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Research Article

Collaboration Between Nursing, Health Assistance, and Emergency Medical Services During Cardiac Arrest Management

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Abstract:

Collaboration among nursing staff, health assistance personnel, and emergency medical services (EMS) is crucial in the effective management of cardiac arrest situations. When a cardiac arrest occurs, the immediate response from all healthcare professionals involved can significantly improve patient outcomes. Nurses play an essential role by rapidly assessing the patient's condition, initiating advanced cardiac life support (ACLS) protocols, and coordinating with EMS while delivering life-saving interventions such as chest compressions and defibrillation. Health assistants, who may be first responders in community settings, provide critical support in these scenarios by performing basic life support (BLS), ensuring that the environment is safe, and aiding in communication between medical teams. Seamless communication and clearly defined roles are paramount during these high-stakes situations, ensuring that every team member contributes effectively and efficiently to the overall care of the patient. The integration of nursing, health assistance, and EMS teams during cardiac arrest

management not only enhances the level of care given but also promotes a comprehensive approach to patient safety and recovery. Regular interdisciplinary training and simulation exercises enable all team members to understand each other's expertise, build trust, and refine their response strategies. This collaboration is further strengthened by the use of advanced technology, like automated external defibrillators (AEDs), which can be employed rapidly by anyone trained in their use. Continuous evaluation and feedback mechanisms post-cardiac events are essential for identifying areas of improvement, fostering an environment of shared learning among all stakeholders. Through cooperative efforts, cardiac arrest management becomes a well-coordinated response that can dramatically increase the likelihood of survival for affected patients.

1. Introduction

Out-of-hospital cardiac arrest (OHCA) represents one of the most critical and time-sensitive medical emergencies encountered in modern healthcare. It is a condition where the heart ceases its effective pumping activity, leading to the immediate cessation of blood flow to the brain and other vital organs. The survival of a patient in cardiac arrest is a race against time, where every minute without cardiopulmonary resuscitation (CPR) and defibrillation decreases the chance of survival by 7-10% [1]. Despite decades of advancement in resuscitation science, the global survival rate for OHCA remains dismally low, with studies indicating that less than 10% of patients survive to hospital discharge in most systems worldwide [2]. This stark statistic underscores not a failure of individual effort, but a profound challenge in our systems of care. The management of cardiac arrest is not a solitary endeavor; it is a complex, high-stakes symphony that demands the seamless, coordinated efforts of multiple responders across different phases of the emergency continuum. The chain of survival—a metaphor developed by the American Heart Association (AHA) and the International Liaison Committee on Resuscitation (ILCOR)—conceptualizes this process, emphasizing early access, early CPR, early defibrillation, advanced life support, and integrated post-cardiac arrest care [3]. The strength of this chain, however, is entirely dependent on the quality of collaboration between its links: the lay responders, emergency medical dispatchers, emergency medical services (EMS) personnel, hospital emergency departments, and critical care units.

The initial link in this chain often involves bystanders and health assistance professionals in community settings such as clinics, nursing homes, or public facilities. Immediate recognition of cardiac arrest and the initiation of high-quality bystander CPR can double or even triple a victim's chance of survival [4]. However, bystander CPR rates vary dramatically, from over 70% in some countries with mandated CPR training to below 20% in others [5]. This is where the first critical collaboration occurs—between a panicked caller and an emergency medical dispatcher. Dispatchers play a crucial role in identifying cardiac arrest through standardized algorithms and providing telephonic instructions for CPR (T-CPR), effectively guiding laypersons to become the first responders. The success of this interaction is a testament to the collaboration between the public and the professional health system, bridging the gap until trained help arrives.

The arrival of Emergency Medical Services (EMS) marks the transition to a more structured and advanced level of care. The EMS team, typically comprised of paramedics and emergency medical technicians, is tasked with performing high-performance CPR, rapid defibrillation, advanced airway management, and administration of pharmacological interventions. The environment in which they operate is often chaotic and uncontrolled, placing a premium on impeccable internal teamwork. Effective crew resource management (CRM), clear closed-loop communication, and defined role allocation within the small EMS team are fundamental to delivering effective care under extreme pressure [6]. Studies have consistently shown that EMS teams with strong non-technical skills, including leadership and mutual support, achieve better CPR quality metrics, such as higher chest compression fraction and reduced peri-shock pauses, which are directly correlated with improved outcomes [7].

