ABC's or CAB's: What's New in the Resuscitation Guidelines . . . And What Was Left Out

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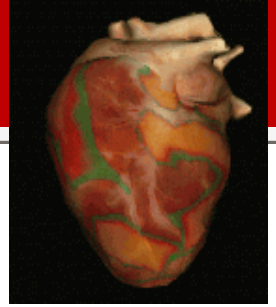
Learning Outcomes

- Review key recommendations from The American Heart Association's 2015 ECC update
- Discuss emergency management strategies that promote optimal outcomes after in-hospital cardiac arrest



Cardiac Arrest Mortality

- 326,200 *out of hospital* (OHCA) arrests/year
  - Survival to discharge in 10.6%
  - Good neurologic recovery in 8.3%
- 209,000 *in hospital* (IHCA) arrests/year
  - Survival to discharge in 24%
- 2500-5000 post-cardiac surgery arrests/year
  - High potential for reversible causes and recovery
  - Wide variation in survival; 40-80%

AHA 2015 Heart & Stroke Statistics

Important AHA 2015 Updates

- Focus on compression fraction
  - Rate 100-120 per minute
  - Compression depth 5-6 cm
- Capnography recommendations
- Medication updates
  - Vasopressin removed
  - Lidocaine not *routinely* recommended
  - Epinephrine for shockable vs non-shockable rhythms
  - Naloxone added for suspected opiate overdose
- Did NOT address cardiac surgery resuscitation

American Heart Association. H I G H L I G H T S of the 2015 American Heart Association Guidelines Update for CPR and ECC. www.heart.org/cpr accessed April 22, 2016

Compressions & High Quality CPR

- CPR quality affected by ***both* rate and interruptions**
- Compression fraction = portion of total CPR time when compressions are performed; goal > 60%
- Optimize by:
  - Increasing rate of compressions (↑ to 120)
  - Reducing interruptions (frequency and duration)
  - Upper limits for both added in 2015

American Heart Association. H I G H L I G H T S of the 2015 American Heart Association Guidelines Update for CPR and ECC. www.heart.org/cpr accessed April 22, 2016

Compressions & High Quality CPR

American Heart Association
life is why™
GUIDELINES 2015 CPR & ECC

Sequence of Interventions Remains C-A-B

Table 1 BLS Dos and Don'ts of Adult High-Quality CPR

Rescuers Should	Rescuers Should *Not*
Perform chest compressions at a rate of 100-120/min	Compress at a rate slower than 100/min or faster than 120/min
Compress to a depth of at least 2 inches (5 cm)	Compress to a depth of less than 2 inches (5 cm) or greater than 2.4 inches (6 cm)
Allow full recoil after each compression	Lean on the chest between compressions
Minimize pauses in compressions	Interrupt compressions for greater than 10 seconds
Ventilate adequately (2 breaths after 30 compressions, each breath delivered over 1 second, each causing chest rise)	Provide excessive ventilation (ie, too many breaths or breaths with excessive force)

American Heart Association

American Heart Association. H I G H L I G H T S of the 2015 American Heart Association Guidelines Update for CPR and ECC. www.heart.org/cpr accessed April 22, 2016

Self-Assessment Question #1

During CPR you note the end-tidal CO2 abruptly changed from 15 to 35 mmHg, which *most likely* indicates:

1. The person performing CPR is tired
2. The patient has expired
3. Epinephrine should be administered
4. Return of spontaneous circulation has occurred

Self-Assessment Question #1

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Capnography

- Provides valuable information about patient *response* during arrest
- Strategies should offer continuous monitoring *without* interrupting compressions
- $ETCO_2$ remains a Class 1 recommendation to confirm intubation; use for prognostication *with other factors*

2015 Recommendations—Updated

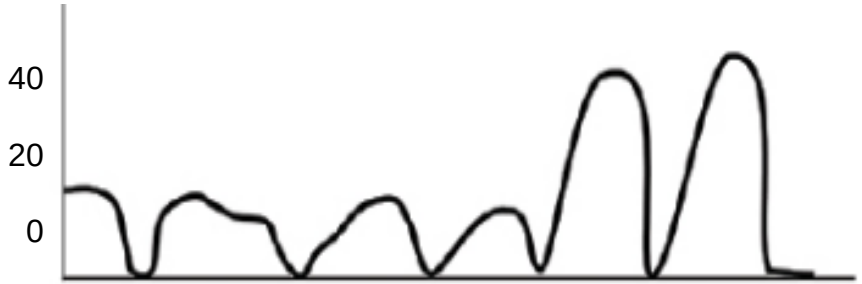
Continuous waveform capnography is recommended in addition to clinical assessment as the most reliable method of confirming and monitoring correct placement of an ETT (Class I, LOE C-LD).

2015 Recommendations—New

In intubated patients, failure to achieve an $ETCO_2$ of greater than 10 mm Hg by waveform capnography after 20 minutes of CPR may be considered as one component of a multimodal approach to decide when to end resuscitative efforts, but it should not be used in isolation (Class IIb, LOE C-LD).

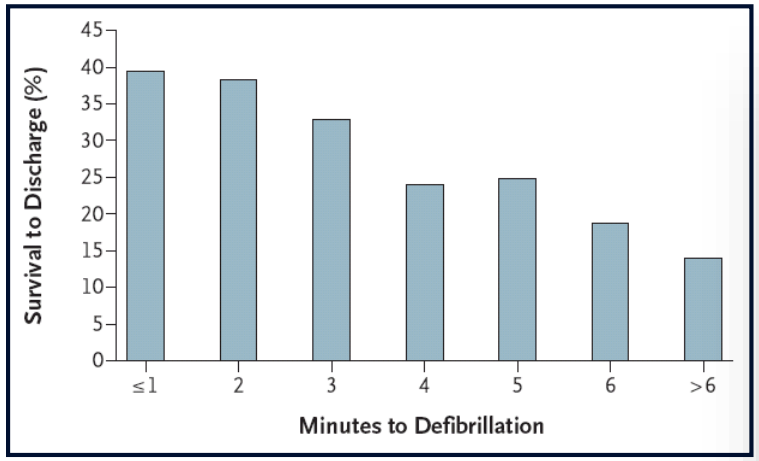
Capnography & CPR Quality

- Eliminate pulse checks!
  - Palpation for a pulse is an *insensitive indicator* of organ perfusion with very poor inter-rater reliability
- $ETCO_2$ to assess perfusion & response to therapy:
  - Assess CPR adequacy; $ETCO_2$ goal 12-15 mmHg
  - $ETCO_2 < 10$ mmHg *may be* poor quality CPR
  - $ETCO_2$ spike to 35-40 mmHg confirms ROSC



Electrical Therapy for VF

- Early defibrillation is critical to survival
  - Guidelines recommend defibrillation within 2 minutes
  - Defibrillation time exceeds 2 min in 30% of US inpatients
  - Survival rates are 17% lower when defibrillation time exceeds 2 min (22.2% vs 39.3%).

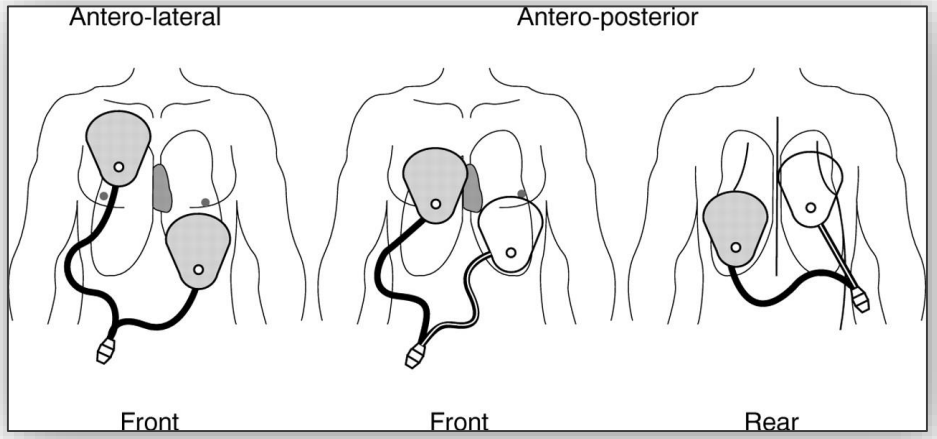


End Point	≤2 Minutes to Defibrillation (N = 4744)	>2 Minutes to Defibrillation (N = 2045)
Survival outcomes — no./total no. (%)		
Return of spontaneous circulation	3165/4744 (66.7)	1003/2045 (49.0)
Survival to 24 hr	2607/4744 (55.0)	765/2045 (37.4)
Survival to discharge	1863/4744 (39.3)	455/2045 (22.2)
Neurologic outcomes — no./total no. (%)‡		
No major disability	931/1549 (60.1)	197/381 (51.7)
Moderate disability	437/1549 (28.2)	134/381 (35.2)
Severe disability	152/1549 (9.8)	36/381 (9.4)
Coma or vegetative state	29/1549 (1.9)	14/381 (3.7)

Chan PS, et al. *NEJM* 2008;358(1):9-17

Reduce Time to Defibrillation!

