"EVOLVING STRATEGIES IN CARDIOPULMONARY RESUSCITATION: A REVIEW OF RECENT PROGRESS"

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BACKGROUND OF THE STUDY:

The Cardio Pulmonary Resuscitation (CPR) has evolved significantly over centuries, transforming from crude techniques to the standardized life-saving procedure. Understanding how to perform CPR correctly can mean the difference between saving a life and losing one during an emergency. As medicine and technology progress, CPR methods continue to evolve and improve. The primary goal is to manually pump blood and oxygen to the heart and brain when someone's heart has stopped. Keeping the blood flow active even partially extends the opportunity for a successful resuscitation once trained medical staff arrive on site.

CPR aims to restore blood circulation to the brain and other critical organs during emergencies. Three primary CPR techniques exist, each with distinct methods, applications, and historical development. The appropriate technique depends on the emergency type and the patient's age. Selecting the correct method significantly improves the victim's survival chances. CPR guidelines were first standardized in 1960. The Guidelines for CPR were first published in 1966 in response to requests from several organizations and agencies about the need for standards and guidelines regarding training and response. Since then, the CPR Guidelines have been reviewed, updated, and published periodically by the AHA. As with prior Guidelines, this document is closely aligned with evidence evaluation conducted by the 2025 International Liaison Committee on Resuscitation (ILCOR) and associated member councils.[1]

Keywords: CPR, Ventilation, Resuscitation, Compression, Airway, AHA, ICLOR

BACKGROUND INFORMATION

Cardiopulmonary Resuscitation (CPR) was formally developed and introduced in **1960** by a team of researchers at Johns Hopkins University. The technique, combining mouth-to-mouth ventilation with closed-chest compressions, became the standard for reviving victims of cardiac arrest.

Modern CPR is the result of centuries of study and the crucial work of several mid-20th century innovators:

- James Elam and Peter Safar (1950s): These physicians validated mouth-to-mouth ventilation as an effective form of artificial respiration, reviving a method that had largely been abandoned. The U.S. armed forces adopted this technique in 1957.
- William Kouwenhoven, James Jude, and Guy Knickerbocker (1950s-1960): While researching defibrillation, this team of engineers and doctors serendipitously discovered that consistent pressure on the breastbone could sustain vital blood flow to the brain. Their research confirmed that external cardiac massage was a viable and effective procedure.
- **18th Century:** In 1740, the Paris Academy of Sciences advocated for mouth-to-mouth resuscitation for drowning victims. The 1767 establishment of the Society for the Recovery of Drowned Persons in Amsterdam marked one of the first organized efforts to address sudden death.

- **19th Century:** Various manual methods for artificial respiration, like the Marshall Hall and Silvester techniques, were prevalent. The first documented successful case of external chest compressions on a human was performed by Dr. Friedrich Maass in 1891.

- **1960s:** The contemporary A-B-C (Airway, Breathing, Circulation) CPR protocol was introduced. The American Heart Association (AHA) formally endorsed CPR in 1963 and released the first national guidelines in 1966. The "Resusci Anne" training mannequin, also introduced around this time, transformed how CPR was taught.

- **1970s:** The 1972 launch of the "Medic II" program in Seattle by Dr. Leonard Cobb was instrumental in making CPR skills widely accessible to the general public. Subsequent advancements include the invention of Automated External Defibrillators (AEDs) in the 1980s and the adoption of "hands-only" CPR guidelines in the 2000s.

- **2020:** The American Heart Association published the 2020 Guidelines for CPR & ECC. As the global source of the official resuscitation science and education guidelines used by training organizations and healthcare professionals, the 2020 American Heart Association Guidelines for CPR and ECC deliver the latest resuscitation science education available to ensure the highest quality of care of improved outcomes.
- **2025:** Since the publication of the 2020 Guidelines, there has been a significant expansion in the number of writing groups and chapters, including the addition of new chapters on post–cardiac arrest care, special circumstances, and ethics. The AHA ECC Committee has also strengthened partnerships with other organizations, such as collaborating with the American Academy of Paediatrics (AAP) to jointly publish and cochair the writing groups for paediatric basic life support (PBLS), paediatric advanced life support (PALS), and Neonatal Resuscitation.

- **THE TRANSFORMATION OF PEDIATRIC CARDIOPULMONARY RESUSCITATION PRACTICES**

CPR techniques for children and infants have undergone significant evolution, with most major changes occurring in recent decades:

Early Recognition (1950s-1960s)

In 1957, an expert panel unanimously agreed that mouth-to-mouth resuscitation was superior to older methods like rocking or back-pressure arm-lift techniques for infants and small children. This marked the first formal recognition that children required different resuscitation approaches than adults.

Formalization Of Paediatric Guidelines (1980s-2000s)

- The American Heart Association began developing specific guidelines for infant CPR in the 1980s.
- In 2005 and 2006, the AHA released comprehensive guidelines for infant and paediatric CPR, officially adopted in 2007, marking a significant milestone as techniques were modified to accommodate children's size, weight, and proportions.

KEY TECHNICAL DIFFERENCES THAT EVOLVED:

Compression Technique:

- Infants require gentler two-finger compressions at about 1.5 inches depth
- Children need one-hand (for smaller children) or two-hand compressions at about 2 inches depth
- The AHA stated that for children ages 1-8 with no circulation signs, AED use is appropriate.

Emphasis On Rescue Breaths: The American Heart Association stresses rescue breaths are crucial for children because asphyxia cardiac arrest from choking, asthma attacks, or anaphylaxis is more common in children than cardiac arrest from heart conditions

Compression-To-Breath Ratios:

- Single rescuer: 30 compressions to 2 breaths
- Two rescuers: 15 compressions to 2 breaths (for children)

2025 updates:
The two-finger compression method for infants is no longer recommended as it doesn't provide adequate depth; instead, use either one-hand or two-thumb encircling hands technique. Additionally, earlier AED use is now encouraged for infants under 1 year.

HISTORICAL DEVELOPMENT OF ADULT CPR PROTOCOLS:

Adult CPR has undergone dramatic transformation since its formalization, with continuous refinement based on emerging research and practical experience.

1960s - The Foundation
The first formalized CPR guidelines were published in 1960, combining mouth-to-mouth resuscitation with chest compressions. The technique was originally called ABCD: Airway, Breathing, Chest compression, and Defibrillation.

2000s - Emphasis On Compressions
In the 2000 guidelines, chest compression became more highlighted than rescue breathing, with the compression rate unified to 100 times per minute for both adults and children. Previously, the recommendation had been 80-100 compressions for adults.
Compression depth was standardized at 4 to 5 cm for adults and the guidelines simplified the process for laypersons by reducing complex steps for checking breathing and pulse.

2005 - New Compression Ratio
The 2005 guidelines introduced a new compression-to-ventilation ratio of 30:2 as well as changes to AED

2008 - Hands-Only CPR Revolution
The AHA released new recommendations that bystanders who are untrained, unwilling, or unable can use Hands-Only CPR to help an adult or teen who collapses suddenly, delaying rescue breaths until help arrives. change reflected research showing that uninterrupted, high-quality chest compressions without rescue breaths can be lifesaving in the first minutes of sudden cardiac arrest.

2010 - CAB Instead of ABC
In 2010, the AHA changed the guidelines order from ABC to CAB, emphasizing compressions first because they help sustain blood flow to the brain. This marked the 50th anniversary of modern CPR. The chain of survival was expanded to include a fifth link: "post-cardiac arrest care"

Current Guidelines (2020s)
The latest adult CPR guidelines emphasize: push chest quickly (100-120/min), compress appropriately (5-6 cm), relax chest fully (complete chest recoil), avoid interruption of compression, and avoid hyperventilation.

KEY TECHNICAL IMPROVEMENTS

- **Compression depth:** Increased from 1.5-2 inches to at least 2 inches (but no more than 2.4 inches)
- **Compression rate**: Standardized at 100-120 compressions per minute
- **Ventilation:** Reduced from 30 breaths per minute to 15 breaths per minute (one breath every 6 seconds)
- **AED usage:** Earlier and more widespread use recommended

2025 Updates

- The AHA reverted to a single chain of survival for all cardiac arrests, regardless of age or location, highlighting early recognition, high-quality CPR, rapid defibrillation, advanced care, and post-cardiac arrest care.
- Mechanical CPR devices are not routinely recommended but may be considered in specific situations where delivering high-quality manual compressions is difficult.