However, the collaboration cannot end at the scene. The most critical interface in the OHCA continuum is often the handover between the EMS team and the awaiting hospital emergency department (ED) staff. This transition of care is a known vulnerability where essential information can be lost, and treatment momentum can falter. A structured, professional handover process is vital. The implementation of tools like the **"CHAN" handover** (C: Chief complaint/Critical care, H: History/History of present illness, A: Assessment/Appraisal, N: Needs/Next steps) or similar mnemonics ensures the transmission of key data: the initial rhythm, time of collapse, downtime,

quality of bystander CPR, interventions performed, and the patient's response [8]. A chaotic, unstructured handover can lead to delays in critical interventions such as targeted temperature management (therapeutic hypothermia) or immediate coronary angiography, both of which are cornerstone therapies in the post-resuscitation phase for eligible patients [9].The final, and perhaps most evolving, aspect of collaboration involves the pre-notification of the hospital by EMS. When EMS providers alert the ED of an incoming resuscitated cardiac arrest patient, it allows the hospital to mobilize a dedicated resuscitation team, prepare essential equipment, and activate key resources such as the catheterization lab or intensive care unit. This pre-arrival activation has been demonstrated to significantly reduce door-to-intervention times. For instance, one multi-center study found that pre-hospital notification was associated with a 20% reduction in door-to-balloon time for patients undergoing percutaneous coronary intervention (PCI) after cardiac arrest [10].

2. Global Burden and Time-Sensitive Nature of Cardiac Arrest

The global burden of Out-of-Hospital Cardiac Arrest (OHCA) is staggering, representing a major public health challenge. Current epidemiological data estimates that hundreds of thousands of individuals experience OHCA annually in developed nations alone. In Europe, the incidence of EMS-treated OHCA is approximately 84 per 100,000 person-years, translating to several hundred thousand cases each year across the continent [13]. In the United States, the American Heart Association reports that emergency medical services respond to more than 350,000 adults experiencing OHCA annually [14]. The most sobering statistic, however, is the survival rate. Despite advances in medical science, the overall global survival-to-hospital-discharge rate for OHCA remains dismally low, consistently reported to be between 6% and 10% in most systems [13, 14]. This statistic underscores a profound failure in our current systems of care and highlights the immense opportunity for improvement. The burden is not evenly distributed; survival rates can vary more than fivefold between different geographic regions and emergency medical systems, pointing to systemic factors that significantly influence outcomes [15]. The pathophysiological process following cardiac arrest creates an unforgiving, time-sensitive scenario. From the moment the heart stops, the body's oxygen reserves are depleted within minutes. The brain, being the most oxygen-sensitive organ, begins to suffer irreversible neuronal damage after only 4 to 6 minutes without blood flow. This process is not uniform; selective vulnerable areas, such as the hippocampus, are affected first. The concept of the "ischemic penumbra"—a region of threatened but still viable tissue—is as relevant in cardiac arrest as it is in stroke, creating a therapeutic window that must be exploited aggressively [16]. For every minute that passes without effective Cardiopulmonary Resuscitation (CPR) and defibrillation, the chance of survival decreases by 7% to 10% [17]. After approximately 10 minutes without intervention, survival with good neurological function becomes exceedingly rare. This biological reality is the fundamental driver behind all resuscitation protocols and underscores why speed and efficiency are paramount.The clinical response to this challenge is conceptualized in the "Chain of Survival," a metaphor developed by the American Heart Association and adopted globally by the International Liaison Committee on Resuscitation (ILCOR). This chain consists of five interlinked rings: 1) Early recognition and call for help, 2) Early bystander CPR, 3) Early defibrillation, 4) Early advanced life support, and 5) Integrated post-cardiac arrest care [18]. The strength of this chain is determined by its weakest link. A failure at any single point—for instance, a delay in starting CPR or a prolonged period without defibrillation—can compromise the entire rescue effort, regardless of how well subsequent steps are performed. This model powerfully illustrates that successful resuscitation is not a single action but a seamless sequence of interdependent events.It is within this context of biological urgency and systemic interdependence that the necessity for collaboration becomes undeniable. No single individual or service can single-handedly ensure a patient's survival. The chain of survival inherently requires a relay team: from the layperson or health assistant who starts CPR, to the dispatcher who guides them, to the EMS crew that provides advanced care, to the hospital team that continues treatment. The transition between these responders are critical handover points where information, responsibility, and the momentum of care must be transferred without faltering. The quality of these collaborations—the clarity of communication, the mutual understanding of roles, and the shared goal—directly impacts the perfusion of the patient's brain and heart during the most vulnerable minutes of their life.

