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Improving In-Hospital Cardiac Arrest Response by Empowering Non-Healthcare Workers with an Innovative Hands-Only CPR (HOCPR) Training Model

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ABSTRACT

In-hospital cardiac arrests are critical emergencies that demand immediate intervention to maximize patient survival rates. However, these events are not confined to clinical areas and can occur in non-clinical areas of the hospital. Recognizing this critical gap, the need to empower non-healthcare workers with the skills to perform basic life support has become increasingly evident. This study aimed to evaluate the effectiveness of a novel training program designed to equip non-healthcare workers with the ability to recognize cardiac arrest, initiate code blue, and perform hands-only CPR. This prospective, interventional cohort study was conducted over a period of 18 months in Ramaiah memorial hospital. A sample size of 329 participants consisting of administration, housekeeping and maintenance staff were selected based on our inclusion and exclusion criteria for the study. The training program was divided into three sessions, each consisting of both video-based and hands-on practical training focused on the key steps of hands-only CPR. The effectiveness of the training was evaluated through pre- and post-assessment of knowledge and skills using a structured 10-question multiple-choice questionnaire and practical demonstrations. Data were analyzed using statistical methods including paired t-tests and McNemar tests. 71.1% of the participants scored <80% during the pre-assessment compared to 88.4% who scored >80% after intervention which was statistically significant. (p value<0.001). On assessment of knowledge, pre-test it was found that 20.36% of the participants had score of 3/10 and post-test 25.55% of the participants scored 7/10. The study conducted demonstrated simple and effective hands-only CPR training for non-health care workers. By implementing such training programs, hospitals can significantly enhance their overall preparedness for in-hospital cardiac arrests, particularly in non-clinical areas, thereby improving patient outcomes.

Introduction

In-hospital cardiac arrest (IHCA) is a critical medical emergency requiring a rapid and coordinated response to optimize patient survival. Despite advancements in cardiopulmonary resuscitation (CPR) protocols and hospital resuscitation teams, IHCA survival rates remain suboptimal, with significant variability based on response time and quality of care. Studies indicate that each minute of delay in initiating CPR following cardiac arrest decreases survival probability by approximately 10%, underscoring the necessity for immediate intervention. [1- 3]

While substantial efforts have been made to enhance IHCA management through training healthcare professionals, limited attention has been given to non-healthcare workers (NHCWs), who may serve as the first responders in non-clinical hospital areas. These areas—including administrative offices, maintenance departments, and common spaces—are often devoid of trained medical personnel but are not exempt from cardiac arrest incidents.[4]

The lack of preparedness among NHCWs represents a crucial gap in the chain of survival, potentially leading to delays in activating emergency response systems and initiating life-saving interventions. Hands-Only CPR (HOCPR) has emerged as a key strategy for improving both out-of-hospital and in-hospital cardiac arrest survival, particularly when performed by lay rescuers.

The American Heart Association (AHA) and other resuscitation councils advocate for HOCPR due to its effectiveness in maintaining circulation and its ease of instruction, especially for individuals without prior medical training. [5], [6]

HOCPR removes the barrier of mouth-to-mouth ventilation, increasing the likelihood of bystander intervention while still ensuring adequate perfusion until professional medical help arrives.[7]

Demonstrating the simplicity and effectiveness of Hands-only CPR (HOCPR) or Compression-only life support (COLS), Ahmed et al emphasized and advocated for widespread training of non-healthcare workers in COLS to improve survival rates in out-of-hospital cardiac arrests. The authors highlight the potential benefits of implementing such training programs within hospital settings for non-medical staff.[8]

Furthermore, in a study by Hirose et al, where they evaluated a 45-minute CPR training program focusing on chest compressions and automated external defibrillator (AED) use among non-medical university hospital staff. The results demonstrated significant improvements in CPR quality and attitudes towards CPR and AED use, suggesting that brief, focused training can effectively enhance resuscitation skills among non-medical personnel of a hospital.[9]

