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In-Hospital Cardiac Arrest Management: A Retrospective Study in the Emergency Department

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ABSTRACT

Background: In-hospital cardiac arrest (IHCA) in the emergency department (ED) remains a high-mortality event, and locally generated outcome data from low- and middle-income settings are limited. Objective: To describe the characteristics, management, and outcomes of ED-based IHCA in a tertiary-care hospital and to evaluate differences in outcomes by initial cardiac arrest rhythm. Methods: This retrospective observational study was conducted in the Emergency Department of Lady Reading Hospital, Peshawar, from June 2025 to December 2025. Adult patients (≥18 years) who developed cardiac arrest in the ED after arrival and received cardiopulmonary resuscitation were included; out-of-hospital cardiac arrest and documented do-not-resuscitation cases were excluded. Data were extracted from ED records and CPR logs using standardized definitions. The primary outcome was return of spontaneous circulation (ROSC); secondary outcomes were survival to ED disposition and survival to hospital discharge. Results: Eighty-six patients were included (mean age 58.4 ± 15.2 years; 60.5% male). Initial rhythms were pulseless electrical activity in 44.2%, asystole in 37.2%, and shockable rhythms in 18.6%. ROSC occurred in 31/86 (36.0%), survival to ED disposition in 18/86 (20.9%), and survival to hospital discharge in 9/86 (10.5%). Shockable rhythms were associated with higher ROSC than non-shockable rhythms (62.5% vs 30.0%; OR 3.89, 95% CI 1.25–12.10; p=0.018). Conclusion: ED-based IHCA was associated with low survival to hospital discharge, with non-shockable rhythms predominating and conferring poorer outcomes. Strengthening early recognition, high-quality resuscitation, and optimized post-arrest care may improve survival.

Keywords: *cardiac arrest; emergency department; cardiopulmonary resuscitation; return of spontaneous circulation; shockable rhythm*

INTRODUCTION

In-hospital cardiac arrest (IHCA) remains a high-mortality emergency that persists despite major advances in resuscitation science and systems of care (1). IHCA is typically defined as the sudden cessation of cardiac mechanical activity in a hospitalized patient with absence of a palpable pulse requiring immediate cardiopulmonary resuscitation (CPR) and/or defibrillation (3). Contemporary cohorts demonstrate that IHCA continues to carry substantial fatality risk, and survival to hospital discharge varies widely across settings, reflecting differences in case-mix, monitoring intensity, resuscitation performance, and post–return of spontaneous circulation (ROSC) care (2). Importantly, rhythm epidemiology is also heterogeneous: non-shockable rhythms such as pulseless electrical activity (PEA) and asystole often predominate and are consistently associated with worse outcomes than shockable rhythms (2). These realities underscore a persistent clinical and health-systems

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problem: even when cardiac arrest occurs within the hospital—where trained staff and equipment are available—meaningful survival remains limited, and performance varies across locations within the hospital (2).

The emergency department (ED) represents a distinct and operationally demanding location for IHCA management because patients frequently present with undifferentiated critical illness and may deteriorate rapidly while diagnostic and treatment priorities compete for time and attention (8). In this environment, survival is highly sensitive to the timeliness and quality of core resuscitation actions—early recognition, immediate high-quality CPR, rapid defibrillation for shockable rhythms, and structured Advanced Cardiac Life Support (ACLS) algorithms with prompt evaluation of reversible causes (4). International guideline frameworks emphasize these time-critical components and the importance of coordinated team performance, supported by systematic training and reliable processes (4). Nevertheless, translating guideline standards into consistent ED practice can be challenging, particularly in high-volume, resource-constrained environments where staffing, monitoring capacity, and post-arrest critical care pathways may be variable (8).

Evidence from low- and middle-income countries (LMICs) suggests that ED cardiac arrest outcomes may be constrained by health-system limitations, including delayed recognition of clinical deterioration, inconsistent availability of skilled personnel, and variability in equipment and post-ROSC intensive care support (6). Retrospective ED-based studies from LMIC settings have reported modest ROSC and discharge survival rates and have highlighted the prognostic importance of the presenting rhythm, with shockable rhythms generally demonstrating higher ROSC and survival probabilities than PEA/asystole (6). Similar findings from other resource-limited contexts reinforce that measurable differences in early resuscitation performance and case characteristics can translate into substantial outcome differences at the population level (7). However, there remains a clear knowledge gap: ED-specific IHCA epidemiology and outcomes are underreported in many LMIC regions, including Pakistan, limiting the ability to benchmark performance, identify modifiable care-process gaps, and design locally appropriate quality-improvement interventions (6).

