

In-Hospital Cardiac Arrest: Current Management and Best Practices

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ABSTRACT

In-hospital cardiac arrest is a time-critical medical emergency associated with substantial mortality and neurological disability. Unlike out-of-hospital cardiac arrest, many in-hospital events are preceded by recognizable physiological deterioration, creating opportunities for prevention through structured monitoring, early warning systems, rapid response teams, and appropriate escalation of care. Once cardiac arrest occurs, outcomes depend on immediate recognition, activation of the hospital resuscitation system, high-quality cardiopulmonary resuscitation, early rhythm analysis, prompt defibrillation of shockable rhythms, appropriate pharmacologic treatment, and identification of reversible causes. Airway management should support oxygenation and ventilation without interrupting chest compressions, while capnography can assist in confirming airway placement and evaluating resuscitation quality. Following return of spontaneous circulation, treatment should focus on oxygenation and ventilation targets, hemodynamic stabilization, diagnosis and treatment of the arrest etiology, fever prevention, neurological monitoring, and delayed multimodal prognostication. Advanced interventions, including extracorporeal cardiopulmonary resuscitation and mechanical circulatory support, may benefit carefully selected patients in experienced centers but should not delay fundamental resuscitation measures. This review summarizes contemporary evidence and guideline recommendations for prevention, acute resuscitation, team organization, special circumstances, and post-cardiac arrest management after in-hospital cardiac arrest.

KEYWORDS: in-hospital cardiac arrest; cardiopulmonary resuscitation; defibrillation; rapid response system; return of spontaneous circulation; post-cardiac arrest care; extracorporeal cardiopulmonary resuscitation.

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INTRODUCTION

In-hospital cardiac arrest is defined as the cessation of cardiac mechanical activity occurring within a healthcare facility and confirmed by the absence of signs of circulation. It differs from out-of-hospital cardiac arrest in several important ways: patients are often already being monitored, trained healthcare personnel may be nearby, vascular access may already be available, and the underlying cause may be recognized more rapidly. Nevertheless, survival remains strongly dependent on the speed and quality of the institutional response.

Many in-hospital cardiac arrests are not completely unexpected. Progressive hypoxemia, hypotension, altered mental status, tachypnea, oliguria, arrhythmia, or other signs of deterioration may be present hours before the event. Therefore, modern management begins before cardiac arrest

occurs and includes prevention systems, escalation pathways, rapid response teams, advance-care planning, and appropriate decisions regarding resuscitation status [1,2].

Once arrest occurs, high-quality chest compressions and early defibrillation remain the most important interventions. Advanced airway management, medications, point-of-care ultrasound, extracorporeal support, and mechanical circulatory devices are adjuncts and must not interfere with the delivery of effective basic and advanced life support [3,4].

Methods

This narrative review was developed from the uploaded literature synthesis and updated using major contemporary international recommendations for adult advanced life support, systems of care, and post-cardiac arrest treatment. The review addresses prevention, recognition, team

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activation, cardiopulmonary resuscitation, defibrillation, vascular access, medications, airway management, reversible causes, extracorporeal cardiopulmonary resuscitation, return of spontaneous circulation, neurological prognostication, and quality improvement.

References are numbered according to their first appearance in the manuscript.

Prevention of In-Hospital Cardiac Arrest

Prevention is a central component of in-hospital cardiac arrest management. Hospitalized patients commonly demonstrate physiological abnormalities before cardiac arrest, particularly respiratory deterioration, hypotension, changes in consciousness, and abnormal heart rate. Structured systems should therefore combine routine physiological monitoring with clear escalation criteria and timely clinical intervention [1,2].