- The overarching trend has been toward simplification, increased emphasis on continuous high-quality chest compressions, and making CPR more accessible to untrained bystanders while maintaining effectiveness**.**

The 2025 Guidelines contain 760 recommendations . Despite recent improvements in support for resuscitation research, 38% of these recommendations are based on limited data.[2]

2025 ANA GUIDELINES FOR THE PERFORMANCE OF CARDIOPULMONARY RESUSCITATION (CPR) AND THE DELIVERY OF EMERGENCY CARDIOVASCULAR CARE (ECC)

Part 1: Executive Summary provides an overview of the 2025 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care, which is organized around the Utstein Formula for Survival and provides updated recommendations aimed at improving survival rates and neurological outcomes following cardiac arrest. These Guidelines also highlight critical post–cardiac arrest care strategies, including targeted temperature management and hemodynamic stabilization. Additionally, they stress the need for population-specific resuscitation approaches, particularly for pediatric patients, pregnant individuals, and individuals with cardiac arrest due to special circumstances. A strong focus is placed on continuous training and education for both medical professionals and lay rescuers to enhance the implementation and effectiveness of these lifesaving interventions. [3]

Part 2: Evidence Evaluation and Guidelines Development: he 2025 guideline process has been the ability to integrate external systematic reviews and guidelines into the AHA guideline process. This can be in the form of adopting existing recommendations or developing recommendations based on the available evidence synthesis termed adolopment. These guidelines encompass adult and paediatric basic and advanced life support, neonatal resuscitation, resuscitation education science, special circumstances, post–cardiac arrest care, ethics, and systems of care. They are informed by the evidence evaluation process conducted by the International Liaison Committee on Resuscitation (ILCOR), published as the 2025 ILCOR Consensus on Science with Treatment Recommendations (CoSTR), along with an independent evidence review carried out by the 2025 Guideline writing groups.[2]
The ILCOR Scientific Advisory Committee—comprising experts in evidence analysis—established a structured methodological framework for evaluating evidence used in the development of the 2025 CoSTR. This process generated three types of reviews: systematic reviews, scoping reviews, and evidence updates. A new feature of the 2025 Guidelines is the American Heart Association's (AHA) internal evidence review process, created to assess topics not covered by ILCOR's reviews but considered essential for AHA guideline users.

Chain of Survival and Newborn Chain of Care

In the 2020 Guidelines, a sixth link was added to the Chain of Survival, with separate versions for adults, children, in-hospital (IHCA), and out-of-hospital (OHCA) cardiac arrests.

For the 2025 Guidelines, these have been combined into one unified six-link Chain of Survival for all situations. The topic of prevention is not yet part of this chain. The writing group recognizes its importance but plans to define it more clearly before adding it as a seventh link in the future.

Figure 1: represents Cardiac arrest Chain of Survival.

Successfully neonatal resuscitation relies on a series of connected, life-saving steps that begin with thorough preparation and assessment before birth, continue through resuscitation and stabilization at birth, and extend into the first 28 days of life.

The 2025 Guidelines introduce the Newborn Chain of Care, which emphasizes the broader environment in which neonatal resuscitation takes place. Recognizing that the health and outcomes of parents and newborns are closely linked, this 7-link Newborn Chain of Care differs from the traditional Chain of Survival. It begins with how health systems provide prenatal and intrapartum care (prevention) and extends through postpartum, postresuscitation, and follow-up care, all aimed at improving outcomes for both parents and their newborns.

Figure2.represents Newborn Chain of Care

Terminology

Standardized terminology enhances clarity and accuracy in emergency response education. The 2025 Guidelines refine key terms to promote consistency across training and clinical practice.

To streamline language, the term **"rescue breaths"** has been discontinued. Now, the term **"breaths"** is used when a person has a pulse but is not breathing, as well as when breaths are delivered during CPR (for example, **CPR with breaths**). The term **"ventilations"** is reserved for use by health care professionals when assisted breathing is provided through mechanical means, such as a bag-mask device or an advanced airway.[4]

In the same way, **"lay rescuer"** has been adopted as the preferred term instead of "layperson" or "lay responder" when referring to non–health care professionals who provide emergency care. The term encourages active involvement, unlike "bystander," which may suggest passivity. By emphasizing the role of the **lay rescuer**, the guidelines highlight the critical contribution of individuals without formal medical training in saving lives.

The 2025 Guidelines also clarify the distinction between **ROSC (return of spontaneous circulation)** and **ROC (return of circulation)** as used in the literature. **ROC** refers to the restoration of circulation achieved through mechanical means, such as extracorporeal membrane oxygenation (ECMO). In contrast, **ROSC** denotes the return of natural cardiac function without mechanical assistance.

Part 3 Ethics:

This section presents an overview of ethical frameworks that guide the analysis of complex medical decisions. It includes principlism—the prevailing framework in medical ethics—which emphasizes the moral principles of beneficence, nonmaleficence, respect for autonomy, and justice. The discussion also acknowledges the significance of dignity and considers additional ethical perspectives such as narrative ethics, crisis standards of care, utilitarianism, virtue ethics, and deontology. Furthermore, it underscores the importance of equity and the responsibility of healthcare professionals and organizations to proactively address structural inequities, social determinants of health, and the resulting disparities in Emergency Cardiovascular Care (ECC).

Part 4: System of Care: The American Heart Association (AHA) and the American Academy of Pediatrics (AAP) have developed these Pediatric Advanced Life Support (PALS) guidelines to provide evidence-based recommendations for resuscitation during cardiopulmonary resuscitation (CPR) and emergency cardiovascular care (ECC). These guidelines serve as a resource for healthcare professionals managing infants and children up to 18 years of age (excluding newborns) across the prearrest, intra-arrest, and post–cardiac arrest phases, as well as in select other emergency situations. They are applicable in various settings, including community, prehospital, and hospital environments. [5]

Ventilation and advanced airway management during CPR; medication administration and weight-based dosing; defibrillation energy levels; monitoring and improving CPR quality and physiology; extracorporeal CPR (ECPR); and post–cardiac arrest care, including temperature management, blood pressure control, oxygenation and ventilation strategies, neurologic monitoring, and seizure management. The guidelines also address neurologic prognostication, post–cardiac arrest survivorship, family presence during resuscitation, evaluation of sudden unexplained cardiac arrest, and management of various clinical conditions such as shock, arrhythmias (bradycardia and tachycardia), myocarditis, cardiomyopathies, single-ventricle congenital heart disease, pulmonary hypertension, and traumatic cardiac arrest.

Finally, the document identifies key gaps in current resuscitation science to promote further research and strengthen the evidence base for future updates to the Pediatric Advanced Life Support guidelines**.**

Part 5 Neonatal Resuscitation:

The American Heart Association and the American Academy of Pediatrics focus upon optimal care of the newborn infant, including those who are proceeding to a normal transition from the fluid-filled uterine environment to birth. Newborn infants who are proceeding to normal transition can benefit from deferred cord clamping for at least 60 seconds in most instances, skin-to-skin with their parent soon after birth, and appropriate assistance with thermoregulation. Some newborn infants require assistance during transition, with interventions ranging from warming and tactile stimulation to advanced airway management, assisted ventilation, oxygen therapy, intravascular access, epinephrine, and volume expansion. In this context, individuals, teams, and health care settings that care for newborn infants should be prepared and have access to appropriate training and resources for neonatal resuscitation. The newborn chain of care provides guidance on considerations that may lead to optimal outcomes for newborn infants starting from prenatal care to recovery and follow-up.

UTSTEIN FORMULA FOR SURVIVAL:

The executive summary offers an overview and introduction to the 2025 Guidelines, which are structured around the Utstein Formula for Survival .According to the Utstein Formula, survival outcomes rely on three interconnected elements: the quality of the guidelines (science), effective education and training of caregivers (education), and strong local implementation through a well-functioning Chain of Survival. Local implementation is primarily driven by systems of care (SOC), which integrate the various links within the Chain of Survival. Each section of this summary outlines the scope of its corresponding part of the Guidelines and highlights the most important and impactful new or updated recommendations. Additionally, each section identifies key knowledge gaps, presenting

major research questions and opportunities to strengthen the Chain of Survival. This summary provides a high-level overview and does not include detailed citations; readers should refer to Parts 2 through 12 for comprehensive evidence reviews and full recommendations.[3]

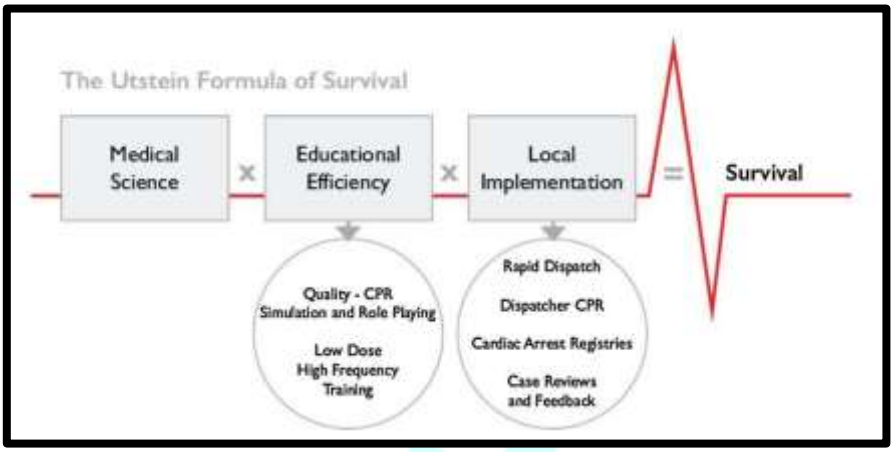


Figure2.1: displace the information about the Utstein Formula for Survival, emphasizing the three components essential to improving survival.