Within this context, generating setting-specific evidence is necessary to inform pragmatic improvements in ED resuscitation systems. Accordingly, the present study focuses on adult patients who develop IHCA within the ED and receive CPR, evaluating arrest characteristics (notably initial rhythm), management features documented in CPR logs/records, and patient-centered outcomes including ROSC and survival to hospital discharge. Using a PICO-oriented framing, the population of interest is adult ED patients with IHCA; key exposures include arrest rhythm category and ED resuscitation management as delivered under ACLS principles; the primary comparison is shockable versus non-shockable initial rhythms; and outcomes include ROSC and survival endpoints relevant to ED and hospital disposition. The research objective is to characterize ED IHCA in a tertiary care hospital and quantify outcomes, with the a priori expectation that shockable rhythms are associated with higher ROSC rates than non-shockable rhythms in this setting (8).

MATERIAL AND METHODS

This retrospective observational study was designed to describe the characteristics, management, and outcomes of in-hospital cardiac arrest occurring within the emergency department, with particular focus on the association between initial cardiac rhythm and resuscitation outcomes. An observational design was selected as it allows systematic evaluation of real-world resuscitation practices and outcomes without influencing clinical

care, in accordance with international recommendations for cardiac arrest research where randomized designs are not feasible or ethical (9).

The study was conducted in the Emergency Department of Lady Reading Hospital, Peshawar, a tertiary-care teaching hospital serving a large urban and referral population. The emergency department functions as a high-volume acute care unit with continuous physician coverage and standardized Advanced Cardiac Life Support (ACLS)–based resuscitation protocols. The study period extended from June 2025 to December 2025, during which all eligible cardiac arrest events occurring after patient arrival in the emergency department were assessed.

The study population comprised adult patients aged 18 years or older who experienced in-hospital cardiac arrest within the emergency department and received active cardiopulmonary resuscitation. Cardiac arrest was operationally defined as the absence of a palpable central pulse with unresponsiveness, requiring initiation of chest compressions and/or defibrillation in accordance with ACLS guidelines (4). Patients were included if cardiac arrest occurred after registration and initial evaluation in the emergency department. Patients brought to the emergency department in cardiac arrest from the community, those with documented “do not resuscitate” orders prior to arrest, and cases lacking essential resuscitation documentation were excluded to ensure a homogeneous in-hospital cohort and reliable outcome assessment.

Participants were identified retrospectively through systematic review of emergency department cardiac arrest logs, CPR records, and electronic medical records. Case identification was cross-verified across data sources to minimize missed events and misclassification. As this was a retrospective review of routinely collected clinical data, individual patient consent was waived in accordance with ethical standards for minimal-risk observational research (10).

Data collection was performed using a standardized data abstraction proforma developed a priori based on Utstein-style reporting recommendations for in-hospital cardiac arrest research (11). Extracted variables included demographic characteristics (age, sex), pre-existing comorbidities, presenting clinical context, initial documented cardiac arrest rhythm, defibrillation status, medications administered during resuscitation, duration of resuscitation efforts, and achievement of return of spontaneous circulation. Initial cardiac rhythm was categorized as shockable (ventricular fibrillation or pulseless ventricular tachycardia) or non-shockable (pulseless electrical activity or asystole). Return of spontaneous circulation was defined as restoration of a palpable pulse with sustained organized cardiac activity for at least 20 minutes. Secondary outcomes included survival to emergency department disposition, defined as leaving the emergency department alive for ward admission, intensive care admission, or inter-facility transfer, and survival to hospital discharge.

To reduce information bias, data abstraction was performed using predefined variable definitions and standardized coding rules. When discrepancies were identified between documentation sources, primary CPR records were prioritized. Potential confounding variables, including age, sex, comorbid conditions, and resuscitation duration, were identified a priori based on biological plausibility and prior literature and were incorporated into the analytical strategy (12).

All eligible cases during the study period were included, representing a consecutive sample rather than a calculated sample size. This approach was chosen to maximize statistical power

and external validity within the constraints of a single-center study and is consistent with established practice in IHCA observational research (13).