Effective prevention systems may include:

- Standardized vital-sign monitoring

- Early warning scores

- Staff concern as an independent escalation trigger

- Rapid response or medical emergency teams

- Continuous monitoring for selected high-risk patients

- Clear transfer criteria for higher-acuity care

- Sepsis, respiratory failure, and hemorrhage pathways

- Advance-care planning and resuscitation-status documentation

Rapid response systems are intended to identify and treat deterioration before cardiac arrest occurs. Although the effectiveness of individual early warning tools varies between settings, outcomes appear most favorable when detection is linked to a reliable response pathway rather than when a score is used in isolation [2,5].

Automated deterioration alerts may help identify high-risk patients, but alarm fatigue, poor specificity, delayed clinician response, and inadequate staffing may reduce their effectiveness. Technology must therefore support—not replace—clinical assessment.

Recognition and Activation of the Resuscitation System

Cardiac arrest should be suspected when a patient is unresponsive and is not breathing normally or has no definite signs of circulation. Healthcare professionals should assess responsiveness and breathing rapidly, activate the emergency response system, begin chest compressions, and obtain a defibrillator or monitor.

The hospital response should include:

- Immediate activation of the code or cardiac arrest team.

- Initiation of high-quality cardiopulmonary resuscitation.

- Connection of a monitor-defibrillator.

- Identification of the cardiac rhythm.

- Defibrillation when a shockable rhythm is present.

- Rapid assignment of team roles.

- Simultaneous preparation for airway management, vascular access, and treatment of reversible causes.

- Delays in recognizing arrest, initiating compressions, or providing defibrillation reduce the probability of return of

spontaneous circulation and favorable neurological survival. Hospitals should therefore standardize emergency numbers, equipment location, code-team activation, and staff responsibilities [1,3].

Organization of the Resuscitation Team

Effective resuscitation requires coordinated teamwork. A well-functioning cardiac arrest team should have a designated leader and clearly assigned roles for chest compressions, airway management, defibrillation, vascular access, medication administration, documentation, and identification of reversible causes.

Closed-loop communication is essential. Instructions should be directed to a specific team member, repeated for confirmation, and verbally acknowledged after completion. The team leader should maintain situational awareness, anticipate the next intervention, minimize interruptions, and periodically summarize the arrest rhythm, interventions, elapsed time, and suspected cause.

Important institutional components include:

- Standardized crash carts

- Uniform defibrillator configuration

- Preassigned team roles

- Regular basic and advanced life-support training

- In situ simulation

- Structured post-event debriefing

- Review of response times and CPR quality

- Psychological support for staff and family members

Simulation should reproduce the clinical environment in which arrests actually occur, including wards, operating rooms, emergency departments, imaging areas, and intensive care units.

High-Quality Chest Compressions

High-quality chest compressions are the foundation of successful resuscitation. In adults, compressions should generally be delivered at a rate of 100–120 per minute and to a depth of approximately 5–6 cm, while allowing complete chest recoil and minimizing interruptions [3,4].

Key quality indicators include:

- Correct hand position on the lower half of the sternum

- Compression rate of 100–120 per minute

- Adequate depth without excessive compression

- Complete recoil after every compression

- Minimal pauses

- Rotation of compressors approximately every 2 minutes

- Avoidance of excessive ventilation

- Immediate resumption of compressions after defibrillation

- Pauses for rhythm analysis, pulse checks, airway placement, vascular access, and ultrasound should be as brief as possible.

- Pulse checks should generally not exceed 10 seconds.

Where available, audiovisual feedback devices can help maintain compression rate, depth, recoil, and chest-compression fraction. However, these tools cannot compensate for inadequate training or delayed recognition.

Rhythm Assessment and Defibrillation

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Cardiac arrest rhythms are divided into shockable and nonshockable categories.

Shockable rhythms:

Ventricular fibrillation

Pulseless ventricular tachycardia

Nonshockable rhythms:

Pulseless electrical activity

Asystole

For ventricular fibrillation or pulseless ventricular tachycardia, early defibrillation is essential. A shock should be delivered according to the defibrillator manufacturer's recommended biphasic energy level, followed immediately by 2 minutes of chest compressions without a prolonged post-shock pulse check [3,4].