- Defibrillator readily available and standardized
- Optimize use of hands free defibrillator pads



- Non-code team members can defibrillate

☑ For pulseless VT/VF, if defibrillator available

Post-op, Routine, CONTINUOUS starting Today at 0815 Until Specified
What is the nursing communication order: For pulseless VT/VF, if defibrillator available
For pulseless VT/VF, if defibrillator available, certified RN to provide 3 stacked shocks at 200J with biphasic defibrillator prior to initiating CPR. Fine VF should be considered if rhythm appears to be asystole, Sign & Hold

2016 Studies Favor Stacked Shocks

- Multicenter review: adults w/ IHCA from VF (n=2733)
- Rapid sequence shocks superior to deferred 2nd shock
  - ROSC in 62.5% vs 57.4% (Risk Ratio 0.92)
  - Survival to discharge in 30.8% vs 24.7% (RR 0.80)

Bradley SM, Liu W, Chan PS, et al. BMJ 2016; 353:i1653. doi:10:1136/bmj.i1653

- Single center review of 3 historical resus protocols
  - 3 SS vs single shock & 2 min CPR vs 3 SS(120j-150j-200j)
- Worst survival with single shock
- Highest survival after resuming 3 SS

"Our data suggest that in cases of monitored VF/VT arrest, expeditious defibrillation with use of stacked shocks is associated with a higher rate of ROSC and survival to hospital discharge."

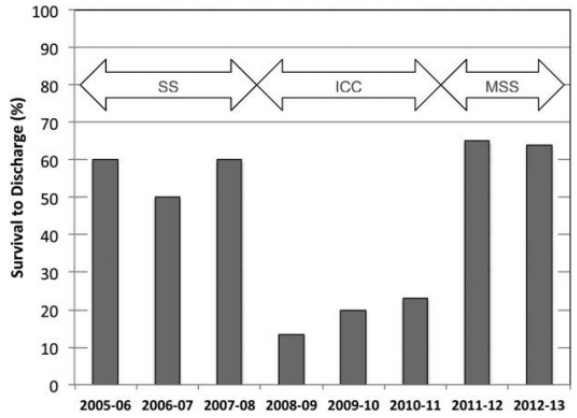


FIG. 1. Survival to discharge for patients with ventricular fibrillation/ventricular tachycardia arrest from 2005 to 2013. Survival was significantly lower during the initial chest compression (ICC) period as compared to stacked shocks (SS) and modified stacked shock (MSS) periods ($P < 0.01$).

Davis D, et al. J Hosp Med 2016;11(4):264-268

Recommendations Regarding 3 Shock Protocol

- For refractory VF/pVT in witnessed IHCA, recent data support use of a 3-shock strategy
- STS recommends 3 sequential shocks after cardiac surgery
- Since 2010 European guidelines recommend 3 sequential attempts at defibrillation for witnessed VF/pVT arrest 'where immediate defibrillation is available'
- *This is currently <u>not recommended</u> in the AHA guideline*

Soar J, et al. ERC Guidelines for Resuscitation. Cardiac arrest in special circumstances. *Resuscitation* 2010; 81:1400-1433.

Medication Update

What's in, what's out . . .

KISS . . . simplify

Self-Assessment Question #2

Which of the following medications does the AHA recommend for a **shockable** rhythm:

1. Epinephrine and Amiodarone
2. Epinephrine and Lidocaine
3. Amiodarone and Lidocaine
4. None of the above

Self-Assessment Question #2

Which of the following medications does the AHA recommend for a **shockable** rhythm:

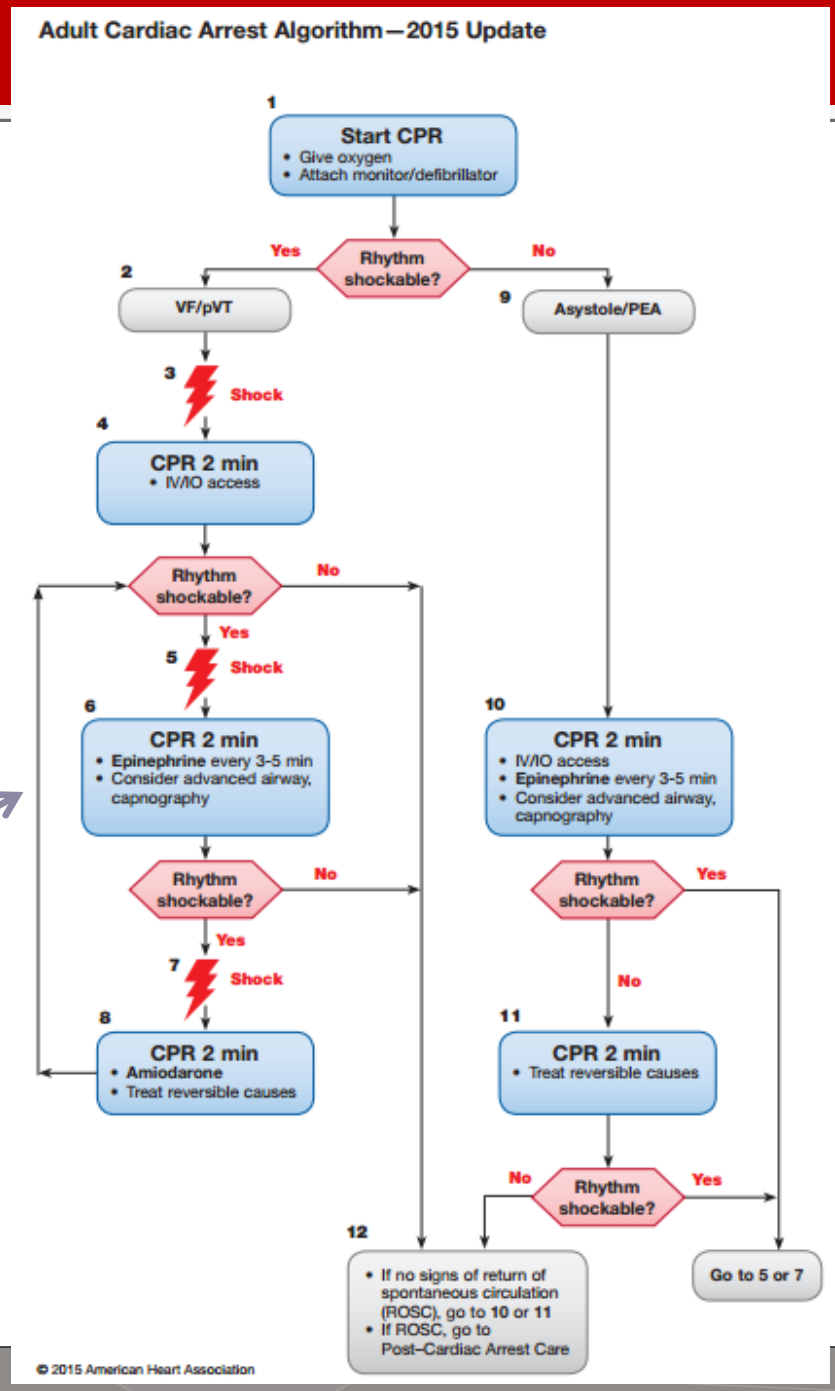
1. Epinephrine and Amiodarone
2. Epinephrine and Lidocaine
3. Amiodarone and Lidocaine
4. None of the above

Drugs for Cardiac Arrest

Drug Therapy

- **Epinephrine IV/IO dose:** 1 mg every 3-5 minutes
- **Amiodarone IV/IO dose:** First dose: 300 mg bolus. Second dose: 150 mg.