Here are the rephrased paragraphs:

Part 3: Ethics

The third section examines ethical challenges particularly pertinent to emergency cardiovascular care and resuscitation procedures. The content is divided into four primary areas. Initially, it presents fundamental ethical frameworks in healthcare that assist medical professionals in making difficult decisions. While the principle-based approach—founded on autonomy, justice, beneficence, and nonmaleficence—remains central, the section also highlights how dignity and equity factor into emergency cardiovascular care. The subsequent portion examines practical methods for ethical decision-making, including advance care planning documents, standardized clinical procedures, and collaborative decision-making processes. Following this, the discussion turns to ethical dilemmas surrounding decisions to withhold or stop CPR across different patient groups, encompassing older individuals, pediatric patients, and neonates. The final segment investigates complications related to predicting outcomes amid uncertainty, choices regarding the limitation or cessation of treatments unlikely to provide benefit, and how cultural beliefs and religious perspectives shape ethical choices.

Part 4: Systems of Care

The fourth section of the 2025 Guidelines, entitled "Systems of Care," examines components applicable to diverse resuscitation scenarios. Earlier SOC guidance established a Chain of Survival framework that starts with preventive measures and readiness for resuscitation, then moves through the resuscitation process itself to care following cardiac arrest, and ultimately to patient recovery and survivorship. The SOC recommendations encompass the education of designated healthcare providers, adoption of evidence-based protocols, and integration of technological and equipment resources to enhance cardiac arrest management, supported by continuous team debriefing sessions and quality enhancement initiatives.

Here are the rephrased sections:

Major New and Revised Recommendations

Preventing In-Hospital Cardiac Arrest: The guidelines now integrate recommendations for early warning systems and rapid response teams across both adult and pediatric populations, advocating for both approaches to prevent in-hospital cardiac arrest. Additionally, safety huddles are now advised for patients classified as high-risk to reduce the likelihood of in-hospital cardiac arrest.

Naloxone Accessibility: Two newly introduced recommendations encourage the establishment of public policies allowing naloxone administration in suspected opioid overdose cases without legal repercussions, and promote widespread naloxone availability through multiple distribution channels.

Community Programs to Enhance Bystander Response to Out-of-Hospital Cardiac Arrest Previous guidance on mobile technology has been consolidated into this comprehensive section focused on promoting bystander CPR and AED usage through diverse strategies. Current recommendations address public education initiatives, widespread media campaigns, policies mandating CPR certification, mobile technology applications, and combined intervention approaches to increase bystander response rates.

Dispatcher Recognition and Guidance The recommendations for dispatcher identification of out-of-hospital cardiac arrest have been reinforced, and the level of evidence supporting compression-only CPR instructions for adult cases has been elevated, based on meta-analytic findings from randomized controlled trials.

Resuscitation Team Structure for Out-of-Hospital and In-Hospital Cardiac Arrest Updated guidance addresses the composition of resuscitation teams in both hospital and prehospital environments. These recommendations emphasize ensuring at least one team member possesses advanced cardiac life support credentials.

Field Resuscitation for Out-of-Hospital Cardiac Arrest Fresh recommendations favour continuing resuscitation efforts at the cardiac arrest location in most instances, rather than prioritizing rapid hospital transport. Since this approach often requires ending resuscitation attempts in the field, emergency medical services personnel should receive training in delivering death notifications to loved ones—a particularly difficult responsibility.

Specialized Cardiac Arrest Facilities Following a recent randomized controlled trial that failed to demonstrate benefit from transporting post-cardiac arrest patients to specialized regional centers, and recognizing ongoing uncertainty about defining cardiac arrest center criteria, the recommendation strength has been downgraded from 2a to 2b, while the level of evidence has been upgraded to B-R.

Systems of Care for Extracorporeal CPR A new section addressing the system components necessary to support extracorporeal CPR has been introduced. Four additional recommendations outline essential system elements for ECPR support, covering patient selection criteria, vascular access techniques, regional ECPR organization, and transport to specialized ECPR facilities during ongoing resuscitation.

Organ Donation Protocols A new highest-level recommendation directs healthcare institutions to establish systematic approaches for assessing cardiac arrest patients with poor anticipated outcomes for potential organ donation eligibility.

Post-Arrest Recovery Programs Institutions are advised to establish comprehensive systems of care bridging inpatient and outpatient settings to assess cardiac arrest survivors for functional impairments and deliver continuous support to maximize their recovery.

Team Debriefing Previous debriefing recommendations have been reaffirmed, with an added suggestion to implement both immediate post-event (hot) and delayed (cold) debriefing sessions as tools for continuous system enhancement.

Part 5: Neonatal Resuscitation

The fifth section of the 2025 Guidelines addresses neonatal resuscitation and provides guidance across the complete resuscitation sequence, encompassing preparation and anticipation, cord management at birth, initial interventions, thermal regulation, cardiac monitoring, breathing assistance, chest compression techniques, vascular access with medication administration, decisions regarding resuscitation initiation or cessation, and care following resuscitation. A collaborative group of specialists from the AHA and AAP, consisting of volunteer professionals, formulated these recommendations.

Recently Revised Guidelines:

Cord Management Delaying cord clamping for a minimum of 60 seconds following delivery generally proves advantageous for both full-term and premature newborns not requiring urgent resuscitation. For full-term newborns showing reduced vigor, intact cord milking represents a viable alternative to immediate clamping, as it may decrease the necessity for cardiorespiratory intervention. However, cord milking should be avoided in extremely premature infants (less than 28 weeks gestational age) due to its association with brain bleeding.

Oxygen Administration Oxygen levels should be titrated based on pulse oximetry readings to achieve target saturations. Room air (21% oxygen) is appropriate for initiating ventilation in full-term and late preterm newborns of 35 weeks gestation or greater. For moderately preterm newborns (32 to 35 weeks gestation), starting with 21% to 30% oxygen may be appropriate, while more premature infants (under 32 weeks) may benefit from higher initial oxygen concentrations, as recent comprehensive research suggests elevated initial oxygen may correlate with improved survival rates.

Assisted Breathing Support Full-term newborns may receive initial inflation pressures up to 30 cm H2O, with subsequent modifications based on response. Preterm newborns should begin with initial inflation pressures between 20 and 25 cm H2O, also subject to adjustment as clinically indicated.

Corrective Ventilation Techniques When initial positive pressure ventilation proves ineffective in newborns requiring respiratory support, corrective ventilation strategies can prove valuable. Video-assisted laryngoscopy offers advantages over conventional laryngoscopy for newborns needing endotracheal tube placement.

Equipment and Airway Devices Laryngeal masks (supraglottic airways) serve as acceptable primary ventilation interfaces for newborns of 34 weeks gestation or greater. These devices also function as backup airways during corrective ventilation attempts when face-mask ventilation fails. T-piece resuscitators offer advantages for ventilating newborns, especially premature infants, as they may shorten ventilation duration and lower the incidence of chronic lung disease.