Statistical analysis was performed using SPSS statistical software. Continuous variables were assessed for normality and summarized as mean with standard deviation or median with interquartile range, as appropriate. Categorical variables were reported as frequencies and percentages. The primary analysis compared ROSC rates between patients with shockable and non-shockable initial rhythms using chi-square or Fisher's exact test, as indicated. Effect estimates were expressed as odds ratios with 95% confidence intervals. Multivariable logistic regression analysis was conducted to evaluate the independent association between initial rhythm category and ROSC while adjusting for prespecified confounders. Missing data were handled using complete-case analysis. Subgroup analyses were performed according to rhythm category to explore outcome heterogeneity. A two-sided p-value of less than 0.05 was considered statistically significant (12).

Ethical approval for the study was obtained from the Ethical Review Board of Lady Reading Hospital, Peshawar, prior to data collection. All procedures complied with the principles of the Declaration of Helsinki. Patient confidentiality was preserved by anonymizing data and restricting access to study files. Data integrity and reproducibility were ensured through secure data storage, double-checking of entered data, and retention of the original abstraction forms to allow independent verification of findings (10).

RESULTS

Table 1 summarizes the baseline profile of the 86 included patients. The cohort had a mean age of 58.4 ± 15.2 years, and males constituted 52/86 (60.5%), compared with 34/86 (39.5%) females. Comorbidity burden was high: hypertension was documented in 48/86 (55.8%), diabetes mellitus in 41/86 (47.7%), and ischemic heart disease in 29/86 (33.7%), indicating that most arrests occurred in patients with substantial cardiovascular and metabolic risk.

As shown in Table 2, initial rhythms were predominantly non-shockable. Pulseless electrical activity (PEA) was the most frequent presenting rhythm, occurring in 38/86 (44.2%), followed by asystole in 32/86 (37.2%).

Shockable rhythms (ventricular fibrillation or pulseless ventricular tachycardia) were less common, identified in 16/86 (18.6%). Defibrillation was delivered in all shockable cases (16/16; 100%). More than half of resuscitations extended beyond 20 minutes, with 47/86 (54.7%) categorized as prolonged efforts.

Overall outcomes are detailed in Table 3. Return of spontaneous circulation (ROSC) was achieved in 31/86 patients (36.0%). Survival to emergency department disposition—defined as leaving the ED alive for onward care—was documented in 18/86 (20.9%). Survival to hospital discharge occurred in 9/86 patients (10.5%), highlighting the steep attrition from ROSC to discharge in this ED IHCA cohort.

Table 4 presents the key group comparison by initial rhythm, demonstrating a clinically and statistically meaningful advantage for shockable rhythms. ROSC occurred in 10/16 shockable arrests (62.5%) versus 21/70 non-shockable arrests (30.0%), corresponding to an odds ratio (OR) of 3.89 (95% CI 1.25–12.10; p = 0.018).

Survival to hospital discharge was also higher in the shockable group—4/16 (25.0%) compared with 5/70 (7.1%)—with an OR of 4.33 (95% CI 0.97–19.30), narrowly missing conventional statistical significance (p = 0.056), consistent with limited power due to small subgroup sizes.

Table 1. Baseline Demographic and Clinical Characteristics (n = 86)

Variable	Value
Age, mean ± SD (years)	58.4 ± 15.2
Male sex, n (%)	52 (60.5)
Female sex, n (%)	34 (39.5)
Hypertension, n (%)	48 (55.8)
Diabetes mellitus, n (%)	41 (47.7)
Ischemic heart disease, n (%)	29 (33.7)

Table 2. Cardiac Arrest and Resuscitation Characteristics

Variable	Overall (n = 86)
Initial rhythm – PEA, n (%)	38 (44.2)
Initial rhythm – Asystole, n (%)	32 (37.2)
Initial rhythm – Shockable (VF/pVT), n (%)	16 (18.6)
Defibrillation performed (shockable only), n (%)	16 (100)
Resuscitation duration >20 min, n (%)	47 (54.7)

Table 3. Overall Resuscitation Outcomes

Outcome	n (%)
Return of spontaneous circulation (ROSC)	31 (36.0)
Survival to ED disposition	18 (20.9)
Survival to hospital discharge	9 (10.5)

