NORTHWEST
COMMUNITY
EMERGENCY
MEDICAL
SERVICES
SYSTEM

EST 1972

Continuing Education

April 2019

Cardiac Arrest:

Forging into the Future of Resuscitation

Questions/Comments
regarding this CE are welcome,
and should be directed to:
Susan Wood RN PM
NWC EMSS In-Field Coordinator
swood@nch.org or 847-618-4486

NWC EMSS Skill Performance Record

CARDIAC ARREST MANAGEMENT

Name #1:	Date:
Name #2:	1st attempt: ☐ Pass ☐ Team repeat
Name #3:	2nd attempt: #1: ☐ Pass ☐ Repeat
Name #4:	#2: ☐ Pass ☐ Repeat
Name #5 (leader)	#3: ☐ Pass ☐ Repeat #4: ☐ Pass ☐ Repeat
Name #6	#5: ☐ Pass ☐ Repeat #6: ☐ Pass ☐ Repeat

General expectations:

- Use "Pit crew" or "Team" approach and bundles of care to manage the patient per SOPs.
- All care is organized around 2 minute cycles in C-A-B priority order unless arrest is caused by hypoxic event – **multiple steps may be done simultaneously** if personnel/resources allow
- Continue resuscitation at point of patient contact for at least 30 minutes; Exception: dangerous environment/adverse climate; pt is in need of intervention not immediately available on scene (PTCA, REBOA, ECMO); penetrating trauma; obvious pregnancy; or ROSC occurs.

Performance standard 0 Step omitted (or leave blank) 1 Not yet competent: Unsuccessful; required critical or excess prompting; marginal or inconsistent technique 2 Successful; competent with correct timing, sequence & technique , no prompting necessary	**Attempt 1 rating**	**Attempt 2 rating**
Verbalizes **equipment needed** at point of care: ☐ BSI ☐ Airways (BLS/ALS) ☐ O_2 source ☐ Suction ☐ $ETCO_2$ NC & inline sensors ☐ BVM ☐ Cardiac monitor/defibrillator ☐ SpO_2 ☐ Quantitative waveform capnography ☐ 12 L ☐ Pace/defib pads (2 sets) ☐ Washcloth/towel to prep skin ☐ Electrodes for 12 L ☐ Real-time CPR feedback ☐ ResQPod ☐ CPR device (approved piston-style optional) ☐ Vascular access supplies ☐ Drugs: epinephrine; amiodarone; naloxone, sodium bicarb; norepinephrine		
Determine unresponsiveness; open airway (manually); assess for breathing/gasping; suction prn **Simultaneously:**		
☐ **Assess pulse**: If not definitively felt in <10 sec: **Determine if CPR is contraindicated:** DNR order, Triple Zero? Blunt trauma? If DNR status is unclear, start CPR; stop if valid order is presented. ☐ Disconnect Zoll Lifevest batteries; remove vest if present; DO NOT disconnect VAD batteries ☐ If pulseless & **VAD placed**: ✓SpO_2 . If perfusing: NO CPR and NO DEFIBRILLATION (even if VF). If questionable: Call VAD Coordinator for instructions.		
☐ If indicated, **begin quality high perfusion CPR with MANUAL COMPRESSIONS** per guidelines w/in 10 seconds of arrest recognition. ☐ A real-time CPR feedback device shall be used until an automated CPR device is deployed ☐ **As soon as possible**, transition to an approved **automated CPR device** (if available and meets protocol) to maintain continuous uninterrupted chest compressions. Interrupt compressions < 5 sec to place device. ☐ Pause/DC CPR device only for TOR or ROSC (precipitous and persistent rise in $ETCO_2$) ☐ NO pause for intubation, defibrillation, rhythm or pulse checks ☐ If no CPR device available or is contraindicated: Continue 2 person CPR (adult, child, infant)		
APNEIC OXYGENATION: 13 and older – Exception: cardiac arrest caused by hypoxic event (asthma, anaphylaxis, submersion – early ventilations indicated for these patients ☐ Insert NPA/OPA; place nasal cannula $ETCO_2$ sensor at 15 L O_2 immediately after initiating CPR		
APPLY CARDIAC MONITOR without interrupting compressions ☐ Remove all clothing from pt's chest; remove nitro patches, briskly wipe skin with dry towel or gauze ☐ ✓ electrodes for expiration date; connect defib cable to pace/defib electrodes. ☐ Peel back electrode protective liner (slowly), beginning with cable connection end. Make sure gel is moist and in the middle of the electrode. ☐ *Place anterior electrode (no gaps or wrinkles) on right upper torso, lateral to sternum and below clavicle ☐ *Place lateral electrode under and lateral to pt's left nipple in the midaxillary line, with center of electrode in the midaxillary line if possible. ☐ *Smooth electrode center and edges onto pt's chest to eliminate air pockets between gel surface and skin. Firmly press all adhesive edges to skin. ☐ *Select paddles mode		