Additionally, Kerketta et al in their study evaluated the effectiveness of structured COLS training among 300 non-medical hospital staff, including security guards, ambulance drivers, and housekeeping personnel. The training involved lectures, audio-visual presentations, demonstrations, and hands-on sessions. Results indicated a significant improvement in post-training assessment scores, demonstrating the training's efficacy in enhancing resuscitation knowledge among non-medical staff.[10]

Our study aimed to bridge the gap in IHCA preparedness by developing and implementing a structured

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HOCPR training program tailored for NHCWs. The program is designed to equip these individuals with the ability to recognize cardiac arrest, activate code blue in the hospital and initiate high-quality chest compressions efficiently. By empowering all hospital staff, regardless of their role, with life-saving resuscitation skills, we seek to enhance IHCA response systems and improve overall survival outcomes.

Methodology:

This was a prospective interventional cohort study conducted by the Emergency Medicine Department in M S Ramaiah memorial hospital located in Bangalore, Karnataka. A quaternary care hospital. After approval by the Institutional research and ethics committee, it was conducted over a period of 3 months from April 2024 to July 2024. A total of 329 participants, including administrative, housekeeping, and maintenance staff, were recruited based on specific inclusion and exclusion criteria. The program was divided into three sessions consisting of video-based and hands-on practical training which focused on key steps of hands-only CPR. The short instructional video was developed in-house by the investigators. The effectiveness of the training was evaluated through pre- and post-assessment of knowledge and skills using a structured 10-question multiple-choice questionnaire and practical demonstrations. Data were analyzed using statistical methods including paired t-tests and McNemar tests to determine the significance of the improvements observed.

A p-value of <0.05 was considered statistically significant. The study was conducted in accordance with the ethical standards of the institutional review board. Written informed consent was obtained from all participants before their inclusion in the study. The study population consisted of 329 non healthcare workers, including administrative staff, housekeeping staff, and maintenance personnel.

Pregnant employees were given the knowledge aspect of training but however did not perform CPR and hence excluded from our study. The training program was divided into three sessions, each lasting approximately one hour. The sessions combined video-based instruction with hands-on practice, focusing on the critical steps of HOCPR. The key elements of the training included:

- **Session 1:** Introduction to cardiac arrest, recognition of symptoms, and the importance of immediate response.
- **Session 2:** Detailed instruction on the 3 C's approach (Check, Call, Compress), including how to assess a collapsed individual, activate the emergency response (Code Blue), and initiate chest compressions.
- **Session 3:** Practical hands-on training using Bluetooth-enabled mannequins that provided real-time feedback on compression quality, including depth and rate.

Results:

The study population included a diverse group of non-healthcare workers, with a mean age of 34.5 years. The majority of participants were male, reflecting the typical gender distribution in maintenance and administrative roles within the hospital. Three participants had controlled comorbid conditions, including diabetes mellitus, hypertension, and ischemic heart disease.

The comparison of pre- and post-test scores revealed a significant improvement across all questions, indicating that the training was highly effective in enhancing the participants' understanding of HOCPR. Notably, the number of participants scoring higher in each question increased dramatically after the training, with statistical significance observed in all comparisons ($p < 0.001$) (Table 2). The pre-test results indicated that a significant proportion of participants had limited knowledge of HOCPR, with only 17.3% scoring above 7 out of 10. Following the training, there was a substantial improvement in knowledge, with 82.4% of participants scoring above 7 out of 10 in the post-test. The results show a significant improvement in the quality of chest compressions post-training, as indicated by the QCPR scores (Table 3). The mean

depth and rate of compressions increased notably, demonstrating that the training effectively enhanced the participants' ability to perform high-quality CPR. The self-assessment data further supports the effectiveness of the training program. Prior to training, a significant number of participants rated their knowledge and skills as poor or fair. Post-training, the majority rated themselves as good or excellent, with statistically significant improvements across all categories ($p < 0.001$) (Table 4).

