

## Rate of Return of Spontaneous Circulation (ROSC) in In-Hospital Cardiac Arrest (IHCA) Cases at AaBET Hospital, Addis Ababa, Ethiopia

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### ABSTRACT

**Background:** Cardiopulmonary resuscitation (CPR) is a life-saving procedure performed to restore the function of the heart and brain in individuals. In-hospital cardiac arrests (IHCA) are common, with 1–5 events occurring per 1000 hospital admissions, and are associated with significant morbidity and mortality. Studies investigating the rate of return of spontaneous circulation (ROSC) for in-hospital cardiac arrest (IHCA) patients have not yet been carried out in Ethiopia. Our study aimed to evaluate the ROSC rate at the AaBET Hospital Emergency and Intensive Care Unit (ICU) in Addis Ababa, Ethiopia.

**Methods:** A cross-sectional study using the Cardiopulmonary Resuscitation (CPR) documentation sheet at AaBET hospital with cardiac arrest at the ED and ICU was conducted from October 2019 to September 2021. The data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 20. Descriptive statistics were computed to summarize and present the data in tables and figures.

**Result:** Out of the 68 cases analyzed, forty-five (66.2%) were male, and the mean age was 38.54, with an SD of 17.4. Fifty-five (80.9%) had trauma, and 33 (48.5%) had traumatic brain injury. Among the patients, 51.5% had a non-shockable rhythm, and twenty-two (32.4%) had asystole as the initial rhythm. Sixty-seven (98.5%) cases received adrenaline, while 24(35.3%) received fluid management. Only 8(11.8%) cases were shocked. Twenty-four had ROSC, which makes the ROSC rate 35.3 % with CI (24.7%-47.8%).

**Conclusion:** Cardiac arrest occurred more frequently in males. Trauma was the leading cause of arrest. Non-shockable rhythm is predominant in this IHCA study. Despite resource limitations, a ROSC rate of 35.3% was achieved, indicating the potential for improvement through structured protocols and training. Further national-level studies and a centralized IHCA registry are essential to improving cardiac arrest outcomes and post-resuscitation care in Ethiopia.

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## 1. Introduction

Cardiopulmonary resuscitation (CPR) is a life-saving procedure performed to restore the function of the heart and brain in individuals who have lost consciousness, mainly due to sudden cardiac arrest (SCA). Sudden cardiac arrest occurs when the heart suddenly stops pumping blood effectively, leading to a cessation of vital organ functions.<sup>(1)</sup> The American Heart Association (AHA) highlights two crucial elements for boosting the odds of survival from sudden cardiac arrest: early recognition and treatment, highlighting the critical value of prompt intervention. Early detection entails quickly recognizing the warning indications of cardiac arrest and activating the code blue team or emergency response system. The prompt start of effective CPR is crucial when cardiac arrest is suspected or confirmed. Chest compressions and rescue breathing are used in CPR to physically pump blood and provide oxygen to the body's essential organs. While rescue breaths give vital oxygen to the lungs and the bloodstream, chest compressions sustain blood flow. Another crucial link in the chain of survival is early defibrillation. Defibrillation involves shocking the heart with electricity to return it to its normal rhythm.<sup>(2, 3, 4)</sup>

In-hospital cardiac arrests (IHCA) are common, with 1–5 events occurring per 1000 hospital admissions, and are associated with significant morbidity and mortality.<sup>(5)</sup> Substantial variations in survival rates from IHCA exist, with rates between 8.3 and 62.5 percent reported.<sup>(6, 7, 8, 9, 10)</sup>

One of the most important metrics in the treatment of cardiac arrest, especially in hospital settings, is the rate of return of spontaneous circulation (ROSC). Studies carried out in different areas have demonstrated that elements including the standard of CPR, the expertise of medical professionals, and the application of modern resuscitation techniques significantly impact ROSC rates. However, the majority of these studies have been carried out in wealthy nations with well-

equipped healthcare systems, which results in comparatively high success rates for resuscitation. Conversely, lower-income nations frequently deal with issues such as a lack of established protocols, insufficient training, and scarce resources, all of which can affect the results for IHCA patients.

