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Resuscitation Quality Improvement Mortality Rates

Jordan Priest
University of Missouri-St. Louis, jmpb9w@umsystem.edu

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Jordan Marie Priest

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Advisory Committee
Susan Dean-Baar, PhD, RN, FAAN
Chairperson

Nancy Magnuson, DNS, CS, FNP-BC, RN

Amelia Payne, DNP, RN

Abstract

This project explores and answers the question: What is the impact of Resuscitation Quality Improvement (RQI) on survival at discharge rates after suffering an In-Hospital Cardiac Arrest (IHCA) when compared to every two-year Basic Life Support (BLS)/Advanced Cardiac Life Support (ACLS) training? Literature review found a lack of research on survival to discharge rates, when comparing resuscitation training methods, BLS/ACLS and RQI. The design was a descriptive comparative evaluation of BLS/ACLS and RQI survival to discharge rates. The setting of the study is the east region of a midwestern faith-based health care system, that includes four hospitals in one state including both urban and rural facilities. A retrospective chart review was conducted on data from the period prior to the initiation of RQI and after the initiation of RQI. Data analysis included descriptive statistics for the two groups and t-tests and chi-square to compare the two groups for gender, admitting diagnosis, prior efforts before initiation of CPR, outcome of CPR efforts and discharge status. The results of the overall data, not specific to individual sites, of BLS/ACLS and RQI and status at discharge observed significant, x^2 (1) = 5.48, and p= 0.019, with less than expected values for survival at discharge after the initiation of RQI. Site A had greater than expected values for survival at discharge, x^2 (1) = 4.61, p= 0.032. Site B had less than expected values for survival at discharge, x^2 (1) = 4.68, p= 0.031. Site C had less than expected values at discharge, x^2 (1) = 4.18, p= 0.041. Site D showed no significance, x^2 (1) = 2.75, p= 0.097. The findings show that overall survival to discharge didn't improve with implementation of RQI and only Site A showed a significant improvement in survival to discharge. Patients who suffer an IHCA are critically ill and the skills of the providers during these situations is

only one variable that will impact survival. With this, the continuous need to utilize and evaluate evidence-based practices for cardiac resuscitation is necessary to implement resuscitation training with the most positive outcome.

Keywords: survival at discharge, cardiac arrest

Resuscitation Quality Improvement Mortality Rates

Cardiac arrest claims the life of one in every 7.4 Americans and appears on 13.5% of death certificates as the leading cause of death (Benjamin, et al., 2018). In the United States, in-hospital cardiac arrests (IHCA) will occur in over 290,000 adults a year and out-of-hospital cardiac arrests will occur in 350,000 adults a year (Andersen, Holmberg, Berg, Donnino, & Granfeldt, 2019). Data shows in the United States the average age of patients who suffer an IHCA is 66 years of age with 58% being men who have an unshockable rhythm including asystole or pulseless electrical activity (Andersen et al., 2019). With the large number of individuals suffering a cardiac arrest within the United States a year, adequate training, knowledge, and skills is essential for positive patient outcomes.

Basic Life Support (BLS) and Advanced Cardiac Life Support (ACLS) is specialized training that was credentialed by the American Heart Association (AHA). Individuals were recertified every two years by completing the training process again. Delayed response to initiation of cardiopulmonary resuscitation (CPR) in cardiac arrest may be the result of the high level of pressure and difficultly remembering ACLS and BLS knowledge during a medical emergency. Medical professionals have expressed concern that there is a problem in them recalling the knowledge and skills learned in ACLS and BLS during a medical emergency. Studies have found that during these events, ACLS and BLS knowledge steps and skills can be forgotten. Nambair, Nedungalaparambil, & Aslesh, (2016) found that 53% of healthcare professionals in the study recalled Circulation-Airway-Breathing (C-A-B) as the correct order for BLS resuscitation. Fifty-five percent of individuals knew the correct adult compression:

ventilation ratio is 30:2, 40% knew that pulse checks are completed every two minutes, and 38% knew that the pulse check should take no more than five to ten seconds. This basic knowledge could be the difference in a positive or negative outcome for an IHCA.

The AHA initiated a new certification model in 2015, that has replaced BLS and ACLS training. Research supports that psychomotor skills can deteriorate rapidly, and the current two-year certification process model doesn't maintain high-quality CPR skills that result in positive patient outcomes. The new Resuscitation Quality Improvement (RQI) program offers a new improved maintenance approach that sustains high-quality CPR skills by utilizing different learning processes that master the skills through low-dose, high-frequency training, and performance feedback (AHA, 2017). AHA in collaboration with Laerdal developed RQI that uses evidence-based research with best-practice guidelines, with Laerdal providing simulation/learning technology (AHA, 2017). RQI uses three components – cognitive training, psychomotor skills, and simulated patient cases. Cognitive training includes interactive lectures, videos, and web-based content to specific providers within the hospital. Psychomotor skills include sessions within the healthcare setting that monitor effectiveness of required skills on specialized equipment and report metrics on attainment of the skills. Simulated patient cases scenarios evaluate participants ability to assess and treat virtual patients and assess the participants ability to apply the acquired RQI skills to a real patient case.

This new model of RQI was introduced in the 3rd quarter of 2020 throughout a midwestern faith-based healthcare system with 45 acute care and specialty hospitals across four states. There is an opportunity for a quality improvement evaluation within one of the regions of this systems that includes rural and urban hospitals within one state.

The purpose of this project is to evaluate the effectiveness of the RQI initiative within one region of the healthcare system on the survival at discharge rate after suffering an IHCA in the inpatient setting.

To guide the development of this project, the Ottawa Model of Research Use will be utilized (White, Dudley-Brown, and Terhaar, 2021). The aim is to compare survival at discharge rates before and after the initiation of RQI. The primary outcome measure of interest is survival at discharge rate. The study question is: What is the impact of Resuscitation Quality Improvement on survival at discharge rates after suffering an IHCA when compared to every two-year BLS/ACLS training?

Literature Review

A literature review was conducted using the AHA website, and EBSCO, PubMed, OVID, and CINAHL databases. The keywords used for the database searches were *Resuscitation Quality Improvement CPR, RQI CPR, 30-day post mortality IHCA, and RQI mortality rates.* There was a yield of 2,253 initial publications generated before inclusion and exclusion criteria were applied. Inclusion criteria were evaluation of a Resuscitation Quality Improvement programs or IHCA mortality rates and studies were required to be published within the last five-years. Exclusion criteria were studies published more than five-years ago and studies that didn't include Resuscitation Quality Improvement programs or mortality rates. After the refined search, the number of generated publications was 15. The final number of publications selected for this literature review was 10 and narrowed down by quality and quantity of information (Appendix A).