*** ✓ rhythm:**

☐ **WITH CPR DEVICE:** No pause in compressions to check rhythm if detectable
☐ **NO CPR DEVICE:** Pause compressions just long enough to determine if rhythm is shockable (< 5 sec) (PVT/VF)

* Shockable? **CONSIDER** need for **DELAYED DEFIBRILLATION**

☐ Prolonged downtime in cardiac arrest (6 min) ☐ Very fine VF (hard to distinguish from asystole ☐ $ETCO_2$ reading < 20 mmHg	If one or more present; pt is acidic; heart is less responsive to electrical therapy. Perform high quality CPR; ventilate/BVM at 10 BPM for 2 min or until $ETCO_2$ >20 before defibrillation.

If $ETCO_2$ above 20:

☐ Adult: Charge monitor to device-specific joule setting
☐ Peds < 50 kg: 2 J/kg then 4 J/kg; > 50 kg: adult energy settings

☐ **WITH CPR DEVICE:** No pause to shock
☐ **NO CPR DEVICE**: *Compressor verbally counts down 5-4-3-2-1; pause CPR (< 5 sec); scan 360°; clear pt.

☐ ***DEFIBRILLATE**: Depress current discharge button(after last compression - not a ventilation)

☐ NO CPR DEVICE: *Change compressors: Without checking ECG or pulse, change compressors and resume chest compressions for 2 mins. Limit time from last compression to shock delivery & resumption of compressions to ≤5 sec.
☐ NO rhythm/pulse check until after 2 min of CPR unless evidence of ROSC
☐ Defibrillate shockable rhythms per procedure in 2 minute cycles

ADVANCED Airway – without interrupting compressions

☐ Apneic oxygenation or ventilation as above until advanced airway (i-gel or ETT) can be safely placed
☐ Confirm placement with 5 point auscultation; $ETCO_2$, secure tube, stabilize head and neck

REGULATE INTRATHORACIC PRESSURE (Age 13 and older)

☐ Place RQP directly on BVM mask or on advanced airway adaptor; attach inline $ETCO_2$ sensor above that to BVM
☐ Ventilate adult at 10 BPM (asthma 6-8 BPM); child at age and size-appropriate rate with volume only to see chest rise and hear bilateral breath sounds midaxillary lines

VASCULAR ACCESS:

☐ Establish vascular access (IV/anterior tibia IO): NS TKO
☐ When IV/IO available, give meds with no interruption in compressions

EPINEPHRINE (1mg/10mL) Repeat every **6 min** as long as CPR continues

☐ **Adult:** 1 mg IVP/IO. If cardiac arrest occurs with anaphylaxis: high dose epi per SOP.
☐ **Peds:** 0.01 mg/kg (0.1 mL/kg) (Max 1 mg) IVP/IO

ANTIDYSRHYTHMIC AGENT if SHOCKABLE RHYTHM

AMIODARONE	☐ Adult: 300 mg IVP/IO	☐ Peds**:** 5 mg/kg IVP/IO (Max 300 mg)
After 5 min:	☐ Adult: 150 mg IVP/IO	☐ Peds: 2.5 mg/kg IVP/IO (Max 150 mg)