For pulseless electrical activity or asystole, defibrillation is not indicated. Management consists of continuous high-quality CPR, early epinephrine, and aggressive identification of reversible causes.

Recurrent or refractory ventricular fibrillation requires confirmation of correct pad placement, good contact, adequate energy delivery, and elimination of interruptions. Alternative pad positions or advanced defibrillation strategies may be considered in selected refractory cases, although evidence for routine use remains limited.

Pharmacologic Treatment

Epinephrine

Epinephrine remains the principal vasopressor used during adult cardiac arrest. For nonshockable rhythms, it should be administered as soon as feasible. For shockable rhythms, it is generally introduced after initial defibrillation attempts have failed. Subsequent doses are typically administered every 3–5 minutes during ongoing resuscitation [3].

Epinephrine may increase coronary and cerebral perfusion pressure and improve return of spontaneous circulation, but it does not replace defibrillation in shockable rhythms or high-quality chest compressions.

Antiarrhythmic Drugs

Amiodarone or lidocaine may be considered for ventricular fibrillation or pulseless ventricular tachycardia that persists despite defibrillation. These medications may facilitate rhythm termination or reduce recurrent ventricular arrhythmia, but their effect on long-term neurologically favorable survival is less certain.

Magnesium is not recommended routinely but is indicated when torsades de pointes or suspected hypomagnesemia is present.

Other Medications

Routine administration of calcium, sodium bicarbonate, or corticosteroids is not recommended for all cardiac arrests. These agents should be reserved for specific circumstances, such as:

Hyperkalemia

Hypocalcemia

Calcium-channel blocker toxicity

Tricyclic antidepressant toxicity

Severe metabolic acidosis in selected prolonged arrests

Certain toxicologic or perioperative emergencies

Medication delivery should never cause prolonged interruption of CPR.

Vascular Access

Intravenous access is generally preferred during in-hospital cardiac arrest because it is frequently already present and allows reliable drug administration. If intravenous access cannot be obtained rapidly, intraosseous access is an acceptable alternative.

Central venous catheter placement should not delay resuscitation and is rarely necessary during the early phase of arrest. Drugs administered through peripheral intravenous access should be followed by a fluid flush and elevation of the extremity when feasible.

Airway and Ventilation Management

The optimal airway strategy depends on the clinical setting, operator experience, and arrest circumstances. Initial ventilation may be performed using a bag-mask device with supplemental oxygen. A supraglottic airway or endotracheal tube may subsequently be placed by a trained operator.

Airway procedures must not produce prolonged interruptions in chest compressions. If intubation cannot be completed rapidly without disrupting CPR, bag-mask ventilation or a supraglottic airway should be continued.

After placement of an advanced airway:

Continuous chest compressions should be maintained.

Ventilation should generally be delivered at approximately 10 breaths per minute.

Excessive ventilation should be avoided.

Waveform capnography should confirm endotracheal tube placement.

Oxygen delivery should initially be maximized during active resuscitation.

Waveform capnography can also help monitor CPR quality and detect return of spontaneous circulation. A sudden sustained increase in end-tidal carbon dioxide may indicate restoration of circulation. However, a low value should not be used alone to terminate resuscitative efforts.

Reversible Causes

Identification and treatment of the underlying cause should occur simultaneously with CPR. A practical framework is the traditional “Hs and Ts.”

Hs

Hypovolemia

Hypoxia

Hydrogen ion excess or severe acidosis

Hypokalemia or hyperkalemia

Hypothermia

Ts

Tension pneumothorax

Cardiac tamponade

Toxins

Pulmonary thrombosis

Coronary thrombosis

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Additional in-hospital causes may include hemorrhage, anaphylaxis, medication error, perioperative complication, airway obstruction, sepsis, and severe metabolic derangement.