3. Collaboration Between Bystanders, Health Assistants, and Emergency Dispatchers

The role of the immediate bystander, whether a layperson or a health assistant, is paramount. Health assistants, including nursing assistants, caregivers in long-term care facilities, and clinical support staff, often find themselves at the forefront of medical emergencies in community settings. Their position provides a unique advantage for early recognition. Unlike the general public, health assistants are trained to identify unresponsiveness and the absence of normal breathing, key signs of cardiac arrest. The immediate action they take—checking for a response and calling for help—initiates the formal emergency response system. However, recognition alone is insufficient; the initiation of high-quality cardiopulmonary resuscitation (CPR) is the critical next step. Studies consistently demonstrate that bystander CPR can double or even triple the chance of survival from out-of-hospital cardiac arrest [21]. Despite its proven benefit, global rates of bystander CPR remain highly variable, ranging from over 80% in some systems with robust public training initiatives to less than 20% in others, highlighting a significant gap in public readiness and a target for systemic improvement [22].

This is where the vital collaboration with the emergency medical dispatcher begins. The dispatcher serves as the calm, guiding voice in a chaotic situation, transforming a panicked caller into an effective first responder. The implementation of standardized, algorithm-driven dispatch protocols is a cornerstone of modern emergency medical systems. These protocols allow dispatchers to systematically interrogate the caller to identify unresponsiveness and agonal breathing, which is often mistaken for signs of life by untrained bystanders [23]. Once cardiac arrest is suspected, the dispatcher provides Telephonic-CPR (T-CPR) instructions. T-CPR is a sophisticated skill that involves providing simple, clear, and real-time instructions for chest compressions, often including corrective feedback. The success of this interaction is a powerful testament to remote collaboration. Evidence shows that dispatcher-assisted CPR significantly increases the rate of bystander CPR initiation and improves the quality of compressions delivered, thereby buying precious time for the patient [24]. The dispatcher, therefore, acts as a remote "coach," extending the reach of the EMS system directly to the patient's side the moment the call is answered.

The collaboration between on-site health assistants and remote dispatchers can be further enhanced by specific protocols and technologies. For health assistants working in institutional settings like clinics or nursing homes, the presence of on-site automated external defibrillators (AEDs) adds another layer to this first-link response. A dispatcher can not only guide CPR but also direct a bystander to retrieve and use an AED. The "pit-crew" model can be initiated even at this basic level, with the dispatcher potentially guiding one person to perform compressions and another to fetch the AED and prepare for its application [25]. The integration of smartphone applications and alert systems that notify nearby trained volunteers of a cardiac arrest is another technological advancement strengthening this link. These systems can dispatch nearby off-duty healthcare professionals or trained citizens to the scene, effectively creating an ad-hoc, community-based first-response team before the arrival of traditional EMS [26].

However, this collaborative first link faces significant barriers. Fear of causing harm, panic, and lack of confidence are major impediments to bystander action, even among some health assistants who may not regularly perform CPR [27]. The emotional state of the caller can also hinder the dispatcher's ability to gather accurate information and provide effective instructions. To overcome these challenges, focused interventions are essential. These include mandatory and frequent CPR and AED training for all health assistance personnel, public awareness campaigns to demystify CPR and address fears, and continuous quality improvement programs for dispatch centers that include review of T-CPR calls and feedback for dispatchers [28, 29].

4. Core Principles of EMS Crew Resource Management

The core of effective EMS team dynamics lies in the establishment of clear roles and responsibilities from the moment of arrival. A structured "pit-crew" model is widely advocated to minimize chaos and maximize efficiency. In this model, roles are pre-assigned or quickly delegated, typically including a team leader, a compressor, an airway manager, a vascular access/medication administrator, and a defibrillator operator [31]. The team leader's role is particularly critical. This individual does not typically perform manual tasks but instead maintains a global perspective, directs the resuscitation, interprets rhythm strips, makes key decisions (e.g., when to shock, which medications to administer), and, most importantly, facilitates communication. By standing back from the hands-on work, the leader can monitor the overall performance, identify problems like deteriorating compression quality or prolonged pulse checks, and ensure adherence to advanced cardiac life support (ACLS) protocols [32]. This clear role clarity

prevents task fixation, where team members become so absorbed in their own duty that they fail to see emerging issues or changing patient needs.