* **If persistent/refractory VF**:

☐ Change pad location to A-P and defibrillate per procedure.
☐ If 2 monitors available: consider **dual sequential defibrillation** at device-specific joule settings

As time allows**: Consider Hs & Ts** (Rx appropriately)

☐ Hypoxia (ventilate/O_2) ☐ Hypothermia (core rewarm) ☐ Hypovolemia (IVF boluses)
☐ Hypo/**hyper**kalemia ☐ H ion (bicarb-responsive acidosis (DKA/TCA /ASA OD, cocaine, diphenhydramine): **SODIUM BICARB** 1 mEq/kg up to 50 mEq IVP/IO
☐ Hypoglycemia (✓glucose; give D10% per protocol)
☐ Toxins **Opioid OD**: **NALOXONE** ☐ Adult: 1 mg IVP/IO; repeat q. 30 sec up to 4 mg
☐ Peds 0.1 mg/kg IVP/IO (max 1 mg); repeat as above
☐ Tamponade, cardiac ☐ Thrombosis (coronary/pulmonary)
☐ Tension pneumothorax (✓ lung snds; pleural decompression)

**<u>If evidence of ROSC:</u> ***Rapid, sustained rise in $ETCO_2$; pt moves; wakes up: ✓pulse; VS; SpO_2

☐ *Support ABCs; **remove ResQPod**
☐ Assist ventilations / Do not hyperventilate even if ↑ $ETCO_2$; titrate O_2 to SpO_2 94% (avoid hyperventilation and hyperoxia)
☐ Start 2nd IV if needed
☐ **Adults:** If SBP < 90 (MAP < 65): IV WO while prepping **NOREPINEPHRINE 8 mcg/min** (2 mL/min IVPB). Retake BP q. 2 min until desired BP reached, then every 5 min. Don't overshoot target BPs. Maintenance: 2 to 4 mcg/min (0.5 mL to 1 mL/min).
☐ **Peds:** If SBP <70: IV WO while prepping NOREPINEPRHINE 1 mcg/kg/min (max 8 mcg/min) IVPB; Titrate to SBP > 70 + (2X Age)
☐ Keep fingers on pulse & watch SpO_2 pleth on monitor for 5 min to detect PEA; Goal: MAP 90-100
☐ Obtain12 L ECG ASAP (call alert if STEMI)
☐ Assess glucose level (Rx hypoglycemia)

If patient remains unresponsive to verbal commands w/ no contraindications: ☐ Chemical cold packs (CCP) to cheeks, palms, soles of feet; if additional CCP available, apply to neck, lateral chest, groin, axillae, temples, and/or behind knees. ☐ Avoid hyperthermia & hyperglycemia		
VERBALIZES criteria for TERMINATION OF RESUSCITATION (TOR): If normothermic pt. remains in persistent monitored asystole for 30 minutes or longer despite steps above, and if $ETCO_2$ remains ≤ 10 for 20 min & no reversible causes of arrest are identified, seek OLMC physician's approval for TOR.		
Critical Criteria - Check if occurred ☐ Failure to perform quality, high perfusion, uninterrupted compression CPR unless justified pause ☐ Failure to appropriately defibrillate if shockable rhythm ☐ Over-ventilation (too much tidal volume/too fast) ☐ Failure to support perfusion after ROSC or detect re-arrest ☐ Performs any improper technique resulting in potential for patient harm ☐ Exhibits unacceptable affect with patient or other personnel		

Scoring: All steps must be independently performed in correct sequence with appropriate timing and all starred (*) items must be explained/ performed correctly in order for the person to demonstrate competency. Any errors or omissions of these items will require additional practice and a repeat assessment of skill proficiency.

Rating: (Select 1) for team

☐ **Proficient**: The paramedic can sequence, perform and complete the performance standards independently, with expertise and to high quality without critical error, assistance or instruction.

