Medical emergencies CAN and DO happen in the practice of dentistry.
### WHEN do they occur?

<table>
<thead>
<tr>
<th>Treatment Stage</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediately before Tx</td>
<td>1.5%</td>
</tr>
<tr>
<td>During or after local</td>
<td>54.9%</td>
</tr>
<tr>
<td>During treatment</td>
<td>22%</td>
</tr>
<tr>
<td>After treatment</td>
<td>15.2%</td>
</tr>
<tr>
<td>After leaves office</td>
<td>5.5%</td>
</tr>
</tbody>
</table>

### Treatment being performed

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth extraction</td>
<td>38.9%</td>
</tr>
<tr>
<td>Pulp extirpation</td>
<td>26.9%</td>
</tr>
<tr>
<td>Unknown</td>
<td>12.3%</td>
</tr>
<tr>
<td>Other treatment</td>
<td>9.0%</td>
</tr>
<tr>
<td>Preparation</td>
<td>7.3%</td>
</tr>
<tr>
<td>Filling</td>
<td>2.3%</td>
</tr>
<tr>
<td>Incision</td>
<td>1.7%</td>
</tr>
</tbody>
</table>
Inadequate PAIN CONTROL

Stress - Related Emergencies

<table>
<thead>
<tr>
<th>Emergency</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syncope (fainting)</td>
<td>15407</td>
</tr>
<tr>
<td>Mild allergy</td>
<td>2583</td>
</tr>
<tr>
<td>Angina pectoris</td>
<td>2552</td>
</tr>
<tr>
<td>Postural hypotension</td>
<td>2475</td>
</tr>
<tr>
<td>Seizures</td>
<td>1595</td>
</tr>
<tr>
<td>Acute asthma</td>
<td>1392</td>
</tr>
<tr>
<td>Hyperventilation</td>
<td>1326</td>
</tr>
<tr>
<td>Epinephrine reaction</td>
<td>913</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>890</td>
</tr>
</tbody>
</table>

75% of medical emergencies (in dental offices) are related to stress and anxiety

And sometimes “stuff” just happens
Legal (moral) Obligation of the Doctor to the “Victim”

“Try to keep the victim alive until they recover or until another - more qualified - individual assumes responsibility for treatment”
Preparation of the Office & Staff

1. Basic Life Support training
2. Preparation of Dental Office Staff Members
3. Emergency Assistance
4. Emergency Drugs & Equipment

BASIC LIFE SUPPORT
(CPR, Resuscitation, Reanimation)
is THE single-most important step in the management of ALL medical emergencies
The Office Emergency Response Team

Member #1
1st person on scene of emergency

- Stay with victim; yell for ‘HELP’
- Administer BLS, as needed

Member #2 on hearing call for HELP . . .

Obtains:
1. Emergency drug kit;
2. Portable O₂ cylinder; and
3. AED
. . . bringing them to site of emergency

Members #3, #4 and on . . .
Assigned ancillary tasks such as:

- Monitoring vital signs (BP, heart rate & rhythm)
- Assist with basic life support
- Activate EMS
- Hold elevator in lobby while awaiting arrival of EMS
- Prepare emergency drugs for administration.
- Keep written time line record during emergency
1. Basic Life Support training
2. Preparation of Dental Office Staff Members
3. **Emergency Assistance**
4. Emergency Drugs & Equipment

**Emergency Medical Services**

**When?**

When the DOCTOR or other PERSON IN CHARGE feels it is necessary

**Never hesitate** to seek help if you feel it is needed

**When?**

911 911 911
1. Basic Life Support training
2. Preparation of Dental Office Staff Members
3. Emergency Assistance
4. **Emergency Drugs & Equipment**

### Critical Drugs & Equipment

**THE BASIC EIGHT**
(as per Malamed)

1. Epinephrine
2. Histamine-blocker
3. Bronchodilator
4. Nitroglycerin
5. ‘Sugar’
6. Aspirin
7. Naloxone
8. Oxygen
Nitroglycerin
- Nitrolingual spray
- Nitrostat sublingual tablets
- 0.4 mg/dose
- **INDICATION:** Angina pectoris; Prehospital management of cardiac pain
- **CONTRAINDICATION:** Hypotension (Systolic BP <90 mmHg)