Underpinning these roles is the practice of explicit, closed-loop communication. In the high-noise, high-stress pre-hospital environment, assumptions and implicit instructions are a recipe for error. Closed-loop communication ensures that critical information is both transmitted and confirmed. The process involves a sender stating a clear message (e.g., "Charge the defibrillator to 200 joules"), a receiver repeating back the message verbatim ("Charging to 200 joules"), and the sender confirming the accurate repetition ("Correct") [33]. This simple but disciplined practice prevents misunderstandings of drug doses, energy levels, and critical instructions. Furthermore, the practice of "thinking out loud" or "shared verbalization" fosters a shared mental model. When the team leader verbalizes their assessment—"I see fine V-fib, we are going to shock, then resume CPR immediately"—it aligns the entire team's understanding of the situation and the planned next steps, ensuring synchronized action [34].

A cornerstone of effective CRM is the cultivation of a climate of psychological safety, where any team member feels empowered to speak up with concerns or observations, regardless of their rank or seniority. In a traditional hierarchy, a junior paramedic might hesitate to question a decision made by a senior team leader. In a CRM-informed culture, this barrier is actively broken down. Team members are trained and expected to use assertive communication, such as the "PACE" model: starting with a Probes ("Are you sure about that dose?"), escalating to an Alert ("I'm concerned that dose is too high"), then a Challenge ("I think we should not give that medication"), and finally an Emergency ("Stop! That is the wrong drug!") [35]. This structured approach allows for respectful yet firm intervention to prevent errors. A classic example is a team member noticing that compressions have stopped for an extended period during a rhythm check and calling out, "We are off the chest for 15 seconds, let's resume compressions now." This collective vigilance is a powerful defense against the degradation of CPR quality that commonly occurs during resuscitations [36].

The physical and cognitive workload during a cardiac arrest is immense, making mutual support and workload management essential CRM components. Team members must continuously monitor each other for signs of task overload or fatigue. High-quality chest compressions are physically exhausting, and a compressor's effectiveness declines rapidly after just two minutes. A vigilant team will proactively rotate compressors every two minutes without being prompted, ensuring that the quality of this most critical intervention does not falter [37]. Similarly, the team leader must manage the cognitive load by delegating tasks and avoiding fixation on a single problem. If a difficult intubation is taking multiple attempts, a skilled leader might direct another member to prepare a supraglottic airway as a backup while the primary airway manager makes one more attempt, thus managing the procedure's timeline and ensuring continuous progress.

The evidence supporting the impact of strong non-technical skills on clinical outcomes is compelling. Studies have consistently correlated effective team leadership and clear communication with improved CPR performance metrics, including higher chest compression fraction (the proportion of time compressions are performed during arrest), shorter pre-shock pauses, and more accurate adherence to ACLS guidelines [38, 39]. Ultimately, these process improvements translate into the most important outcome: improved rates of return of spontaneous circulation (ROSC) and survival to hospital discharge [40]. In conclusion, the collaboration within the EMS team on the scene is a complex, dynamic interplay of defined roles, disciplined communication, mutual respect, and shared mental models. By systematically applying CRM principles, the EMS team can deliver a standardized, high-quality, and efficient resuscitation, creating the best possible chance for survival as they prepare to hand over care to the next link in the chain.

5. EMS Pre-Notification and Hospital Activation

The process begins with the EMS team's recognition of a high-acuity patient, most notably a cardiac arrest victim, whether still in arrest or who has achieved ROSC. Upon this recognition, the protocol mandates an early pre-notification call to the receiving hospital. This call is far more than a simple alert; it is a structured communication designed to activate the hospital's resources. The information transmitted during this call is critical and follows a standardized format, often encapsulated in mnemonics such as **ASDiH** (Anticipation, Situation, Demographics, ETA, Help needed) or **ATMIST** (Age, Time of incident, Mechanism, Injuries, Signs, Treatment). For a cardiac arrest, key elements include the patient's age and sex, the time of collapse, the initial rhythm (e.g., shockable vs. non-shockable), whether bystander CPR was provided, the current rhythm and hemodynamic status (especially if ROSC has been achieved), a summary of

interventions performed (e.g., number of shocks, medications administered, airway secured), and the estimated time of arrival (ETA) [33]. This precise information allows the ED to anticipate the patient's needs accurately.