☐ **Competent:** Satisfactory performance without critical error; minimal coaching needed.

☐ **Practice evolving/not yet competent:** Did not perform in correct sequence, timing, and/or without prompts, reliance on procedure manual, and/or critical error; recommend additional practice

CJM 3/19

____

Preceptor (PRINT NAME – signature)

CPR/Resuscitation Guidelines for Adults, Children, Infants			
Age group	**Adults**	**Children**	**Infants**
If not a candidate for apneic oxygenation: Compression/ventilation ratio **before** adv airway	30:2	30:2 - single rescuer; 15:2 – 2 HCP rescuers	
CPR **sequence**	CAB – unless hypoxia-related arrest		
Compression **rate**	100-120/min (*100-110 when using RQP)* avoid rate >120 (use audible prompt for correct rate)		
Compression **depth**	2” – 2.4” (5-6 cm)	At least ⅓ AP chest depth (~2 in)	At least ⅓ AP chest depth (~1½ in)
Hand location	2 hands; lower ½ of sternum	2 hands or 1 hand (very small child) on lower ½ of sternum	1 rescuer: 2 fingers center of chest, just below nipple line 2 or more rescuers: 2 thumb–encircling hands center of chest, just below nipple line
Chest wall **recoil**	Allow full recoil after compression; lift hand slightly off chest		

Seven Tools Result in Dramatic Improvements in Cardiac Arrest Outcomes in Rialto, Calif.

Fri, Dec 1, 2017

Joe Powell, EMT-P is the EMS coordinator for the Rialto (Calif.) Fire Department.

Kevin Dearden, BS, EMT-P, is the EMS quality improvement coordinator for the Rialto (Calif.) Fire Department.

Sean Grayson, MS, EMT-P, is the fire chief for the Rialto (Calif.) Fire Department.

The Rialto Fire Department developed seven cardiac survivability tools to increase neurologically intact survival from sudden cardiac arrest. Photos Rick McClure

Seven survivability tools lead to dramatic improvements in cardiac arrest outcomes

In the United States, an estimated 10% of cardiac arrest patients survive, with 90% never leaving the hospital.[1] Are these acceptable cardiac arrest survival rates where you and your family live, work and play? They weren't for the Rialto (Calif.) Fire Department (RFD), so the RFD embarked on a complete review and revision of their approach to cardiac arrest resuscitation.

This article describes the RFD's journey toward increased SCA survival-a journey that, in 2016, resulted in a 71% (Utstein) survival rate from sudden cardiac arrest (SCA) in Rialto. This is due in large part to what the RFD *unlearned* about cardiac arrest; Rialto's outcome-based data now shows that all of these assumptions are *false*:

- CPR should be done on a hard, flat surface;
- Always defibrillate ventricular fibrillation (v fib);
- Intubation attempts should be limited to 30 seconds;
- ALS actions are what saves lives;
- Prioritize epinephrine to improve cerebral perfusion and survival;
- Asystolic patients have essentially no survivability; and
- Rapid transport to the hospital improves outcomes.

After just two years, the RFD is seeing dramatic results, including a significant improvement of ROSC and patient survival.

The RFD's mission is to be, "An organization that brings value to the community, measured in lives saved and quality of life protected."[2] To further this, the RFD embarked on a journey to improve neurologically intact survival from SCA.

The RFD enjoys an organizational structure that isn't common in California. The RFD is both the fire-based first responder and the ambulance transport provider for the city of Rialto.

All RFD first responder and transport units are staffed with paramedics and all RFD personnel are trained to the same standards. The RFD doesn't participate in the CARES registry and acquiring outcome data depends upon extending the RFD culture of teamwork to receiving facilities.

Apneic oxygenation allows for passive oxygenation of a patient who's already receiving continuous, uninterrupted compressions.