Continuum of Newborn Care The Newborn Chain of Care framework encompasses the complete healthcare environment surrounding neonatal resuscitation, illustrating how integrated systems—spanning prenatal care through post-resuscitation management and subsequent follow-up—can enhance outcomes for newborns.[5]

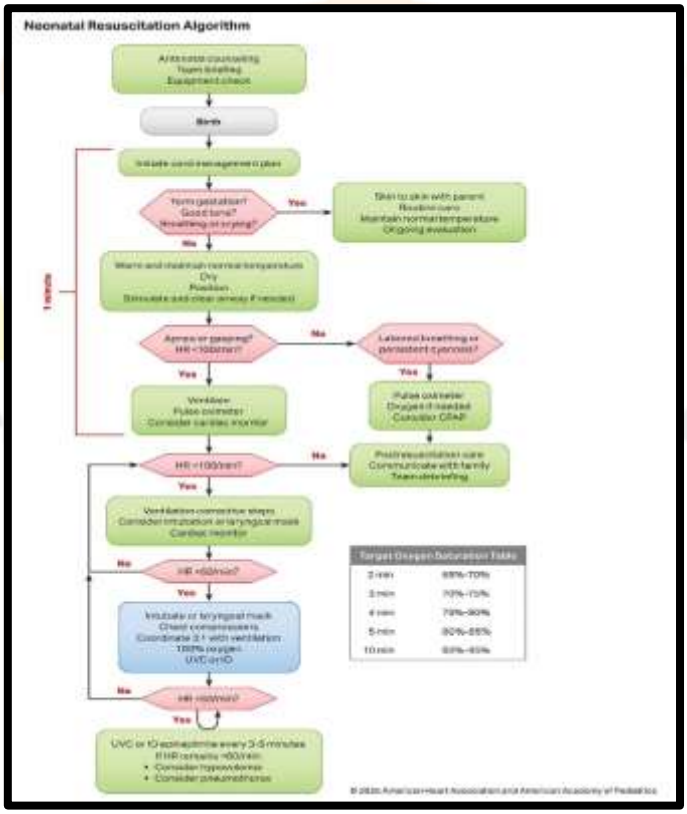


Fig 3 The Neonatal Resuscitation Algorithm

Part 6: Pediatric Basic Life Support

The sixth section of the 2025 Guidelines, "Pediatric Basic Life Support (PBLS)," delivers revised guidance for treating cardiac arrests occurring both outside hospitals and within healthcare facilities in children past the neonatal period. Departing from the 2020 Guidelines that merged PBLS and Pediatric Advanced Life Support into a single chapter, the 2025 revision separates PBLS to highlight its distinctive characteristics. A collaborative expert group representing the American Heart Association and the American Academy of Pediatrics formulated these recommendations.

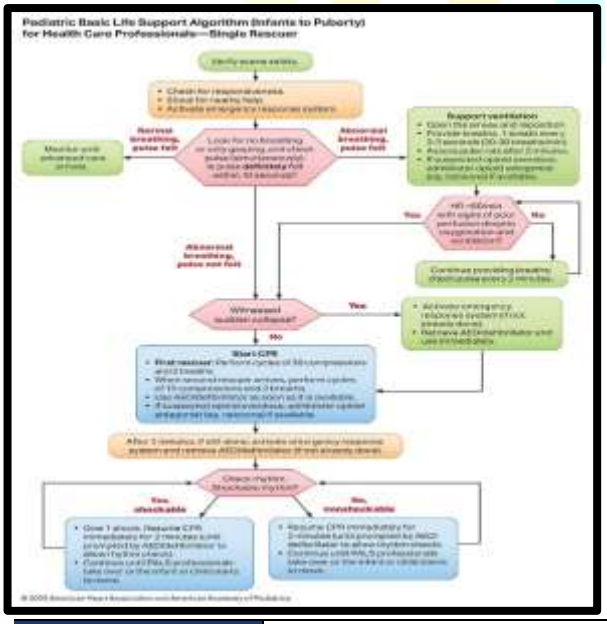
Pediatric cardiac arrest presents distinct differences from adult cases, predominantly arising from breathing difficulties that progress to cardiac arrest rather than originating from primary cardiac pathology. The PBLS Guidelines draw upon current resuscitation research and are applicable to infants and children before puberty begins, covering management during both the pre-arrest and active arrest periods across various settings including community, emergency medical services, and hospital environments.

Prioritizing Rescue Breaths with Compressions Although compression-only CPR has become more prevalent in both adult and paediatric populations, with varied findings when comparing traditional CPR to compression-only approaches, extensive observational research in paediatric out-of-hospital cardiac arrest demonstrates superior results with traditional CPR incorporating breaths. Limited observational data from school-age children showed comparable outcomes between both CPR methods. Nevertheless, substantial observational evidence confirms that compression-only CPR by bystanders yields better results than no bystander intervention at all.

Discontinuation of Two-Finger Compression Method For infant resuscitation, comprehensive reviews and pooled analyses of simulation research indicate that the two-thumb encircling hands method outperforms two-finger compressions, especially regarding compression depth achievement. A large-scale, prospective multicentre registry investigation revealed that single-handed compressions produced greater depth than the two-thumb approach in infants, while compression rates remained consistent across techniques. The two-finger method appeared infrequently in this research, and when employed, failed to meet AHA paediatric resuscitation standards in any documented compression sequences.

Reducing Interruptions Around Defibrillation Extended interruptions in chest compressions surrounding shock administration diminish blood circulation and oxygen transport to critical organs including the brain and heart, correlating with reduced survival rates.

Choking Management Recent observational research in adult choking cases indicates superior foreign object removal using back blows compared to abdominal thrusts. To maintain teaching uniformity, and given the absence of evidence suggesting paediatric inferiority, the management protocol for severe paediatric choking now begins with alternating cycles of 5 back blows and 5 abdominal thrusts, continued as needed.



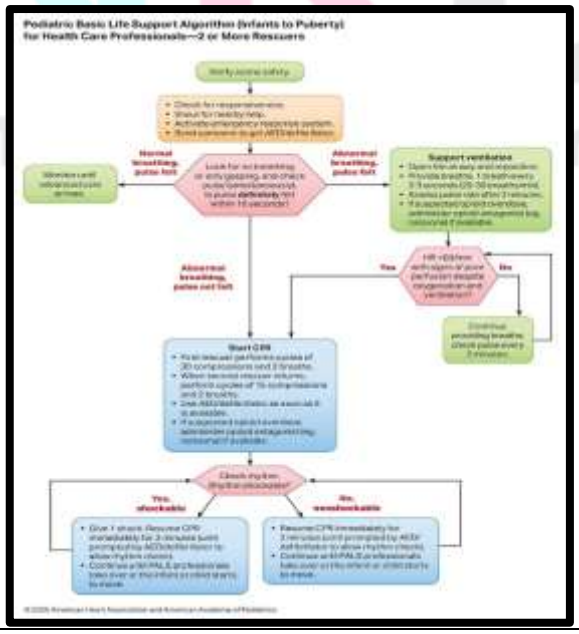
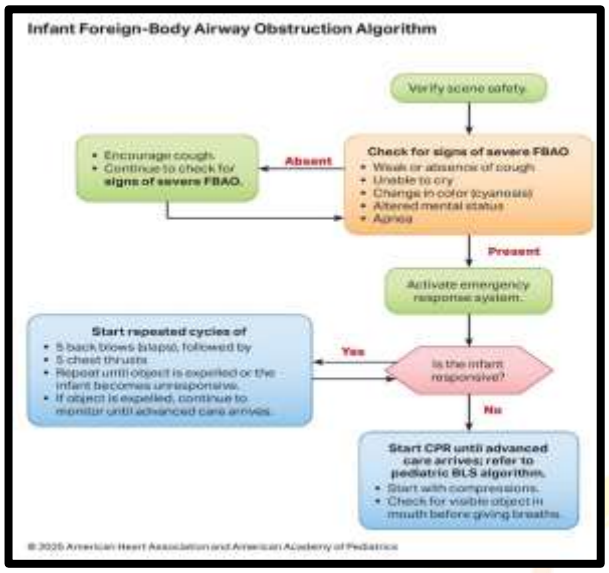


Fig 4: Paediatrics BLS Algorithm-Single Rescuer

Fig 4.1: Paediatrics BLS Algorithm-2 or More Rescuer



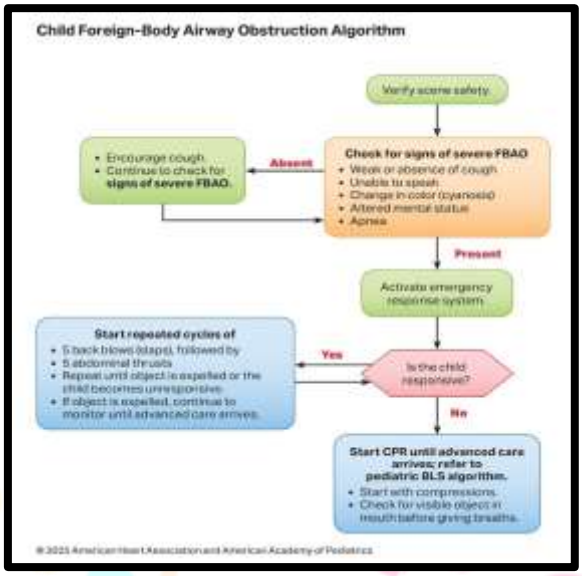


Fig 4.2: Infant Foreign -Body Airway Obstruction Algorithm

Fig 4.3: Child Foreign -Body Airway Obstruction Algorithm

Part 7: Adult Basic Life Support

The seventh section of the 2025 Guidelines, "Adult Basic Life Support," offers guidance for managing adults experiencing cardiac arrest, respiratory arrest, and choking emergencies. Timely delivery of high-quality CPR combined with rapid defibrillation represents the most critical interventions for enhancing survival from adult cardiac arrest. This chapter covers identifying cardiac arrest, initiating CPR procedures, and specific performance elements including compression rate and depth. Visual algorithms demonstrate the resuscitation sequence for adult cardiac arrest and choking intervention protocols. A significant modification to the adult BLS algorithm involves incorporating naloxone administration by non-medical rescuers during respiratory and cardiac arrest situations.