In reviewing the literature, it was found that there is a gap in evidence-based literature that correlates the new AHA guideline RQI program and IHCA survival to discharge rates. Studies reviewing the prior ACLS guidelines found that high deviations from the AHA recommended ACLS guidelines were associated with a decreased likelihood of return of spontaneous circulation (ROSC) and survival to hospital discharge (Honarmand, Mepham, Ainsworth, & Khalid, 2018).

The incidence of an IHCA event occurring while hospitalized is 1 to 5 per 1000 admissions, with more than 290,000 IHCA a year (Schluep, Rijkenberg, Stolker, Hoeks, & Endeman, 2018; Anderson et al., 2019). Schleup, et al. (2018) report that in studies in the 1980-1990's survival to discharge after IHCA were 15. With the advancements in technology, evidence-based research, and medical procedures, they found the survival to discharge rates after experiencing an IHCA between 2003-2014, to be 18-27% and an overall one-year survival rate for patients admitted to the intensive care unit (ICU) after an IHCA was 26%.

Reviewed literature supports RQI programs for learning life saving measures. (Dudzik, et al., 2019; Kardong-Edgren & Oermann, 2020; Oermann, Krusmark, Kardong-Edgren, Jastrzembski, & Gluck, 2020; Panchal, Norton, Gibbons, Buehler, & Kurz, 2020; & Saramma, Raj, Dash, & Sarma, 2016). The AHA conducted a three-year developmental phase of the RQI program that evaluated sites and conducted pilot tests that measured the functionality of the RQI program (AHA, 2017.). Panchal et al. (2020) found that clinical compression fraction data from IHCA, before and after the quarterly initiation of a RQI program, improved from 83% pre-RQI to 93% post-RQI and compression rate per minute increased from 109 to 120. Kardong-Edgren & Oermann

(2020) studied students who had previously completed BLS training to the use of RQI training. Baseline data, collected prior to the first RQI session, showed adequate compression depth was completed 59% of the time and adequate rate of compression 42% of the time. After one RQI training session, student scores for the overall compression score mean increased from a pretest mean of 42.76 to a posttest mean of 77.87 and overall ventilation scores increased from a pretest mean of 19.06 to a posttest mean of 70.61 (Kardon-Edgren & Oermann, 2020).

Evaluation of CPR training frequency for participants completing four different training intervals including daily, weekly, monthly, and quarterly determined that shorter intervals between training sessions resulted in higher performance and skills are acquired faster (Oermann et al., 2020). When comparing the 396 participants that completed the training sessions, no participants were able to get a successful passing pretest score of the required 75% (Oermann et al., 2020). Overall means from the pretest to the final session increased for all four interval groups for both overall compression and overall ventilation. The shorter interval between training resulted in greater increases with the daily interval group showing the greatest increases in overall compression score and the daily and weekly group showing the greatest increase in overall ventilation score. While the idea of daily or weekly, RQI sessions may be unrealistic, monthly and quarterly training sessions did increase performance and increase retention of CPR skills.

Beneficial components of using the RQI program allows for real-time feedback from a manikin available 24/7 and decreases the cost of suppling an instructor for the instructor-led training. Dudzik et al. (2019) found that the initiation of a RQI program was cost effective in reducing the cost for the facility by 47.4%, when compared to the

traditional biennial BLS/ACLS. The cost of the RQI program is determined by institution characteristics and involves the types of courses required, the number of participants, and the number of simulation stations. Once the initial determination is made, the price is locked in and not effected by any guideline changes made by the AHA (AHA, 2017).

The review of literature supports the need for evaluation of the survival at discharge rates after the implementation of the RQI program. The literature supports the current AHA RQI guidelines and use of the RQI for maintenance of staff skills but has a gap in literature related to the impact on mortality rates and survival to discharge after the implementation of the program in facilities.

Limitations found in the literature reviewed included noncompliance from staff members, small sample sizes, inadequate timeframes, and not being able to differentiate the staff members that performed the lifesaving measures.

The Ottawa Model of Research Use will be used to guide this project. Developed by Logan and Graham, the Ottawa Model of Research Use views research as a dynamic process of actions and decisions that focus on the implementation efforts of already existing knowledge that is ready to be shared to others (White, Dudley-Brown, and Terhaar, 2021). The three current phases of the model include assess barriers and supports to the translation of the research into practice , monitor the interventions, and evaluate and monitor the outcomes (White, Dudley-Brown, and Terhaar, 2021). Utilizing the Ottawa Model is beneficial within this project as it uses all phases to evaluate the effectiveness of the RQI implementation. including assessing barriers to the implementation of RQI, monitoring the already implemented RQI intervention, and evaluate the survival to discharge outcome (Christenbery, 2017). The project will

evaluate the implementation of the RQI and the evaluation of the survival to discharge rate following IHCA after implementing the RQI.

Method

Design

To evaluate the proposed question a descriptive comparison design was used. The design will consist of a BLS/ACLS and RQI evaluation of quarterly survival to discharge rates prior to the initiation of the new RQI program and after the initiation of the new RQI program. During the pre-implementation period, the current life support training measures were the ACLS and BLS that were recertified every two years. During the post-implementation period, the RQI is being used with recertification every quarter.

Setting

The setting of the study is the east region of a midwestern faith-based health care system, that includes four hospitals in one state including both urban and rural facilities. The rural facility has a total of 140 beds that offers medical/surgical, cardiac, ICU/TCU, and OB services. The urban area hospitals include a 321-bed facility that offers medical/surgical, rehab, psych, cardiac, ICU/TCU, and OB services, a 767-bed hospital that includes medical/surgical, ICU/TCU, rehab, NICU, OB, cardiac, and psych services, and a 859 bed facility that offers medical/surgical, pediatric, NICU, ICU/TCU, cardiac, OB and psych services.

Sample

The population includes inpatients, 18 years of age and over, who experienced an IHCA between October 1, 2019, and, March 31, 2020 and inpatients, 18 years of age and older, who experienced an IHCA in between October 1, 2020 and March 31, 2021.

