



Health Tech Symposium Fall, 2009

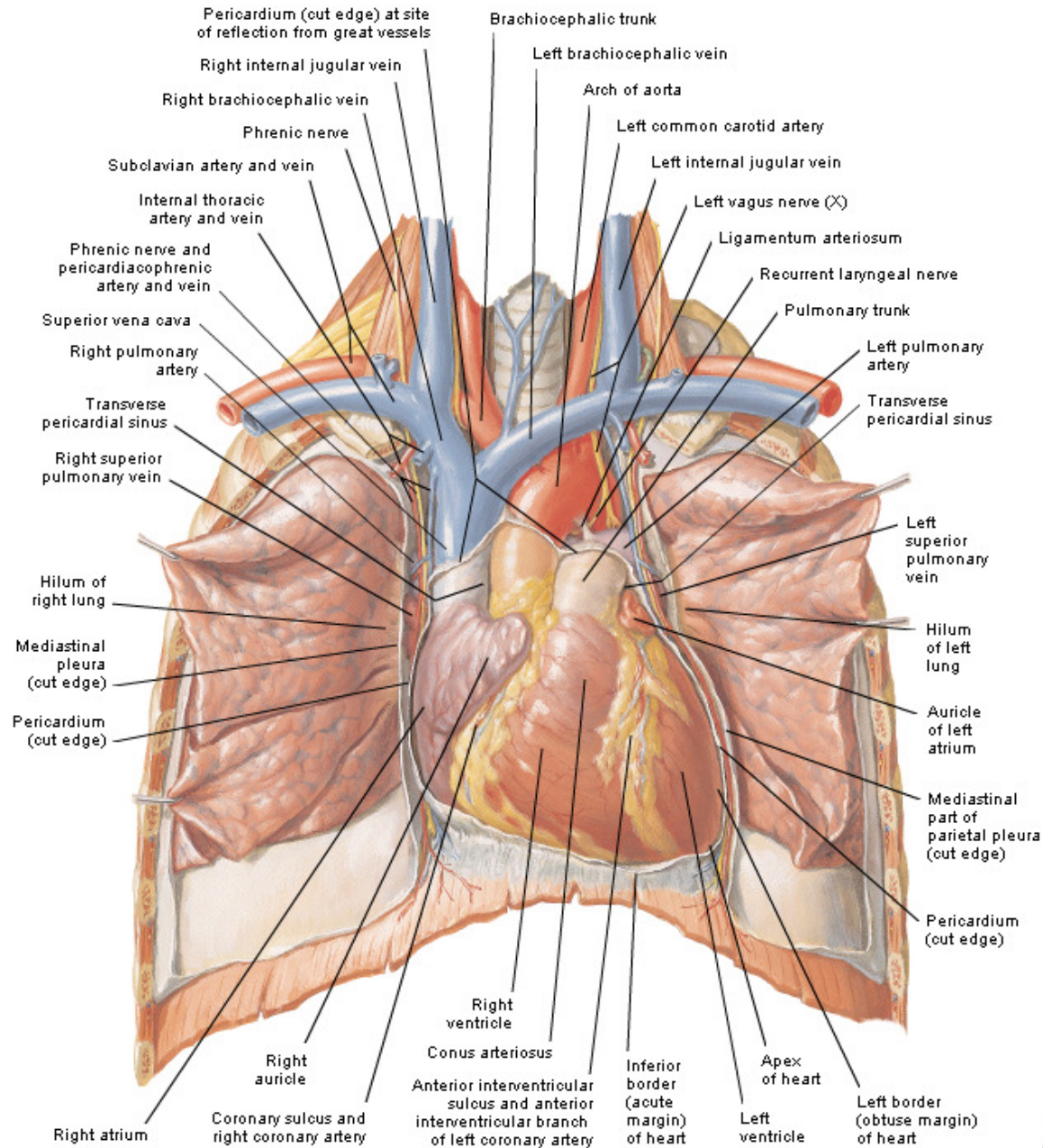
Dan Sommers P.E.
EMT-P



Human Physiological Signals

***Simple Explanations for Complicated
Systems***

Heart: Anterior Exposure

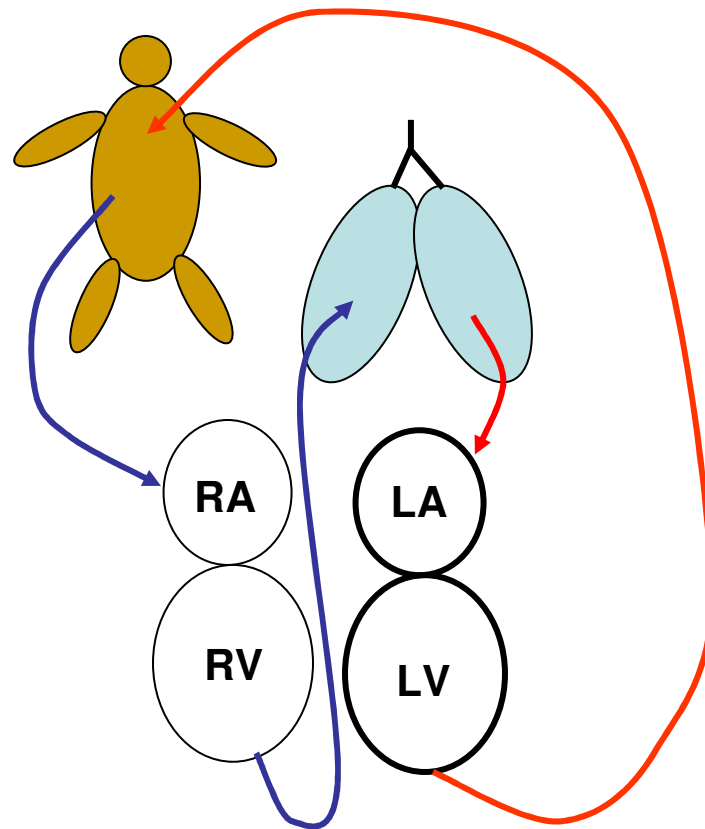


Ref: Atlas of Human Anatomy, 4th Edition



F. Netter M.D.
© I&B

Simple Schematic



AGENCY NAME NOVAL
 DISPATCH INFORMATION Trj from a Fall
 CALL LOCATION 107 Trolley Barn Ln.

MILEAGE
 LOCATION CODE B E I O D
3335 TOTAL

CALL REC'D 261
 ENROUTE 202
 AT SCENE 202
 FROM SCENE 205
 AT DESTINATION 210
 IN SERVICE
 IN QUARTERS



NAME [REDACTED] NAME [REDACTED]
 APPT/UNIT NUMBER [REDACTED] (340)
NORTH SYRACUSE NY ZIP 12-+4
 D.O.B. [REDACTED]

Residence
 Health
 Farm
 Industrial
 Other Work
 Recreational
 Road
 Other
 Call Received as
 EMERGENCY
 NON EMERGENCY
 STANDBY

Physician Dr Baum CARE IN PROGRESS ON ARRIVAL:
 None Citizen PD/FO/Other First Responder Other EMS PAD used
 MVA (✓ seat belt used →) Fall of Progs Standing GSW Machinery Extrication required Seat belt used? Crew Patient
 Struck by vehicle Unarmed assault Knife minutes Yes No Unknown Use Reported By Police Other

CHIEF COMPLAINT My head hurts SUBJECTIVE ASSESSMENT 73410 ♀ presents sitting on floor ~ 400 blood from
1ac on back of head 1x stroke she doesn't remember falling. Denies
neck pain @ pain on palpation. C40X3, @ NU, @ syncope

PRESENTING PROBLEM
 Allergic Reaction Unconscious/Unresp. Shock Major Trauma OB/GYN
 Syncope Stroke/CVA Seizure Head injury Trauma-Blunt Burns
 Airway Obstruction General Illness/Malaise Behavioral Disorder Spinal Injury Trauma-Penetrating Environmental
 Respiratory Arrest Gastro-Intestinal Distress Substance Abuse (Potential) Fracture/Dislocation Soft Tissue Injury Heat
 Respiratory Distress Diabetic Related (Potential) Poisoning (Accidental) Amputation Bleeding/Hemorrhage Cold
 Cardiac Related (Potential) Cardiac Arrest Pain Other Hazardous Materials
 Death