Epinephrine not recommended until after *2nd failed shock*

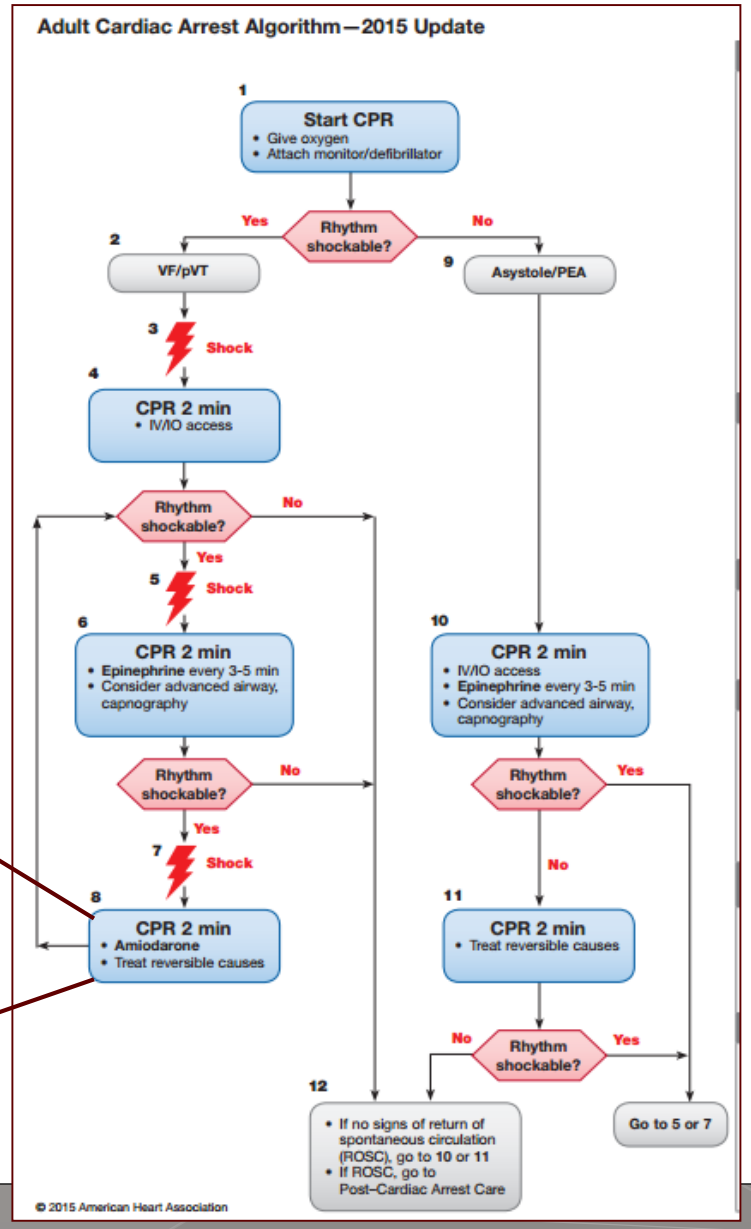


Lidocaine Gone

Post–Cardiac Arrest Drug Therapy: Lidocaine

2015 (New): There is inadequate evidence to support the routine use of lidocaine after cardiac arrest. However, the initiation or continuation of lidocaine may be considered immediately after ROSC from cardiac arrest due to VF/pVT.

CPR 2 min
- **Amiodarone**
- Treat reversible causes



Why? The ALPS

- The **A**miodarone, **L**idocaine, or **P**lacebo **S**tudy
- Multicenter RCT; 3026 pts randomly assigned to 1 of 3 treatment groups by EMS (out of hospital)
- Enrolled after at least one failed shock for VF/pVT
- Results: no significant difference in survival or neurologic recovery between the 3 groups

Table 3. Outcomes According to Trial Group in the Per-Protocol Population.*

Outcome	Amiodarone (N=974)	Lidocaine (N=993)	Placebo (N=1059)
Primary outcome: survival to discharge — no./total no. (%)†	237/970 (24.4)	233/985 (23.7)	222/1056 (21.0)
Secondary outcome: modified Rankin score ≤3 — no./total no. (%)‡	182/967 (18.8)	172/984 (17.5)	175/1055 (16.6)

Kudenchuk PJ, Brown SP, Daya M, et al. NEJM.org, April 4, 2016 DOI: 10.1056/NEJMoa1514204.

Important Differences *if Witnessed*

Table S2. Survival to Discharge in A Priori Subgroups in the Per-Protocol Population

	Amiodarone	Lidocaine	Placebo	Amiodarone vs Placebo Difference (95% CI) P	Lidocaine vs Placebo Difference (95% CI) P	Amiodarone vs Lidocaine Difference (95% CI) P	P for Interaction
Witnessed status							0.05
EMS witnessed, n (%) [N=57;43;54]	22 (38.6%)	10 (23.3%)	9 (16.7%)	21.9% (5.8%, 38.0%) P=0.01	6.6% (-9.5%, 22.7%) P=0.42	15.3% (-2.6%, 33.2%) P=0.09	
Bystander witnessed, n (%) [N=618;632;684]	171 (27.7%)	176 (27.8%)	155 (22.7%)	5.0% (0.3%, 9.7%) P=0.04	5.2% (0.5%, 9.9%) P=0.03	-0.1% (-5.1%, 4.9%) P=0.97	
Unwitnessed, n (%) [N=271;282;286]	41 (15.1%)	45 (16.0%)	48 (16.8%)	-1.7% (-7.8%, 4.4%) P=0.58	-0.8 (-6.9%, 5.3%) P=0.80	-0.9% (-6.9%, 5.1%) P=0.77	

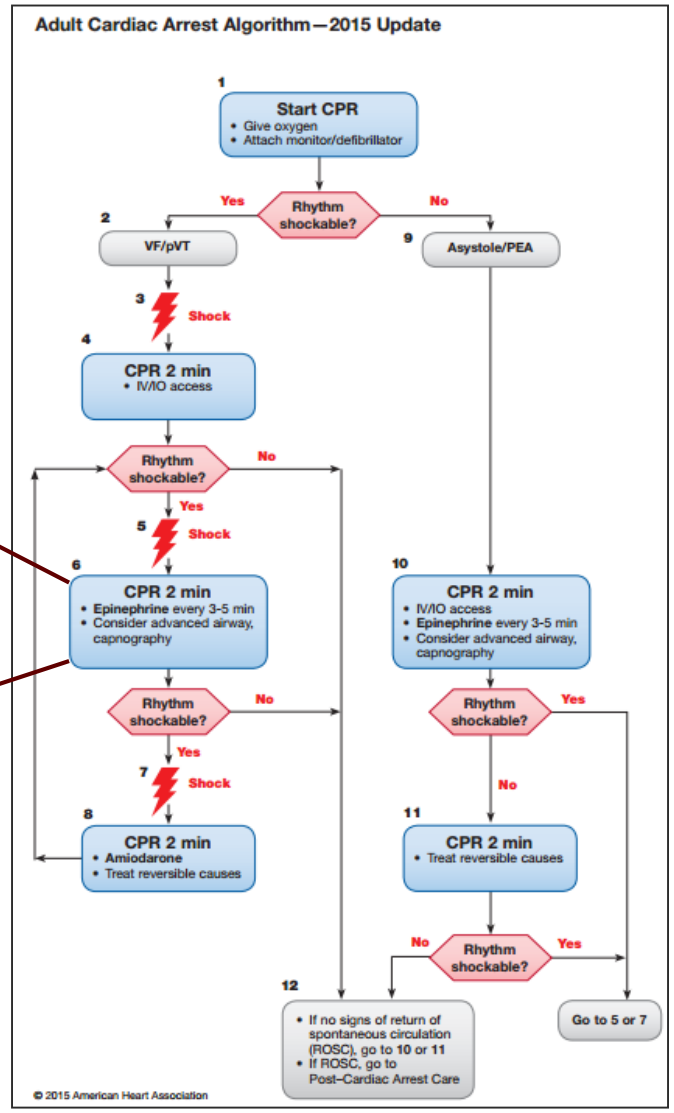
Kudenchuk PJ, Brown SP, Daya M, et al. NEJM.org, April 4, 2016 DOI: 10.1056/NEJMoa1514204.

Bye Bye Vasopressin

Vasopressors for Resuscitation: Vasopressin

2015 (Updated): Vasopressin in combination with epinephrine offers no advantage as a substitute for standard-dose epinephrine in cardiac arrest.