Inclusion criteria include an IHCA event within one of the four healthcare facilities between the dates of 10/1/2019-3/31/2020 or 10/1/2020-3/31/2021, be 18 years of age or older, and be documented within the organizations Epic Code Documentation. Exclusions will include IHCA younger than 18 years of age, cardiac arrest due to trauma, or cardiac arrests in the emergency department or during surgery.

Approval

The project was approved by the healthcare organization and University of Missouri-St. Louis IRB committees.

Data Collection and Analysis

Data for this project was provided by a liaison to the facilities resuscitation committee. Data was de-identified prior to being provided to the investigator. It was kept on a password protected computer. Reports generated for the purpose of the project will be deleted upon completion of the study. No paper records will be maintained for this project. Only project team members have access to the study data and the study records. Information provided included the patients, gender, hospital location, admitting diagnosis, novel coronavirus disease (COVID-19) results (for post RQI group) prior efforts before CPR initiation including rapid responses, outcome of CPR efforts, and discharge status (Appendix B).

Data analysis included descriptive statistics for the two groups and t-tests and chi-square to compare the two groups for gender, admitting diagnosis, prior efforts before initiation of CPR, outcome of CPR efforts, and discharge status.

Procedures

After approval of the project by both IRBs, communication with each individual resuscitation committee chair occurred to request the data. The data query included the previous identified variables for inpatients, 18 years of age and over, who experienced an IHCA between October 1, 2019, and March 31, 2020, and inpatients, 18 years of age and older, who experienced an IHCA between October 1, 2020 and March 31, 2021 for each of the hospitals within the region. The initial data query identified gender, hospital location, admitting diagnosis for patients who had an IHCA. The data provided a retrospective chart review to identify novel coronavirus disease (COVID-19) results (for post RQI group), prior efforts before CPR initiation including rapid responses, outcome of CPR efforts, and discharge status. Data was entered into Intellectus Statistics data analysis program to describe and compare demographic data, admitting diagnosis, prior efforts before CPR initiation, outcome of CPR efforts, and discharge status BLS/ACLS and RQI implementation to determine impact on survival to discharge rates.

Results

The evaluation of the effectiveness after the initiation of the RQI, within one region of the healthcare system, on the survival at discharge rate after suffering an IHCA in the inpatient setting was successfully completed. A retrospective chart review was collected on data from the period prior to the initiation of RQI, October 2019- March 2020, and data was collected from the period after the initiation of RQI, October 2020-March 2021.

Overall data collected found 449 IHCA that met inclusion requirements, with 40 at hospital A, 40 at hospital B, 183 at hospital C, and 186 at hospital D. There were 214

IHCA prior to the start of RQI and 235 IHCA after the implementation of RQI (Table 1). Site specific data is found in Table 1.

Table 1.

IHCA by Site

BLS/ACLS vs RQI	Site A	Site B	Site C	Site D	Total
1. BLS/ACLS	19	10	102	83	214
2. RQI	21	30	81	103	235
Total	40	40	183	186	449

The overall sample included 191 (42.54%) females and 258 (57.46%) males (Table 2). Site specific data is found in Table 2.

Admitting diagnosis of patients included 37 patients (8.24%) with pneumonia, 19 patients (4.23%) congestive heart failure, 1 patient (0.22%) COPD, 48 patients (10.69%) respiratory failure, 10 patients (2.23%) atrial fibrillation, 18 patients (4.01%) NSTEMI/STEMI, and 316 patients (70.38%) experiencing other including drug overdose, hip fracture, gastrointestinal bleed, etc. Site specific data is found in Table 2.

Table 2.

Gender and Admitting Diagnosis by Site

Gender	Site A	Site B	Site C	Site D	Total
1. Female	23	15	75	78	191
2. Male	17	25	108	108	258
Total	40	40	183	186	449
Admitting Diagnosis					
1. Pneumonia	3	5	17	12	37
2. Congestive Heart Failure	0	2	10	7	19
3. COPD	0	1	0	0	1
4. Respiratory Failure	8	10	14	16	48
5. Afib	3	1	2	4	10
6. NSTEMIS/STEMI	4	1	7	6	17
7. Other	22	20	133	141	316
Total	40	40	183	186	449

Prior efforts of a rapid response before the IHCA occurred 39 times (8.69%) before an IHCA (Table 3). Site specific data is found in Table 3.

Cumulative resuscitation attempts, with the number of compression rounds after return of pulse and then loss of pulse representing an IHCA, found 1 resuscitation attempt in 358 (79.73%), 2 attempts 53 (11.80%), 3 attempts 15 (3.34%), 4 attempts 4(0.89%), 5 attempts 1 time (0.22%), and intubation only in 19 (4.23%) (Table 3). Site specific data is found in Table 3.

Table 3.

Prior Effort and Cumulative Resuscitation Attempts by Site

Prior Efforts	Site A	Site B	Site C	Site D	Total
1. Rapid Response	15	5	6	13	39
2. None	25	35	177	173	410
Total	40	40	183	186	
Cumulative Resuscitation Attempts					
1. 1 Resuscitation Attempt	26	36	158	138	358
2. 2 Resuscitation Attempts	6	2	15	30	53
3. 3 Resuscitation Attempts	0	1	6	8	15
4. 4 Resuscitation Attempts	1	0	2	1	4
5. 5 Resuscitation Attempts	0	0	0	1	1
6. Intubation only	6	1	2	8	17
Total	40	40	183	186	449

CPR outcomes found that overall, 19 patients (4.23%) required intubation only, 129 patients (28.73%) were pronounced during the resuscitation attempt, 131 patients (29.18%) resulted in a return of pulse during the resuscitation attempt, 86 patients (19.15%) were intubated and had a return of pulse, 28 patients (6.24%) were made comfort measures by family at the time of the resuscitation attempt, and 56 patients (12.47%) were intubated and pronounced (Table4). Site specific data is found in Table 4.

Table 4.

CPR Outcome by Site

CPR Outcome	Site A	Site B	Site C	Site D	Total
1. Intubated	7	1	2	9	19
2. Patient pronounced	9	17	53	50	129
3. Return of pulse	6	5	76	44	131
4. Intubated/return	8	5	29	44	86
5. Comfort Measures Only	3	5	10	10	28
6. Intubated/pronounced	7	7	13	29	56
Total	40	40	183	186	449

The status at discharge for the total sample included 96 patients (21.38%) were alive at discharge, 347 patients (77.28%) were dead at discharge, and 6 patients (1.34%) were transitioned to hospice at time of discharge (Table 5). Site specific data is found in Table 5.

Table 5.