Table 4. Outcomes by Initial Cardiac Arrest Rhythm

Outcome	Shockable	Non-shockable	Odds Ratio	p-value
ROSC, n (%)	10 (62.5)	21 (30.0)	3.89 (1.25–12.10)	0.018
Survival to discharge, n (%)	4 (25.0)	5 (7.1)	4.33 (0.97–19.30)	0.056

Table 5. Association Between Resuscitation Duration and ROSC

Resuscitation Duration	ROSC, n/N	Odds Ratio	p-value
≤20 minutes	18/39 (46.2)	Reference	—
>20 minutes	13/47 (27.7)	0.29 (0.11–0.78)	0.012

Finally, Table 5 shows the association between resuscitation duration and ROSC. Patients with resuscitation duration ≤20 minutes achieved ROSC in 18/39 cases (46.2%), whereas those with duration >20 minutes achieved ROSC in 13/47 cases (27.7%). Prolonged resuscitation was associated with substantially lower odds of ROSC (OR 0.29, 95% CI 0.11–0.78; p = 0.012), supporting the observed pattern that longer arrest/resuscitation courses were less likely to result in sustained circulation.

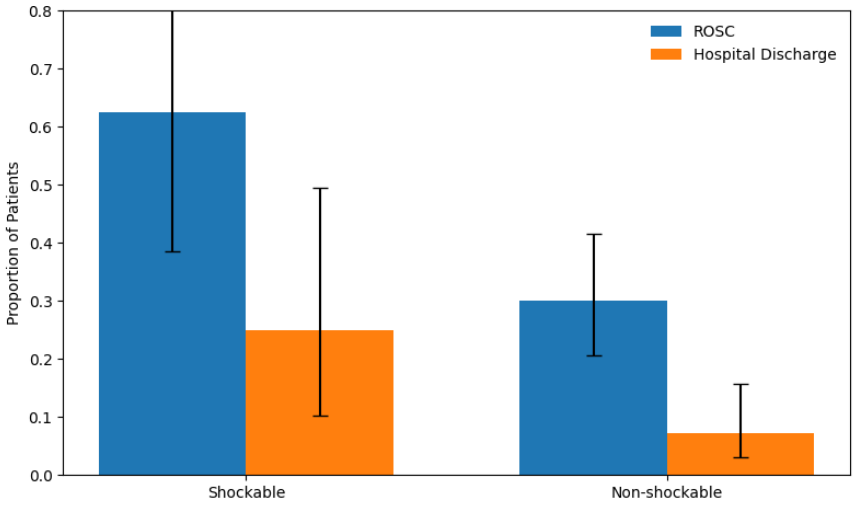

Figure 1. Outcome gradients by initial cardiac arrest rhythm in emergency department in-hospital cardiac arrest

This figure illustrates a clear outcome gradient across initial cardiac arrest rhythm categories, with shockable rhythms demonstrating consistently superior outcomes at both early and late clinical endpoints. The proportion achieving return of spontaneous circulation was 62.5% in shockable arrests compared with 30.0% in non-shockable arrests, with non-overlapping central tendencies and wider confidence intervals in the shockable group reflecting smaller sample size. A pronounced attrition is evident between ROSC and hospital discharge in both groups; however, discharge survival remained markedly higher among shockable rhythms at 25.0% versus 7.1% in non-shockable rhythms. The widening separation between rhythm groups across outcome stages highlights a clinically meaningful interaction between arrest rhythm and survivorship trajectory, underscoring that initial rhythm not only influences immediate resuscitation success but also confers a sustained survival advantage through to hospital discharge despite overall low absolute survival rates.

DISCUSSION

In this retrospective observational study of in-hospital cardiac arrest occurring in the emergency department of a tertiary-care hospital, we found that overall outcomes remained poor, with ROSC achieved in just over one-third of patients and survival to hospital discharge limited to approximately one in ten. These findings are consistent with prior ED-based IHCA studies demonstrating that, despite immediate access to resuscitation resources, meaningful survival remains constrained, particularly in patients presenting with non-shockable rhythms (14). The emergency department represents a uniquely high-risk environment where patients often present with advanced physiological derangement, which may partially explain the modest survival observed despite rapid initiation of care.