CPR 2 min
- **Epinephrine** every 3-5 min
- Consider advanced airway, capnography



American Heart Association. H I G H L I G H T S of the 2015 American Heart Association Guidelines Update for CPR and ECC. www.heart.org/cpr accessed April 22, 2016

The Rationale

- Important note ….
- Recommendation based on two new studies showing *lack of clear benefit*, <u>not harm</u>
- No benefit demonstrated for OHCA with VF/pVT
- Single study showed *possible* role for vasopressin in IHCA "bundle" combined with epi and steroids

+

= ?

Circulation 2015;132[suppl 2]:S444–S464. DOI: 10.1161/CIR.0000000000000261

Self-Assessment Question #3

Which of the following statements about Epinephrine is TRUE for a VF arrest:

1. Epinephrine is advocated AFTER the 2nd failed shock attempt and not before
2. Epinephrine significantly improves neurologic recovery after arrest
3. Epinephrine is equally effective in shockable vs non-shockable rhythms
4. None of the above

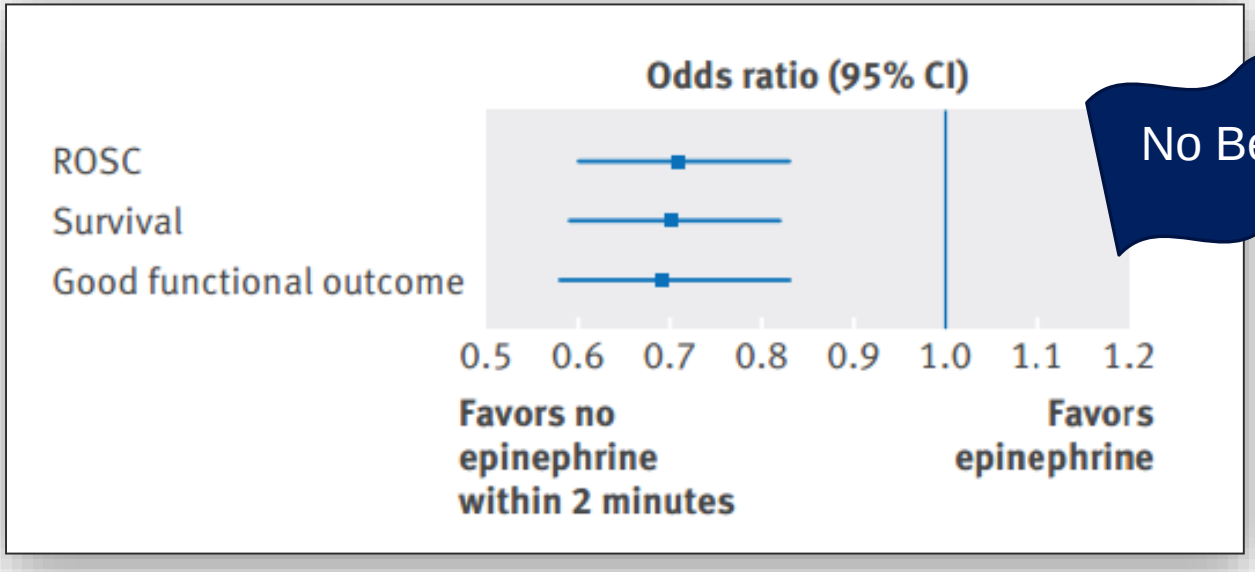
Self-Assessment Question #3

Which of the following statements about Epinephrine is TRUE for a VF arrest:

1. Epinephrine is advocated AFTER the 2nd failed shock attempt and not before
2. Epinephrine significantly improves neurologic recovery after arrest
3. Epinephrine is equally effective in shockable vs non-shockable rhythms
4. None of the above

Epinephrine for **Shockable** Rhythms

- Multicenter RCT evaluating outcomes when epi given ≤ 2 minutes of first defibrillation failure
- 2978 patients matched using propensity scores
- Epinephrine associated with worse outcomes

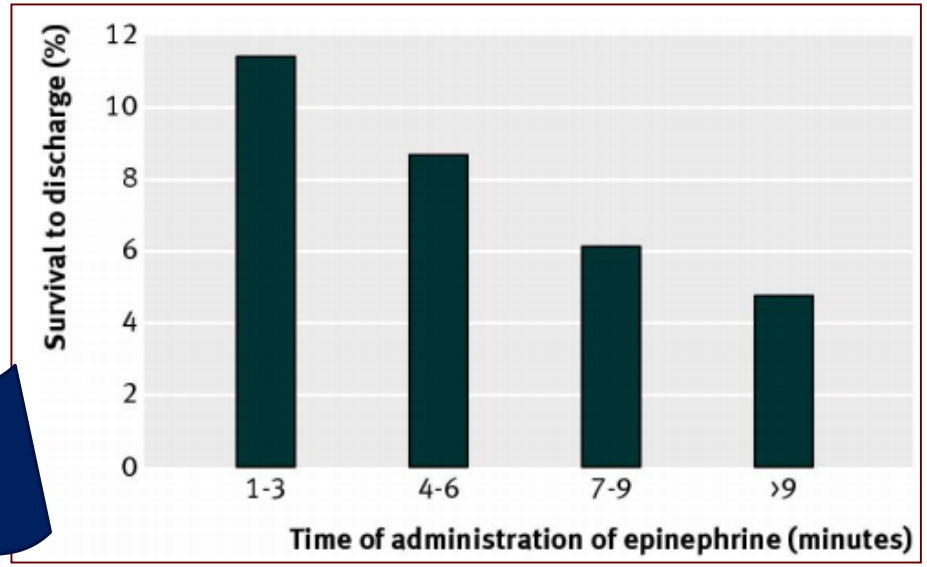


No Benefit

Andersen LW, Kurth T, Chase M, et al. BMJ 2016;353:i1577 doi:10.1136/bmj.i1577

Epinephrine for **Non-Shockable** Rhythms

- Improved survival in 3 OHCA trials* (2 large RCT) when epi given within 9-10 minutes of CPR
- Improved neurologically intact survival in 1 IHCA trial† (n=25,095) with *early initiation* of epinephrine



Benefit Seen

† Donnino MW, et al *BMJ.* 2014;348:g3028

* Goto Y, et al. *Crit Care.* 2013;17:R188. doi: 10:1186/cc12872.
* Nakahara S, et al. *Acad Emerg Med.* 2012;19:782-792.
* Koscik C, et al. *Resuscitation.* 2013;84:915-920.

Summary of Epinephrine Data

- Controversy persists surrounding the optimal use of epinephrine for cardiac arrest
- Improved neurologically intact survival has <u>not</u> been demonstrated for VF/pVT but was recently reported for non-shockable rhythms
- For shockable rhythms
  - Use no earlier than 2nd failed shock in standard dose
- For non-shockable rhythms
  - Consider early administration

The Opioid Epidemic




- 21.5 million Americans > age 12 have a substance abuse disorder – 1.9 million from prescription pain relievers.
- Drug overdose is now the leading cause of accidental death in the US.
  - 47,055 fatal OD in 2014: 18,893 from pain meds vs 10,574 from heroin
- Almost half a million adolescents use pain relievers and 168,000 were addicted to pain relievers in 2014.
- 48,000 women died of prescription drug overdose between 1999-2010.

American Society of Addiction Medicine. 2016 Opiod Addiction Facts & Figures. www.asam.org/docs/default-source/advocacy/opiod-addition-disease-facts-figures.pdf

First Responders

Opioid Overdose Treatment

2015 (New): Empiric administration of IM or IN naloxone to all unresponsive victims of possible opioid-associated life-threatening emergency may be reasonable as an adjunct to standard first aid and non-HCP BLS protocols.

- Impact on in-hospital arrest
  - Algorithms
  - Medication availability

Resuscitation After Cardiac Surgery

The Society of Thoracic Surgeons

A New STS National Standard

NEWS BRIEFS

Statements Released on Clinical Practice Guidelines Development, Cardiac Arrest

New statements published in *The Annals of Thoracic Surgery* outline recommendations for developing clinical practice guidelines and handling cardiac arrest after cardiac surgery. "The American Association for Thoracic Surgery/Society of Thoracic Surgeons Position Statement on Developing Clinical Practice Documents," available at **www.sts.org/guidelines**, proposes a scientific framework for reliable and transparent synthesis of evidence-based recommendations in cardiothoracic surgery.