Notable New and Revised Recommendations

Choking Emergency Management Supported by expanded evidence regarding efficacy and safety, back blows are now advised as the first intervention for alert adults experiencing choking, subsequently followed by abdominal thrusts. Consistent with 2020 guidance, when the individual loses consciousness, the protocol calls for beginning CPR while checking the mouth for visible foreign objects before attempting rescue breaths. An updated algorithm for adult choking treatment has been incorporated.

Ventilation Fundamentals Incorporating rescue breaths with chest compressions is advised for both healthcare providers and bystanders who are willing and able to perform them. Bystanders willing to give breaths may utilize pocket masks, face shields, or direct mouth-to-mouth ventilation. Research demonstrates that pocket masks deliver more effective ventilations compared to face shields, making pocket masks the preferred choice when available. Observational evidence indicates that rescue breaths during CPR frequently prove insufficient; therefore, all rescuers and healthcare providers should deliver each breath until visible chest elevation occurs.

Optimal Positioning for CPR Chest compression effectiveness can be enhanced by optimizing rescuer hand placement, rescuer body positioning, and patient positioning. CPR should be conducted on a firm surface whenever feasible. Rescuers should align their knee with the patient's chest, achieved either by kneeling beside the patient or employing a step stool to enhance compression quality. The COVID-19 pandemic expanded experience with prone CPR after widespread use of prone positioning for severe respiratory failure. Although

supine positioning remains preferred, rescuers may contemplate performing CPR with the patient face-down when turning them supine proves impossible or would substantially delay compression initiation.

Performance Enhancement Tools and Automated CPR Additional research supports recommending real-time feedback devices during CPR to enhance manual compression quality. Comparative studies between automated and manual CPR reveal that mechanical devices offer no survival advantage over manual techniques. Currently, routine implementation of mechanical CPR devices is not advised; however, they may be considered in particular situations where maintaining high-quality manual CPR proves challenging or for healthcare provider safety, such as during patient transport.

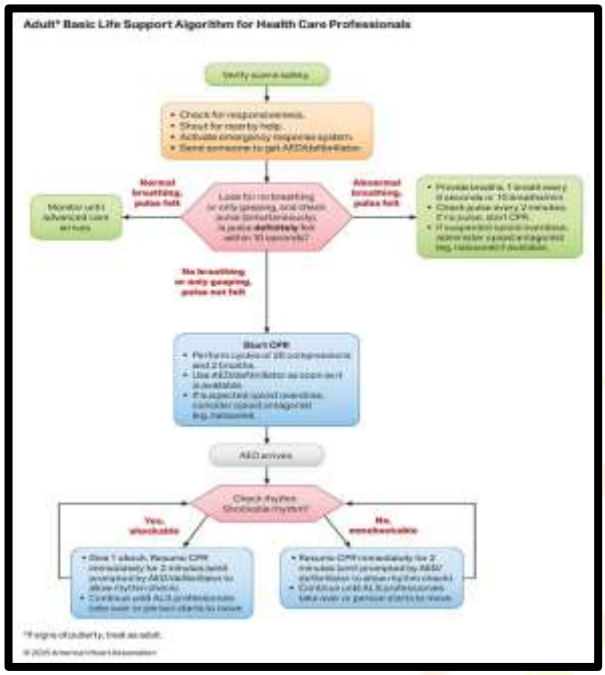


Fig 5: Adult Basic Life Support Algorithm For Health Care Professionals

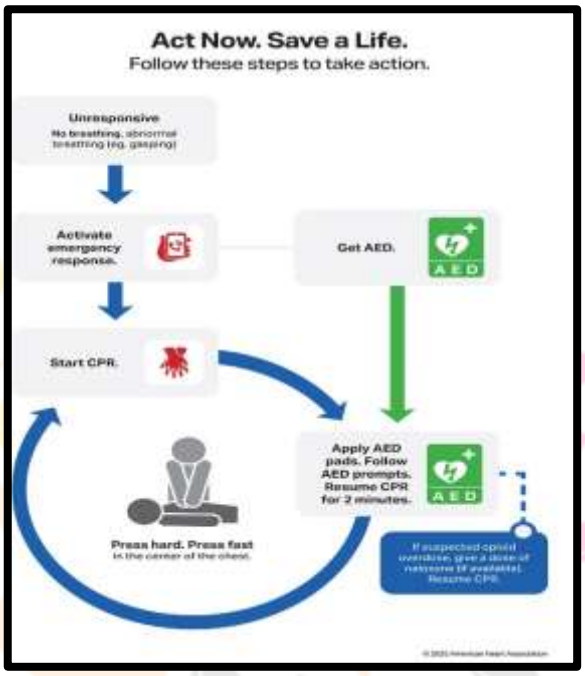


Fig 5.1: Act Now Save a Life Steps

Part 8: Paediatric Advanced Life Support

The eighth section of the 2025 Guidelines, "Pediatric Advanced Life Support," encompasses recommendations for managing paediatric cardiac arrests both in and out of hospital settings, including post-resuscitation management and long-term recovery. These PALS Guidelines reflect current resuscitation evidence and were created by a collaborative expert team led by volunteer specialists from the AHA and AAP. Within PALS guidelines, pediatric patients include infants and children up to 18 years of age, excluding neonates. Conversely, PBLS guidelines target infants and children who have not yet reached puberty.

New additions to PALS recommendations encompass post-cardiac arrest management, neurological outcome prediction, and recovery processes. This 2025 overview concentrates exclusively on PALS, emphasizing new and revised recommendations that will significantly influence procedural approaches and patient outcomes following cardiac arrest**.:**

Major New and Revised Recommendations

Timely Epinephrine Administration Epinephrine given during CPR aims to enhance coronary perfusion pressure and sustain cerebral perfusion pressure. Prompt epinephrine administration during CPR correlates with improved outcomes in infants and children. For paediatric cardiac arrest patients presenting with non-shockable rhythms, administering the first epinephrine dose as promptly as possible is appropriate. Likewise, for paediatric patients with initial shockable rhythms, epinephrine administration following 2 defibrillation attempts or earlier when immediate defibrillation proves unfeasible may be appropriate.

Using Diastolic Blood Pressure to Monitor CPR Quality For patients who have invasive arterial blood pressure monitoring already in place when cardiac arrest occurs, healthcare providers may appropriately utilize diastolic blood pressure readings to evaluate the child's response to resuscitation. Optimal blood pressure goals during CPR are now specified for infants and children with continuous invasive arterial monitoring during resuscitation. In such situations, healthcare providers may appropriately aim for diastolic blood pressure readings of ≥25 mm Hg in infants and ≥30 mm Hg in children aged 1 year or older.

Blood Pressure Monitoring and Goals After Cardiac Arrest Low blood pressure frequently occurs following paediatric cardiac arrest resuscitation and may worsen brain and heart ischemic damage. Post-resuscitation hypotension correlates with decreased hospital discharge survival rates. Following cardiac arrest in infants and children, continuous arterial pressure monitoring is advised to detect and address hypotension when adequate resources exist. Furthermore, after paediatric cardiac arrest, maintaining systolic and mean arterial blood pressure at or above the 10th percentile for age is recommended.

Neurological Outcome Prediction Timely and dependable neurological outcome prediction following paediatric cardiac arrest resuscitation proves essential for guiding therapy, facilitating accurate family counselling, and delivering family support. Additionally, precise neurological prediction is vital to prevent premature withdrawal of life-sustaining interventions in patients who might achieve meaningful recovery, while simultaneously avoiding futile life-sustaining treatments.