**Aspirin (ASA)**
- 325 mg
- Chewed / swallowed or Chewable or Powdered
- **INDICATION:** Suspected myocardial infarction
- **CONTRAINDICATION:** Allergy

**Oxygen**
- 'E' cylinder + delivery system
- **INDICATION:** Any medical emergency
- **CONTRAINDICATION:** None
1. Epinephrine
2. Histamine-blocker
3. Bronchodilator
4. Nitroglycerin
5. ‘Sugar’
6. Aspirin
7. Naloxone
8. Oxygen

Disposable face masks (pediatric & adult for ventilation with supplemental O₂)

Automated External Defibrillator (AED)
Equipment

Automated External Defibrillator (AED)

Why YOU want 2 AED's

Survival Rates from SCA

Survival - to hospital discharge - is dependent upon:
- Bystander initiated CPR
- Time from collapse to defibrillation

Sudden Cardiac Arrest

- 70% of out-of-hospital SCA occur in the HOME of the victim.
- As dentists we have TWO homes:
  - The one in which we live
  - The one in which we work

Chronobiology of Sudden Cardiac Arrest

Every day into 6 hour segments:
- 12:01 AM - 06:00 AM
- 06:01 - Noon
- 12:01 PM - 06:00 PM
- 06:01 PM - Midnight
EMERGENCY MANAGEMENT ALGORITHM

P - C - A - B - D

Algorithm for ALL emergency management

P = Position . . . . . . . Conscious = anything; Unconscious = supine

C = Circulation . . . . . Assess & chest compression if needed

A = Airway . . . . . . Assess & maintain airway (head tilt-chin lift) if needed

B = Breathing . . . . . Assess & ventilate if needed

D = Definitive Care . . . Diagnosis, Drugs, Defibrillation

Emergency Medicine
Recognition & Management

Cardiovascular Disorders

• Angina Pectoris
• Myocardial Infarction
• Cardiac Arrest
• Defibrillation

Chest ‘Pain’
The HEART is a PUMP

Right side of heart pumps blood into LUNGS

Left side of heart pumps blood to ALL CELLS of body

Coronary Arteries

Coronary Arteries

Diagram showing blood flow through arteries and veins.
Blood flows through coronary arteries only during **DIASTOLE**, not systole.

- Skeletal muscle extracts **25%** to **30%**
- Cardiac muscle extracts **60%** to **80%** of available **O₂** in blood;
- Coronary arteries dilate when myocardial workload increases.
Angina Pectoris

Angina pectoris, commonly known as angina, is the sensation of chest pain, pressure, or squeezing, often due to ischemia of the heart muscle from obstruction or spasm of the coronary arteries.

Anything increasing the workload of the heart can induce an anginal episode

The 4 E’s of angina
- Exertion
- Emotion
- Eating
- Extremely cold or hot weather
Transient Myocardial Ischemia = Angina Pectoris

Myocardium not receiving an adequate blood supply becomes ischemic, leading to the onset of anginal 'pain'.

Angina Pectoris

With rest or administration of nitroglycerin the myocardial workload decreases and the chest 'pain' dissipates.

Angina Pectoris . . . Management

P . . . Conscious = Comfortable (usually upright preferred)
C . . . Assess . . . prn
A . . . Assess . . . prn
B . . . Assess . . . prn
D . . . Nitroglycerin, O₂
D . . . Determine cause, modify future treatment

Nitroglycerin

Nitroglycerin produces a 28% increase in coronary artery lumenal diameter.
Angina pectoris and dentistry

The only time **ANGINA** should be considered as a diagnosis in acute chest "pain" is where the patient (victim) has a **PREEXISTING HISTORY** of **ANGINA**

Consider **Myocardial Infarction**:

**ALWAYS** when there is no prior history of cardiovascular disease

Consider Myocardial Infarction

In **anginal** patient when:

- ‘Pain’ worse than usual
- 3 doses of nitroglycerin fail to relieve discomfort
  - doses every 5 minutes
- Nitroglycerin relieves ‘pain’, but ‘pain’ returns.

Acute Myocardial Infarction
Infarction

Obstruction of the blood supply to an organ or region of tissue, typically by a thrombus or embolism, causing local death of the tissue.

Prolonged Myocardial Ischemia

RUPTURE of the PLAQUE into the lumen of the coronary artery abolishes blood flow to an area of myocardium.