"The Society of Thoracic Surgeons Expert Consensus for the Resuscitation of Patients Who Arrest After Cardiac Surgery," available at **www.sts.org/expertconsensus**, describes a new protocol on cardiac arrest that takes into account issues particular to cardiac surgery, including timing of emergency resternotomy, number of attempts at defibrillation before resternotomy, and use of the intra-aortic balloon pump. ■

We Know That . . .

Standard CPR is *ineffective* in:

- CARDIAC TAMPONADE
- PROFOUND HYPOVOLEMIA / BLEEDING
  - TENSION PNEUMOTHORAX

Without effective CPR - IRREVERSIBLE BRAIN DAMAGE occurs *within 5 minutes*

Performing a RAPID (< 5 min)

EMERGENCY RESTERNOTOMY is essential to survival

Self-Assessment Question #4

The STS protocol for resuscitation after cardiac surgery now endorses which of the following practices:

1. Perform CPR for only 1 minute prior to defibrillation
2. Defibrillate first, prior to starting CPR, if available within 1 minute of witnessed arrest
3. Administer high dose epinephrine (10 mg) for cardiac arrest with a shockable rhythm
4. Administer atropine for asystole/profound bradycardia

Self-Assessment Question #4

The STS protocol for resuscitation after cardiac surgery now endorses which of the following practices:

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The STS/EACTS Resuscitation Protocol

- 2003: Two UK surgeons initiate project: *J Dunning, A Levine*
- 2004: First UK course in Manchester, England
- 2009: EACTS Guideline for Resuscitation After Cardiac Surgery

  Dunning J, Strang T, Levine A, et al. *Eur J Cardiothorac Surg* 2009;36:3-28
- 2009: First US course in San Francisco, California 

- 2010: International Liaison Committee on Resuscitation & European Resuscitation Council guidelines

  Nolan JP, et al. *Resuscitation* 2010;81:1219-1276
- 2015: STS Resuscitation Task Force initiated
- 2017: Publication of STS Expert Consensus Statement

  Dunning J, Levine A, Ley J, et al. *Ann Thorac Surg*, Feb 2017

STS/EACTS Protocol vs ACLS

STS /EACTS Protocol	ACLS
For VF/pVT	
Defibrillation takes priority; may defer CPR for up to 1 minute	CPR should be performed immediately on all patients
3 successive shocks before CPR	CPR → 1 shock → CPR

The Society of Thoracic Surgeons Expert Consensus for the Resuscitation of Patients Who Arrest After Cardiac Surgery

The Society of Thoracic Surgeons Task Force on Resuscitation After Cardiac Surgery*

Executive Summary

The Society of Thoracic Surgeons Task Force on Resuscitation After Cardiac Surgery provides this professional society perspective on resuscitation in patients who arrest after cardiac surgery. This document was created using a multimodal methodology for evidence generation and includes information from existing guidelines, from the International Liaison Committee on Resuscitation, from our own structured literature reviews on issues particular to cardiac surgery, and from an international survey on resuscitation hosted by CTSNet.

In gathering evidence for this consensus paper, searches were conducted using the MEDLINE keywords "cardiac surgery," "resuscitation," "guideline," "thoracic surgery," "cardiac arrest," and "cardiac massage." Weight was given to clinical studies in humans, although some case studies, mannequin simulations of potential protocols, and animal models were also considered.

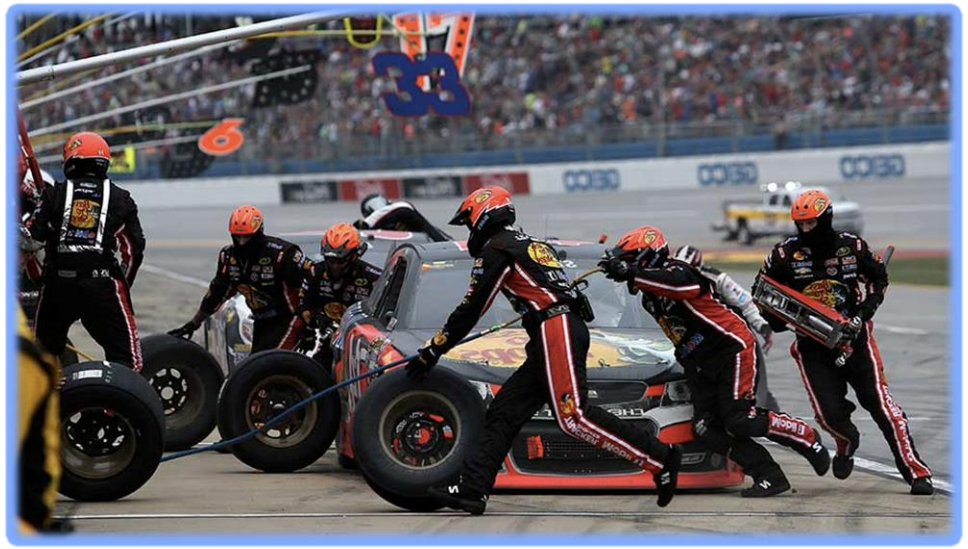
importance of early emergency resternotomy within 5 minutes. In addition, because internal massage is more effective than external massage, it should be used preferentially if other quickly reversible causes are not found.

We present a protocol for the cardiac arrest situation that includes the following recommendations: (1) successful treatment of a patient who arrests after cardiac surgery is a multidisciplinary activity with at least six key roles that should be allocated and rehearsed as a team on a regular basis; (2) patients who arrest with ventricular fibrillation should immediately receive three sequential attempts at defibrillation before external cardiac massage, and if this fails, emergency resternotomy should be performed; (3) patients with asystole or extreme bradycardia should undergo an attempt to pace if wires are available before external cardiac massage, then optionally external pacing followed by emergency resternotomy; and (4) pulseless electrical activity should receive prompt rest-

March 2017– *Ann Thorac Surg*

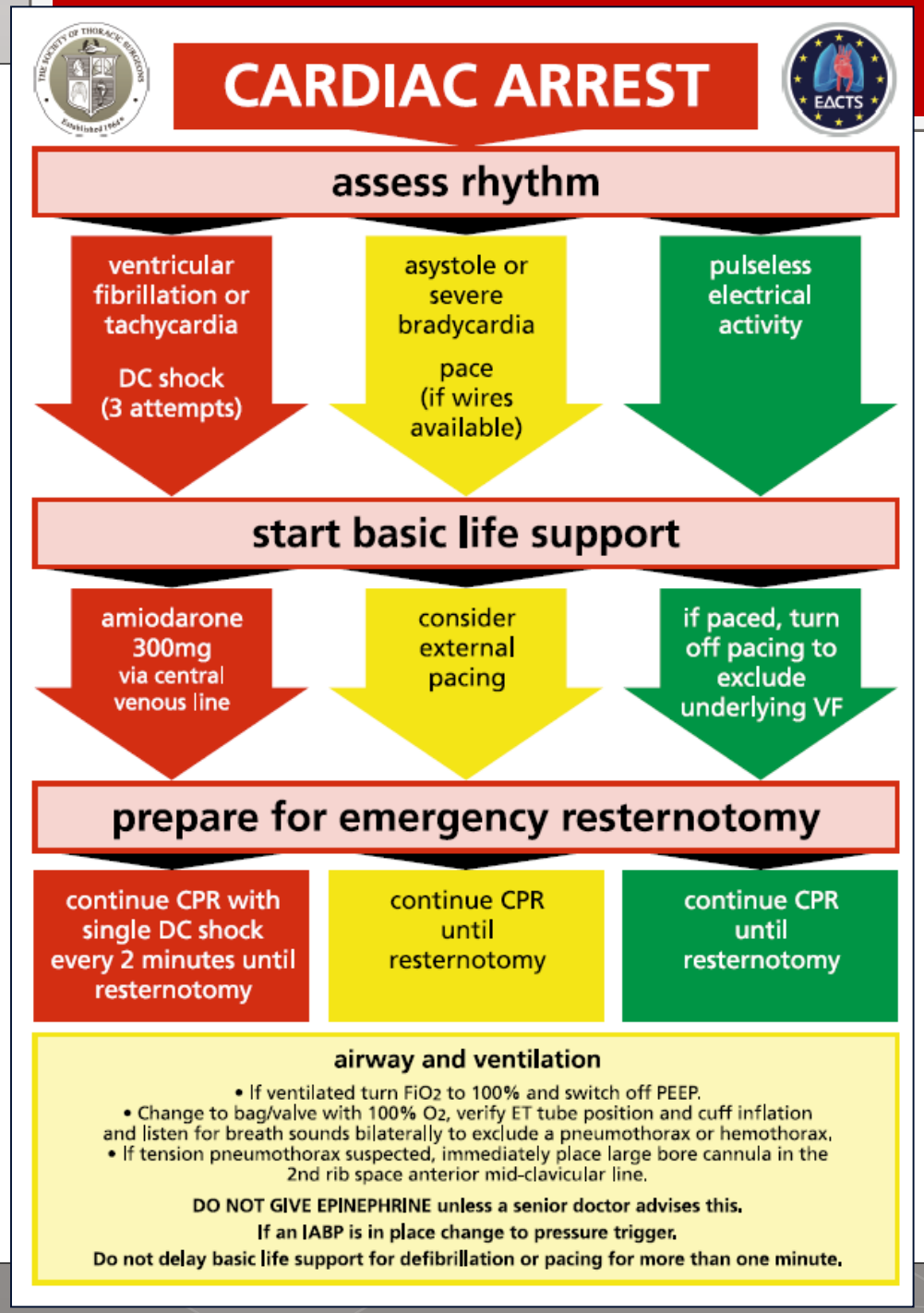
STS Protocol Implementation

- Designation of specific roles for team members
- Clearly defined expectations by role
- Protocol implemented <u>without waiting</u> for orders
- TEAM-work!



