Major clinical syndrome of CAD
60% of deaths from CAD
1,000 deaths/day
(250,000/yr in US)
Sudden death definition:
Death within 1 hr of symptom onset (VF)
⅔ of cardiac-related deaths unexpected
47% die prior to getting to a hospital

Dysrhythmias or conditions associated with cardiac arrest

Upon completion the participant will
identify priorities of care for pts in cardiac arrest.
describe components of quality CPR.
sequence management of cardiac arrest using a "pit crew" approach.
discuss science supporting cardiac arrest mgt
explain critical elements of post-resuscitation care.
Guidelines for care
Recommendations continue to evolve based on research
AHA guidelines - October 2010
Protocols should be based on evidence, not tradition or local bias

“A perfectly run code is a thing of beauty; but this “creature,” although sometimes seen in captivity (on the carpets or tables in training centers), is unfortunately seldom seen in the wild. This is not good……”

“…when the patient dies it is simply too easy to attribute failure to the disease, to elevated adrenaline levels of rescuers, or the fact that personnel experience only a few codes a year.”
“Such rationalizations may protect us emotionally, but they foster clinical nihilism that in turn justifies a failure to improve performance.”

“…Failure to resuscitate a patient from a witnessed out-of-hospital cardiac arrest should not be accepted as an inevitable consequence of either the disease process or the complexity of the organized chaos we call resuscitation….”

“So, what should be done if a patient is found unconscious and not breathing?”
Unless contraindicated, CPR should be started when pt is unresponsive and pulse cannot be palpated. If DNR status unclear, start resuscitation. D/C later if valid DNR is obtained.

No CPR: Profound dependent lividity
Blue-purple coloring d/t blood pooling in dependent areas
Seen 30 min - 2 h after death; max 6-12 h
Body part in contact w/ firm surface shows impression as indentation surrounded by lividity (livor mortis).

No CPR: Rigor mortis
Stiffening after death - loss of ATP from muscles
Face & neck affected first (jaw)
Begins ~2 h after death; 8-12 h completely stiff; lasts up to 18 h
Reverses & body returns to flaccid - gone after 36-48 hrs.

Why change?
Highest survival for VF/PVT – critical elements are chest compressions & early defibrillation
In ABC sequence, compressions delayed to do A & B
< 50% of cardiac arrest victims get bystander CPR – find rescue breaths problematic?
Cardiac arrest management
Connie J. Mattera, NWC EMSS

Links are interdependent – System of Care
Immediate recognition of SCA & activation of emergency response system
Early, high quality BLS with emphasis on chest compressions
Rapid defibrillation

Effective ALS
Integrated post-cardiac arrest care

Code team roles
Depends on # of rescuers – focus on building team as additional persons arrive or delegate roles if multiple rescuers present.

Team leader

Code team roles
If a two-person response – one starts CPR and the other calls for help immediately from predetermined resources.
If a Private, this may mean the local 9-1-1 EMS service.

Major emphasis
All care organized around 2 minute cycles of CPR – many tasks can be performed concurrently rather than sequentially by integrated team.
Cardiac arrest management
Connie J. Mattera, NWC EMSS

Look – Listen – Feel **DELETED**
Inconsistent & time consuming
Tap victim on shoulder & shout, “Are you all right?”
simultaneously with checking for absent or abnormal breathing
(only gasps)
Treat pt with gasps as if they are apneic

After years of debate regarding drugs, devices, and defib waveforms, what’s most important?
If CPR is done poorly, it doesn’t matter what ALS interventions are used

**Science says...**
Good ALS does NOT make up for poor BLS

De-emphasize pulse check
Can be unreliable & difficult to detect when BP low or absent
Take <10 sec
If not definitely felt within that time, start compressions after placing pt on a firm surface if possible

What does CPR actually do?
Blood flow depends on chest compressions
Quality CPR may
- prevent VF from deteriorating to asystole;
- ↑ chance of successful defibrillation;
- improve survival by providing circulation to heart and brain

What is **QUALITY CPR?**
Push HARD
Push FAST
RELEASE completely
Minimize interruptions
(last compression to shock delivery)
Rotate compressor every 2 min
Continuous compressions once advanced airway placed

Unless monitor is equipped with CPR feedback software, cannot determine adequacy of compressions by looking at ECG...
What’s the best noninvasive measure of CPR quality and CO during compressions? Palpating a carotid/femoral pulse. EtCO₂ values (capnography). If <10 X 20 min unlikely to survive.