Table 1: Participants and Comorbid conditions

Variable	**n (%)**
Participants with Comorbidities	3 (0.9%)
Diabetes Mellitus	1 (0.3%)
Hypertension	1 (0.3%)
Ischemic Heart Disease	1 (0.3%)

Table 2: Comparison of Pre and Post Test Scores

Question	**Pre-Test n (%)**	**Post-Test n (%)**	**p-value**
Q1	110 (33.4%)	150 (45.6%)	0.001*
Q2	137 (41.6%)	199 (60.5%)	<0.001*
Q3	267 (81.2%)	328 (99.7%)	<0.001*
Q4	162 (49.2%)	299 (90.9%)	<0.001*
Q5	87 (26.4%)	271 (82.4%)	<0.001*
Q6	108 (32.8%)	301 (91.5%)	<0.001*
Q7	45 (13.7%)	114 (34.7%)	<0.001*
Q8	129 (39.2%)	176 (53.5%)	<0.001*
Q9	137 (41.6%)	264 (80.2%)	<0.001*
Q10	195 (59.3%)	275 (83.6%)	<0.001*

Table 3: Quality of Compression Scores Pre and Post Assessment

Variable	**Pre-Assessment Mean (SD)**	**Post-Assessment Mean (SD)**	**p-value**
QCPR	55.15 (31.74)	88.46 (24.34)	<0.001*
Compression Quality	57.05 (31.90)	88.25 (24.75)	<0.001*
Total Compressions	115.29 (42.33)	105.15 (28.45)	<0.001*
Correct Depth	70.90 (40.37)	90.90 (25.21)	<0.001*
Correct Rate	24.91 (33.37)	65.70 (29.51)	<0.001*
Correct Release	91.74 (283.94)	85.25 (27.86)	0.677
Mean Rate	119.71 (67.22)	106.51 (29.03)	<0.001*
Mean Depth	47.39 (14.18)	51.09 (14.04)	<0.001*

Table 4: Self-Assessment of Knowledge and Skills Before and After Training

Skill Level	**Pre-Test n (%)**	**Post-Test n (%)**	**p-value**
Knowledge Level - Poor	52 (15.8%)	0 (0%)	<0.001*
Knowledge Level - Fair	76 (23.1%)	4 (1.2%)	<0.001*
Knowledge Level - Good	201 (61.1%)	125 (38.0%)	<0.001*
Knowledge Level - Excellent	0 (0%)	200 (60.8%)	<0.001*

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Skill Level - Poor	45 (13.7%)	0 (0%)	<0.001*
Skill Level - Fair	72 (21.9%)	7 (2.1%)	<0.001*
Skill Level - Good	212 (64.4%)	87 (26.4%)	<0.001*
Skill Level - Excellent	0 (0%)	235 (71.4%)	<0.001*

Discussion:

The results of our study clearly demonstrate that a structured, focused training program on hands-only CPR (HOCPR) can significantly improve both the knowledge and practical skills of non-healthcare workers (NHCWs) in a hospital setting. This improvement is crucial, as NHCWs are often the first responders in non-clinical areas where IHCA can occur. [11- 13]

The significant improvement in post-training scores and the enhanced quality of chest compressions observed through the QCPR application underscores the training program's effectiveness. Use of a feedback device and the QCPR application to demonstrate the effectiveness helps the NHCW see his own learning curve and is a key strength of our study. [14], [15]

Ali et al in their randomized control trial compared the effectiveness of video-based versus instructor-led COLS training among participants. Findings revealed that both methods significantly improved participants' knowledge and skills in performing COLS, suggesting that flexible training approaches can be employed to educate non-healthcare hospital staff effectively.[16]

In our study a combination of the above was used as a teaching methodology thus enhancing the learning experience in addition to the study effectiveness.

Prior to the training, many participants had limited knowledge of CPR techniques, as reflected in the low pre-test scores. However, the post-training assessments revealed marked improvements, with most participants achieving high scores, indicating a better understanding of the HOCPR protocol.[17]

Furthermore, our results show that participants were able to apply the theoretical knowledge gained during the training to practical scenarios, as evidenced by the improved quality of compressions, particularly in terms of depth and rate. These findings are consistent with existing literature that emphasizes the importance of hands-on training in improving CPR performance.