Healthcare providers should refrain from relying on isolated data elements at any single time point to forecast favourable or unfavourable neurological outcomes. Accurate prognostication for pediatric cardiac arrest survivors requires multiple data elements.

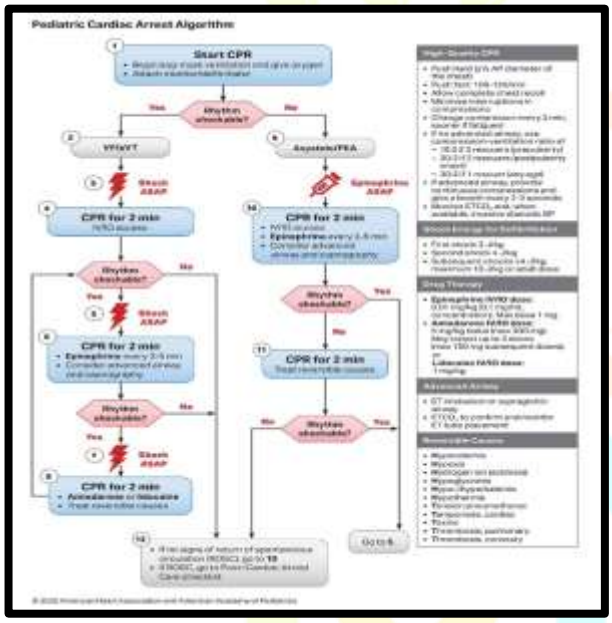


Fig 6: Paediatrics Cardiac Arrest Algorithm

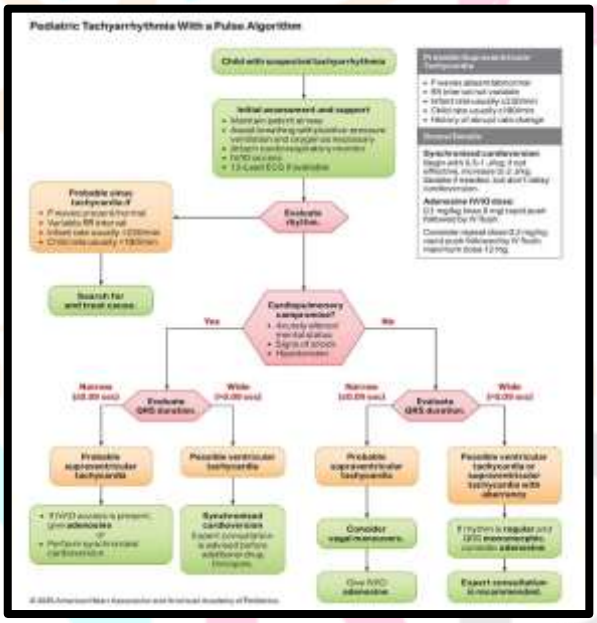


Fig 6: Paediatrics Tachyarrhythmias with a pulse algorithm

Part 9: Adult Advanced Life Support

The ninth section of the 2025 Guidelines, "Adult Advanced Life Support," provides guidance for managing adult cardiac emergencies, including urgent arrhythmia treatment in both stable and unstable patients. These recommendations incorporate and build upon the 2023 AHA Focused Update on Adult Advanced Life Support. When such arrhythmias result in out-of-hospital or in-hospital cardiac arrest, these Guidelines examine and recommend appropriate electrical therapy, medication management, airway control, and considerations for ending resuscitation efforts when return of spontaneous circulation is not achieved.

This chapter excludes recommendations for basic life support, healthcare professional training, special circumstances in advanced life support delivery, post-cardiac arrest management, or integration of advanced life support techniques or personnel into resuscitation systems.

Electrical Conversion of Atrial Fibrillation or Flutter Rapid heart rate from atrial fibrillation or flutter elevates heart muscle oxygen requirements while simultaneously undermining compensatory mechanisms to satisfy that demand. Unstable patients and those experiencing rate-related insufficient blood flow from atrial fibrillation or flutter require urgent electrical cardioversion. Earlier Guidelines recommended a gradual approach however, beginning at 200 J is now advised because emerging evidence shows improved initial shock effectiveness, decreased risk of triggering ventricular fibrillation, reduced anaesthesia duration, and lower total electrical exposure with this strategy.

Dual Sequential Defibrillation When combined with CPR, successful biphasic defibrillation delivering current across the chest between electrode pads terminates ventricular fibrillation and ventricular tachycardia approximately 75% of the time. Dual sequential defibrillation has surfaced as a possible intervention for patients with shock-resistant ventricular fibrillation. Technology to consistently distinguish shock-resistant ventricular fibrillation from recurrent ventricular fibrillation after defibrillation, and to accurately deliver dual sequential external defibrillation within the ideal therapeutic window measured in milliseconds, needs additional research before routine practice recommendations can be made.

Elevated Head Position CPR Elevated head position CPR attempts to enhance traditional supine CPR by increasing cerebral perfusion pressure to improve favourable neurological outcomes. This approach represents a bundled intervention studied as a combination of automated chest compressions, an impedance threshold device, and an automated device controlling gradual elevation of the head and chest during compressions. Present evidence for elevated head position CPR remains limited, and without randomized controlled trials or contemporary comparison evaluations, its application is not advised outside properly designed clinical trials with appropriate community authorization.

Polymorphic Ventricular Tachycardia Persistent polymorphic ventricular tachycardia causes diminished ventricular filling and ultimate cessation of cardiac output and coronary blood flow, unavoidably making the patient clinically unstable. While earlier Guidelines suggested various treatment approaches based on clinical stability, current recommendations call for all adult patients with sustained polymorphic ventricular tachycardia to receive immediate defibrillation. Although other medications may help prevent polymorphic ventricular tachycardia or its recurrence based on underlying disease, these approaches must not postpone defibrillation to stop polymorphic ventricular tachycardia.

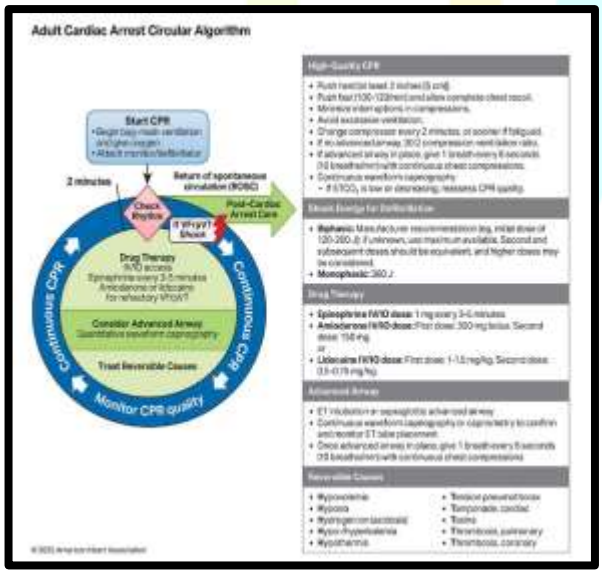


Fig 7: Adult Cardiac Arrest Circular

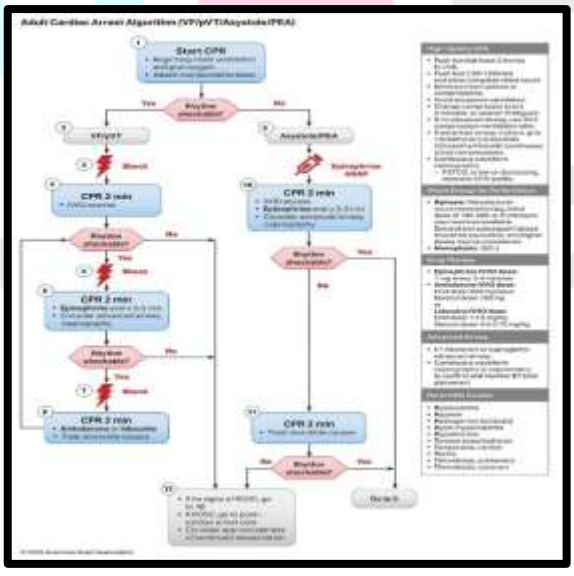
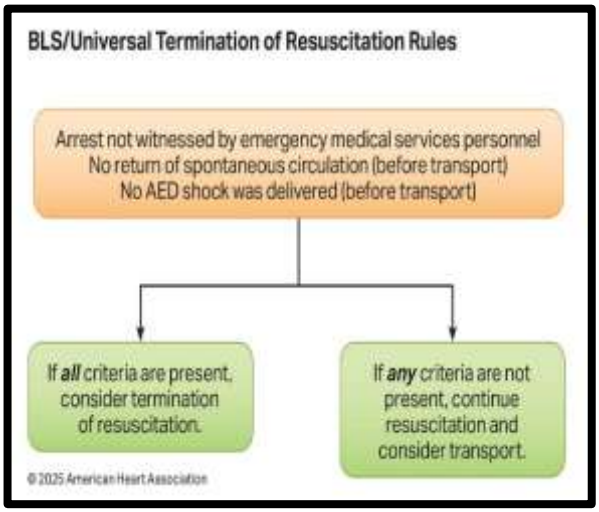