Upon receiving a high-quality pre-notification, the ED team initiates a cascade of preparatory actions. The primary action is the mobilization of a dedicated resuscitation team. In a well-drilled ED, this involves a pre-defined announcement, such as a "Code Blue" or "Cardiac Arrest Team," which summons emergency physicians, critical care or emergency nurses, respiratory therapists, and clinical pharmacists to the resuscitation bay [2]. Simultaneously, nursing staff prepare the physical space and equipment: turning on the monitor-defibrillator, setting up suction, preparing the ventilator, drawing up essential medications like vasopressors and antiarrhythmics, and priming IV lines. The most significant impact of pre-notification, however, lies in the activation of specialized hospital resources that are crucial for post-cardiac arrest care. For patients who have achieved ROSC, the EMS call can trigger the activation of the cardiac catheterization lab, alerting the interventional cardiology team to stand by for immediate coronary angiography, which is often indicated to identify and treat the causative coronary lesion [40].

The clinical benefits of an effective pre-arrival handshake are substantial and well-documented. The most significant impact is the reduction in time to critical interventions. Multiple studies have demonstrated that pre-hospital notification for ST-elevation myocardial infarction (STEMI) patients significantly reduces door-to-balloon times. This principle directly extends to post-cardiac arrest patients with a suspected cardiac cause. One multi-center analysis found that pre-arrival notification was associated with a median reduction of over 20 minutes in door-to-balloon time for OHCA patients with ROSC [44]. Beyond cardiac catheterization, pre-notification reduces the time to initiation of targeted temperature management (TTM), also known as therapeutic hypothermia. By having cooling equipment ready and protocols initiated upon patient arrival, the ED team can begin TTM much faster, which is time-sensitive for neuroprotection [12]. This seamless transition from field to hospital ensures that the patient moves from one phase of advanced life support to the next without a drop in the standard or momentum of care.

However, the quality of pre-notification is not universal, and several barriers can impede its effectiveness. These include communication challenges, such as poor radio or cellular reception, background noise at the scene, and the cognitive load on the EMS provider who is simultaneously managing patient care [10]. Incomplete or inaccurate information transmission is another common pitfall; if the ETA is wrong or key clinical details are omitted, the hospital's preparation may be misaligned with the patient's actual needs. Furthermore, a lack of formalized, structured communication tools can lead to a disorganized and inefficient transfer of information.

To overcome these barriers, quality improvement initiatives are essential. Joint training sessions involving both EMS and ED staff, including simulated handovers, can build familiarity and reinforce the use of standardized communication tools [41]. Technological solutions, such as the use of secure text messaging with pre-formatted templates or video streaming from the ambulance, can supplement voice communication and provide visual data like ECG tracings [42]. Finally, closed-loop feedback systems where hospital staff provide constructive feedback to EMS crews on the quality and utility of their pre-notifications can foster a culture of continuous improvement and mutual respect [40].

6. Conclusion

The management of out-of-hospital cardiac arrest represents one of the most complex challenges in modern emergency care, where success depends not on individual heroism but on the flawless execution of a coordinated system-wide response. This research has systematically examined the critical collaboration between nursing and health assistance personnel, emergency medical dispatchers, and EMS teams throughout the cardiac arrest continuum. The evidence consistently demonstrates that survival with good neurological outcome is not merely a function of technical skill or advanced technology, but rather the product of seamless interprofessional collaboration at every stage of the Chain of Survival.

The findings reveal that effective collaboration begins with the first link in the chain, where emergency medical dispatchers serve as vital connectors between panicked bystanders and professional responders, transforming laypersons into effective first responders through telephonic CPR guidance. The internal dynamics of EMS teams in the field prove equally crucial, where the application of Crew Resource Management principles—clear role

allocation, closed-loop communication, and mutual support—directly correlates with improved CPR quality metrics and ultimately, survival rates. Perhaps most critically, the "pre-arrival handshake" between EMS and hospital teams emerges as a pivotal determinant of outcomes for patients achieving ROSC, where structured pre-notification processes significantly reduce time to critical interventions like coronary angiography and targeted temperature management.

The implications of these findings are profound for clinical practice, education, and system design. First, they underscore the necessity of moving beyond siloed training toward integrated, interprofessional simulation that replicates the real-world challenges of cardiac arrest management. Second, they highlight the critical importance of standardizing communication protocols and implementing structured handover tools across the care continuum. Third, they emphasize the need for ongoing quality improvement initiatives that monitor not just technical performance but the quality of collaboration at every interface.

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