Even though comprehending ROSC in the context of IHCA is crucial, research that is especially targeted to Ethiopia is conspicuously lacking. This disparity is important because, in contrast to high-income nations, Ethiopia's healthcare system is unique, with unique obstacles and procedures. The availability of emergency medical services, the education of medical staff, and hospital infrastructure are a few examples of factors that might affect the outcome of cardiac arrest. Furthermore, it is challenging to evaluate how global findings apply to the Ethiopian environment in the absence of local data. The lack of data makes it difficult to create customized training programs and resuscitation techniques that might help cardiac arrest patients in Ethiopian hospitals have better outcomes.

By examining the rate of ROSC among IHCA patients in Ethiopia, the current study seeks to close this crucial evidence gap. A thorough investigation that gathers data from AaBET hospitals will serve as a baseline for future research and provide valuable insights into the efficacy of current resuscitation procedures. Our study aimed to evaluate the ROSC rate at the AaBET Hospital emergency and ICU in Addis Ababa, Ethiopia.

## 2. Methods and Materials

### Study Design

A cross-sectional descriptive study using cardiopulmonary resuscitation (CPR) documentation sheet from October 2019 to September 2021 was done at Addis Ababa Burn Emergency and Trauma (AaBET) Hospital.

### Study Area

AaBET Hospital is an affiliate of Saint Paul's Hospital Millennium Medical College (SPHMMC), which serves as a referral center for emergency, burn, and trauma cases. It offers various medical services, including emergency and critical care, orthopedic surgery, neurosurgery, general surgery, and plastic and reconstructive surgery.

The hospital's Emergency and Critical Care Department operates both the emergency department and the intensive care unit (ICU). The department provides a 3-year residency program for physicians specializing in emergency medicine and critical care. The emergency room has three zones (red, orange, and yellow /green) for accepting patients based on their triage level. ICU has 11 beds and two-bed step-down units.

### Study Participants

All patients who had complete CPR documentation sheets for whom CPR was done at AaBET Hospital emergency and ICU were included, while out-of-hospital cardiac arrest and dead bodies on arrival were excluded from this study.

### Data collection instruments and procedures

A thorough dataset was gathered for the study by employing the AaBET hospital CPR documentation

sheet. This dataset included vital information on the CPR procedures, such as the time and order of treatments, the delivery of medications, defibrillation, and procedures (intubation and/ or chest tube).

### Data Analysis

The data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 20. Descriptive statistics were computed to summarize and present the data in the form of tables. Ethical clearance was obtained from the SPHMMC institutional ethical review board (IRB).

## 3. Result

### Socio-demographics

A total of 97 CPR documentation sheets were found filled during the study period, and 68 cases were analyzed after excluding 13 incomplete documentation and 16 out-of-hospital cardiac arrests (9 at home, 3 out of home, and four dead bodies on arrival). Forty-five (66.2%) were male, and the mean age was 38.54 with SD 17.4. Fifty-five (80.9%) had trauma, and 33 (48.5%) had traumatic brain injury. Twenty-two (32.4%) had asystole as the initial rhythm. (Table 1)

**Table 1: Socio-demographic status of patients with IHCA at AaBET Hospital, Addis Ababa, Ethiopia, October 2019 to September 2021**

| Variables (n=68)          | Category                 | Frequency | Percent |
|---------------------------|--------------------------|-----------|---------|
| Age(Mean = 38.54,SD 17.4) | <20 years                | 14        | 20.6    |
|                           | 21-40 years              | 26        | 38.2    |
|                           | 41-60 years              | 21        | 30.9    |
|                           | > 60 Years               | 7         | 10.3    |
| Sex                       | Male                     | 45        | 66.2    |
|                           | Female                   | 23        | 33.8    |
| Place of arrest           | Red                      | 27        | 39.7    |
|                           | Orange                   | 14        | 20.6    |
|                           | Intensive Care Unit(ICU) | 27        | 37.5    |
| Underlying condition      | Medical condition        | 13        | 19.1    |
|                           | Trauma                   | 55        | 80.9    |
| Diagnosis                 | TBI                      | 33        | 48.5    |
|                           | Thoraco-abdominal injury | 12        | 17.6    |
|                           | Burn injury              | 5         | 7.4     |
|                           | Bone fracture            | 4         | 5.9     |