The STS/EACTS Resuscitation Protocol

For Postoperative Cardiac Surgical Arrest



Role Functions in Postop Arrest

 # 1: Defib or pace, then start CPR

 # 2: Airway, ↑O2 to 100%, no PEEP

 # 3: External defibrillator - switch to internal defib; pacemaker

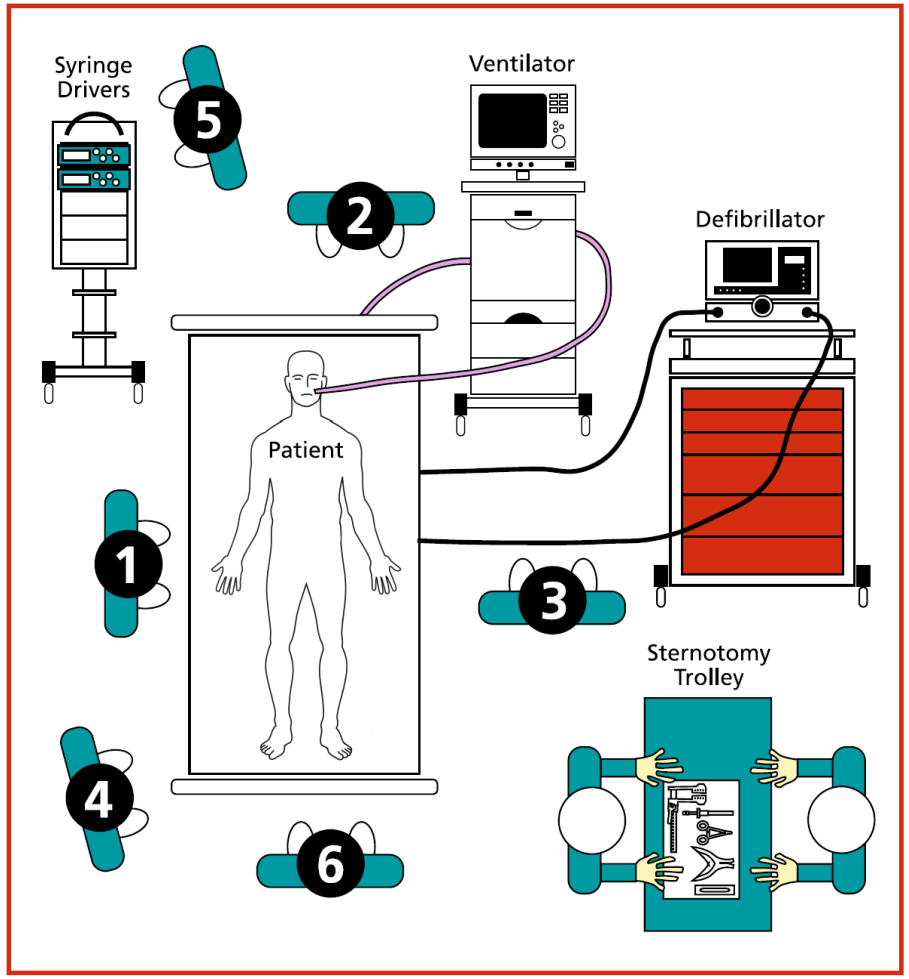
 # 4: Run code, in charge of *arrest*

 # 5: Amiodarone, stop other drips

 # 6: Run unit, delegate resources

#7 and #8: Prepare for re-entry

Figure 3. Six key roles in the cardiac arrest



Six key roles in the cardiac arrest:

1. External cardiac massage
2. Airway and breathing
3. Defibrillation
4. Team leader
5. Drugs and syringe drivers
6. ICU co-ordinator

B2362

Dunning J, Alessandro F, Phillippe HR, et al. *Eur J CTS* 2009;36:3-28

“Mini” Resternotomy Set

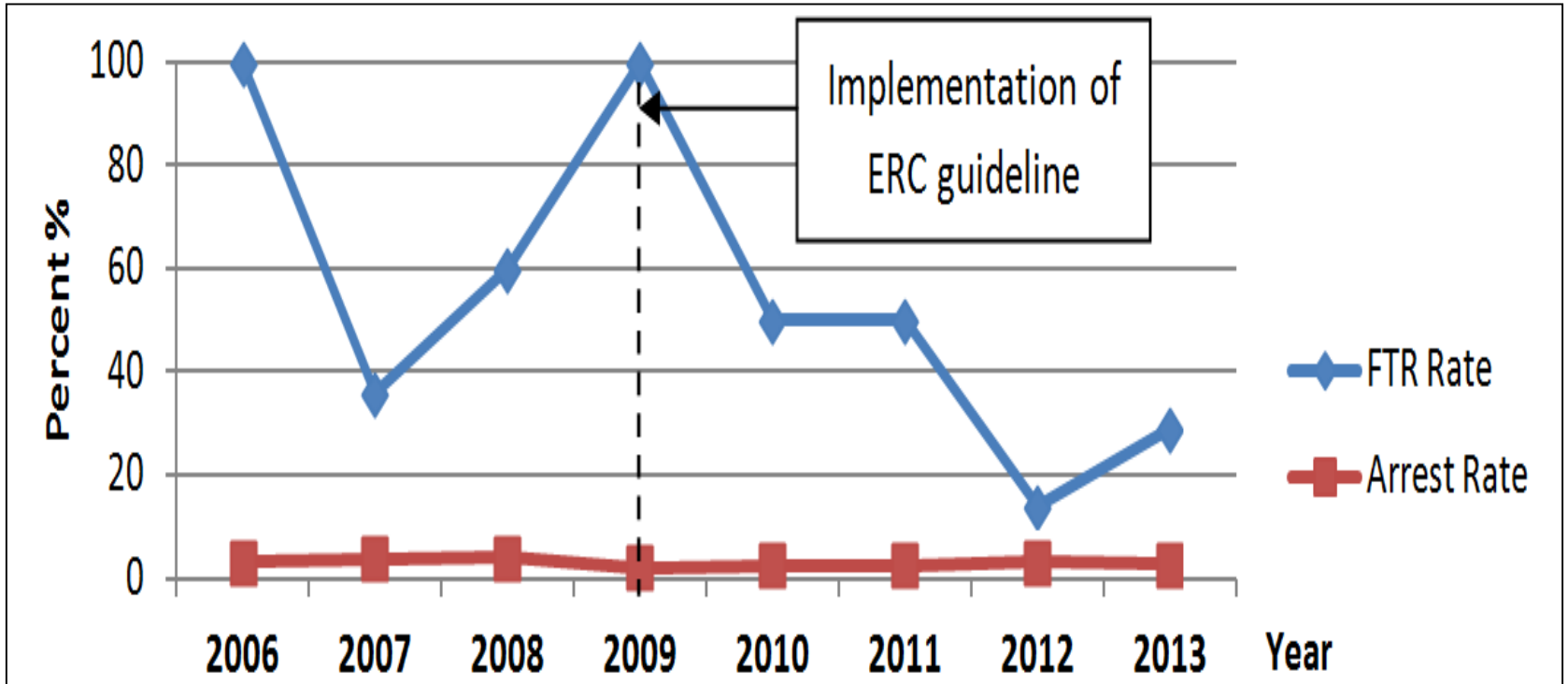
1. Scalpel
2. Wire cutter
3. Wire puller
4. Retractor
5. Suction tubing/yankauer
6. Optional: scissor, forceps

