In-Hospital Cardiac Arrest (IHCA): Integrating Nursing, Paramedics, Emergency Management, Pharmacy, and Dental Assistance in Quality Improvement and Response

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Abstract

In-hospital cardiac arrest (IHCA) poses a significant challenge to healthcare systems, necessitating a collaborative response from diverse healthcare professionals. The integration of nursing, paramedics, emergency management, pharmacy, and even dental assistance is vital for enhancing patient outcomes. Nurses play a critical role in recognizing early warning signs and administering immediate lifesaving interventions. Paramedics can provide advanced cardiac care and support, while emergency management ensures that protocols are in place for swift response. Pharmacy professionals contribute by ensuring that medications used during resuscitation are readily available and appropriate, and dental professionals can assist in airway management when necessary. This comprehensive approach not only improves the quality of care delivered but also fosters a culture of teamwork and communication within the hospital setting. Quality improvement initiatives centered on IHCA require systematic evaluation and ongoing training among all stakeholders involved. Regular simulations and drills that include nursing staff, paramedics, emergency responders, pharmacists, and dental teams can help identify gaps in training and communication, ultimately leading to better preparedness during actual events. Emphasizing multidisciplinary collaboration and the establishment of clear protocols allows for a rapid and coordinated response, which is crucial in saving patient lives. Ultimately, understanding the role each professional plays in the IHCA management process leads to accelerated improvements in care standards and better survival rates, underscoring the importance of integrated efforts across various healthcare domains.

Keywords: In-Hospital Cardiac Arrest (IHCA), nursing integration, paramedics, emergency management, pharmacy role, dental assistance

Introduction

In-hospital cardiac arrest represents one of the most time-critical emergencies encountered in healthcare settings, defined as the cessation of cardiac mechanical activity confirmed by absence of signs of circulation in a hospitalized patient, and this emergency demands immediate coordinated intervention to prevent irreversible organ damage and death [1]. The incidence of IHCA varies across institutions with reported rates of 1.5 to 6 events per

1,000 hospital admissions, and annually nearly 400,000 hospitalized patients in the United States experience IHCA, yet only approximately one in four survives to hospital discharge [2, 3]. The prognosis following IHCA is influenced by multiple factors including initial cardiac rhythm, location of arrest, response times, quality of cardiopulmonary resuscitation (CPR), and effectiveness of post-resuscitation care, with patients presenting with shockable rhythms demonstrating significantly better outcomes compared to those with non-shockable rhythms. [4- 7].

Notably, approximately 80% of IHCA events are preceded by hours of abnormal vital signs, which highlights the critical importance of early detection and prevention strategies in improving survival rates, and patients with non-shockable rhythms including asystole or pulseless electrical activity account for approximately 71% of initial IHCA rhythms [3]. The 2025 AHA Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care represent the most current evidence-based recommendations for IHCA management, emphasizing the implementation of early warning systems and rapid response teams as preventive strategies alongside consolidated recommendations for post-resuscitation care [4, 8]. Similarly, the 2025 European Resuscitation Council guidelines provide aligned yet distinct recommendations for advanced life support during cardiac arrest, including specific guidance against routine administration of calcium, sodium bicarbonate, and corticosteroids except for particular indications. Traditional approaches to IHCA management have often treated resuscitation as primarily the domain of physicians and nurses, but contemporary evidence increasingly supports a broader multidisciplinary model wherein diverse healthcare professionals contribute unique expertise across the IHCA care continuum. [9, 10]