Status at Discharge by Site

Status at Discharge	Site A	Site B	Site C	Site D	Total
1. Alive	11	7	42	36	96
2. Dead	27	33	138	149	347
3. Hospice	2	0	3	1	6
Total	40	4	183	186	449

A Chi-square Test of Independence was used to evaluate the effect of RQI on survival to discharge after suffering an IHCA. The results for the overall sample found a significant difference between the BLS/ACLS and RQI groups, x^2 (1) = 5.48, and p= 0.019 (Table 6). The RQI group had less than expected values for survival at discharge.

Table 6

Status at Discharge

	CPR Training Approach				
Status at Discharge	BLS/ACLS	RQI	χ^2	*df*	*p*
1. Alive	59[48.61]	43[53.39]	5.48	1	.019
2. Dead	155[165.39]	192[181.61]			

A Chi-square Test of Independence was conducted on individual sites to evaluate the survival to discharge at each individual site. Site A had a total of 40 IHCA with 19 in the BLS/ACLS group and 21 in the RQI group. The Chi-square test showed significance, x^2 (1) = 4.61, p= 0.032 (Table 7) . The RQI group had greater than expected values of survival at discharge.

Table 7

Status at Discharge Site A

	CPR Training Approach				
Status at Discharge	BLS/ACLS	RQI	χ^2	*df*	*p*
1. Alive	3[6.17]	10[6.83]	4.61	1	.032
2. Dead	16[12.82]	11[14.18]			

Site B had a total of 40 with 10 in the BLS/ACLS group and 30 in the RQI group. The Chi-square test showed significance, x^2 (1) = 4.68, p= 0.031 (Table 8). The RQI group had less than expected values of survival at discharge. Further statistical evaluation was done with the completion of a Fisher exact test, due to the small sample size from site 2, as the expected values were not more than five (McHugh, 2013). The Fisher exact test were found to be not significant, suggesting that status at discharge and format for training could be independent from one another.

Table 8

Status at Discharge Hospital B

	CPR Training Approach				
Status at Discharge	BLS/ACLS	RQI	χ^2	*df*	*p*
1. Alive	4[1.75]	3[5.25]	4.68	1	.031
2. Dead	6[8.25]	27[24.75]			

Site C had a total of 183 IHCA with 102 in the BLS/ACLS group and 81 in the RQI group. The Chi-square test found significance, x^2 (1) = 4.18, p= 0.041 (Table 9). The RQI group had less than expected values of survival at discharge.

Table 9

Status at Discharge Hospital C

	CPR Training Approach				
Status_at_Discharge	BLS/ACLS	RQI	χ^2	*df*	*p*
1. Alive	31[25.08]	14[19.92]	4.18	1	.041
2. Dead	71[76.92]	67[61.08]			

Site D had a total of 186 IHCA with 83 in the BLS/ACLS group and 103 in the RQI group. The Chi-square test showed no significance, x^2 (1) = 2.75, p= 0.097 suggesting that status at discharge and approach to CPR training could be independent from one another.

COVID-19 results were collected for patients in the post RQI group in order to be able to evaluate the impact of a COVID-19 diagnosis may have had on the results of the study. It was found that 69 patients (15.37%) had a COVID-19 diagnosis. The BLS/ACLS data collection period was prior to the start of the COVID-19 pandemic.

A Chi-square Test of Independence was used to evaluate the survival to discharge rate related to COVID-19 diagnosis within all facilities (Table 10). Chi-square test found significance, x^2 (1) = 4.12, p= 0.042 with greater than expected values of expiration when COVID positive.

Table 10

COVID-19 Results and Status at Discharge

	COVID_19_Results				
Status_at_Discharge	Negative	Positive	χ^2	*df*	*p*
1. Alive	35[29.56]	7[12.44]	4.12	1	.042
2. Dead	129[134.44]	62[56.56]			

A Chi-square test to evaluate the relationship of status at discharge and gender resulted in no significance based on alpha value of 0.05, x^2 (1) = 1.51, p= 0.220. A Chi-square test to evaluate the relationship of status at discharge and prior efforts (rapid response) found no significance, x^2 (1) = 0.73, p= 0.392.

Discussion

To answer the question: What is the impact of Resuscitation Quality Improvement on survival at discharge rates after suffering an IHCA when compared to every two-year BLS/ACLS training, analysis for the total sample as well as each individual site was conducted. Evaluation of the total sample found that overall survival at discharge rates were greater with the previous resuscitation education of BLS/ACLS. Analysis of each individual sites found differing results. Sita A had better survival to discharge ratio with the implemented RQI. Site B and Site C had better survival to discharge rates with the previous BLS/ACLS resuscitation education. Site D showed no significance difference between the two approaches on survival to discharge. Although the analysis suggests that

the BLS/ACLS approach to training may lead to more positive outcomes for survival to discharge than the RQI approach, further consideration and evaluation need to be done to compare compliance rates for the RQI approach. Data on compliance with the RQI training approach was not available. Anecdotal evidence from one of the sites suggests that staff may not be completing the RQI training sessions as designed. Further investigation of the relationship between training compliance and survival status at discharge is needed.

There are several site characteristics that may have also impacted the results of the project. Sites C and D, as bigger facilities, have readily available specialty units that are specific for the condition the patient is suffering from including neuro intensive care units (ICU), burn units, cardiac ICU, etc. These patients are also a higher acuity requiring care at larger facility. These readily available services can impact the quality of services available that affect patients' outcomes, over the smaller facilities that do not have numerous specialty availability. Sites C and D also had a greater volume of IHCA than the smaller Sites A and B. This increased volume and concurrent increase in acuity of patients may provide more regular hands-on real-life scenarios that supplement the training.

Status at discharge rates comparing gender variables found no significant impact between genders and survival at discharge. Indicating that gender did not affect the patient's overall outcome to survival to discharge.

Status at discharge for COVID-19 patients found significant impact on survival at discharge. Indicating that positive COVID-19 patients were more likely to have a negative survival to discharge outcome.

Limitations

A major limitation found during data collection was inadequate charting. Data generated during the running of the reports yielded data that met criteria but lacked supporting data to be considered an IHCA, such as a rapid response, or had no data charted within the IHCA charting timeline. Ultimately data collected for prior efforts were not charted within the separate charting location of rapid response and were discovered to have been called when reading physician notes in the IHCA timeline. Per facility policy rapid responses and IHCA are charted under different locations and are required to be charted separately, even when called during the same incident.