PAST MEDICAL HISTORY	VITALS	TIME	RESP	PULSE	B.P.	LEVEL OF CONSCIOUSNESS	GCS	R	PUPILS	L	SKIN	STATUS
<input type="checkbox"/> None <input checked="" type="checkbox"/> Allergy to <u>Codine</u> <input checked="" type="checkbox"/> Hypertension <input type="checkbox"/> Stroke <input type="checkbox"/> Seizures <input type="checkbox"/> Diabetes <input type="checkbox"/> COPD <input type="checkbox"/> Cardiac <input type="checkbox"/> Other (List) <input type="checkbox"/> Asthma	Rate: <u>24</u> <input type="checkbox"/> Regular <input type="checkbox"/> Shallow <input type="checkbox"/> Labored	20:28	Rate: <u>96</u> <input type="checkbox"/> Regular <input type="checkbox"/> Irregular	158 122	<input checked="" type="checkbox"/> Alert <input type="checkbox"/> Voice <input type="checkbox"/> Pain <input type="checkbox"/> Unresp.	4/5 6	<input checked="" type="checkbox"/> Normal Dilated <input type="checkbox"/> Constricted <input type="checkbox"/> Sluggish <input type="checkbox"/> No-Reaction	<input type="checkbox"/> Cool <input type="checkbox"/> Warm <input type="checkbox"/> Moist <input type="checkbox"/> Dry	<input type="checkbox"/> Unremarkable <input type="checkbox"/> Pale <input type="checkbox"/> Cyanotic <input type="checkbox"/> Flushed <input type="checkbox"/> Jaundiced	<input type="checkbox"/> C <input type="checkbox"/> L <input type="checkbox"/> F <input type="checkbox"/> S		
Current Medications (List) <u>Levetiracetam</u> <u>Lorazepam</u> <u>Soma</u> <u>Lidocaine</u> <u>Hydralazine</u>	Rate: <u>20</u> <input type="checkbox"/> Regular <input type="checkbox"/> Shallow <input type="checkbox"/> Labored	20:48	Rate: <u>100</u> <input type="checkbox"/> Regular <input type="checkbox"/> Irregular	156 82	<input checked="" type="checkbox"/> Alert <input type="checkbox"/> Voice <input type="checkbox"/> Pain <input type="checkbox"/> Unresp.	4/5 6	<input checked="" type="checkbox"/> Normal Dilated <input type="checkbox"/> Constricted <input type="checkbox"/> Sluggish <input type="checkbox"/> No-Reaction	<input type="checkbox"/> Cool <input type="checkbox"/> Warm <input type="checkbox"/> Moist <input type="checkbox"/> Dry	<input type="checkbox"/> Unremarkable <input type="checkbox"/> Pale <input type="checkbox"/> Cyanotic <input type="checkbox"/> Flushed <input type="checkbox"/> Jaundiced	<input type="checkbox"/> C <input type="checkbox"/> L <input type="checkbox"/> F <input type="checkbox"/> S		
	Rate: <u>20</u> <input type="checkbox"/> Regular <input type="checkbox"/> Shallow <input type="checkbox"/> Labored	20:58	Rate: <u>98</u> <input type="checkbox"/> Regular <input type="checkbox"/> Irregular	156 82	<input checked="" type="checkbox"/> Alert <input type="checkbox"/> Voice <input type="checkbox"/> Pain <input type="checkbox"/> Unresp.	4/5 6	<input checked="" type="checkbox"/> Normal Dilated <input type="checkbox"/> Constricted <input type="checkbox"/> Sluggish <input type="checkbox"/> No-Reaction	<input type="checkbox"/> Cool <input type="checkbox"/> Warm <input type="checkbox"/> Moist <input type="checkbox"/> Dry	<input type="checkbox"/> Unremarkable <input type="checkbox"/> Pale <input type="checkbox"/> Cyanotic <input type="checkbox"/> Flushed <input type="checkbox"/> Jaundiced	<input type="checkbox"/> C <input type="checkbox"/> L <input type="checkbox"/> F <input type="checkbox"/> S		

OBJECTIVE PHYSICAL ASSESSMENT Surgery April 23; tummy touch/reconstitutive best
Prevacid, Novadol
Lantus, Cymbalta
 COMMENTS Atos, Atace
Ambien
See CLK

TREATMENT GIVEN FILL IN CIRCLE
 Moved to ambulance on stretcher/backboard
 Moved to ambulance on stair chair
 Walked to ambulance
 Airway Cleared
 Oral / Nasal Airway
 Esophageal Obturator Airway / Esophageal Gastric Tube Airway (EOA/EGTA)
 EndoTracheal Tube (E/T)
 Oxygen Administered @ 04 L.P.M., Method NC @ NRB to keep mouth clear for Nausea
 Suction Used
 Artificial Ventilation Method
 C.P.R. in progress on arrival by: Citizen PD/FO/Other First Responder Other
 Medication Administered (Use Continuation Form)
 IV Established Fluid EMBS V1 Cath. Gauge
 Mast Inflated @ Time
 Bleeding / Hemorrhage Controlled (Method Used: _____)
 Spinal Immobilization Neck and Back
 Limb Immobilized by Fixation Traction
 (Heat) or (Cold) Applied
 Vomiting Induced @ Time _____ Method _____
 Restraints Applied, Type _____
 Baby Delivered @ Time _____ In County _____