Treatment should be cause-directed. Examples include blood-product resuscitation for hemorrhage, needle or surgical decompression for tension pneumothorax, pericardial drainage for tamponade, calcium and insulin-based therapy for hyperkalemia, thrombolysis or embolectomy for selected pulmonary embolism, and urgent coronary intervention for coronary occlusion.

Point-of-Care Ultrasound

Point-of-care ultrasound may assist in identifying reversible causes such as tamponade, right ventricular dilation, severe ventricular dysfunction, or hypovolemia. It should be performed only by trained clinicians and must not prolong pauses in chest compressions.

Image acquisition should ideally occur during a planned rhythm check, with preparation before the pause begins. Ultrasound findings should be interpreted within the entire clinical context. Absence of visible cardiac movement should not be used as the sole reason to terminate resuscitation.

Mechanical CPR

Mechanical chest-compression devices are not routinely superior to high-quality manual CPR. They may be considered when sustained manual compressions are difficult, unsafe, or impractical, including during transport, prolonged procedures, catheterization-laboratory interventions, or preparation for extracorporeal support.

Deployment can interrupt compressions; therefore, teams using mechanical devices require specific training and standardized application protocols.

Extracorporeal Cardiopulmonary Resuscitation

Extracorporeal cardiopulmonary resuscitation refers to the initiation of venoarterial extracorporeal membrane oxygenation during refractory cardiac arrest. It may provide temporary circulatory support while a reversible cause is treated.

Potential candidates generally have:

Witnessed arrest

Immediate high-quality CPR

A potentially reversible cause

Short no-flow time

Refractory ventricular fibrillation or selected pulseless electrical activity

Reasonable pre-arrest functional status

Access to an experienced extracorporeal resuscitation program

ECPR should be considered only within a mature institutional system capable of rapid cannulation, perfusion support, critical care, coronary intervention, and neurological management. Current evidence supports selective rather than routine use, and outcome varies according to patient selection, arrest location, timing, and institutional expertise [6].

Special In-Hospital Circumstances

Perioperative Cardiac Arrest

Intraoperative cardiac arrest frequently occurs under continuous monitoring, allowing immediate recognition. The cause may be directly related to anesthesia, hemorrhage, airway difficulty, embolism, anaphylaxis, surgical manipulation, pneumothorax, or electrolyte disturbance.

Management follows standard advanced life-support principles but may require immediate modification of anesthesia, cessation of surgical stimulation, rapid hemorrhage control, repositioning, or emergency surgical intervention. Open-chest cardiac massage may be appropriate in selected thoracic or cardiac surgical settings [7].

Cardiac Arrest in the Catheterization Laboratory

Coronary occlusion, dissection, tamponade, arrhythmia, or contrast-related complications may cause arrest. Immediate defibrillation, pericardiocentesis, coronary intervention, mechanical support, or ECPR may be rapidly available.

Cardiac Arrest in Pregnancy

Management requires manual left uterine displacement, standard chest compressions and defibrillation, rapid airway control, and preparation for resuscitative delivery when indicated. Maternal resuscitation remains the priority.

Toxicologic Cardiac Arrest

Treatment may require specific antidotes, lipid emulsion, sodium bicarbonate, calcium, high-dose insulin therapy, or extracorporeal support depending on the toxin.

Return of Spontaneous Circulation

Return of spontaneous circulation marks the beginning of a new phase of treatment rather than the end of resuscitation. Immediate priorities include stabilization of airway, breathing, circulation, diagnosis of the cause, neurological protection, and transfer to an appropriate critical-care environment.

A structured post-cardiac arrest checklist reduces omission of essential care.

Oxygenation and Ventilation After ROSC

Immediately after return of spontaneous circulation, supplemental oxygen is appropriate until reliable arterial oxygen saturation or blood-gas measurement is available. Oxygen should then be titrated to avoid both hypoxemia and prolonged hyperoxemia.