Fig 7.1: Adult Cardiac Arrest algorithm algorithm



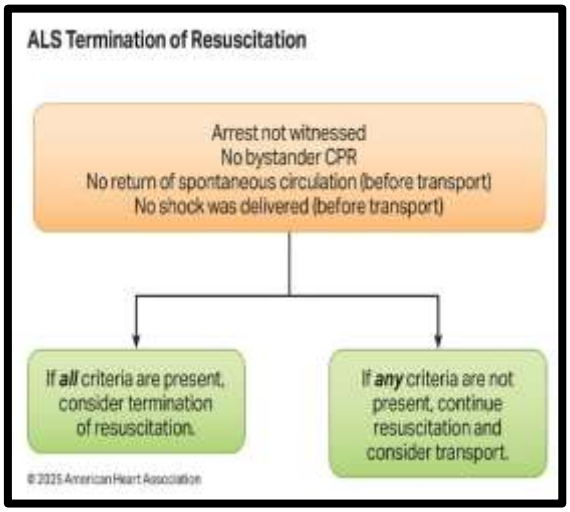
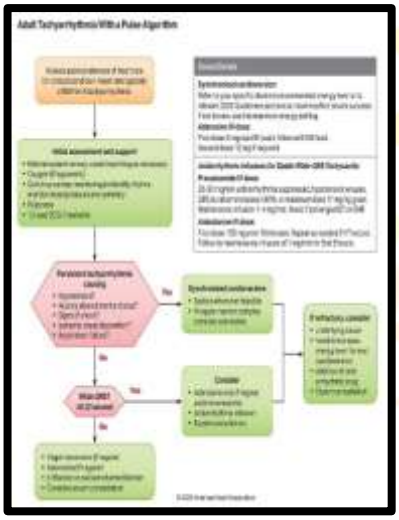
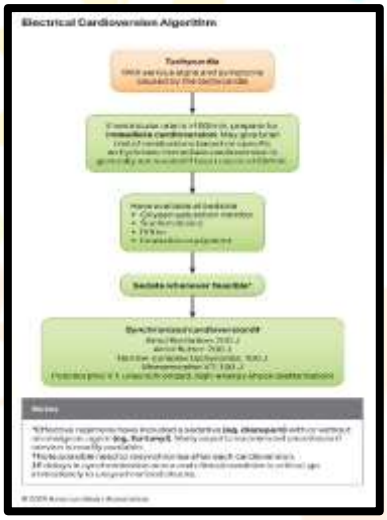


Fig 8 BLS Termination of Resuscitation Rules **Fig 8.1 ALS Termination of Resuscitation Rules**





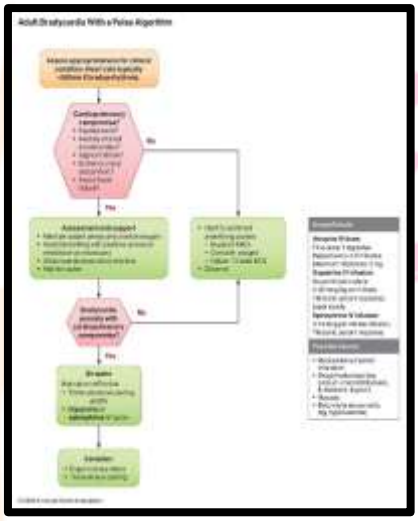


Fig 9: Adult Tachyarrthymia with a Pulse Algorithm **Fig 9.1: Electrical Cardio-version Algorithm** **Fig 9: Adult Tachycardia with a Pulse Algorithm**

Part 10: Adult and Pediatric Special Circumstances of Resuscitation

The tenth section of the 2025 Guidelines, "Adult and Pediatric Special Circumstances of Resuscitation," presents modifications to basic and advanced life support for adults and children in unique situations. Based on available data, recommendations address managing patients in cardiac arrest or patients with life-threatening conditions that may include cardiac arrest. The 2020 Guidelines incorporated special resuscitation circumstances within adult basic and advanced life support recommendations. The 2025 Guidelines emphasize evidence review for both adult and paediatric populations, providing population-specific recommendations where applicable. Combined adult and paediatric recommendations appear when class of recommendation and level of evidence align; otherwise, paediatric recommendations are presented separately.

These recommendations also incorporate and update the 2023 AHA toxicology focused update and the 2024 AHA drowning focused update. Additionally, new guidance addresses: interposed abdominal compressions, electrical injury, gas embolism, high-risk respiratory pathogens, elevated body temperature, durable left ventricular assist devices, amniotic fluid embolism in peripartum patients, and poisoning from volatile hydrocarbon exposure. Overall, the updated special circumstances guidance modified 44 existing recommendations and introduced 140 new recommendations.

Significant New and Revised Recommendations

Extracorporeal Life Support While unavailable in all settings or applicable to undifferentiated cardiac arrest, adults and children experiencing cardiac arrest or near-arrest with potentially reversible causes receive support from extracorporeal life support devices, including venoarterial extracorporeal membrane oxygenation, for conditions such as anaphylaxis, asthma, cardiac surgery, cardiac catheterization procedures, hypothermia, pregnancy, pulmonary embolism, and poisonings from agents including beta-blockers, calcium channel blockers, cocaine, local anaesthetics, sodium channel blockers, and sympathomimetics. Consult the guidelines for specific class of recommendation and level of evidence for extracorporeal life support use with each poisoning agent in adults and children.

High-Risk Respiratory Pathogens Chest compressions, bag-mask ventilation, defibrillation, airway suctioning, and endotracheal intubation should be regarded as aerosol-producing procedures that create infection risk for resuscitation team members. However, real-world research demonstrated that SARS-CoV-2 transmission rates to properly protected resuscitation team members remained low.

Elevated Potassium Levels Clinical evidence supporting intravenous calcium or intravenous sodium bicarbonate administration remains limited in humans, with uncertain benefit for survival or favourable neurological outcomes. The value of other interventions such as insulin with glucose and inhaled beta-agonists, designed to reduce potassium levels during cardiac arrest, remains unclear when weighing potential benefits against harm risks if these potentially interrupt well-established interventions like CPR.

Elevated Body Temperature Adults and children with life-threatening hyperthermia from environmental exposure, cocaine poisoning, or sympathomimetic poisoning require rapid cooling, optimally at rates of at least 0.15°C per minute. Ice water immersion achieves this most effectively.

Left Ventricular Assist Devices Absent palpable pulses can complicate cardiac arrest confirmation in adults and children with left ventricular assist devices, necessitating perfusion assessment through alternative indicators including cool skin temperature, central bluish discoloration, delayed capillary refill, and low mean arterial pressure. Treatment involves prioritizing CPR while concurrently evaluating and attempting to restore left ventricular assist device function if additional rescuers are present.

Pregnancy-Related Cardiac Arrest Managing cardiac arrest during pregnancy presents a complex clinical challenge requiring resuscitation approaches that account for pregnancy's physiological alterations. Manual leftward uterine displacement during chest compressions should be implemented for pregnant cardiac arrest patients when the uterine fundus reaches or exceeds the umbilicus, allowing optimal cardiac output by relieving inferior vena cava and aortic compression. Pregnancy's anatomical and physiological changes complicate airway management given reduced hypoxia tolerance and aspiration risk. Airway management should be prioritized during pregnant patient cardiac arrest resuscitation. Emergent delivery relieves aortocaval compression and returns sequestered uterine blood to systemic circulation to aid maternal resuscitation. Team preparation should commence upon cardiac arrest recognition, with fetal delivery completed within 5 minutes.

Opioid-Related Emergencies For trained rescuers assisting adults or children with suspected opioid overdose experiencing respiratory depression or respiratory arrest with a detectable pulse, rescue breaths or bag-mask ventilation should be delivered. For bystanders assisting adults or children with suspected opioid overdose who are unresponsive and not breathing normally, CPR including breaths should be performed. Opioid antagonists should be administered to individuals with respiratory arrest from suspected opioid overdose. Trained rescuers, bystanders, and general public members can all give naloxone.