So what to do w/ ventilations?

*Practice is changing!*

No ventilation at all for several min
Passive oxygenation (OPA & NRM)
Continuous compressions w/o pausing for ventilations w/ BLS airways.

Science says...

Why can pts in cardiac arrest do OK without ventilations in early stages?

JAMA, 299:10:1188.

Airway & Ventilations

At this time, there is insufficient evidence to support the removal of ventilations from CPR provided by EMS professionals (AHA)

Open airway w/ manual maneuver
Head is heavy and will not easily stay where placed.

What does AHA recommend in an adult?

Before advanced airway:
2 breaths during brief (3-4 s) pause after 30 compressions.
Cardiac arrest management
Connie J. Mattera, NWC EMSS

Why 30:2?

<table>
<thead>
<tr>
<th>Hemodynamic Parameter</th>
<th>15:2</th>
<th>15:2+tidal</th>
<th>30:2</th>
<th>30:2+tidal</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP mmHg</td>
<td>55±3.5</td>
<td>68±6.5</td>
<td>54.6±5.5</td>
<td>62±4.5</td>
</tr>
<tr>
<td>DBP mmHg</td>
<td>19.6±4.2</td>
<td>21±2.4</td>
<td>24.4±1.3</td>
<td>29.7±1.6</td>
</tr>
<tr>
<td>Cerebral Blood Flow (mL/min)</td>
<td>14.7±4.2</td>
<td>62.8±4.9</td>
<td>51.7±4.5</td>
<td>111.7±4.7</td>
</tr>
<tr>
<td>Compressions/min</td>
<td>66.3±2.4</td>
<td>65.3±2.1</td>
<td>83.9±1.6</td>
<td>85±1.7</td>
</tr>
<tr>
<td>No compression time (seconds)</td>
<td>20.3±1.44</td>
<td>20.1±1.7</td>
<td>9.6±0.85</td>
<td>9.2±0.7</td>
</tr>
</tbody>
</table>

Why is gastric distension a problem?
Elevates diaphragm
Cannot ventilate
Predisposes patient to vomiting and aspiration

Initial BLS airway
No advanced airway to start
Size & insert OPA &/or NPA for effective BVM ventilations

Initial ventilation challenges
Failure to use BLS airways will require ↑ pressure on BVM to create adequate tidal volume
Excessive pressure causes gastric distension

BVM technique
2 persons preferred
Lift jaw into mask; hold mask against face w/ tight seal
Ventilation depth & rate important!
Chest compressor squeezes bag over 1 sec

Why is gastric distension a problem?
Elevates diaphragm
Cannot ventilate
Predisposes patient to vomiting and aspiration

What can be added to mask that improves effectiveness of chest compressions?
Cardiac arrest management  
Connie J. Mattera, NWC EMSS

**Initial ventilations**

Just see chest rise:  
6-7 mL/kg,  
~400-600 mL  
O₂, 15 L when available

**Goal: Deliver O₂, but don’t overdo it!**

**Remember:**  
95% O₂ is 5 X more than RA (21%)  
O₂ consumption is decreased during cardiac arrest

**Hyperventilation-Induced Hypotension During Cardiopulmonary Resuscitation**

**Background:** A clinical observational study revealed that patients consistently hyperventilated during out-of-hospital cardiopulmonary resuscitation (CHPR). The objective of this study was to quantify the degree of excessive ventilation in humans and determine if comparable excessive ventilation rates during CPR in animals significantly decreased coronary perfusion pressure and survival.

**Methods and Results:** In-hospital, ventilation rate and duration during CPR was electronically recorded by professional rescuers. In 10 survivors, adults (average age, 62±5; range, 47-73 years) undergoing CHPR (15 mm Hg, 95% O₂, ventilation rate 22-30 breaths per minute, ventilation volume 500 mL, range, 260-600 mL) and 10 non-survivors, adults (average age, 62±5; range, 40-78 years) undergoing CHPR (15 mm Hg, 95% O₂, ventilation rate 22-30 breaths per minute, ventilation volume 500 mL, range, 260-600 mL) and 10 non-survivors, adults (average age, 62±5; range, 40-78 years).