Epidemiology and Current Outcomes of In-Hospital Cardiac Arrest

Contemporary epidemiological data reveal that IHCA survival to hospital discharge for adults ranges from 15% to 34%, with significant variation across institutions and patient populations, while for children survival rates approach 45%, and return of spontaneous circulation is achieved in approximately 63% of IHCA events [1,2,12]. Long-term outcomes demonstrate that 18.7% of patients survive 12 months after hospital discharge and 37% of patients are alive at 12 months post-arrest, yet IHCA survival has plateaued in recent years after decades of gradual improvement, and analysis of the Get With The Guidelines-Resuscitation registry indicates that survival rates have significantly diverged between urban and rural hospitals over the past decade [11,12,13]. Several factors independently predict survival following IHCA including observed cardiac arrest (witnessed event) and continuous ECG monitoring which are significant positive predictors for return of spontaneous circulation and improved survival, while shockable initial rhythms, cardiac primary diagnosis, female sex, and younger age are associated with favorable in-hospital survival rates and extended life expectancy [5,13,14]. Among IHCA survivors, the risk of severe neurological injury is substantial, with 22.9% of survivors experiencing severe brain damage ultimately leading to death in intensive care units, and this neurological morbidity represents a critical quality indicator as survival without meaningful neurological recovery is increasingly recognized as an inadequate outcome measure, leading contemporary quality improvement initiatives to emphasize neurologically intact survival as the primary goal of resuscitation efforts [14,15].

The 2025 Resuscitation Guidelines

The 2025 AHA Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care provide comprehensive evidence-based recommendations for managing adult cardiac arrest including ventricular fibrillation, pulseless ventricular tachycardia, asystole, and pulseless electrical activity, with key updates for IHCA management comprising consolidated recommendations regarding early warning systems and rapid response teams, new recommendations on the use of safety huddles as a preventive strategy, and guidance on systems of care for optimal post-resuscitation recovery for cardiac arrest survivors [3,9,10]. The 2025 European Resuscitation Council guidelines align with AHA recommendations on many core principles but exhibit notable differences, notably recommending against routine

administration of calcium, sodium bicarbonate, and corticosteroids during cardiac arrest except for specific indications, and both guideline bodies emphasize the importance of continuous quality improvement and structured multidisciplinary response systems [4,8,10]. The guidelines recommend that all healthcare professionals involved in resuscitation receive regular simulation-based training and participate in post-event debriefing to identify opportunities for process improvement, and they also emphasize the critical role of early warning systems in preventing IHCA before it occurs, providing specific recommendations for measuring chest compression fraction, time to defibrillation, and time to epinephrine administration as key quality indicators [3,9,10,11]. These guideline recommendations provide the evidence-based foundation for multidisciplinary integration strategies across nursing, paramedicine, pharmacy, emergency management, and dental assistance, underscoring the need for coordinated action and clear role definitions during resuscitation events [3,4,8].

Nursing

Nurses serve as the frontline surveillance system for hospitalized patients, uniquely positioned to detect early signs of clinical deterioration because approximately 80% of IHCAs are preceded by hours of abnormal vital signs, creating a window of opportunity for preventive intervention through rapid response systems that link ward surveillance to a multidisciplinary team capable of intercepting the pre-arrest phase through early recognition and treatment of physiological deterioration [16,17]. Clinical triggers systems have been developed to help nurses identify early markers of decompensation and advocate for prompt bedside assessment and interventions, and under these systems when clinical triggers are identified the nurse notifies a provider who performs a bedside assessment within 15 minutes, while high-acuity response team programs integrate early warning systems with proactive rounding by critical care nurses, significantly reducing intensive care unit readmissions and improving patient care [16,17,18]. During active resuscitation, nurses fulfill multiple critical functions including hemodynamic monitoring, medication administration, and ventilator management, and studies demonstrate that integrating performance metrics into routine review processes enhances resuscitation preparedness and improves patient outcomes, while high-fidelity simulation has emerged as an effective training modality for enhancing nurses' knowledge, practical skills, and confidence in managing IHCA [18,19]. Nurse-led post-code debriefing represents an essential quality improvement strategy, with post-code debrief tools initiated by unit lead nurses facilitating systematic analysis of resuscitation performance, identification of barriers to optimal care, and development of corrective action plans, and the creation of resuscitation scorecards with key metrics provides feedback to staff on CPR quality, no-flow times, and other performance indicators, with ICU nurses in particular bringing specialized expertise in hemodynamic monitoring and ventilator management to the code team [18,19,20].