|                     |                        |    |      |
|---------------------|------------------------|----|------|
|                     | Sepsis                 | 3  | 4.4  |
|                     | Gullian-Barré Syndrome | 2  | 2.9  |
|                     | Pneumonia              | 2  | 2.9  |
|                     | Cardiac illness        | 1  | 1.5  |
|                     | Coma                   | 2  | 2.9  |
|                     | Diabetic ketoacidosis  | 1  | 1.5  |
|                     | Asthma                 | 1  | 1.5  |
|                     | Osteomyelitis          | 1  | 1.5  |
| Mechanism of injury | Road traffic injury    | 10 | 14.7 |
|                     | Fall related accident  | 10 | 13.9 |
|                     | Burn                   | 5  | 7.4  |
|                     | Gunshot                | 3  | 4.4  |
|                     | Fighting               | 2  | 2.9  |
|                     | Stab                   | 1  | 1.5  |
|                     | Unknown                | 4  | 5.9  |

### Interventions and outcomes

Adrenaline was administered in 98.5% of cases (n=67), while 24(35.3%) received fluid management. Only 8(11.8%) cases were shocked,

and 2 cases were shocked six times. Sixteen (23.5%) cases were intubated. (Table 2). Twenty-four had ROSC, which makes the ROSC rate 35.3 % with CI (24.7%-47.8%). (Figure 1)

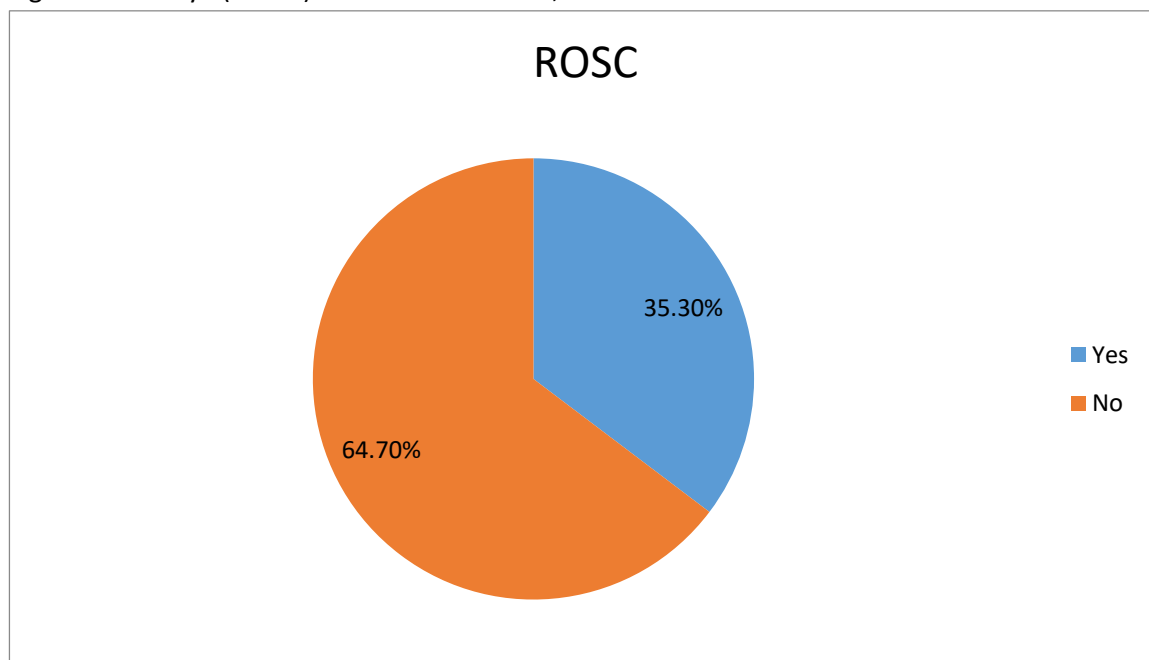


Figure 1: ROSC in patients with IHCA at AaBET hospital, Addis Ababa, Ethiopia, October 2019 to September 2021