**Conclusion:** In-hospital, ventilation rate and duration significantly decreased coronary perfusion pressures and survival rates.

**But, Hyperventilation kills!**

Avoid ventilating too fast or too deeply  
Every breath ↓ cardiac output

**Science says… hyperventilation kills!**

port is that positive pressure ventilations during cardiac arrest may be harmful because they increase intrathoracic pressure, thereby decreasing venous return and subsequent myocardial and cerebral blood flow. **Probably due to the excitement and stress of resuscitation efforts, excessive ventilations by both physicians and EMS personnel are common.**

**Be prepared**

Patients in arrest are often a fountain of vomit  
Airway may need frequent suctioning
When should the 1st shock be provided?

Continue compressions while applying electrodes

Time critical

Goal:
Interval from collapse to 1st shock < 3 min in 90% of arrests

Continue compressions while applying electrodes

Make sure pads are flat and firmly on skin without folds or gaps

Anterior-posterior
Anterior-left infrascapular
Anterior-right infrascapular
All OK

Pad placement adjustments
Pts w/ implanted ICDs, pacemakers, or VADs
Place electrodes 1" from device

Prep skin
Pad placement:
Anterior - R of sternum, under clavicle
Lateral - L of nipple in axilla

Cardiac arrest management
Connie J. Mattera, NWC EMSS
How & when should rhythm be assessed?

Pause compressions no more than 5 sec to rotate compressor and \( \checkmark \) ECG.

If shockable rhythm...
Stop using, “I’m clear, you’re clear, we’re all clear.”
Continue CPR while defibrillator is charging
Compressor announce CLEAR (end w/compression)
Shock immediately

When should the pulse be checked?
If organized rhythm on the monitor
No pulse – resume CPR
Yes pulse – Check BP

When should ECG be \( \checkmark \) again?
After 2 minutes of CPR when compressors are rotated.

Science says...
Keep time between last compression & shock delivery to absolute minimum.

A second contributor to suboptimal survival of adults with out-of-hospital cardiac arrest is that defibrillation is typically provided after 5 or more minutes of VF cardiac arrest, the “circulatory” phase of VF arrest, when preshock and/or postshock myocardial perfusion are necessary for maintaining remissions of spontaneous circulation. Prolonged VF (the circulatory phase) is different from short-duration VF in regard to myocardial bioenergetics, cellular electrophysiology, whole-organ myocardial electrophysiology, and response to therapy. Furthermore, a recent clinical investigation demonstrated that even 10- to 20-second pauses in preshock compressions decrease defibrillation success. Long pauses also increase the risk of pro-arrhythmia, especially if the rhythm is less likely. Experimental and clinical studies indicate that preshock chest compressions for prolonged VF can improve the rate of successful resuscitation.
Caveats for VF
VF means heart is getting some blood
Without coronary perfusion → asystole
Resuscitate aggressively
If prolonged VF, alter placement of pads, seek order to ↑ defib energy level

Should intubation or IV access be attempted before the first shock?

Why?
They will delay definitive treatment, which is CPR & defibrillation

Advanced airway
Attempt to place w/o stopping compressions
Consider deferring until patient fails to respond to initial CPR & defib or has ROSC (Class IIb)
Optimize 1st attempt with suction, position, styletted tube, laryngeal pressure, lip retraction

ETI
If unsuccessful, resume compressions, re-oxygenate
Stop compressions < 10 sec - only if needed to visualize cords and insert tube
Resume compressions immediately

Problem!
ETI frequently associated with frequent / prolonged interruption of compressions

Better choice?

Science says…
Double improvement in long-term survival when rescue airway used first (Fales)
Possible explanations:
Alternate airway placed quickly while CPR continues
Once inserted, continuous compressions without pauses for ventilations are delivered
Cardiac arrest management
Connie J. Mattera, NWC EMSS

Ventilations after advanced airway
Do NOT pause compressions to ventilate
Do NOT attempt to synchronize compressions & ventilations

8-10/min
Breath q. 6 sec

Pulse ox?
NOT reliable in cardiac arrest
Blood flow inadequate in peripheral tissues
Assess oxygenation old fashioned way:
color (lips, mucous membranes, tongue)

Don’t use while pulseless

After moving an intubated patient in cardiac arrest from bed to floor the capnography alarm sounds
This waveform is seen:

What just happened?