Paramedics

While traditionally associated with prehospital emergency response, paramedics increasingly serve within hospital settings as members of rapid response teams and medical emergency teams, bringing skills in rapid assessment, early clinical intervention, effective stabilization, and timely decision-making to the hospital environment, where they integrate their prehospital experience with inpatient protocols providing valuable expertise in airway management, vascular access, and rhythm interpretation [17,21]. The inclusion of paramedics on rapid response teams has been shown to improve patient outcomes by reducing response times and enhancing the quality of initial resuscitation efforts, and paramedics contribute to the three-tiered structure of rapid response systems which typically include an afferent limb (detection of deterioration), an efferent limb (team response), and an administrative limb (quality oversight) [17,21,22]. Their experience in high-acuity low-frequency events positions them well to maintain composure and procedural competence during resuscitation emergencies, and paramedic protocols ensure structured approaches to emergency assessment and treatment, reducing variability in care and enhancing coordination between responding team members [21,22]. Within integrated emergency response models, paramedics collaborate with emergency

physicians, nurses, and other healthcare professionals to ensure continuity of care across the resuscitation continuum, and the role of the hospital-based paramedic has expanded significantly in recent years, with many institutions now employing paramedics specifically to serve on rapid response teams and to support nursing staff in recognizing early signs of deterioration, while also contributing to code blue response teams as dedicated airway managers or vascular access specialists [17,21,22].

Emergency Management Response

The Code Blue Response System represents the standardized emergency activation protocol designed to streamline hospital responses to cardiac arrest events, and studies evaluating Code Blue Response System implementation demonstrate significant improvements in response times and survival outcomes, as a Code Blue alert rapidly engages a specialized team of healthcare professionals trained to provide immediate life-saving measures [23,24]. Emergency management coordinators are responsible for maintaining the operational readiness of Code Blue systems including ensuring appropriate equipment availability and functionality, managing communication systems for rapid team activation, coordinating training and drill schedules, and integrating Code Blue response with hospital disaster plans, and standardization of emergency codes across institutions reduces confusion and improves response efficiency [23,24,25]. In many healthcare systems, Code Blue indicates adult cardiac arrest while Code Pink denotes pediatric cardiac arrest, with emergency management professionals overseeing the adoption and implementation of uniform emergency codes as part of hospital emergency and disaster plans, and during active IHCA events emergency management coordinators play a vital role by ensuring adequate staffing, equipment, and space resources [24,25]. Their responsibilities extend to coordinating with paramedical and allied health services as well as ancillary personnel including housekeeping, biomedical engineering, transport, maintenance, and security services, enabling clinical team members to focus exclusively on patient care during resuscitation, and emergency management professionals also lead regular mock code drills to ensure that all hospital staff remain prepared for cardiac arrest events, with the integration of emergency management principles into hospital resuscitation systems having been shown to improve team performance and reduce variability in response times [23,24,26].

Performance Improvement and Data Management

Performance improvement specialists in IHCA management focus on three primary domains: the presence of early warning signs prior to cardiac arrest in non-critical care units, the quality of CPR delivered during resuscitation, and patient outcomes following cardiac arrest, with core quality metrics including time to shock (interval from arrest recognition to first defibrillation with a target of less than 3 minutes for shockable rhythms) and time to epinephrine (interval from arrest recognition to first epinephrine dose with a target of less than 5 minutes) [18,27]. Chest compression fraction (proportion of resuscitation time with active compressions with a target of 80% or greater) and confirmation of airway (time to definitive airway placement) are also essential metrics for evaluating resuscitation quality, and prospective cardiac arrest quality improvement databases enable systematic tracking of performance measures, with observers assigned to code teams documenting real-time performance data which are subsequently compared against retrospective electronic health record documentation to identify discrepancies and improve data accuracy [27,28]. Participation in national registries such as the Get With The Guidelines-Resuscitation program provides benchmarking capabilities, enabling hospitals to compare their outcomes against national averages and identify best practices from high-performing institutions, and multimodal quality improvement interventions have demonstrated effectiveness in enhancing resuscitation quality metrics, with a recent intervention in an emergency department setting successfully enhancing CPR quality metrics achieving guideline-concordant compression parameters, increasing end-tidal carbon dioxide values, and improving chest compression fraction from 65% to 81% [15,28,29]. Nurse-centric resuscitation institutes have utilized survivability quality metrics to create multifaceted approaches to education and process improvement,

resulting in improved early recognition, optimal resuscitation practices, and enhanced post-cardiac arrest care, and continuous quality improvement cycles that include regular data feedback to frontline staff have been shown to improve CPR quality metrics over time [28,29,30].