Class I Recommendation

Protocol for Reopening

1. "Sterile OR personnel"
   - Apply large sterile drape over entire bed
   - Receive "mini" instrument set onto sterile field
   - Stand back when surgeon ready with scalpel
2. Scalpel used along prior incision down to wired sternum
3. Remove wires; cut/pull (side w/knot)
4. Insert closed chest retractor *carefully*
   - Crank retractor until sternum open widely
   - Assess for bleeding; ready with suction
   - Internal massage $\geq$ 1 min
   - Internal defibrillator paddles 20j x 3

Impact on Failure To Rescue



	2006	2007	2008	2009	2010	2011	2012	2013
Arrest rate:	5/161	11/280	10/235	5/224	6/227	6/235	7/211	7/234
FTR rate:	5/5	4/11	6/10	5/5	3/6	3/6	1/7	2/7

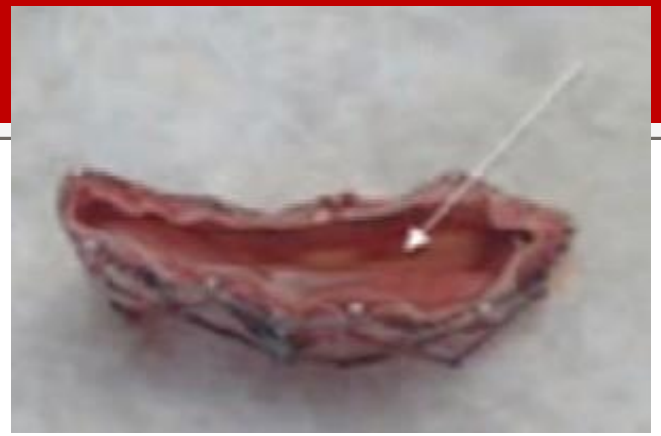
Benchmark 60%

Ley SJ, Gaudiani VG, Egrie GE, Shaw RE, Brewster J. Poster presented at STS 51st Annual Meeting, January 2015, San Diego, CA

Potential Cath Lab Emergencies

- **Procedure related**
  - Vessel dissection
  - Pneumothorax
  - Tamponade
- **Rhythm related**
  - **Brady arrhythmias/tachyarrhythmias**
- **Hypotension/ST changes**
    - Preload/volume e.g. femoral blood loss
    - Pump – problem e.g. Ischemia, dissection, stunning
    - Afterload e.g. drug reaction or GTN
    - Tamponade e.g. cardiac and pneumothorax
    - Co –morbidities e.g. CVA, DM
- **Drug Related**
  - Sedation- airway compromise, respiratory depression
  - Anaphylaxis
  - Drug errors
  - Hypotension (i.e. secondary to NTG)

CPR after TAVR



Complete Crush of a Balloon-expandable Bioprosthesis After Prolonged Cardiopulmonary Resuscitation

Tobias Spangenberg, Christian Frerker, Ralf Bader and Ulrich Schäfer

To our knowledge, this is the first reported case of a deformed aortic valve prosthesis after cardiopulmonary resuscitation. Nevertheless, there have been reports on deformed pulmonary valves, coronary stents, or stentgrafts after chest compressions.[2–4] Thus, further investigations to increase the radial force or crush resistance of current and future TAVI devices are warranted, especially in view of endeavors to extend minimal invasive aortic valve replacement therapies to healthier patient populations.

Circ Cardiovasc Interv. 2013;6:e1-e2
doi: 10.1161/CIRCINTERVENTIONS.112.975904

Circulation
Cardiovascular Interventions

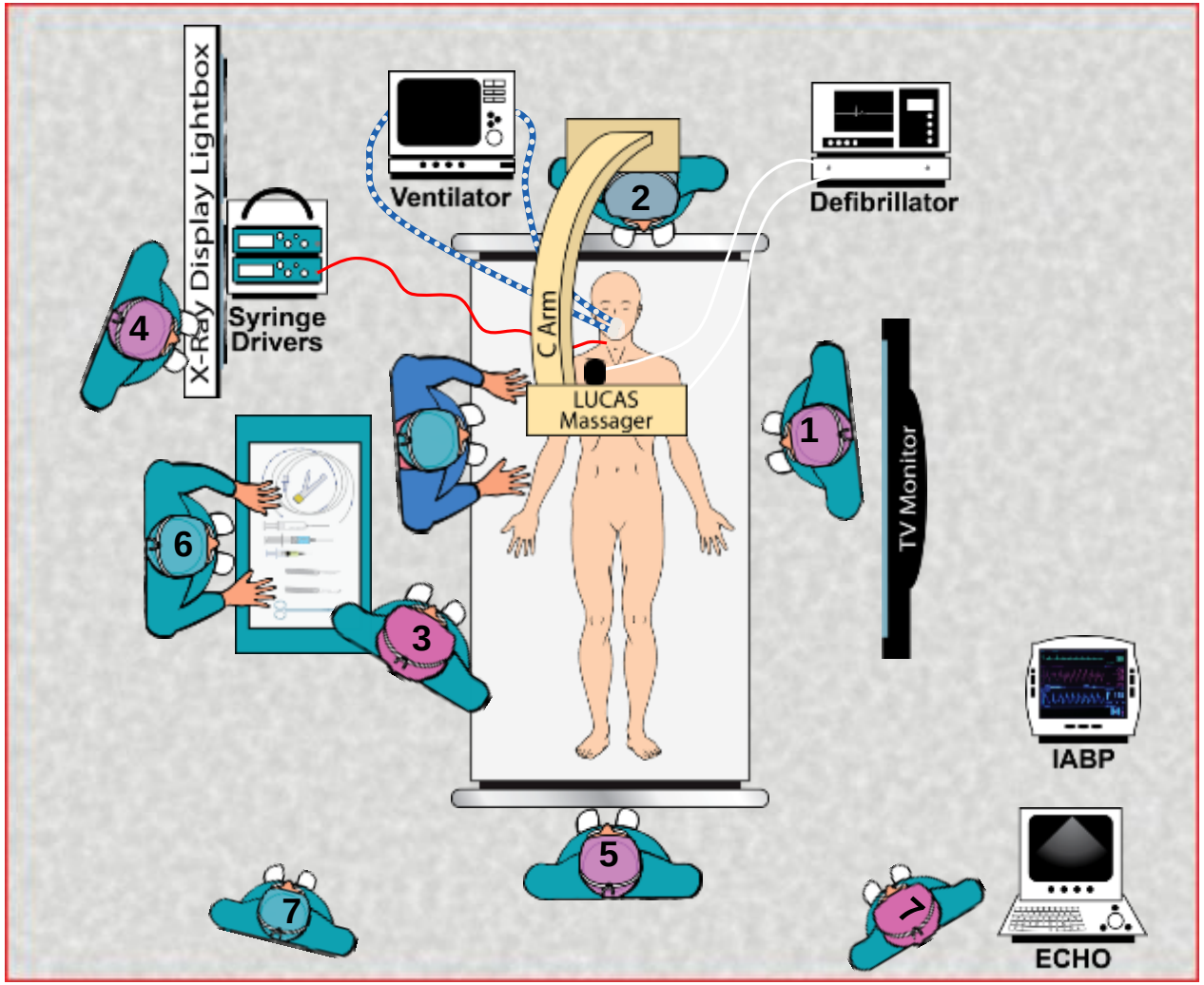
Cardiac Catheterization Lab: Response to Emergencies

Cath Lab Team – What is Your Immediate Response to These Complications?

Does the room/equipment configuration lend itself to emergency resuscitation?