Activity at time of infarction

<table>
<thead>
<tr>
<th>Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>At rest</td>
<td>51</td>
</tr>
<tr>
<td>Modest or usual exertion</td>
<td>18</td>
</tr>
<tr>
<td>Physical exertion</td>
<td>13</td>
</tr>
<tr>
<td>Sleep</td>
<td>8</td>
</tr>
<tr>
<td>During surgical procedure</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
</tr>
</tbody>
</table>

Acute Coronary Syndrome
First Time Chest ‘Pain’

911

P . . .  Conscious = Comfortable
C . . .  Assess . . . prn
A . . .  Assess . . . prn
B . . .  Assess . . . prn
D . . .  MONA - Nitroglycerin, O₂
D . . .  Activate EMS

Signs of a myocardial infarction (‘heart attack’)

Acute Myocardial Infarction

SILENT MI

• Women (up to 50% of MIs)
• Elderly
• Diabetics
• Do not present with classic signs & symptoms

Suspected MI . . . Management

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MONA

Acronym for the **PRE-HOSPITAL MANAGEMENT OF A SUSPECTED MYOCARDIAL INFARCTION**

Morphine
Oxygen
Nitroglycerin
Aspirin

Prehospital management of suspected MI

MONA

Morphine
Oxygen
Nitroglycerin
Aspirin

MONA = NONA

Morphine = N₂O-O₂
Oxygen
Nitroglycerin
Aspirin

Prehospital management of suspected MI

Nitrous oxide has been used effectively in cases of chest pain secondary to infarction and angina;
- kidney stones;
- acute urinary retention;
- severe burns;
- fractures, dislocations & other forms of musculoskeletal trauma;
- pediatrics;
- sedation & analgesia prior to IV cannulation;
- childbirth to treat labor pains.

**N₂O-O₂ in Emergency Medicine**

**Commonly used in Australia, Canada & France & United Kingdom (1970 Wales)**

Entonox (50% N₂O 50% O₂ premixed)

**USA - 30 states EMS employ N₂O-O₂**

Individual cylinders (per FDA), mixing valve delivers 50% each gas

---

**Administer O₂ or N₂O-O₂ (50% - 50%)**

Administer aspirin

---

**Nitrous Oxide - Oxygen**

50% - 50%

As analgesic as IV morphine (10 mg)
- Separates pain from suffering

**Sedative**
- Relaxes scared patient

50% O₂
- 2.5 times ambient air

---

**Aspirin in Myocardial Infarction**

325 mg. **POWDERED**, if available, with water

20 minute onset
Aspirin in Myocardial Infarction

- Prevents blood clot (thrombosis) from increasing in size
- Increases chance of primary balloon angioplasty being successful

Percutaneous coronary intervention (PCI)

Arrival of EMS 911

ECG monitoring

Transport to hospital ED
Acute Myocardial Infarction

Myocardium = DYSRHYTHMIAS

When cells are damaged, hypoxic or anoxic, they become hyperexcitable.

Normal Sinus Rhythm - NSR

AUTOMATICITY

Auto

maticity is the cardiac cell's ability to spontaneously generate an electrical impulse (depolarize). Cells that are dedicated to the purpose of generating an impulse to maintain a heart rate commensurate with the body's need are called pacemaker cells.

Myocardium

Right ventricle

Left ventricle

Myocardium
Normal Sinus Rhythm - NSR

- 'P' wave: Atria contract
- 'QRS' complex: Ventricles depolarize
- 'T' wave: Ventricles repolarize

Premature Ventricular Complexes

**Mono**morphic (**Uni**focal)

- ALL PVC's look alike

Premature Ventricular Complexes

**Mono**morphic (**Uni**focal)

- Area of ischemic myocardium

Premature Ventricular Complexes

**Poly**morphic (**Mult**ifocal)

- PVC's vary in size & shape
Premature Ventricular Complexes

Poly

morphic (Multifocal)

PVC's vary in size & shape

MORE CLINICALLY SIGNIFICANT!

Left Ventricular Ejection Fraction

LVEF

LVEF is the percentage of blood ejected from the left ventricle during systole

LVEF ranges from 0.55-0.70

55% to 70%

Premature Ventricular Contractions

PVC's

LVEF ranges from 0.55-0.70

Patient is CONSCIOUS

8 of 11 contractions (systoles) are normal, ejecting blood into the systemic circulation.