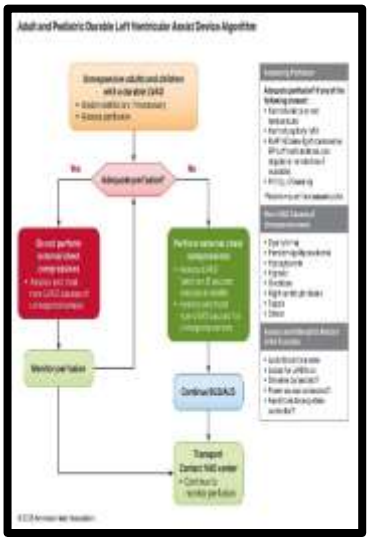


Fig 10: Adult and paediatric assist device Algorithm

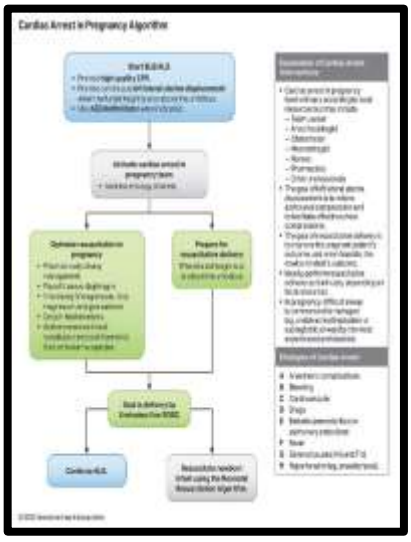


Fig 10.1: Cardiac Arrest in Pregnancy Algorithm

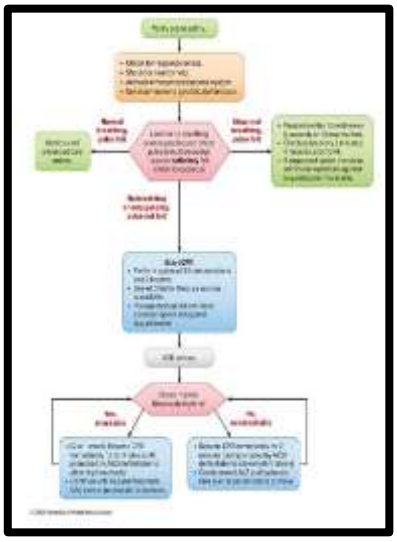


Fig 10.2: Opioid related Emergency

Part 11: Post-Cardiac Arrest Care

The eleventh section of the 2025 Guidelines, "Post-Cardiac Arrest Care," provides recommendations for managing adult patients after return of spontaneous circulation. These recommendations incorporate and update the 2023 AHA adult life support focused update. This encompasses management across prehospital, emergency department, and hospital settings. Patient management during the post-return of spontaneous circulation period proves critically important, spanning the Chain of Survival from acute resuscitation through long-term survivorship.

Notable New and Revised Recommendations

Diagnostic Testing After Return of Spontaneous Circulation Twelve-lead electrocardiograms, echocardiography, point-of-care cardiac ultrasound, and computed tomography imaging help identify clinically significant diagnoses requiring intervention in post-arrest patients, including determining cardiac arrest's underlying cause and identifying and treating cardiac arrest and CPR complications. A twelve-lead electrocardiogram should be obtained, and computed tomography, echocardiography, or point-of-care cardiac ultrasound may be reasonable for adult patients after return of spontaneous circulation. These diagnostic modality uses are examined, with ultrasound and computed tomography imaging recommendations representing new additions.

Temperature Management Duration Temperature control encompasses the complete active temperature management period, whether targeting hypothermic or normothermic ranges. Maintaining temperature between 32°C and 37.5°C for adults unresponsive to verbal commands following return of spontaneous circulation is recommended. In settings initially using hypothermic targets, fever prevention or normothermic temperature control may subsequently follow. Clinical trials vary in temperature control durations for both hypothermic and normothermic targets. One randomized controlled trial found no outcome differences comparing 24-hour versus 48-hour hypothermic temperature control. Another randomized controlled trial found no outcome differences comparing 12-hour versus 48-hour device-based fever prevention following an initial 24-hour temperature control period at 36°C. Other randomized controlled trials protocolized 72 hours of total temperature control for all patients. Recognizing evolving evidence and temperature control definitions, 36 hours represents the minimum recommended total temperature control duration.

Managing Low Blood Pressure After Return of Spontaneous Circulation Hypotension requiring vasopressor medications commonly occurs in post-cardiac arrest patients. No large-scale randomized controlled trials compare clinical outcomes between different vasopressors. Data from cardiogenic shock patients, many experiencing cardiac arrest, suggest epinephrine and dopamine associate with less favorable safety profiles; however, recent cardiac arrest-focused literature meta-analysis did not confirm this. Thus insufficient evidence

exists to recommend a specific vasopressor for treating low blood pressure in adult post-cardiac arrest patients. Additionally, temporary mechanical circulatory support devices have been employed to elevate blood pressure and cardiac output in cardiogenic shock patients, often supplementing vasopressor therapy. In carefully selected adult patients with resistant cardiogenic shock after cardiac arrest and return of spontaneous circulation, temporary mechanical circulatory support may be considered.

Invasive Brain Monitoring Hypoxic-ischemic brain injury disrupts cerebral homeostasis physiological processes, creating secondary brain injury risks. Neurological injury primarily causes death in patients initially surviving to return of spontaneous circulation; consequently, interest exists in enhancing neurological care during the post-arrest period. While multiple studies have examined various invasive neurological monitoring approaches for hypoxic-ischemic brain injury, methodological limitations prevent recommendations about any invasive neuromonitoring technique. Discussion regarding monitoring intracranial pressure, cerebral blood flow, and brain tissue oxygenation usefulness appears in the Guidelines, acknowledging expanding literature on this topic and movement toward personalized neurological care in the post-cardiac arrest period. These different invasive neuromonitoring modality utilities remain unestablished.

Seizure and Myoclonus Management Seizures and status epilepticus represent common acute neurological complications during the post-cardiac arrest period, affecting 10% to 35% of patients not following commands after return of spontaneous circulation. Myoclonus constitutes a clinical examination finding potentially representing seizure manifestation when occurring time-synchronized with electroencephalogram correlates, or myoclonus may occur without electroencephalogram correlation. Therefore, after return of spontaneous circulation, promptly performing and interpreting electroencephalograms is recommended for diagnosing seizures in adult patients with myoclonus. Recommendations addressing myoclonus diagnosis and management, along with electroencephalogram findings on the ictal-interictal continuum, represent important additions.

Predicting Favorable Neurological Outcomes Accurate neurological prognostication proves important for avoiding inappropriate life support withdrawal in patients potentially achieving favorable outcomes and avoiding ineffective treatment when unacceptable or unfavorable outcomes prove inevitable. Neuroprognostication historically focused on identifying prognostic tests predicting unfavorable outcomes with high specificity. Increasing focus now exists on developing prognostic tests predicting favorable outcomes. Recommendations focused on favorable outcome prognosis represent new Guidelines additions.

Healthcare Professional Burnout An important Guidelines addition acknowledges stressors affecting healthcare professionals caring for cardiac arrest patients. Healthcare worker burnout occurs commonly and negatively affects healthcare professionals' productivity and patient care quality.

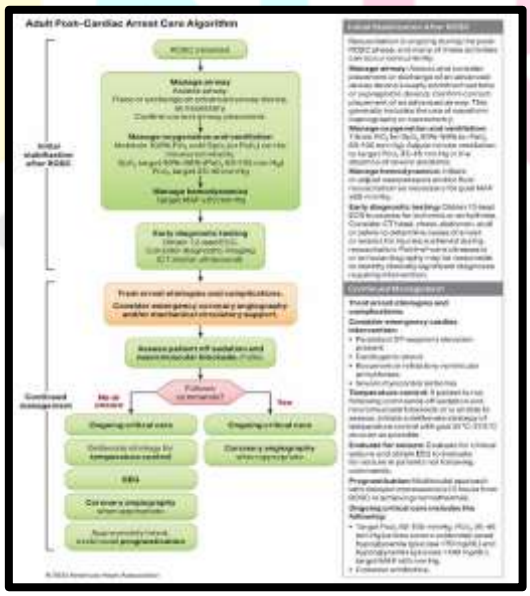


Fig 11: Adult Post Cardiac Arrest Care Algorithm

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