Table 2: Interventions and outcomes for patients with IHCA at AaBET Hospital, Addis Ababa, Ethiopia, from October 2019 to September 2021

| Variables                                    | Category                               | Number | Percent |
|----------------------------------------------|----------------------------------------|--------|---------|
| Medication/fluid given at the time of arrest | Adrenalin                              | 67     | 98.5    |
|                                              | Normal Saline                          | 24     | 35.3    |
|                                              | Blood                                  | 1      | 1.5     |
| Initial rhythm                               | Asystole                               | 22     | 32.4    |
|                                              | Pulseless electrical activity(PEA)     | 13     | 19.1    |
|                                              | Pulsless Ventricular tachycardia(Vtac) | 6      | 8.8     |
|                                              | Ventricular fibrillation(Vfib)         | 2      | 2.9     |
|                                              | Not documented                         | 25     | 36.8    |
| Defibrillation                               | Yes                                    | 8      | 11.8    |
| Number of shocks                             | 2.00                                   | 6      | 8.8     |
|                                              | 6.00                                   | 1      | 1.5     |
|                                              | 7.00                                   | 1      | 1.5     |
| Intubation                                   | Yes                                    | 16     | 23.5    |
|                                              | No                                     | 39     | 57.4    |
|                                              | Already intubated                      | 13     | 19.1    |
| Chest tube                                   | Yes                                    | 14     | 20.6    |
|                                              | No                                     | 53     | 77.9    |
|                                              | Already inserted                       | 1      | 1.5     |

Of those with ROSC, 45.8% were between 41 and 60 years old, 66.7% were male, and 54% had a non-shockable rhythm. (Table 3)

Table 3: ROSC in patients with cardiac arrest at AaBET hospital, Addis Ababa, Ethiopia, October 2019 to September 2021

| Variables                 | Subcategories       | Return of Spontaneous Circulation (ROSC) |          |
|---------------------------|---------------------|------------------------------------------|----------|
|                           |                     | Yes n=24                                 | No n=44  |
|                           |                     | No. (%)                                  | No. (%)  |
| Age(Mean = 38.54,SD 17.4) | <20 years           | 8(33.3)                                  | 6(13.6)  |
|                           | 21-40 years         | 11(45.8)                                 | 15(34.1) |
|                           | 41-60 years         | 4(16.7)                                  | 17(38.6) |
|                           | > 60 Years          | 1(4.2)                                   | 6(13.6)  |
| Sex                       | Male                | 16(66.7)                                 | 29(65.9) |
|                           | Female              | 8(33.3)                                  | 15(34.1) |
| Place of arrest           | Emergency           | 14(58.3)                                 | 27(61.4) |
|                           | Intensive Care Unit | 10(41.7)                                 | 17(38.6) |
| Underlying condition      | Medical             | 5(20.8)                                  | 8(18.2)  |

|                       |                      |          |           |
|-----------------------|----------------------|----------|-----------|
|                       | <b>Trauma</b>        | 19(79.2) | 36(81.8)  |
| <b>Initial rhythm</b> | <b>Non-Shockable</b> | 8(18.2)  | 27(61.4%) |
|                       | <b>Shockable</b>     | 3(12.5)  | 5(11.4)   |
|                       | <b>Unknown</b>       | 13(54.2) | 12(27.3)  |
| <b>Defibrillation</b> | <b>Yes</b>           | 3(12.5)  | 5(11.4)   |
|                       | <b>No</b>            | 21(87.5) | 39(88.6)  |
| <b>Medication</b>     | <b>Yes</b>           | 23(95.8) | 44(100.0) |
|                       | <b>No</b>            | 1(4.2)   | 0(0.0)    |

## Discussion

This is the first study examining the frequency of ROSC in the AaBET hospital's emergency and ICU. This measure is critical since it is a crucial sign of whether or not resuscitation attempts for cardiac arrest victims were effective. Healthcare practitioners can evaluate the success of their actions and pinpoint areas where emergency care protocols need to be improved by looking at the rate of ROSC.

Males constituted 66.2% of the subjects in this research who required cardiopulmonary resuscitation (CPR). Moreover, 69.1% of the cases were in the age range of 20 to 60, the most common age group.

The hospital's primary specialization in trauma care, alongside other emergency services, likely explains the high prevalence of trauma patients (80.9%) observed in this study.

Traumatic brain injury (48.5%) was the most commonly seen diagnosis among individuals who suffered from cardiac arrest. It draws attention to the necessity of early diagnosis, suitable treatment, and all-encompassing care for those with traumatic brain injuries. Studies showed that traumatic cardiac arrest has a poor prognosis.<sup>(11)</sup>

Most patients in this research who received cardiopulmonary resuscitation (CPR) had non-shockable initial heart rhythms. In particular, upon cardiac arrest, 51.5% of the patients had a non-

shockable rhythm. This is similar to previous reports that in-hospital, the most common arrest rhythm was non-shockable.<sup>(8,12,13)</sup> In general, non-shockable rhythms have a poorer survival rate than shockable rhythms, which respond better to defibrillation.