Rialto's Toolkit

In 2016, the RFD developed the seven components of cardiac survivability, referred to as the RFD Cardiac Survivability Tools:

1. Continuous uninterrupted compressions utilizing an automated CPR device;
2. Apneic oxygenation;
3. Use of an impedance threshold device (ITD);
4. Heads-up CPR;
5. Delaying defibrillation for a certain subset of patient presentations;
6. Expanded utilization of waveform capnography; and
7. Deprioritizing epinephrine in the order of interventions.

When applying the RFD Cardiac Survivability Tools to cardiac arrest patients, the RFD realized a 60% return of spontaneous circulation (ROSC) for all non-traumatic adult arrests; not just the very small number of patients that fit into the Utstein measurement, but *all* patients in cardiac arrest. By working hard at this process and unlearning previous assumptions, the RFD gleaned some keys to success.

Rialto Fire Department's goal for automated CPR delivery is to initiate and maintain continuous, uninterrupted compressions as soon as possible after patient contact.

Once the automated CPR device is in place, crews quickly move the patient to the gurney and then raise the head/shoulders to a 30-degree angle.

Uninterrupted Compressions

If the RFD could impart only one data-driven, outcome-oriented finding, it's this: nothing trumps compressions, *nothing*! Not ALS or BLS, airway or venous access, defibrillation or definitive medical care; nothing should interrupt compressions. Uninterrupted compressions have been shown to be one of the key components to saving lives, so everything else should be support for those compressions.

The RFD has been using the AutoPulse automated CPR device since 2009. The generalized research on automated CPR devices hasn't shown significant benefit in patient outcomes with their use.[3] Research conducted in 2015 illustrated ROSC rates to be 5% higher for all non-traumatic adult cardiac arrest patients in Rialto with use of automated CPR vs. manual CPR

However, it was when evaluating the use of automated CPR devices that the RFD had its first eureka moment-a moment that would set the stage for the data-driven, outcome-oriented cardiac survivability tools that would follow.

The RFD was using automated CPR in the same fashion it had previously used manual CPR-with too many pauses in compressions. Today, the RFD goal is to initiate and maintain continuous, uninterrupted compressions as soon as possible after patient contact, effectively maintaining a 100% compression fraction rate within the first 30 seconds of the resuscitation.

In practice, RFD crews will initiate manual CPR, transition to the AutoPulse device within 30 seconds and then *never* turn off the device; not for intubation, defibrillation, rhythm checks or pulse checks.

Under RFD's cardiac arrest protocol, the automated CPR device can only be turned off for two reasons: termination of resuscitation efforts or if ROSC is achieved, as noted by a precipitous and persistent increase in end-tidal carbon dioxide ($EtCO_2$).

To ensure compliance with the Cardiac Survivability Tools, the RFD uses software (ImageTrend ePCR report writer and ZOLL Case Review) to review all sudden cardiac arrests. Each compression, ventilation and all vitals are represented for the duration of the resuscitation in the program.

Those patients that achieve ROSC share an extended period of uninterrupted high-quality CPR as the underlying factor. Although patients in shockable rhythms generally achieve ROSC as a result of defibrillation, those who achieve ROSC from non-shockable rhythms generally have no discernable causal intervention other than the absence of breaks in CPR for several minutes prior to ROSC.

Patients that achieve return of spontaneous circulation share an extended period of uninterrupted high-quality CPR as the underlying factor.

Apneic Oxygenation

For years, paramedics have been taught that 30 seconds is all the time they have to establish an advanced airway, or the intervention should be delayed and a round of pre-oxygenation ventilations should be instituted. Apneic oxygenation allows for passive oxygenation of a patient that's already receiving continuous, uninterrupted compressions, capitalizing on the low tidal volume but high minute volume of ventilations generated by the automated CPR device.[4]

The RFD goal for this survivability tool is to initiate and maintain continuous oxygenation of patients from the time that continuous, uninterrupted CPR by automated CPR device is initiated until an advanced airway is secured.

In practice, crews place a nasal cannula on the patient at 15 liters per minute immediately after initiating the automated CPR device.