A key finding of this study is the strong association between initial cardiac arrest rhythm and resuscitation outcomes. Shockable rhythms accounted for less than one-fifth of arrests but were associated with nearly fourfold higher odds of achieving ROSC compared with non-shockable rhythms. This aligns with extensive prior literature identifying initial rhythm as one of the most powerful predictors of survival following IHCA (14,15). The predominance

of PEA and asystole in our cohort mirrors patterns reported across diverse hospital settings, where non-shockable rhythms are increasingly common and often reflect severe underlying hypoxia, metabolic derangements, or prolonged pre-arrest instability (15). These pathophysiological factors likely limit the reversibility of arrest even when CPR is promptly initiated.

The marked attrition observed between ROSC and hospital discharge highlights the critical importance of post-resuscitation care. Although 36.0% of patients achieved ROSC, fewer than one-third of these ultimately survived to discharge, underscoring that successful initial resuscitation does not necessarily translate into long-term survival. Similar patterns have been reported in multicenter registries, where post-ROSC mortality is driven by recurrent arrest, refractory shock, and hypoxic–ischemic brain injury (16). The relatively lower discharge survival among patients with non-shockable rhythms in our study further supports the concept that arrest etiology and physiological reserve exert ongoing influence well beyond the resuscitation phase.

Resuscitation duration emerged as another clinically relevant factor, with prolonged efforts beyond 20 minutes associated with significantly lower odds of ROSC. This finding is consistent with previous studies demonstrating an inverse relationship between resuscitation duration and survival, likely reflecting both the severity of the underlying insult and diminishing probability of achieving sustainable circulation with extended CPR (16). While prolonged resuscitation may still be appropriate in selected cases, particularly when reversible causes are identified, these data emphasize the importance of early, high-quality interventions and rapid correction of precipitating factors in the emergency department setting.

From a systems perspective, our findings reinforce the need for continued focus on early recognition of clinical deterioration in the ED, standardized ACLS-based team responses, and robust post-cardiac arrest care pathways. Prior work has shown that dedicated resuscitation teams, regular simulation-based training, and structured post-ROSC protocols can improve outcomes following IHCA (14). In resource-limited settings, targeted quality-improvement initiatives—such as improving monitoring for high-risk patients, optimizing CPR quality, and ensuring timely access to critical care beds—may represent feasible strategies to narrow observed survival gaps.

Several limitations should be considered when interpreting these results. The retrospective single-center design limits causal inference and generalizability, and unmeasured confounding related to illness severity or arrest etiology may have influenced outcomes. Neurological outcomes at discharge were not assessed, precluding evaluation of functional survival. Additionally, although consecutive cases were included to minimize selection bias, the modest sample size limited statistical power for some subgroup analyses, particularly for survival to discharge. Nevertheless, the strength of this study lies in its detailed characterization of ED-specific IHCA outcomes in a setting where such data are scarce.

In summary, this study demonstrates that in-hospital cardiac arrest in the emergency department is associated with low survival to hospital discharge, with initial cardiac arrest rhythm and resuscitation duration serving as key determinants of outcome. Shockable rhythms confer a substantial advantage in achieving ROSC and subsequent survival, while non-shockable rhythms remain the predominant and most lethal presentation. These findings highlight the continued need for system-level interventions aimed at early detection, high-quality resuscitation, and optimized post-arrest care to improve outcomes for ED patients experiencing IHCA.

CONCLUSION

In-hospital cardiac arrest occurring in the emergency department is associated with low survival to hospital discharge, despite a moderate rate of return of spontaneous circulation. Non-shockable rhythms predominate and are linked to substantially poorer outcomes compared with shockable rhythms, while prolonged resuscitation duration further reduces the likelihood of successful resuscitation. These findings highlight that, even in a monitored and resource-equipped setting such as the emergency department, survival following IHCA remains limited. Strengthening early recognition of deterioration, ensuring consistently high-quality cardiopulmonary resuscitation, and optimizing post-resuscitation care pathways are essential to improve outcomes. Locally generated data such as these are critical to inform targeted quality-improvement strategies and guide future prospective research in similar healthcare settings.

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DECLARATIONS

Ethical Approval: Ethical approval for this study was obtained from the Institutional Ethical Review Board of Lady Reading Hospital, Peshawar, Pakistan

Informed Consent: Informed Consent was taken from participants.

Authors' Contributions:

Concept: MAK; Design: MAK, MKH; Data Collection: MKH, US, EA, AS, SS; Analysis: MAK, EF; Drafting: MAK, MKH, US, EA, AS, SS, EF

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Data Availability: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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