Obtain ASAP w/o interference w/ quality compressions
Do NOT use warm IVF
What if peripheral veins collapsed?

Vascular access

Drug administration
ECC guidelines decrease emphasis on drugs - few supported by strong evidence
Priorities
- Good CPR
- Rapid defib
- Airway mgmt
- Then, vascular access and meds
Drug administration caveats
Given in their own time cycles separate from CPR/defib cycles
Drug Tsar should have drawn up & ready to go
Do NOT pause compressions to give drugs

Properly performed CPR achieves a cardiac output that is approximately ___% of normal.
  33% for the first 10 minutes
  1% after 10 minutes

What can be done to improve this?

Vasopressors
1st med for all arrests
Prepare before ECG is known

Vasopressin &/or epinephrine

Vasopressin dose
40 units IVP/IO (usually 2 vials)
One time only
Half life = 10-20 min
May be used to replace 1st or 2nd dose of epinephrine

Epinephrine cardiac arrest doses
Adults: 1:10,000 1 mg IVP/IO q. 3-5 min
Peds: IV/IO: 1:10,000 0.01 mg/kg

How can you document drug administration times accurately?
Or use event marker on ECG monitor
Antidysrhythmics

Amiodarone or Lidocaine (not the preferred drug)

Amiodarone dose VF

Adult: 300 mg IVP/IO
Do not dilute
Rapid IVP/IO for VF

Should amiodarone be given ASAP after vasopressor or wait 3-5 min to see the effects of vasopressin or epi?

DON'T wait
Vasopressors & amiodarone are given for different reasons
Vasopressors improve CPR effectiveness
Amiodarone treats the dysrhythmia

At what dose may amiodarone be repeated for a patient in persistent VF?
A. 50 mg
B. 100 mg
C. 150 mg
D. 300 mg

Persistent/Refractory VF

Apply new set defib pads in alternate position
Minimize compression interruption placing posterior pad
Defib using new pads in alternate position

Persistent/Refractory VF

If Philips consider ↑ defib energy to 200 J
NA – ZOLL biphasic: max = 200 J
NA – Physio LP12/15: max = 360 J
Persistent/Refractory VF
If 2nd defibrillator is available…

The patient remains pulseless and nonbreathing…

Consider Hs & Ts
Hypovolemia (Most common treatable cause): IVF challenges
Hypoxia: airway; O₂ delivery; gas exchange
Hypothermia: Core rewarming w/resuscitation
Hypo/hyperkalemia (? renal failure/dialysis) – bicarb & albuterol
Hydrogen ion (acidosis): (? DKA, renal failure/dialysis, ASA OD) – consider need for bicarb

Asystole
Same priorities as VF except no defibrillation

Why is atropine out?

Thrombosis (coronary): 12 L ECG ASAP after ROSC
Thrombosis (pulmonary): IVF challenges
Tamponade: IVF challenges
Toxins: glucagon (beta blocker); bicarb (TCAs)
Tension pneumothorax: lung sounds; pleural decompress

Cardiac arrest management
Connie J. Mattera, NWC EMSS
How likely is it that someone will survive a cardiac arrest?

VF: 2%-50% depending on the study
If VF converts to a rhythm w/ a pulse > 100, survival is > 40%

Factors associated w/ survival
- Time to defibrillation
- Effectiveness of CPR
- Skill & knowledge of code commander
- Timeliness of medication administration

Return of spontaneous circulation

What's your first clue that the patient has experienced ROSC?