Providers can readily assess the effectiveness of apneic oxygenation through the use of pulse oximetry. The patient should maintain or improve their oxygen saturation and $EtCO_2$ levels even when providers aren't ventilating the patient to secure an advanced airway.

Applying this tool supports the entire process by avoiding interruption of CPR to secure an advanced airway and eliminates arbitrary time standards to secure the advanced airway based on the need to maintain patient oxygenation.

Regulating Intrathoracic Pressure

The RFD uses the ResQPOD ITD, a noninvasive device that delivers intrathoracic pressure regulation (IPR). The ITD acts as a one-way valve allowing oxygen to be delivered during ventilations but restricts ambient air from entering the thoracic cavity during the recoil phase of chest compressions and between ventilations. This lowers thoracic pressure, creating a vacuum which pulls more blood back to the heart, increases preload and decreases intracranial pressure (ICP), allowing for quality cerebral perfusion. It's a blood in, blood out equation. Studies have shown that the ITD increases blood flow to the heart by 25% and increases cerebral perfusion by 50%.[5-7]

The RFD goal for this survivability tool is to increase cardiac and cerebral perfusion by initiating and maintaining the use of the ITD from the time an advanced airway is secured until ROSC is achieved. In practice, crews place the ITD inline of the ventilation circuit immediately after verifying placement and security of the advanced airway.

The RFD hasn't found a definitive indicator that the ITD is providing increased circulation. However, for patients who subsequently achieve ROSC, there's generally noted improvement in $EtCO_2$ from the time of ITD placement. This improvement in $EtCO_2$ occasionally occurs rapidly and, in several cases, has precipitated ROSC without additional intervention.

Heads-Up CPR

Performing heads-up CPR, with the patient's head and torso in a 30-degree elevated position, has been found to optimize perfusion in the shock state of cardiac arrest. It's a simple, yet effective way of decreasing ICP, increasing preload and enhancing post ROSC neurological function.[8]

By elevating the head to a 30-degree angle, venous pressure is relieved and allows gravity to drain blood back to the heart. Decreasing ICP and increasing preload allows for more blood in and more blood out of the brain. From an ergonomic and effectiveness perspective, heads-up CPR can only be performed with an automated CPR device and should only be performed with an ITD in place to maximize the pressure variant and cerebral perfusion. Heads-up CPR has a synergistic effect when provided as a concomitant therapy to the ITD.[9]

For heads-up CPR, the most recently implemented cardiac survivability tool, the goal is to initiate and maintain heads-up CPR from the time the ITD is placed until ROSC is achieved. In practice, once the automated CPR device is in place, crews move the patient onto the stretcher and then raise the head of the gurney to a 30-degree angle.

Although the RFD hasn't found a definitive indicator that heads-up CPR is providing increased circulation, the same improvement in $EtCO_2$ has been seen in those patients who subsequently achieve ROSC when heads-up CPR is initiated immediately after the placement of the ITD.

After heads-up CPR was added as a survivability tool, RFD crews found that many patients who eventually achieved ROSC were noted to gasp or provide patient-initiated ventilation attempts within a short period of time after heads-up CPR was initiated. The gasping response hasn't been historically documented and is an anecdotal corollary finding. It may not be caused by heads-up CPR; however, during heads-up CPR, gasps have been observed along with a discernable capnography waveform.

Delayed Defibrillation

One of the links in the chain of survival is early defibrillation. Matching national data, 24% of RFD patients have an initial presenting rhythm of v tach or v fib, the two classic shockable rhythms of cardiac arrest.

The RFD provides early defibrillation to patients in shockable rhythms whenever possible. Unfortunately, the arrival of responders may occur after the window in which defibrillation will result in ROSC has closed.

There are three clinical findings that suggest the patient is outside the window for early defibrillation such that defibrillation may not be successful: 1) prolonged patient downtime in cardiac arrest; 2) very fine v fib (barely distinguishable from asystole);[10] and 3) an $EtCO_2$ reading of less than 20 mmHg.[11] Patients with these clinical findings are acidotic and have hearts that are less receptive to electrical therapy. Before defibrillation, these patients require high-quality CPR to increase perfusion, correct hypoxia and resolve the acidosis.