Another limitation was the inability to collect data on compliance with BLS/ACLS and RQI education that could potentially provide a correlation between employees completing the mandatory education and the outcome of survival to discharge rates.

Recommendations

To address inadequate charting, facility administration should incorporate mandatory education on charting of rapid responses and IHCA to current and future employees. Educating on the difference in charting. In addition, further studies should investigate compliance with the mandatory RQI education and survival to discharge rates. The smaller facilities that generated a smaller sample size than the later facilities, do not complete real life IHCA scenarios as frequently as the larger facilities. Completion of quarterly RQI in the smaller facilities with less hands-on IHCA experience can potentially impact positive results, rather than larger facilities that conduct IHCA more frequently and have hands on experience.

Conclusion

The findings of this study answered the question: What is the impact of Resuscitation Quality Improvement on survival at discharge rates after suffering an IHCA when compared to every two-year BLS/ACLS training? The findings show that overall survival to discharge after suffering an IHCA didn't improve with implementation of RQI. Upon further review of individual sites, Site A had better survival to discharge ratio with the implemented RQI. Site B and Site C had better survival to discharge rates with previous resuscitation education. Site D showed no significance to prior or post RQI. The results of this project must be used with caution because of the number of variables that may have impacted the findings. Patients who suffer an IHCA are critically ill and the skills of the providers during these situations is only one variable that will impact survival.

Further studies should be done to evaluate the correlation between compliance of BLS/ACLS and RQI and the survival to discharge rates. Further evaluation between the real-life hands-on IHCA sections and facility size should be considered. With this, the continuous need to utilize and evaluate evidence-based practices for cardiac resuscitation is necessary to implement resuscitation training with the most positive outcome on IHCA.

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Kardong-Edgren, S. & Oermann, M. et al. (2020). Baseline Cardiopulmonary Resuscitation Skill Performance of Nursing Students Is Improved After One Resuscitation Quality Improvement Skill Refresher. *Journal for Nurses in Professional Development*, ***36***, 57-62. https://doi.org/10.1097/NND.0000000000000614

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Oermann, M. H., Krusmark, M. A., Kardong-Edgren, S., Jastrzembski, T. S., & Gluck, K. A. (2020). Training interval in cardiopulmonary resuscitation. *PloS One, 15*(1), e0226786. https://doi.org/10.1371/journal.pone.0226786

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Saramma, P. P., Raj, L. S., Dash, P. K., & Sarma, P. S. (2016). Assessment of long-term impact of formal certified cardiopulmonary resuscitation training program among nurses. *Indian Journal of Critical Care Medicine : Peer-Reviewed, Official Publication of Indian Society of Critical Care Medicine, 20*(4), 226–doi.232. .4103/0972-5229.180043

Schluep, M., Rijkenberg, S., Stolker, R. J., Hoeks, S., & Endeman, H. (2018). One-year mortality of patients admitted to the intensive care unit after in-hospital cardiac arrest: A retrospective study. *Journal of Critical Care, 48*, 345-351. doi:10.1016/j.jcrc.2018.09.029

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*Indicates included in Evidence Matrix (Appendix A) but not cited in paper

Appendix A

Evidence Matrix

CITATION	**PURPOSE / BACKGROUND**	**PARTICIPANTS SETTING**	**METHODS / DESIGN**	**RESULTS / LIMITATIONS / RECOMMENDATIONS**
Author(s), Date, Title, Journal Information, doi	Purpose & Outcome Measures or Goals (Aims)	Sample & Setting	Study Design & Interventions	Results, Strengths/Weaknesses, Limitations, & Recommendations
Cortegiani, A., Russotto, V., Montalto, F., Iozzo, P., Meschis, R., Pugliesi, M., Mariano, D., Benenati, V., Raineri, S. M., Gregoretti, C., & Giarratano, A. (2017). Use of a Real-Time Training Software (Laerdal QCPR®) Compared to Instructor-Based Feedback for High-Quality Chest Compressions Acquisition in Secondary School Students: A Randomized Trial. *PloS One, 12*(1), e0169591. Doi.10.1371/journal.pone.0169591	The aim of the study was to assess the effectiveness of a real-time training software compared to a standard instructor-based feedback for chest compressions.	The randomized study was conducted at a secondary school in Palermo, Italy. Study phases were conducted from January to May 2016. The study consisted of three phases; interactive frontal lesson on BLS-D and high quality chest compressions, randomization into two groups: QCPR group and standard feedback from instructor, training on chest compressions according to the randomization group, and final evaluation. The sample size included 144 participants.	Phase one included a 30 minute interactive lesion on cardiac arrest and BLS-D to all students. With the instructor demonstrating and performing CPR. At the end of phase one, participants were randomized into two groups: QCPR group and SF group. Phase 2 at the beginning all participants were familiarized with the equipment/devices. QCPR group received training by the instructor on chest compression using a mannequin connected to a computer with real-time feedback on compressions. The second group received feedback from the instructor according to their opinion. Phase 3, seven day later all students were asked to	All of the 144 participants completed the training phase with five students minimum compression score of 60% after the 2 minute training session and repeated it. Median score overall compression score of QCPR group at the end was 96. Six students in the SF group didn't reach the minimum overall quality after evaluation by the instructor. A significant difference was seen in compression scores above 75% among the QCPR group 42/60, 70% compared to the SF group 26/65, 40%. Limitations: The intervention was only assessed at 7 days without further follow up. It could be noted that longer training sessions could result in different effect on data. Recommendations: Is to evaluate the interventions further than a 7 day limit. Compare ventilations on the manikins.