Sharma et al. in their pre-experimental study assessed the impact of simulation-based training on Compression-Only Life Support (COLS) among 139 General Duty Assistants (GDAs). Post-training assessments revealed significant improvements in both knowledge and skills related to COLS, highlighting the effectiveness of simulation-based interventions for non-medical hospital staff.[18]

The study also highlights the importance of regular and ongoing training, as even brief interventions can have a significant impact on knowledge retention and skill acquisition. The positive feedback from participants, who rated their knowledge and skills as significantly improved after the training, suggests that such programs can increase confidence and preparedness among NHCWs, ultimately leading to better outcomes during cardiac arrest events.[19]

The training's success in elevating the quality of CPR provided by these individuals highlights the potential of similar programs to enhance the overall preparedness and response capabilities within healthcare institutions. Despite the promising results, the study has limitations that should be considered. Our study

was conducted in a single tertiary care hospital, which may limit the generalizability of the findings to other settings. Additionally, while the immediate effects of the training were positive, the study did not assess long-term retention of knowledge and skills, which is an important factor in ensuring sustained improvements in IHCA outcomes.

Future research should focus on expanding the training program to multiple centers and evaluating the long-term impact on both CPR performance and patient outcomes. Additionally, incorporating regular refresher courses could help maintain the high standards achieved through the initial training.

Conclusion:

This study highlights the significant contribution that non-clinical staff can make in enhancing the management of in-hospital cardiac arrests, especially in areas outside direct patient care. The HOCPR training initiative introduced here proved highly successful in boosting both the knowledge and practical skills of the participants, as shown by notable gains in post-training evaluations. Empowering non-healthcare personnel to identify cardiac arrest and begin effective CPR can help address key weaknesses in hospital emergency responses and potentially raise survival rates.

Given its effectiveness, this training approach could serve as a model for broader adoption in healthcare institutions. Sustained training efforts, supported by regular evaluations and refresher sessions, are essential to ensure continued high-quality CPR delivery by non-clinical staff. Overall, the findings make a strong argument for ongoing CPR education for all hospital employees, regardless of their job title, as a strategy to enhance patient safety and clinical outcomes.

Figure 1: Screen shot of the instructional video

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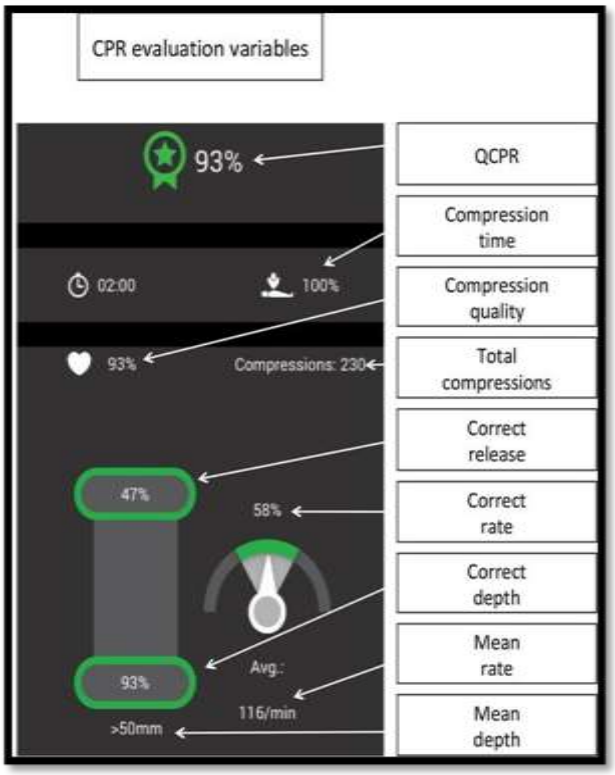

Figure 2: QCPR Results on mobile screen

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