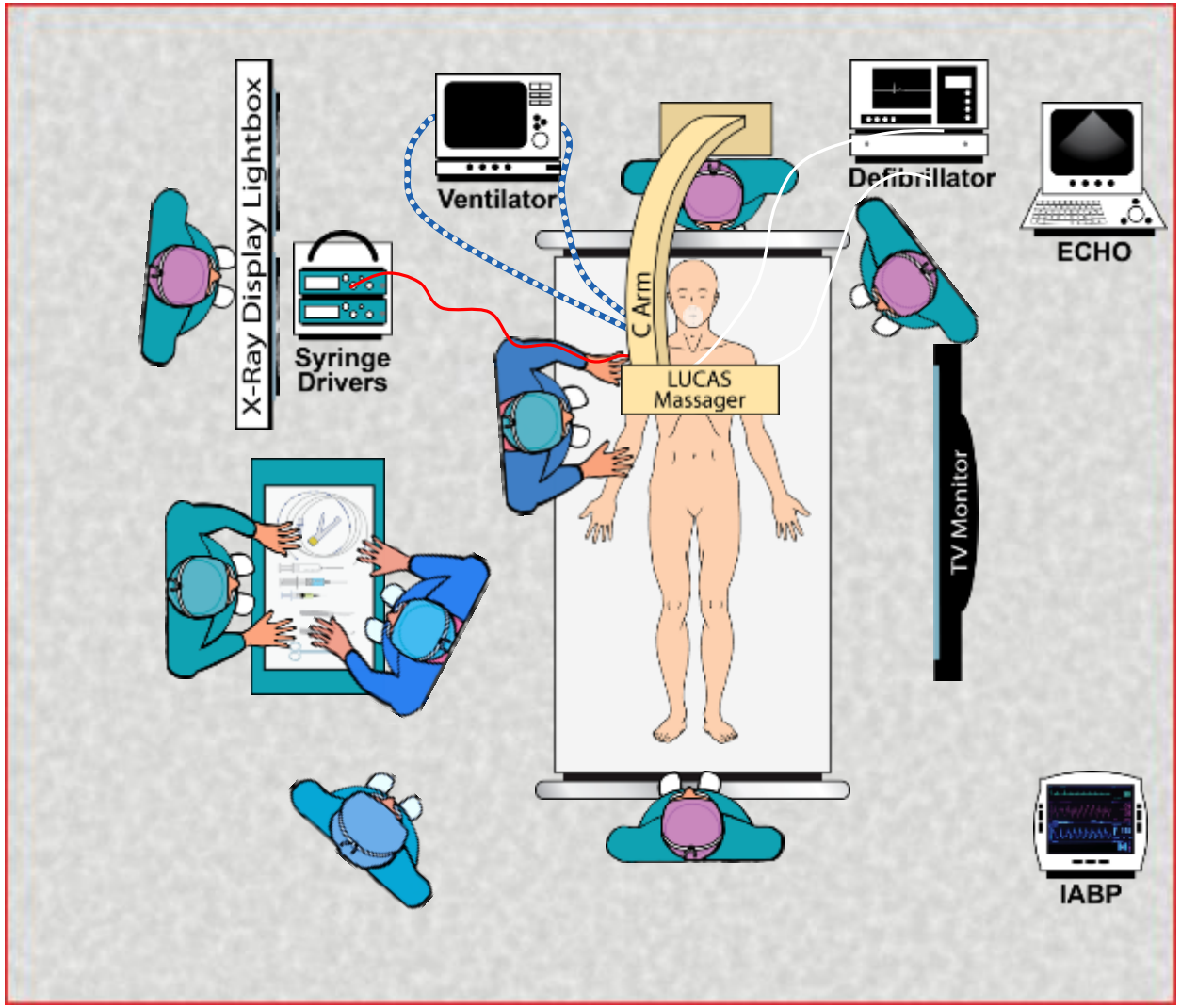
Does your team train for / rehearse these emergencies?

Personnel Positioning



1. Massage/Defib
2. Airway
3. Team Leader
4. Drugs
5. Resource Manager
6. Scrub Nurse
7. Runners

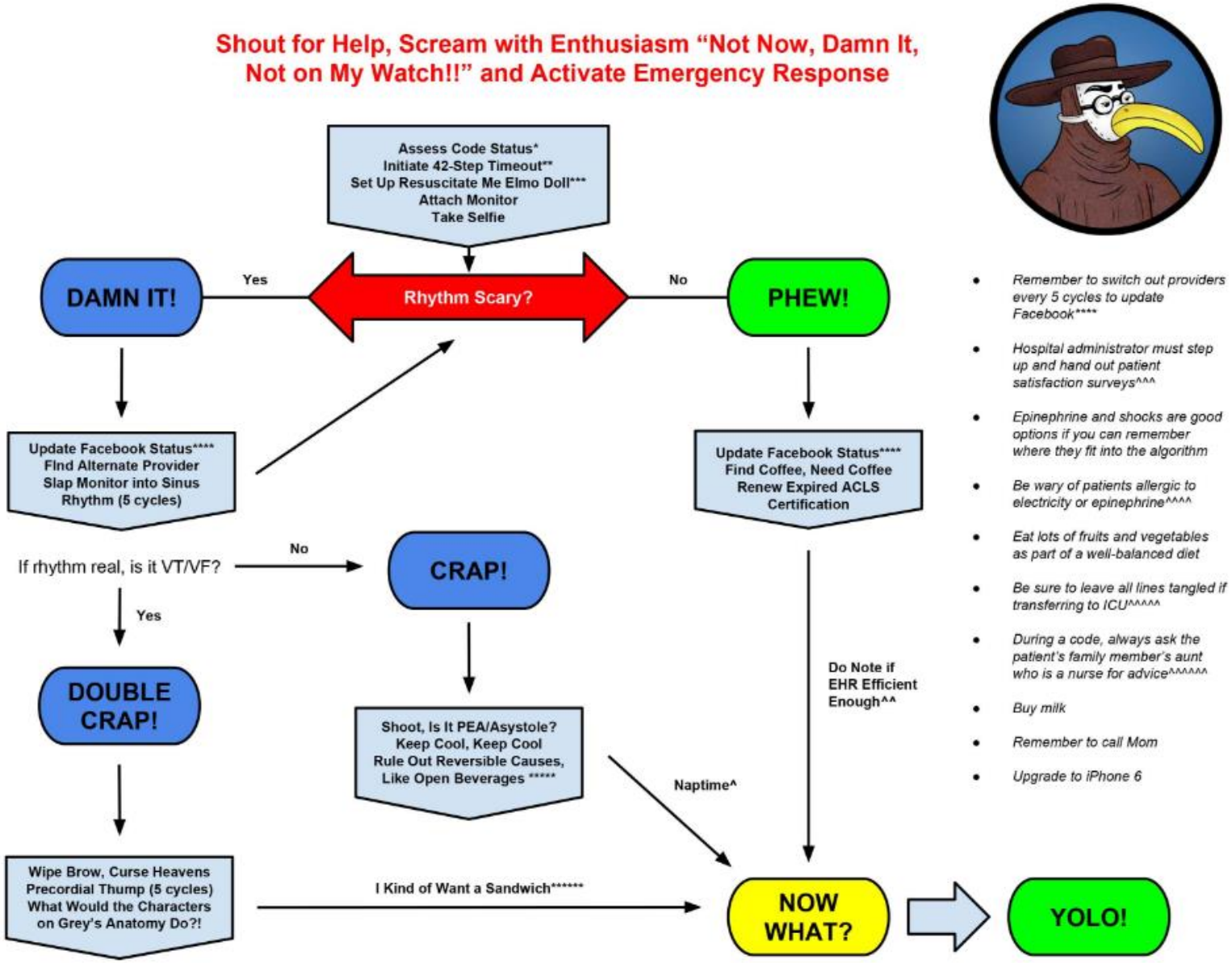
Personnel Positioning



Summary

- **Shockable** rhythms
  - Early defibrillation saves lives - shock without delay
  - Consider stacked shocks for witnessed IHCA
  - Amiodarone is the *only* recommended antiarrhythmic
  - Epinephrine has no survival benefit
- **Nonshockable** rhythms
  - Epinephrine may be of benefit, if given early
- New protocol recommended **post-cardiac surgery**
- **Simplify** arrest management to what works:
  - High quality CPR saves lives
  - Capnography is our best monitor for ETT placement and ongoing response

"Universal" ACLS Algorithm



- *Remember to switch out providers every 5 cycles to update Facebook****
- *Hospital administrator must step up and hand out patient satisfaction surveys^^^*
- *Epinephrine and shocks are good options if you can remember where they fit into the algorithm*
- *Be wary of patients allergic to electricity or epinephrine^^^^*
- *Eat lots of fruits and vegetables as part of a well-balanced diet*
- *Be sure to leave all lines tangled if transferring to ICU^^^^^*
- *During a code, always ask the patient's family member's aunt who is a nurse for advice^^^^^^*
- *Buy milk*
- *Remember to call Mom*
- *Upgrade to iPhone 6*

http://gomerblog.com/wp-content/uploads/2014/11/Updated-2015-ACLS-Algorithm.jpg