The investigation found that the first arrest rhythm of 36.8% of the patients was not recorded. This could have substantial consequences, including delays in identifying and treating shockable rhythms. Developing quality improvement initiatives, educating nurses on proper recording techniques, having physicians review documentation, and conducting audits are all essential in addressing the problem of incomplete documentation and insufficient data on early arrest rhythms. Only 11.7% of the cases had shockable rhythms, and defibrillation was done.

Almost all patients got adrenaline, but no patient from those with shockable rhythms got amiodarone according to advanced cardiac life support (ACLS) algorithms. The absence of amiodarone administration to patients with shockable rhythms may be attributed to either the unavailability of the drug or the failure of healthcare professionals to document or order its administration. Hence, the availability of essential drugs is crucial during resuscitation. Healthcare professionals should rigorously adhere to the ACLS algorithms and be aware of the medications recommended for various cardiac arrest rhythms.

This adherence improves the likelihood of a successful resuscitation and enhances patient outcomes.

The overall ROSC rate of this study was 35.3%. This is lower than international reports from Chicago (40.3%), USA14(44%), Canada 15(46.9%), Cambridge 16(68.5%) but closer to Beijing (35.5%), and other studies<sup>(8-10,14-16)</sup> This could be because of dedicated team and trainings in ACLS at the hospital which requires further study.

Sixty-five percent of trauma patients in this research had no ROSC, and it was noted that traumatic cardiac arrests had a poor outcome. In light of these findings, it is advised that trauma CPR adheres to the trauma CPR algorithm, as indicated by the Berlin guidelines.<sup>(17)</sup>

ED ROSC rate was 34.1%, while in ICU, it was 37 %, which is higher than the Uganda study ED (2.5%) and ICU (25%).<sup>(18)</sup> In this study area, both the ED and ICU were run by the Emergency and Critical Care Medicine department, and the team has similar resuscitation skills and techniques.

Different studies showed that involvement in national quality improvement, using technologies and feedback mechanisms, showed improved ROSC trends.<sup>(19, 20)</sup> Performing quality improvement projects and making feedback devices available could help improve the study site's ROSC rate.

#### Limitation

Since the study was cross-sectional, it found that some cases lacked documentation. Furthermore, the single-center design of the study precluded extrapolating the results to other emergency rooms. Since it has a small sample size, determining factors for ROSC were not analyzed, and further study is needed in the future, including post-cardiac arrest care and out-of-hospital survival. Multicenter research with the development of a CPR registry is necessary to fully

evaluate the rate of Return of Spontaneous Circulation (ROSC) in Ethiopia.

#### Conclusion

Cardiac arrest occurred more frequently in males. Trauma was the leading cause of arrest. Non-shockable rhythm is predominant in this IHCA study. Despite resource limitations, a ROSC rate of 35.3% was achieved, indicating the potential for improvement through structured protocols and training. Further national-level studies and a centralized IHCA registry are essential to improving cardiac arrest outcomes and post-resuscitation care in Ethiopia.

#### Abbreviations

AaBET: Addis Ababa burn, emergency and trauma  
ACLS: advanced cardiac life support  
CPR: Cardiopulmonary Resuscitation; ED-emergency department  
ICU: Intensive Care Unit; IHCA-In-hospital Cardiac Arrest; IRB-Institutional Review Board  
MRI: Magnetic Resonance Imaging  
ROSC: Return of Spontaneous Circulation; RTA-Road Traffic Accident  
SPHMMC: St. Paul's Hospital Millennium Medical College  
SSI: Surgical Site Infection  
USA: United States of America

#### Author Contributions

The authors have all contributed equally to the conception of the work, including the acquisition, analysis, or interpretation of data, drafting and revising, and final approval of the version to be published, and they have agreed to be accountable for all aspects of the work.

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#### Competing interests

The authors declare no conflicts of interest.

#### Data Availability



The data used to support the findings of this study are available from the corresponding author upon request.

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