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
			participated in a repeat 2 minute chest compression session without feedback from QCPR of instructor. All sessions were evaluated by a Skill Reporter.	Strengths: The standard training attempted to use "real-life" comparison settings to compare to the QCPR group allowing for a more realistic setting that can change just as a real-life code situation.
Crowley, C., Salciccioli, J., & Kim, E. (2020). The association between ACLS guideline deviations and outcomes from in-hospital cardiac arrest. *Resuscitation, 153*, 65-70. https://doi.org/10.1016/j.resuscitation.2020.05.042	The aim of the study was to evaluate the association between deviations from ACLS protocol and patient outcomes.	A retrospective review at a single medical center in Cambridge, MA that collected data on patients who suffered cardiac arrest from December 2015-Novemeber 2019. Main collected of data was for ROSC and secondary data included survival to discharge and discharge with favorable neurological outcomes.	Medical records were reviewed to collect demographics including length of event, initial rhythm, location, and suspected cause. Deviations from the ACLS algorithm were classified by a collection tool validated by McEvoy and Honarmand. Deviations includes delays in CPR, delays in medication administration or defib, medications administered a the wrong time of interval, or airway management not performed.	Results found that of the 108 patients included, 74 obtained ROSC, and 23 survived to discharge. The probability of obtaining ROSC was 96% with 0-2 deviations, 59% with 2-5 deviations, and 11% with greater than 6 deviations during event. Strengths: Include that in comparison to similar studies the results were similar in finding that higher rates of deviations are associated with a decreased likelihood of ROSC. Limitations: Data collected could have been impacted by poor documentation
Dudzik, L. R., Heard, D. G., Griffin, R. E., Vercellino, M., Hunt, A., Cates, A., & Rebholz, M. (2019). Implementation of a Low-Dose, High-Frequency Cardiac Resuscitation Quality Improvement Program in a Community Hospital. *Joint Commission journal on*	The aim for this study was to evaluate the RQI program at a community hospital with an analysis program, CPR performance technique, and participant impressions after the implementation of the American Heart Associations (AHA) 2015 launched Resuscitation	Conducted in Illinois in 2016, within the first hospital to adapt the RQI program within a 49-bed rural acute care hospital. The hospital required BLS certification through the RQI program. Participants were those who began the initial RQI training in	Participants completed quarterly training and were analyzed using two skill activities including compressions, ventilations, and three measurements; quarterly scores for the first score per session, highest score per session achieved for each skill activity and	With noncompliance in completing the quarterly training in both ventilation and compression activities, 165/294 participant data is used. Compression skill acitivity median score per session was higher in Q4 2016 compared to Q1 2016 (89 vs 84, p=0.0011). Ventilation skill activity, the median first score and higher

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
quality and patient safety, *45*(12), 789–797. https://doi.org/10.1016/j.jcjq.2019.08.010	Quality Improvement (RQI) program. Program implementation was conducted at the first hospital in Illinois to adopt RQI in 2016.	the first quarter of 2016. Study was conducted between 2016 and 2018.	quarterly number of attempts to complete successful pass each skill activity. Outcomes were measured and analyzed between Quarter 1 to Quarter 4 using the Wilcoxon signed ranking test for each of the skill activities. Participants also completed survey data including learner demographics and Likert scale survey responses that analyzed descriptive statistics to yield frequencies, standard deviations, and percentages.	scores per session were higher Q4 2016 comparted to Q1 (84.6 vs 62, p=0.0000) and (98 vs 92, p=0.0000). The number of attempts needed to pass were lower in Q4 than Q1 (1.0 vs 2.0, p=0000). Strengths: Program is cost effective with 47.4% less spend yearly than the traditional BLS. It improved CPR psychomotor compression and ventilation skill performance skills and greater confidence and satisfaction for program participants. Limitations: Noncompliance within all four quarters was a limitation. Data was only collected from those that completed quarterly training. Survey was launched 30 months after RQI program was implemented and didn't track how many quarterly training sessions survey were completed. Recommendations: Is to compare IHCA to be able to evaluate the real-word CPR performance and survival rates.
Honarmand, K., Mepham, C., Ainsworth, C., & Khalid, Z. (2018). Adherence to advanced cardiovascular life support (ACLS) guidelines during in-hospital cardiac arrest is associated with improved outcomes. *Resuscitation,*	The aim of the study is to determine the extent in which adherence to the 2010 AHA ACLS guidelines in their entirely affects the patient outcome.	A retrospective review of 160 records for cardiac arrests that occurred on hospitals floors and the hospital code team at three care centers over 2 to 4 years. Primary outcome included ROSC and	Records were reviewed for cardiac arrests at three tertiary care centers over 2 to 4 years between 2010-2014were hospital code teams are used. A standardized checklist was created and used to determine if	Of the 160 events ROSC was achieved in 75 events (46.9) and survival to hospital discharge in 20 patients. On average 2.3 deviations from ACLS guidelines during events led to ROSC and 3.9 deviations during events did not lead to ROSC. The fewer the deviations during

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
129, 76-81. https://doi.org/10.1016/j.resuscitation.2018.06.005		survival to hospital discharge.	deviations from the ACLS guidelines were found. Exclusions included early termination of resuscitation for non-clinical reasons including determining that ACLS would not be consistent with patients established goals and cardiac arrests in the ER, ICU, operating rooms, and cath lab or cardiac arrests with inadequate documentation. Deviations from ACLS included required actions, delays in providing appropriate therapy, therapy not appropriate for the ACLS algorithm, or excess to appropriate therapy. Deviations that were directly related to ACLS protocols were recorded.	events led to survival to hospital discharge compared. Final conclusion was that higher number of deviations from ACLS guidelines are associated with the lower likelihood of ROSC and survival to discharge. Limitations: The measures of deviations from the ACLS guidelines adherence can only be determined by accurate documentation completed by the medical staff. Recommendations: A study that explores the adherence to ACLS and the effects on patient outcomes in other setting including ICU and ER.
Kardong-Edgren, Suzan, PhD, RN, ANEF, CHSE, FSSH, FAAN, Oermann, Marilyn, PhD, RN, et al. (2020). Baseline Cardiopulmonary Resuscitation Skill Performance of Nursing Students Is Improved After One Resuscitation Quality	The purpose of this study is to evaluate the baseline CPR skill performance measurement for nursing students. The baseline measurement is compared to performance after a 10 minute refresher training session on the RQI program. The article	467 nursing students who were beginning students in either their associated degree or bachelor of science degree program were used. 10 schools were used in the student over a 2 year period. A site coordinator was	Study comparted the CPR performance of 467 nursing students in 10 different nursing schools across The United States to asses their retention of the skills post BLS certification and following one training session with the RQI	Even with recent completion of BLS training on 59% of students compressions were performed with an adequate depth and 42% were compressed with an adequate rate at baseline. Overall compression scores improved from pretest m=42.76, SD= 36.23 and posttest m=77.87, SD=26.26 with an 81% increase