Output of blood is 73% of normal

Premature Ventricular Contractions

PVC's

Patient is CONSCIOUS

yet demonstrating S&S of decreased blood flow to periphery:

- Cyanotic mucous membranes
- Ashen gray skin color
- Diaphoresis
- Generalized feeling of fatigue
The doctor’s goal in a medical emergency situation

Try to **keep the victim alive until:**
(1) Recovery occurs or
(2) Help arrives to take over management

So, what exactly has been done prior to EMS arrival to **PREVENT** the occurrence of cardiac arrest?

**M**orphine (N₂O-O₂)  
**O**xygen  
**N**itroglycerin  
**A**spirin

So, what exactly has been done prior to EMS arrival to **PREVENT** the occurrence of cardiac arrest?

**NOTHING**
Ischemic myocardial still exists;  
Victim is symptomatic;  
Dysrhythmias still occurring;  
But the pump - though damaged - is still pumping

2015

70% of out-of-hospital cardiac arrests (OHCA) occur in the victims home
19.8% in public settings
10.6% in nursing homes
Most OOH-CA are related to acute dysrhythmias (VF/pulseless VT). Most occur during the 1st hour after symptom onset. 52% of MI mortality.

Deaths from MI:
- Pre-hospital: 24 hrs, in-hospital: 48 hrs, in-hospital: 30 days.

19% within 1st hour.
21% within 24 hrs, in-hospital: 48 hrs, in-hospital: 30 days.

Getting into the 'system' (9.1.1.) is THE most important thing that can be done for the victim of a 'suspected heart attack' (AMI).

The significant mortality rate associated with MI is in part based on the average delay (4.9 hours) between the onset of signs and symptoms and intervention by the emergency medical system.
CARDIAC ARREST occurs when the heart ceases to PUMP BLOOD

In CARDIAC ARREST the heart, usually, is still BEATING. It is no longer PUMPING.

There are 4 rhythms that constitute cardiac arrest:

1. (pulseless) Ventricular Tachycardia
2. Ventricular Fibrillation (coarse & fine)
3. Asystole
4. Pulseless Electrical Activity (PEA)

The ischemic area of myocardium has taken control. ALL beats are PVCs.

Ventricular Tachycardia VT
VT with a pulse or pulseless VT

VT degenerates into a CHAOTIC, unorganized quivering of the myocardium - VENTRICULAR FIBRILLATION.
Cardiac Arrest

Shockable rhythms

Ventricular Tachycardia
Ventricular Fibrillation
coarse & fine

Non-shockable rhythms

Asystole
Pulseless Electrical Activity

NOT A SHOCKABLE RHYTHM
Asystolic Cardiac Arrest

What happens when the heart stops **PUMPING** blood?
Blood pressure falls to **zero**, (<60mmHg)
Pulse is not palpable,
Consciousness is **lost**, and
Respirations **cease**.
And the victim is . . .
Our goal in resuscitation is to prevent the *PERMANENT* death of the victim.

- Cells in the victim's body will die when they use up all of the \( O_2 \) available to them
- **CELLULAR** or **BIOLOGICAL** death occurs
- Cellular or biological death is *irreversible*

The time between the occurrence of **CLINICAL** and **BIOLOGICAL DEATH** represents the period in which **RESUSCITATION** may be successful.

**Chronology of Sudden Cardiac Arrest**

- **Time = up to 1 hour before SCA**
- **Time 0**
- **Time = less than 10 seconds**
- **Time = 4 to 6 minutes**
- **Time = 10-14 minutes**

**Signs & symptoms**

- **Occurrence of sudden cardiac arrest**
- **Loss of consciousness**
- **Brain damage begins**
- **Biological (cellular) death**
Brain cells (neurons) have a high metabolic rate. A degree of permanent neurologic deficit can be expected when neurons are deprived of O₂ for 4-6 minutes.

Doctors and nurses also tend to give up too soon. CPR is typically performed for 15 to 20 minutes, but research shows that longer attempts at CPR, up to one hour, can lead to survival. These patients ultimately may fare as well those who are resuscitated more quickly. In patients with a chance of recovery, experts now advise attempting CPR for at least 45 minutes.