Pharmacy

Clinical pharmacists are increasingly recognized as essential members of hospital code teams, and systematic review evidence demonstrates that pharmacist involvement in emergency response teams leads to reduction in medication errors, improved adherence to advanced cardiovascular life support protocols, decreased time to medication administration, and potential cost savings for institutions, with pharmacist participation in cardiopulmonary code resuscitation events directly linked to better-quality care and lowered mortality rates [30,31,32]. During active resuscitation, pharmacists fulfill several critical functions including medication preparation (drawing up and preparing medications as needed during the code), dose calculation (calculating appropriate medication doses based on patient weight and clinical condition), protocol guidance (advising the team on ACLS medication protocols and sequencing), medication safety (verifying medication identities, doses, and administration routes), and code cart management (maintaining ownership of the code cart and ensuring medication availability) [30,31]. Pharmacists are often described as the most consistent member of code efforts, providing continuity and medication expertise across resuscitation events, and the presence of pharmacists during resuscitation has been attributed to increased guideline compliance, mortality reduction, cost reduction, and reduced error rates, with critical care pharmacists in particular contributing to adjunctive therapy selection and advanced medication management strategies to further enhance their role in IHCA response [31,32]. Pharmacy residency training programs increasingly include medical emergency response training components to prepare trainees for hospital emergency response roles, and studies have shown that pharmacist involvement reduces the time to epinephrine administration and decreases the number of medication errors during code blue events, while the integration of pharmacists into rapid response teams has been associated with improved patient outcomes [30,31,32].

Dental Assistance

While dental assistants are not typically considered core members of hospital code teams, their training in airway management and basic life support makes them valuable contributors to IHCA response, particularly in outpatient settings, dental clinics within hospitals, and as part of hospital-wide emergency response systems, as dental professionals must receive specific basic life support certification to recognize and handle life-threatening situations including choking, cardiac arrest, and respiratory emergencies [33,34]. Dental assistants receive training in recognition of airway obstruction and choking, use of oropharyngeal and supraglottic airways, oxygen administration and ventilatory equipment operation, and patient positioning including recovery position and modified positions for airway optimization, and studies evaluating emergency management knowledge among dental students in Saudi Arabia found that 67.7% prioritized airway, breathing, and circulation in managing unconscious patients, while 44.3% advocated immediate chest compressions for sudden cardiac arrest [34,35]. Dental assistants often serve in patient safety officer roles within dental settings, leading mock emergency drills and ensuring role-playing occurs with all team members, and this experience translates effectively to hospital environments where regular emergency preparedness drills require active participation from all staff categories [34,35]. While dental assistants may not lead hospital code teams, their basic life support certification and airway management skills enable them to function effectively as first responders in the crucial initial minutes of an IHCA event, and in hospital settings where dental assistants work within dental departments or ambulatory surgery centers they can serve as immediate responders until the code blue team arrives, providing basic airway support and initiating chest compressions, thus expanding the pool of potential first responders within healthcare facilities and improving overall resuscitation preparedness [33,34,35].

Multidisciplinary Team Integration

The complexity of IHCA management necessitates coordinated action across multiple professional domains, and no single discipline possesses all the knowledge, skills, and resources required for optimal resuscitation, as multidisciplinary Heart Team-based collaborations are crucial in delivering compassionate care and optimizing clinical outcomes in cardiac arrest management, with structured simulation-based multidisciplinary interventions having demonstrated significant improvements in time to defibrillation for in-hospital cardiac arrests [25,26]. Structured, expert-driven, multidisciplinary review processes shift event analysis from describing what happened during a cardiac arrest to explaining why and how it occurred, thereby revealing upstream factors that improve recognition of decompensation, team response, and CPR performance, and these processes involve consensus-based determinations of IHCA preventability based on objective measures typically conducted through interdisciplinary ward IHCA debriefing programs [25,26,27]. For refractory cardiac arrest cases, advanced protocols such as Code ECPR (Extracorporeal Cardiopulmonary Resuscitation) represent structured team-based approaches to rapidly identify candidates and initiate mechanical circulatory support, requiring seamless collaboration among emergency physicians, intensivists, cardiac surgeons, perfusionists, nurses, and pharmacists [25,26]. Effective multidisciplinary integration requires clear role definition, regular cross-disciplinary training, and shared mental models of resuscitation events, and hospitals that have implemented structured multidisciplinary code team models report improved communication, reduced role confusion, and better clinical outcomes, while the integration of nursing, paramedics, emergency management professionals, pharmacists, and dental assistants into a unified response system requires ongoing commitment from hospital leadership and regular evaluation of team performance metrics [26,27,28].