Ventilation should aim for physiological carbon dioxide levels unless a specific clinical circumstance requires modification. Severe hypocapnia may reduce cerebral blood flow, whereas marked hypercapnia can worsen acidosis and intracranial pressure.

Arterial blood gases, waveform capnography, chest imaging, and continuous pulse oximetry are useful during stabilization [8,9].

Hemodynamic Management

Post-cardiac arrest myocardial dysfunction and vasoplegia may cause hypotension and recurrent shock. Management includes:

Isotonic fluid administration when appropriate

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Vasopressor support

Inotropic therapy for myocardial dysfunction

Echocardiographic assessment

Continuous arterial pressure monitoring in unstable patients

Correction of ongoing hemorrhage or metabolic disturbance

Blood pressure targets should be individualized to maintain adequate organ and cerebral perfusion. Persistent hypotension should prompt evaluation for cardiogenic shock, vasoplegia, hemorrhage, tamponade, pulmonary embolism, or ongoing ischemia [8].

Coronary Reperfusion and Cause-Directed Investigation

A 12-lead electrocardiogram should be obtained after stabilization. Emergency coronary angiography is indicated when there is persistent ST-segment elevation or strong evidence of acute coronary occlusion.

In patients without ST elevation, immediate routine angiography is not necessary for every arrest survivor. Decisions should consider hemodynamic instability, recurrent ventricular arrhythmia, ongoing ischemia, clinical suspicion of coronary occlusion, and alternative causes.

Additional investigations may include:

Bedside echocardiography

Computed tomography of the head, chest, or abdomen

Pulmonary angiography

Toxicology studies

Electrolyte and metabolic testing

Infection evaluation

Device interrogation

Temperature Control and Fever Prevention

Contemporary recommendations emphasize active fever prevention in unconscious patients after return of spontaneous circulation. Routine deep hypothermia is no longer required for every patient, but a deliberate temperature-control strategy remains important.

Hospitals should have a protocol that includes:

Continuous core-temperature monitoring

Prevention and treatment of fever

Avoidance of rapid uncontrolled rewarming

Sedation and shivering control when needed

Continued neurological observation

The specific target and duration should be individualized according to institutional protocols and contemporary guideline recommendations [8,9].

Neurological Monitoring and Prognostication

Neurological prognosis should not be determined prematurely. Sedatives, neuromuscular blockers, hypothermia, metabolic abnormalities, shock, and organ failure may confound the examination.

Multimodal prognostication may include:

Serial neurological examination

Pupillary and corneal reflexes

Electroencephalography

Somatosensory evoked potentials

Biomarkers

Computed tomography or magnetic resonance imaging

Clinical course over time

No single test should determine prognosis in isolation. Definitive prognostication should generally be delayed until confounding factors have resolved, and early withdrawal of life-sustaining treatment should be avoided unless there are unequivocal findings or prior patient preferences [8].

Post-Arrest Critical Care and Rehabilitation

Survivors may develop post-cardiac arrest syndrome, including brain injury, myocardial dysfunction, systemic ischemia-reperfusion injury, and persistence of the precipitating disease.

Critical care should include:

Hemodynamic and ventilatory support

Glucose and electrolyte management

Seizure detection and treatment

Prevention of fever

Nutrition

Deep-vein thrombosis prevention

Infection surveillance

Early rehabilitation assessment

Psychological support

Cognitive and functional follow-up

Cardiac arrest survivors may experience memory problems, fatigue, anxiety, depression, post-traumatic stress, weakness, and reduced quality of life. Family members may also require communication and psychological support.

Termination of Resuscitation and Ethical Considerations

Decisions to withhold or terminate resuscitation should consider the clinical context, known patient preferences, advance directives, arrest cause, duration, response to treatment, and likelihood of meaningful recovery.

No isolated factor—such as age, arrest duration, rhythm, end-tidal carbon dioxide, or ultrasound appearance—should automatically determine termination. Decisions should be individualized and made by an experienced team whenever possible.