Therapeutic Hypothermia positively affects functional recovery and reduce cerebral deficits. Induction of hypothermia after return of spontaneous circulation post cardiac arrest has been found to positively affect functional recovery and reduce cerebral deficits.
How critical is response time to survival?

In the absence of CPR, for every minute a victim is in cardiac arrest the chance of survival decreases by between 7% and 10%.

Survival to hospital discharge

Probability of Survival (no CPR)*

<table>
<thead>
<tr>
<th>Minutes Since Collapse</th>
<th>Chance of Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90%</td>
</tr>
<tr>
<td>2</td>
<td>80%</td>
</tr>
<tr>
<td>3</td>
<td>70%</td>
</tr>
<tr>
<td>4</td>
<td>60%</td>
</tr>
<tr>
<td>5</td>
<td>50%</td>
</tr>
<tr>
<td>6</td>
<td>40%</td>
</tr>
<tr>
<td>7</td>
<td>30%</td>
</tr>
<tr>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>9</td>
<td>10%</td>
</tr>
<tr>
<td>10</td>
<td>0%</td>
</tr>
</tbody>
</table>

About 0% after 10 minutes

Survival to hospital discharge

2010 AHA Guidelines for CPR and ECC. Circulation 122:S706, 2010

Stats of the State of Idaho 2017
Survival Rates from SCA

Survival - to hospital discharge - is dependent upon:
✓ Bystander initiated CPR
✓ Time from collapse to defibrillation

How critical is response time to survival?

With CPR initiated prior to EMS arrival, for every minute a victim is in cardiac arrest the chance of survival decreases by between 3% to 4%.

Survival to hospital discharge

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Bystander Initiated CPR

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Survival to hospital discharge

2010 AHA Guidelines for CPR and ECC. Circulation 122:S706, 2010
Simplistically, an AED is a battery operated computer which is capable of determining whether or not VF/VT is present.

- **VF/VT present:**
  - "SHOCK ADVISED"
How to use an AED

- Any rhythm other than VF/VT
- PEA, asystole, NSR
- ‘NO SHOCK ADVISED’
- ‘Check airway’
- ‘Check breathing’
- ‘Check pulse’
- ‘If no pulse, continue CPR’

AED accuracy in rhythm analysis

Overall accuracy for shockable & non-shockable rhythms = 99% (702/709)

How to use an AED

VF... chaotic, uncoordinated ‘quivering’ of myocardium

AED delivers a biphasic (2 shocks) shock across the chest - through the myocardium - depolarizing all myocardial cells at the same time.

How an AED works
How an AED works

AED delivers a biphasic (2 shocks) shock across the chest - through the myocardium - depolarizing all myocardial cells at the same time, producing . . .

ASYSTOLE

The more ‘alive’ the myocardium when depolarized the more likely it is that the SA node will spontaneously depolarize inducing a normal sinus rhythm.

AUTOMATICITY

Heart muscle - MYOCARDIUM - loves to contract

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Can the chest be compressed adequately with the victim in the dental chair? **YES**

Lepere AJ, Finn J, Jacobs I
Efficacy of cardiopulmonary resuscitation performed in a dental chair
J Australian Dental Association 48(4) 244-247, 2003 (December)

- Average response time in the USA:
  - Call to shock is 10-minutes
  - Can this be improved upon?

Chance of Survival from Cardiac Arrest

Minutes to Defibrillation

Sweed

Claesson A, Backman A, Ringh M, Svensson L etal

Sweden

Sweden
**Time to delivery of an automated external defibrillator using a drone for simulated out-of-hospital cardiac arrests vs Emergency Medical Services**

- **Median time from dispatch to arrival - DRONE** = 5.21 minutes
- **Median time from dispatch to arrival - AMBULANCE** = 22 minutes


**Discussion**

This preliminary study found that it was possible to autonomously transport and deliver an AED using a drone in out-of-sight flights. The drone arrived in less time than the EMS in all simulated cases. Therefore, drones carrying AEDs may reduce time to defibrillation in OHCA. Saving 16 minutes is likely to be clinically important.


**Northern NEVADA**

February 2018

REMSA to use drones to deliver defibrillator for cardiac arrest emergencies

**Rules to Remember**

The very first step in management of all medical emergencies is **BASIC LIFE SUPPORT**, as needed
Drug therapy is ALWAYS secondary to basic life support.