For patients who meet one or more of the three clinical findings for deferred defibrillation, the RFD goal for this survivability tool is to implement the four previous tools (continuous, uninterrupted compressions utilizing an automated CPR device; apneic oxygenation; use of an ITD and heads-up CPR) for a minimum of five minutes prior to delivering defibrillation.

Case review and field providers have been able to assess the effectiveness of this practice by a decrease in the number of defibrillated patients that convert into asystole and an increase in the number of defibrillated patients that ultimately achieve ROSC.

The ResQPOD ITD acts as a one-way valve which lowers thoracic pressure, creating a vacuum that pulls more blood back to the heart, increasing preload while decreasing intracranial pressure to allow for quality cerebral perfusion.

The common practice of terminating resuscitation for an asystolic patient after two rounds of medications or 10-15 total minutes may be limiting survivability.

Expanded Use of Capnography

EtCO2 levels provide information that cells are alive and metabolically active. Waveform capnography can help verify the continued placement of an advanced airway, and it can help guide delayed defibrillation.

Waveform capnography can also be an indicator of a patient who may ultimately survive but may require additional time for resuscitation. The common practice of terminating resuscitation for an asystolic patient after two rounds of medications or 10-15 total minutes may be limiting survivability. The RFD uses $EtCO_2$ to help guide this decision.

The goal for this valuable tool, which is integrated into the X Series monitor/defbrillator used by the RFD, is to ensure that patients who show signs that resuscitation may result in ROSC continue to receive care unless clinical findings determine otherwise.

In practice, the RFD only terminates resuscitation efforts if the $EtCO_2$ is less than 15 mmHg and trending downward (after confirming that high-quality resuscitation is being performed with all of the previously noted cardiac survivability tools).

If a patient has an $EtCO_2$ that's greater than or equal to 15 mmHg and is trending upward, RFD crews remain on scene, providing all of the survivability tools for at least 30 minutes before transporting or terminating resuscitation.

Even providers who were initially highly skeptical of this requirement have seen positive results. The RFD rate of ROSC for the initial presenting rhythm of asystole, including unwitnessed arrests, is 26%. Of those patients, the average time from arrival of RFD crews until ROSC is 24 minutes. All of those patients had an initial $EtCO_2$ greater than or equal to 15 mmHg. Half of those patients survived to hospital discharge.

From an ergonomic and effectiveness perspective, heads-up CPR can only be performed with an automated CPR device and should only be performed with an ITD in place to maximize the pressure variant and cerebral perfusion.

De-emphasizing Epinephrine

The type, dosage and priority of administration of medications in cardiac arrest has varied dramatically over time. Matching national standards, local EMS protocols that the RFD operates under require epinephrine administration as the first pharmacological intervention for all cardiac arrest victims.

Prioritizing the administration of epinephrine has led to other demonstrably more impactful interventions being delayed.[12] To address this, consistent with local protocol, the emphasis should be on high-quality uninterrupted CPR followed by appropriate interventions.

By sequencing the priority of interventions, it's likely that epinephrine, when administered, will be given when the patient is more receptive to its pharmacological impact: after the patient has adequate perfusion, resolution of underlying acidosis and with an adequate $EtCO_2$.

The RFD goal for this survivability tool is to emphasize the activities that are essential in the initial minutes of resuscitation and to subsequently defer epinephrine administration until priority treatments are realized. The RFD has seen an increase in survival-to-discharge as a result of this sequencing approach.