Quality Improvement Infrastructure

Effective multidisciplinary IHCA management requires robust quality improvement infrastructure, and quality improvement experts engage with hospitals through Plan-Do-Study-Act cycles, providing guidance on implementation strategies and helping avoid common pitfalls, while monthly collaborative webinars facilitate shared learning, quality improvement education, and data sharing on IHCA processes and outcomes [28,29]. Creating situational awareness and shared mental models among resuscitation teams is essential for optimal performance, and quality improvement initiatives have developed structured approaches for discussing the most likely reasons for IHCA for particular patients along with mitigation and rescue plans, enabling entire teams to recognize early deterioration and respond effectively [27,28,29]. Electronic documentation of IHCA events enables leadership to properly abstract time-sensitive performance measures and conduct systematic quality review, and electronic health record systems increasingly include resuscitation narrator modules designed to capture real-time performance data during code events, while continuous quality improvement cycles that include regular data feedback to frontline staff have been shown to improve CPR quality metrics over time [28,29,30]. Hospitals that participate in national quality improvement collaboratives demonstrate faster improvement in IHCA survival rates compared to those that do not, and the integration of performance improvement specialists into code response teams ensures that data collection occurs in real time and that opportunities for improvement are identified immediately, with these specialists also playing a key role in developing and implementing corrective action plans based on debriefing findings, while quality improvement infrastructure must also include systems for tracking long-term outcomes including neurological status at hospital discharge and survival at 12 months post-arrest [15,28,29].

Challenges and Future Directions

Despite compelling evidence supporting multidisciplinary IHCA response, several barriers impede widespread implementation including role clarity issues where overlap between professional roles can create confusion during high-stress events, training disparities with variable resuscitation training requirements across professions, resource constraints where smaller hospitals may lack dedicated personnel for each specialty role,

hierarchical dynamics where traditional medical hierarchies may inhibit full participation of all team members, and data infrastructure limitations where many institutions lack the information systems needed for comprehensive quality tracking [11,14,30]. These barriers disproportionately affect rural and community hospitals which already experience worse IHCA outcomes compared to academic medical centers, and addressing these disparities requires targeted investment in training, staffing, and technology, while several innovations promise to enhance multidisciplinary IHCA response in coming years including real-time CPR feedback devices providing audiovisual guidance on compression depth, rate, and recoil; tele-resuscitation support enabling remote expert consultation during code events; machine learning prediction models identifying patients at high risk for IHCA before clinical deterioration; and standardized multidisciplinary simulation curricula ensuring consistent training across professional groups [15,21,30]. Future research should address optimal composition and staffing models for rapid response teams, comparative effectiveness of different debriefing formats, cost-effectiveness of dedicated code team pharmacists, best practices for integrating dental professionals into hospital emergency response systems, and implementation strategies for resource-limited settings, while the development of artificial intelligence-based early warning systems that integrate electronic health record data with real-time vital signs monitoring may further enhance the ability to predict and prevent IHCA before it occurs [21,22,30,31].

Conclusion

In-hospital cardiac arrest (IHCA) presents a significant challenge requiring multidisciplinary collaboration for effective intervention. This paper highlights the key roles of nursing, paramedicine, emergency management, performance improvement, pharmacy, and dental assistance in IHCA prevention and response. Optimal outcomes rely on integrated systems where each discipline's expertise is utilized, continuously refined through quality improvement. The 2025 AHA and ERC guidelines stress evidence-based approaches, emphasizing systems of care, early warning systems, and team-based models. Success is measured by not just survival, but meaningful neurological recovery, achievable through coordinated efforts of the resuscitation team. Institutions must develop structured response systems supported by robust data and quality processes, invest in simulation training, and recognize each team member's role in enhancing IHCA outcomes and improving patient survival rates.

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