could assist in preparing a deteriorating patient or a patient with a high risk of having a cardiac arrest. After the training, they were invited into the simulation center where there was a deteriorating virtual patient and a typical patient room environment was simulated. They were then placed in this room and a real life situation was simulated with a deteriorating virtual patient. They were told that the patient was not doing great and it was possible that the patient may soon need a higher level of care. The patient's bedside nurse was actively working with the patient and they were asked to assist in making sure that if that patient got worse, there should be no barriers to reviving the patient. Each of the candidates was observed as they put into practice what they had learnt in the training.

4. Results

A total of 125 people answered the twelve questions before and after the study. Out of 125 participants, 81 of them (64.8%) knew that having a patient on a monitor could reduce the time from cardiac arrest to defibrillation as compared to 125 (100%) participants ($p < 0.001$) after receiving the training. Before the training, 93 of 125 participants stated that the patient needed to be placed on O₂ or at least make sure O₂ was available if needed, but after the training, all 125 participants ($p < 0.001$) responded that they had to get the patient on O₂ or at least make sure O₂ was readily available if needed. Just 58.4% of the (Table 1) participants thought that they should remove any unwanted objects positioned in a way that could crowd and obstruct

responders from administering defibrillation within two minutes as recommended. After the training, 100% of the participants agreed that these objects needed to be removed from the bedside. Also as noted on the table there was a statically significant difference in the number of people who thought a backboard needed to be readily available to place on the patient's back prior to CPR before and after the training. By the same token, before the training 61.6 of the participants thought that it was important to adjust the bed level for a possible CPR/ACLS and for defibrillation but after the training, 98.4% of the trainees agreed that it is important to get the bed at a comfortable level for CPR/ACLS and for defibrillation ($P < 0.001$). There was also a statistically significant difference between the participants who though having available and appropriately functioning equipment was important in achieving a less than two-minute time lapse from when a patient has a cardiac arrest to when the patient receives defibrillation. Before the training, 51.2% of the participants did not think it was necessary to place the monitor in a position that the team leader could easily see and so determine the next step in the care, but after the training, all of the participants agreed that placing the

monitor in a visible position for the team lead could reduce the time to defibrillation and so contribute to a successful code. Prior to the training 89 participants (71.2%) as compared to 125 participants (100%) $P < 0.0001$ after the training thought it was important to make sure patients at high risk of going into cardiac arrest have an intravenous access. Before the training, only 96 participants (76.8%) knew the right numbers to call for a code or emergency help, but after the training, this number rose to 125 participants (100%) ($P < 0.001$).

Finally, prior to the training, 968 answers to these questions were correct. After the training, 1484 answers were correct (Value is < 0.00001). As shown in the table, the correct answers before and after the training all had a statistically significant difference for each question on the table. The difference was statistically significant for each of the questions. This indicated that there is a gap in knowledge on how to improve the time from recognition of a cardiac arrest to the defibrillation and so improving the chances of having a successful code in patients at high risk of having a cardiac arrest.

Table 1. Questionnaire with the total pre training and post training responses to each question.

Questions	Pre training	Pre training %	Post training	Post training %	P-Value
Was patient placed on a monitor?	81	64.8	125	100	0.0001
Was patient placed on oxygen	93	74.4	125	100	0.0001
Were all unwarranted objects that could crowd area removed?	73	58.4	125	100	0.0001
Was a back board placed under the patient?	63	50.4	123	98.4	0.0001
Position bed for BLS (Lower patient bed for better compressions and) take the head of the bed off	77	61.6	116	92.8	0.0001
Were pads /defibrillator/AED applied to the patient's chest?	72	57.6	125	100	0.0001
Were the ambu bag and all airway equipment made available and connected to oxygen source on the wall	80	64.0	125	100	0.0001
Place monitor in a visible position to the team leader?	64	51.2	125	100	0.0001
Was a code cart obtained?	107	85.6	125	100	0.0002
Were the CPR personnel position for CPR?	73	58.4	120	96.0	0.0001
Make sure patient has an IV access	89	71.2	125	100	0.0001
Which number do you call for all emergencies?	96	76.8	125	100	0.0001

5. Conclusions

Most code situations are disorganized and the hypothesis is that recognizing a patient at a high risk of having a cardiac arrest and preparing the patient and his environment to an eventual successful code may be of great benefit to the patient. This training program covered the most common environmental aspects that could contribute to rapid intervention and consequently a successful code. To the best of our knowledge, very few studies have focused on environmental and patient-centered factors in high-risk patients that could influence the outcome of the code, especially factors that could reduce the time to defibrillation to less than two minutes. We would like to see more studies that focus on environmental factors that can influence the outcome of a code.

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