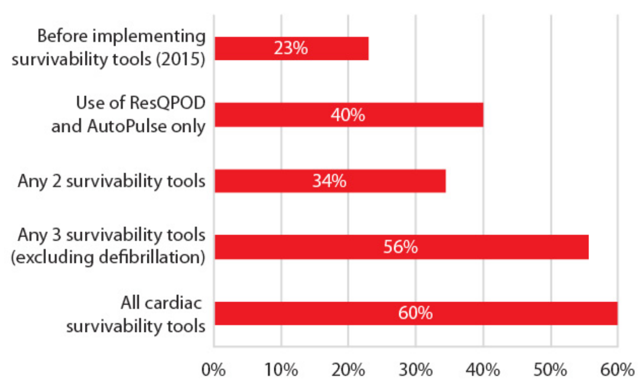
Holistic Approach

There's no magic ingredient to successful cardiac arrest resuscitation. Although case review has shown increased ROSC rates associated with application of all of the RFD Cardiac Survivability Tools, the significant increase in survival-to-discharge is due to the implementation of the whole system rather than a single element.

The RFD's system-based approach relies upon a strong quality improvement (QI) and training platform alongside one of the RFD's core values: teamwork.

The most impactful QI actions have come from the RFD establishing post-resuscitation feedback that alerts providers and department leadership to compliance with the RFD Cardiac Survivability Tools. This allows for focused assessment of each incident and aids in establishing training needs so that small course adjustments can be made on a regular basis.

Figure 1: Percentage of patients where ROSC was achieved



Conclusion

So, let's be clear, what we have been taught isn't working! We have to stop doing what we have always done. We need to ask, in no uncertain terms, does every single thing I do in the cardiac arrest setting improve neurologically intact survival. If not, why do we do it?

The RFD is hopeful that you've unlearned some of the things you were previously taught and are motivated to evaluate this new paradigm and how it could increase cardiac survivability in your community.

References

1. American Heart Association. (2017.) CPR facts and stats. Retrieved Oct. 27, 2017, from http://cpr.heart.org/AHAECC/CPRAndECC/AboutCPRFirstAid/CPRFactsAndStats/UCM_475748_CPR-Facts-and-Stats.jsp.

2. Rialto Fire Department. (2017.) Rialto Fire Department operations manual. [Internal document.]

3. Duchateau FX, Gueye P, Curac S, et al. Effect of the AutoPulse automated band chest compression device on hemodynamics in out-of-hospital cardiac arrest resuscitation. Intensive Care Med. 2010;36(7):1256-1260.

4. Farkus J. (July 2, 2014.) Preoxygenation and apneic oxygenation using a nasal cannula. PulmCrit (EMCrit). Retrieved Oct. 27, 2017, from www.pulmcrit.org/2014/07/preoxygenation-apneic- oxygenation-using.html.

5. Langhelle A, Strømme T, Sunde K, et al. Inspiratory impedance threshold valve during CPR. Resuscitation. 2002;52(1):39-48.

6. Lurie KG, Mulligan KA, McKnite S, et al. Optimizing standard cardiopulmonary resuscitation with an inspiratory impedance threshold valve. Chest. 1998;113(4):1084-1090.

7. Yannopoulos D, Aufderheide TP, Abella BS, et al. Quality of CPR: An important effect modifier in cardiac arrest clinical outcomes and intervention effectiveness trials. Resuscitation. 2015;94:106-113.

8. Frascone RJ. And the dead shall rise: Head up CPR & the revolutionary research model used to develop it. JEMS. 2017;42(1):33-37.

9. Debaty G, Shin SD, Metzger A, et al. Tilting for perfusion: Head-up position during cardiopulmonary resuscitation improves brain flow in a porcine model of cardiac arrest. Resuscitation. 2015;87:38-34.

10. Soar J, Nolan JP, Böttiger BW, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 3. Adult advanced life support. Resuscitation. 2015;95:100-147.

11. UCSD Center for Resuscitation Science. (2014.) 2014 UCSD Medical Center Advanced Resuscitation Training Manual. UC San Diego Health. Retrieved Oct. 27, 2017, from https://health.ucsd.edu/medinfo/nursing/edr/education/ Documents/ART%20MANUAL.pdf.

12. Hagihara A, Hasegawa M, Abe T, et al. Prehospital epinephrine use and survival among patients with out-of-hospital cardiac arrest. JAMA. 2012;307(11):1161-1168.