Capnography readings often suddenly rise ~30 seconds prior to pulse detection

ROSC Objectives

Control body temp to optimize survival & neurological recovery
Identify and treat ACS
Optimize mechanical ventilation to minimize lung injury
Reduce risk of multorgan injury and support organ function

ROSC: Post-resuscitation Care

Ensure adequate airway & support breathing
Elevate head 30° if tolerated to ↓ ICP, aspiration & pneumonia
Monitor closely capnography, pulse ox, VS
Titrate O2 to maintain SpO2 94% w/o oxygen toxicity

Post ROSC Care

Do NOT hyperventilate even if ↑ ETCO2
Support BP/MAP maintain heart & brain perfusion
Acquire 12L
Initiate TH
Patients have to overcome “opening pressure” of ResQPod’s resistance system (~ -10 cm H₂O) before air can enter device. Remove as soon as CPR stopped.

**Pathophysiology**
- Stunned myocardium
- Epinephrine wears off
- Coronary perfusion pressure decreases
- If tx does not affect overall mortality rate

**EMS implication**
- Monitor VERY CLOSELY first 10 min
- Keep finger on pulse (assign someone to detect weakening/loss of pulse)
- Have dopamine ready – before need it

**Re-Arrest**

**Incidence:**
- Occurs in 38%

**Time to re-arrest:**
- Ave 2.6 min

**Most common type:**
- PEA

Thus, watching ECG will not detect. Need to be palpating pulse.

---

**Post ROSC Care**

BP support HIGHER priority than TH
- If hypotensive, begin DOPAMINE – FIRST
- After dopamine started, then start line for IVF

**Q:** How do I give dopamine via IO line?
- Turn OFF main IV on pressure bag using roller clamp
- Connect dopamine to proximal IV port
- Regulate dopamine w/ roller clamp
- Due to lower rate of infusion (mcgtt/s) dopamine should flow w/o pressure bag
- Won’t flow at mcgtt rate needed for dopamine?
  - Flush IO with 20 mL NS or
  - Begin peripheral IV line for dopamine

---

**Note to self...**

Patients have to overcome “opening pressure” of ResQPod’s resistance system (~ -10 cm H₂O) before air can enter device. Remove as soon as CPR stopped.
Therapeutic Hypothermia (TH)

Indications: Cardiac Arrest w/ ROSC

Therapeutic Hypothermia (TH)

Consider therapeutic hypothermia (32°C-34°C) for any pt unable to follow verbal commands after ROSC.

Therapeutic Hypothermia (TH)

- Awake/follows commands
- Bleeding (known bleeding or bleeding disorder)
- Pregnancy – known/suspected
- Surgery (major head, chest, abd) within 14 days
- Temperature less than 34°C / 93.2°F
- Traumatic arrest
- Caution: Pediatric – contact OLMC prior

Therapeutic Hypothermia (TH)

Equipment needed

- Maintain minimum of 2 liters cold NS
- In minimum of one cooler set @ 4°C / 39°F

Therapeutic Hypothermia (TH)

Practice (re)evolution:
Field Rx vs. rapid transport

Why should EMS not move most pts during CPR?

Quality compressions critical to good outcomes
Studies demonstrate quality compressions are NOT performed when pt is being moved
Do NOT transport w/ CPR in progress unless pt needs Tx NOT available on scene (trauma) or scene unsafe
What would happen to the person doing CPR in the back?

Don’t practice until you get it right, practice until you can’t get it wrong.

If monitored asystole persists
Consider quality of resuscitation
Are any atypical clinical features present?
After 30 minutes of resuscitation, seek an order to cease resuscitation

Practice - Practice - Practice
Requires excellent preparation and careful attention to procedure sequencing and performance to skillfully manage a cardiac arrest

AHA Guidelines
“Stated succinctly, if ACLS care in the field cannot resuscitate the victim, ED care will not resuscitate the victim... Cessation of efforts in the out of hospital setting, following system-specific criteria and under direct medical control, should be standard practice in all EMS systems.”
Time passes.  
Life happens.  
Distance separates.  
Children grow up.  
Love waxes and wanes.  
Hearts break.  
Loved ones die.  
Colleagues forget favors.  
Careers end.

But…  
Special people are there no matter how much time and how many miles are between you.  
When you have to walk a lonesome valley, they will be on the valley’s rim, cheering you on, praying for you, pulling for you, waiting with open arms at the valley’s end.

Sometimes, they will walk beside you, or come in and carry you out.

‘Friends are quiet angels who lift us to our feet when our wings have trouble remembering how to fly.’

We are strong, because we’re on your shoulders…