Advance-care planning should occur before deterioration in patients with advanced illness. Clear documentation of goals of care can prevent unwanted or nonbeneficial resuscitation while ensuring that appropriate emergency treatment is provided to patients who desire it [2].

Quality Improvement

Every in-hospital cardiac arrest should be considered an opportunity for systems improvement. Structured review should examine:

Whether deterioration was recognized

Whether escalation occurred appropriately

Time to code activation

Time to first compression

Time to defibrillation

Compression quality

Airway and medication timing

Availability of equipment

Team communication

Post-arrest treatment

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Preventability of the event

Immediate “hot” debriefing can identify operational problems while details remain fresh. Later multidisciplinary review may address deeper systems issues and produce measurable interventions.

Quality-improvement initiatives that reduce response time and standardize ward-based arrest management have been associated with improved resuscitation performance and survival in some institutional studies [10].

Proposed In-Hospital Cardiac Arrest Algorithm

Recognize deterioration early and activate the rapid response system before arrest when possible.

Confirm cardiac arrest in an unresponsive patient without normal breathing or signs of circulation.

Activate the code team and obtain the monitor-defibrillator.

Begin high-quality CPR with minimal interruptions.

Identify the rhythm as shockable or nonshockable.

Defibrillate immediately for ventricular fibrillation or pulseless ventricular tachycardia.

Administer epinephrine appropriately according to rhythm and timing.

Use amiodarone or lidocaine for refractory shockable rhythms.

Establish intravenous or intraosseous access.

Provide effective ventilation without hyperventilation or prolonged compression pauses.

Identify and treat reversible causes.

Consider ultrasound, mechanical CPR, or ECPR selectively without delaying basic interventions.

After ROSC, stabilize oxygenation, ventilation, and circulation.

Identify and treat the arrest cause, including coronary reperfusion when indicated.

Prevent fever and provide structured critical care.

Delay neurological prognostication and use a multimodal approach.

Debrief and review the event for systems improvement.

DISCUSSION

The strongest evidence in in-hospital cardiac arrest management supports interventions that are simple, immediate, and reproducible: early recognition, high-quality chest compressions, rapid defibrillation, organized teamwork, and prompt treatment of reversible causes. Advanced technologies can improve care in selected situations, but they cannot compensate for delayed activation or poor CPR quality.

A major advantage of the in-hospital environment is the opportunity to prevent arrest. Abnormal vital signs and clinical deterioration should trigger timely escalation before progression to circulatory collapse. However, early warning scores are only effective when paired with trained personnel, rapid response capacity, and a culture that empowers staff to seek help.

During active arrest, airway procedures and medication administration should be integrated without interrupting compressions or delaying defibrillation. Ultrasound and extracorporeal support may be valuable, but their use should be protocolized and restricted to teams capable of deploying them efficiently.

Post-cardiac arrest care strongly influences final outcome. Restoration of circulation alone does not guarantee survival or neurological recovery. Hemodynamic support, fever prevention, cause-directed investigation, seizure management, and delayed prognostication are essential components of a complete resuscitation system.

CONCLUSION

Optimal in-hospital cardiac arrest management begins with prevention and continues through resuscitation, post-arrest critical care, rehabilitation, and systems review. High-quality chest compressions and early defibrillation remain the most important acute interventions. Epinephrine, antiarrhythmic drugs, airway devices, ultrasound, mechanical CPR, and extracorporeal support should be used as adjuncts according to rhythm, cause, and institutional capability. After return of spontaneous circulation, care should focus on oxygenation, ventilation, hemodynamic support, diagnosis of the underlying cause, fever prevention, and delayed multimodal neurological prognostication. Hospitals can improve outcomes by implementing rapid response systems, standardized code-team roles, regular simulation, structured debriefing, and continuous quality improvement.

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