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
Improvement Skill Refresher. *Journal for Nurses in Professional Development*, *36*, 57-62. https://doi.org/10.1097/NND.0000000000000614	evaluates the effectiveness of the RQI system for reestablishing and/or improving CPR skills after one practice session on the system and to objectively document the CPR skill loss expected for the novice learner based on findings prior to the study.	designated in each school of nursing to conduct the study and were trained on the use of the RQI system and study protocol prior to the start of the research. Prior CPR experience and CPR performance date were identified.	system. Students used the Laerdal Resusci Anne Quality Cardiopulmonary Resuscitation adult manikin to conduct their CPR practice. The RQI system measured data by the RQI system on the quality of students compression depth, compression rate per minute, ventilation volume, full chest release, and ventilation with visible chest rise, and rate of breaths per minute. Students conducted a baseline reading, completed learning material, and retested with real-life feedback.	following a 10 minute RQI training session. Students improved percentages of compressions with adequate depth by 47% and compression rate by 30% after one training session. Pretest bag-valve-mask ventilations overall score improved from initial pretest m=19.06, SD=21.68 to posttest m=70.61, SD 33.29. Percentage of ventilations with adequate volume increased by 30% after one training session. Strengths: Study supported previous studies that CPR skill are difficult to master and retain without frequent guided expert practice. The sensory cues provided by the manikin provide real-time feedback more than a instructor can with observation. Limitations: It remains unclear if skills aren't being learned at a mastery level at initial training or it it's the inability of an instructor to judge the effectiveness of CPR compressions and ventilations. There is still a gap in literature that remains on determining how often one must refresh CPR skills to maintain them. Recommendations: Research needs to evaluate if CPR can be initially taught successfully using a RQI system and the

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
				extent of initial skill decay through the use of these systems.
Nambiar, M., Nedungalaparambil, N. M., & Aslesh, O. P. (2016). Is current training in basic and advanced cardiac life support (BLS & ACLS) effective? A study of BLS & ACLS knowledge amongst healthcare professionals of North-Kerala. *World journal of emergency medicine*, *7*(4), 263–269. https://doi.org/10.5847/wjem.j.1920-8642.2016.04.004	The aim of the study was to evaluate current knowledge of BLS/ACLS guidelines in unregulated licensing countries to suggest remedial measures to tackle any deficiencies.	A cross sectional study was completed among healthcare professionals including physicians, nurses, and supporting staff in public and private hospitals in North-Kerala. Inclusions included all private and government hospitals with ICU and ER services. Participants were chosen by volunteer into the study. Exclusions included interns and paramedical students.	A multiple choice self-administered questionnaire was provided as a study tool. 461 participants were included in the study. The primary outcome measure in the study was of BLS/ACLS guideline knowledge among healthcare professionals involved in emergency patient care. Answers were validated in accordance with the AHAs BLS/ACLS teaching manual.	Among the 461 healthcare professionals 50.5% knew the correct order of BLS resuscitation, 55.5% were aware of the compression ventilation rate 30:2 in adult and 39.7% knew children CPR was 15:2 with two rescuers. 77.2% of participants suggested that BLS/ACLS should be included in their mandatory teaching and 88.5% agreed to the need to have frequent training of healthcare professionals on BLS/ACLS principles to keep themselves knowledgeable. Strengths: Improvements could be made to provide training for professionals that would improve BLS/ACLS knowledge. Limitations: Further research is needed to evaluate insufficient improvement in the BLS/ACLS knowledge among healthcare professionals. Due to the use of questionnaire based study the theoretical knowledge could not be assessed in detail.
Oermann, M. H., Krusmark, M. A., Kardong-Edgren, S., Jastrzembski, T. S., & Gluck, K. A. (2020). Training interval in cardiopulmonary resuscitation. *PloS One,*	The aim is to establish optimal training intervals for CPR frequency. The study compared nursing students CPR skills using four different training intervals including daily,	Nursing students were randomly assigned to variations of training intervals within 10 different nursing schools across the United States. Participants were required to be within the	CPR training was performed on a Laerdal Resusci Anne QCPR adult manikin on the RQI mobile simulation station within the schools simulation or skills laboratory.	Out of the 475 participants, 396 completed all four training intervals: daily (n=96), weekly (n=101), monthly n=93), and quarterly (n=106). During the pretest, all participants were unable to provide quality compressions, scoring less than

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
15(1), e0226786. https://doi.org/10.1371/journal.pone.0226786	weekly, monthly, and quarterly.	first year of their prelicensure nursing program and be certified in basic life support (BLS) from the American Heart Association. Exclusions were made for anyone who had a health condition that affected participant from performing CPR. Study was conducted from September 2015 and June 2018.	Participants had to complete a pretest where they performed 60 compressions followed by 12 bag-mask ventilations to assess their current CPR knowledge skills. Participants were then provided with brief demonstration videos and reinforcement of compressions and ventilation were summarized. Following instructional videos, participants completed 60 compressions and 12 bag-mask ventilations with real-time feedback. Overall score of 75% most be achieved in move on to ventilations. If minimum score isn't achieved, students must repeat the training session. Percentages were scored by compressions with adequate depth, rate, and release, and correct hand placement.	the required 75%. Daily training interval pretest scores increased from a mean session of 1 of 61.7 to a mean of 90.0 at the fourth session. The shorter training intervals resulted in higher performance increase than longer training intervals, therefore meaning the participants acquired skills faster if time between training intervals opportunities are shorter (p=0.014). Limitations: demographics and CPR experience data for 41 of the participants weren't collected. 47 of the students completed a different CPR training during the study and ultimately that wasn't included in the study. Recommendations: completing a study that examines retention within a health care setting, rather than new students learning from a beginner's level. Strengths: Allows for CPR skills to be mastered quickly with shorter times between training sessions and practice may be the most effective method for developing and maintaining CPR skills over time.
Panchal, A. R., Norton, G., Gibbons, E., Buehler, J., & Kurz, M. C. (2020). Low dose- high frequency, case based psychomotor CPR	Aim is to evaluate the feasibility and compliance with low dose-high frequency case based on mobile psychomotor CPR	Study was conducted at a tertiary care medical centre where simulation-based CPR training and clinical CPR	The study followed the launch of a novel low dose high frequency case based mobile psychomotor CPR	Compliance of participants to complete their quarterly activities was greater than 97% with lack of compliance being primarily due to appropriate

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
training improves compression fraction for patients with in-hospital cardiac arrest. *Resuscitation, 146*, 26–31. Doi. 10.1016/j.resuscitation.2019.10.034	training platform in an in-hospital setting replacing the standard basic life support recertification. Evaluation was completed on the effectiveness of low dose-high frequency CPR training for maintenance or improvement of CPR skills, participant compliance with these training methods, and CPR performance during clinica IHCA following the implementation of this CPR training.	performance of in-hospital clinical staff. Staff members included nurses and patient care associated assigned to clinical duty in two hospital floors between October 2014 through October 2015.	training platform which replaced the standard BLS recertification (Resuscitation Quality Improvement (RQI) American Heart Association). Simulation stations were placed in nursing unites with training activities. Quarterly participants were required to perform different activities to enhance CPR training. Quarter 1 activities included baseline basic life support training, Q2 separate focused training of compressions and ventilations, Q3 separate focused training of compressions and ventilations, Q4 training focused on combined one rescuer performance of compressions and ventilations. A passing score for each activity most be achieved. Data on compression and ventilation performance, specifically compression depth, rate, adequate release, ventilation rate, and tidal volume that he simulation station collected. IHCA events in the targeted clinical	medical leave exemptions. Between Q2 and Q3 there was no difference in compression or ventilation skills. Data demonstrated increased compressions with adequate rate Q2 83% and Q4 90%. Clinical compression data from IHCA treated before RQI and post RQI. A total of 20 IHCA event occurred on the nursing floors. Compression fraction improved pre-RQI to post RQI from 83% to 93%. Limitations: all training and assessments were conducted on a simulant and CPR performance on humans may be different. CPR on the RQI station are performed for a brief period of time whereas during clinical cardiac arrest events may require longer sustained periods of time. Not able to determine what provider is performing CPR during a clinical IHCA event. Strengths: study was able to demonstrate that CPR training through low dose-high frequency simulation is feasible and may improve in-hospital clinical chest compressions. The design and structure of the intervention directly related to higher compliance rates. Recommendations: Further research is needed to understand the effect of RQI on

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
			setting were obtained from the quality improvement dataset and evaluated for compression fraction and compression/min during pre-RQI and Post-RQI.	IHCA morbidity and mortality rate.
Saramma, P. P., Raj, L. S., Dash, P. K., & Sarma, P. S. (2016). Assessment of long-term impact of formal certified cardiopulmonary resuscitation training program among nurses. *Indian Journal of Critical Care Medicine : Peer-Reviewed, Official Publication of Indian Society of Critical Care Medicine, 20*(4), 226–doi.232. .4103/0972-5229.180043	To evaluate the impact of formal certified CPR training program knowledge and skill of CPR among nurses, to identify self-reported outcomes of attempted CPR and training needs of nurses.	BLS and ACLS training program that was conducted in a 253 bedded, tertiary level referral hospital in Kerala, India. The study included two parts. First part included RNs were randomly selected by nursing services to attend any of the 12 training courses- 20 hours of intense CPR training over a period of 10 days. Training was completed between 2010-2011. Second phase included available CPR certified nurses completing an interview to evaluate long-term impact of formal certified CPR training program on CPR knowledge and skills among nurses, to identify self-reported outcomes of attempted CPR, and training needs of nurses. Two phase was conducted within 3	The CPR training was a 10 day program that included both BLS and ACLS imparting both theoretical knowledge and simulated practice sessions. Performance test evaluated demonstration of the BLS algorithm (assessing unresponsiveness, checking carotid pulse, hand location for external cardiac compression, effective cardiac compression, airway opening techniques, and rescue breaths using the bag-mask technique). Observation checklists were used to maintain the objectivity of evaluation and took 30 minutes per participant. A score of 80% was required.	54 nurses (35.5%) passed the in the pretest and 142 (93.4%) passed in the postetest. However only 89 (58.6%) passed in the performance test which was conducted only once after the training program. Limitations: The knowledge was only tested 3-4 years after the initial training. Only three in or out of hospital cardiac arrest affects after the program, therefore not providing data to support training. Recommendations: A follow up study needs to be conducted sooner than 3-4 years post training. Strengths: A correlation was seen between pretest and retest. A correlation was seen in needing to deliver ACLS education more frequently than annually would increase skills maintenance and lessen skill decays.

CITATION	PURPOSE / BACKGROUND	PARTICIPANTS SETTING	METHODS / DESIGN	RESULTS / LIMITATIONS / RECOMMENDATIONS
		months from September-November 2014 with 206 RNs, 93 CPR certified and 113 noncertified nurses.		
Schluep, M., Rijkenberg, S., Stolker, R. J., Hoeks, S., & Endeman, H. (2018). One-year mortality of patients admitted to the intensive care unit after in-hospital cardiac arrest: A retrospective study. *Journal of Critical Care, 48*, 345-351. doi:10.1016/j.jcrc.2018.09.029	The aim of the study was to evaluate and report the one year survival of patient after IHCA and identify any predicting factors	A single-center retrospective study of adults in the inpatient setting that received CPR attempts between 2003-2014 in a tertiary teaching hospital with 555 beds and tracked for a year after discharge from hospital.	The primary outcome of the study was one-year survival rates. Secondary outcomes were initial survival, ICU-survival, survival to discharge and factors that could predict one-year survival. Exclusions were made for CPR in the OR, ER, and ICU.	CPR was performed on 417 patients in the hospital setting. ROSC was achieved 283 patient or 68% of patients. 234 patients were admitted to the hospital and 95 or 23% of patients survived one year after they were discharged. One year survival of patients that were admitted to the ICU after IHCA was 26%. Limitations: full data was only available for patients who were transferred to the ICU, including data on characteristic of CPR.

Appendix B

Data Collection Tool

BLS/ACLS

Subject #	Hospital Location	Age	Gender	Admitting Dx	Prior Efforts	CPR Outcome	Discharge Status

RQI

Subject #	Hospital Location	Age	Gender	Admitting Dx	COVID	Prior Efforts	CPR Outcome	Discharge Status

Data Coding

Hospital Location
1= Hospital A
2=Hospital B
3= Hospital C
4= Hospital D

Gender
1= Female
2= Male

Admitting Dx
1= Pneumonia
2= Congestive Heart Failure
3= COPD
4= Respiratory Failure
5= Atrial Fibrillation
6= NSTEMI/STEMI
7= other including, no diagnosis, acute kidney injury, GI bleed

COVID
1=No
2=Yes
99= not applicable

Prior Efforts
1=Rapid Response
2= none

CPR Outcome
1= Intubated
2= patient pronounced
3= return of pulse
4= intubated and return of pulse
5= comfort measures
6= intubated and pronounced

Status at Discharge
1= Alive
2=Dead
3= hospice

Number of cardiac code resuscitations

Resuscitation Quality Improvement Mortality Rates
38

1= 1
2=2
3=3
4=4
5=5
6=0