PCR: Vital Signs



VITAL SIGNS	TIME	RESP	PULSE	B.P.	LEVEL OF CONSCIOUSNESS	GCS	R	PUPILS	L	SKIN
	2028	Rate: 24 <input checked="" type="radio"/> Regular <input type="radio"/> Shallow <input type="radio"/> Labored	Rate: 76 <input checked="" type="radio"/> Regular <input type="radio"/> Irregular	158 / 122	<input checked="" type="radio"/> Alert <input type="radio"/> Voice <input type="radio"/> Pain <input type="radio"/> Unresp.	4/5/6	<input checked="" type="radio"/>	<input checked="" type="radio"/> Normal <input type="radio"/> Dilated <input type="radio"/> Constricted <input type="radio"/> Sluggish <input type="radio"/> No-Reaction	<input checked="" type="radio"/>	<input checked="" type="radio"/> Unremarkable <input type="radio"/> Cool <input type="radio"/> Warm <input type="radio"/> Moist <input type="radio"/> Dry <input type="radio"/> Pale <input type="radio"/> Cyanotic <input type="radio"/> Flushed <input type="radio"/> Jaundiced
	2048	Rate: 20 <input checked="" type="radio"/> Regular <input type="radio"/> Shallow <input type="radio"/> Labored	Rate: 100 <input checked="" type="radio"/> Regular <input type="radio"/> Irregular	156 / 82	<input checked="" type="radio"/> Alert <input type="radio"/> Voice <input type="radio"/> Pain <input type="radio"/> Unresp.	4/5/6	<input checked="" type="radio"/>	<input checked="" type="radio"/> Normal <input type="radio"/> Dilated <input type="radio"/> Constricted <input type="radio"/> Sluggish <input type="radio"/> No-Reaction	<input checked="" type="radio"/>	<input type="radio"/> Unremarkable <input type="radio"/> Cool <input type="radio"/> Warm <input type="radio"/> Moist <input type="radio"/> Dry <input type="radio"/> Pale <input type="radio"/> Cyanotic <input type="radio"/> Flushed <input type="radio"/> Jaundiced
	2058	Rate: 20 <input checked="" type="radio"/> Regular <input type="radio"/> Shallow <input type="radio"/> Labored	Rate: 98 <input checked="" type="radio"/> Regular <input type="radio"/> Irregular	156 / 82	<input checked="" type="radio"/> Alert <input type="radio"/> Voice <input type="radio"/> Pain <input type="radio"/> Unresp.	4/5/6	<input checked="" type="radio"/>	<input checked="" type="radio"/> Normal <input type="radio"/> Dilated <input type="radio"/> Constricted <input type="radio"/> Sluggish <input type="radio"/> No-Reaction	<input checked="" type="radio"/>	<input type="radio"/> Unremarkable <input type="radio"/> Cool <input type="radio"/> Warm <input checked="" type="radio"/> Moist <input type="radio"/> Dry <input type="radio"/> Pale <input type="radio"/> Cyanotic <input type="radio"/> Flushed <input type="radio"/> Jaundiced

Respiration

Pulse

Blood Pressure

Life Threats



A) Airway

B) Breathing

C) Circulation

Respiration: Breathing



Method:

Watch chest rise & fall for 30 seconds

Concerns:

- Tissue perfusion
- O_2/CO_2 exchange in the lungs
- Diaphragm Activity



Respiration: Tools

Stethoscope:

Conducts vibrations on the skin to
clinician's ears (Auscultation)

Detectable Conditions:

- Bronchial Spasm
- Pneumonia
- Pneumothorax



Pulse: Circulation

Method:

Palpate “thump” on artery for 30 seconds

Concerns:

- Cardiac Disrhythmia
- Compartment Syndrome
- Shock



Pulse: Tools

Electro Cardio Gram:

Captures electrical signals on skin

Detectable Conditions:

- Electrical Activity of Heart
- Cardiac Dysrhythmia
- Myocaridal Infarction

Blood Pressure: CO



Method:

Squeeze artery to occlusion, bleed pressure, detect restoration of flow

Concerns:

- Dehydration
- Arteriosclerosis / Atherosclerosis
- Advanced Stages of Shock

Blood Pressure: Tools



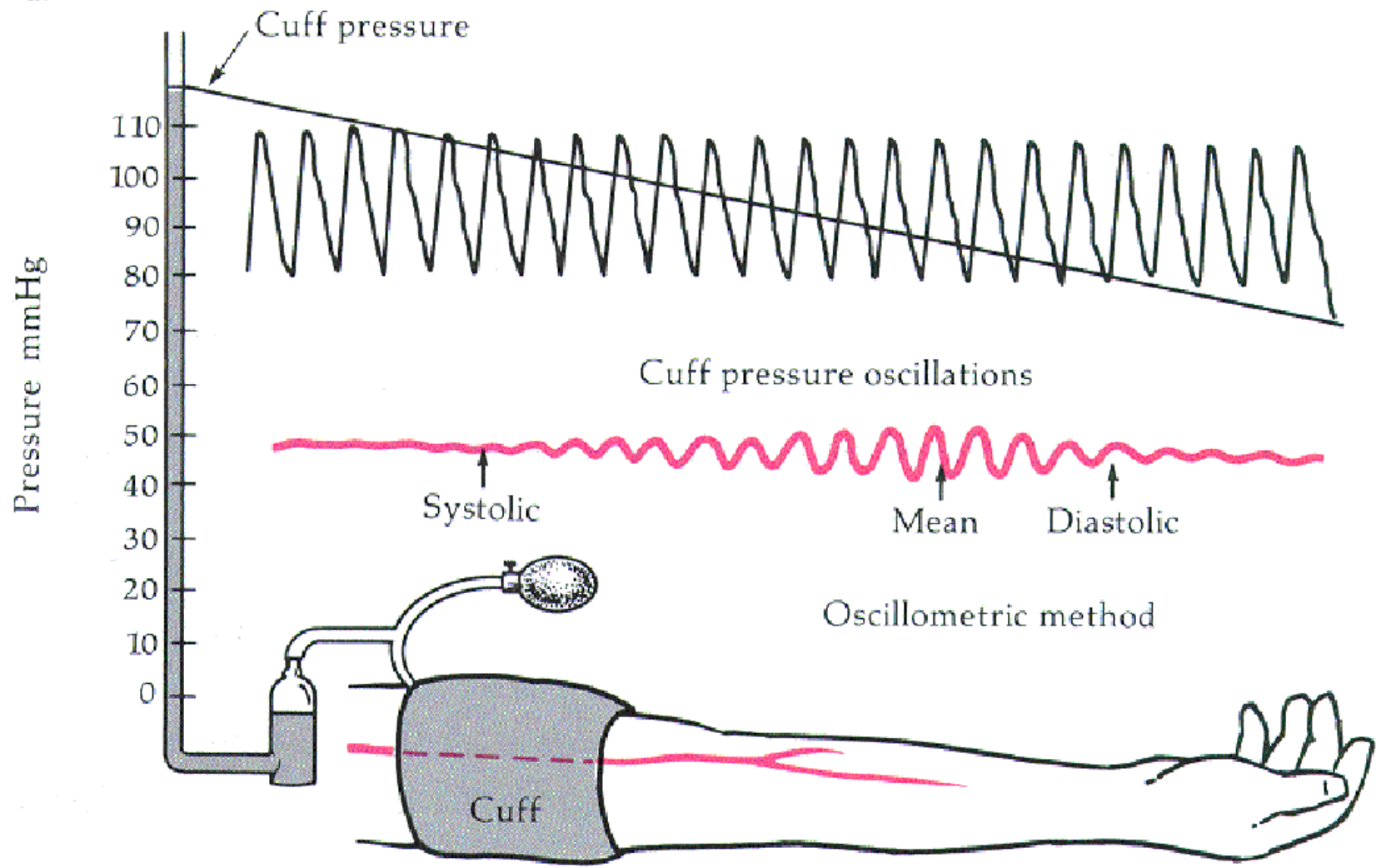
Blood Pressure Cuff:

Applies even pressure to entire
appendage, provides calibrated bleed

- Auscultatory: Korotkoff Sounds
- Oscillometric: Pressure Differential

Poor-Man's Measure of Cardiac Output

Oscillometric Method



Vital Signs Combined



The **Cushing** reflex:

- Hypertension
- Bradycardia
- Rapid Respirations

High Index of Suspicion for increasing inter-cranial pressure

Temperature



Method:

- a) Detect and report molecular kinetic energy
- b) Look at the skin

Concerns:

- Hyper/Hypo Thermia
- Infectious Disease / Immune Response

Temperature: Tools



Thermometer:

Absorbs heat, transduces to optical or electrical signal

Predictive thermometry: doesn't wait until the temperature stabilizes

Core vs. Peripheral: Heat Conservation

Capnography: EtCO₂



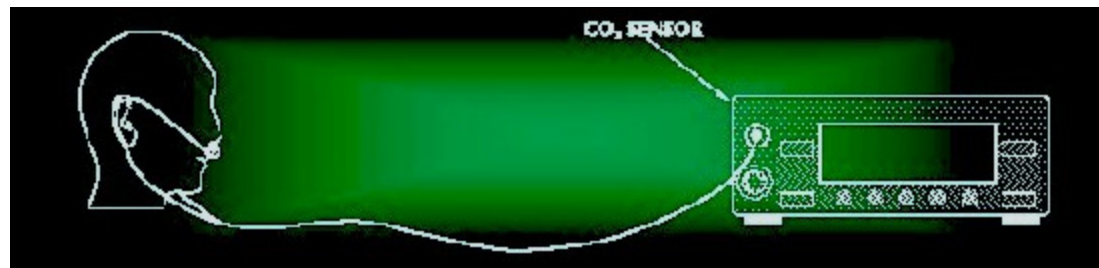
Method:

Measure concentration of exhaled CO₂

Concerns:

- Proper Intubation
- Proper Ventilation
- Perfusion (Cellular Metabolism)

Capnography: Tools

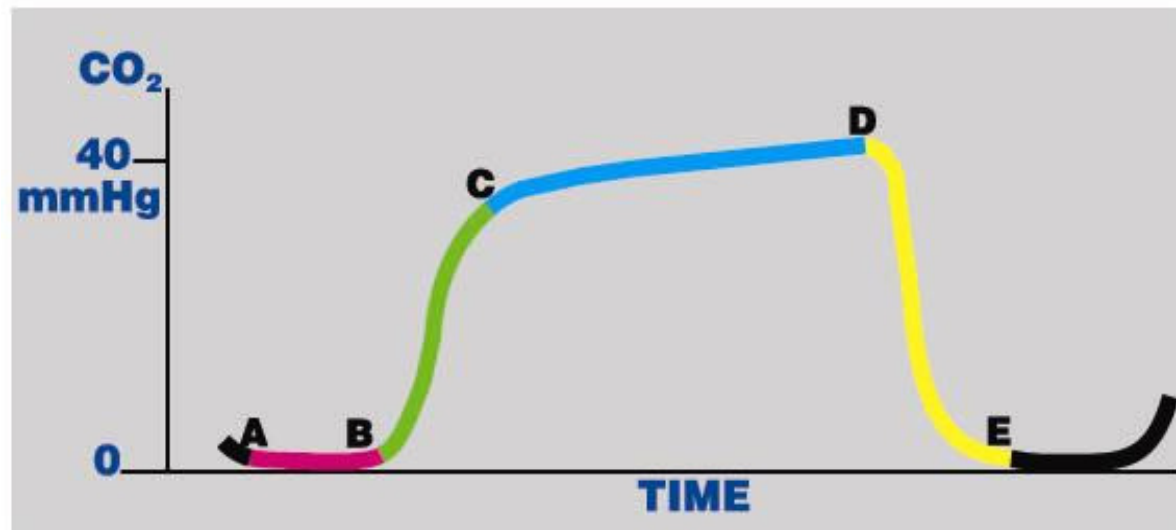


Nasal Cannula



Intubation

Capnography: Waveform



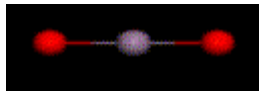
- Normal Waveform
- Near Zero Baseline (A-B)
- Rapid Rise (B-C)
- Alveolar Plateau (C-D)
- End Tidal Value (D)
- Rapid Decrease to Baseline (D-E)

CO₂ Measurement

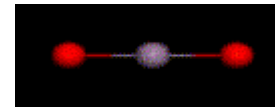


IR Spectroscopy

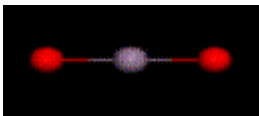
Asymmetric Stretch



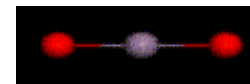
Symmetric Stretch



Vertical Bend



Horizontal Bend

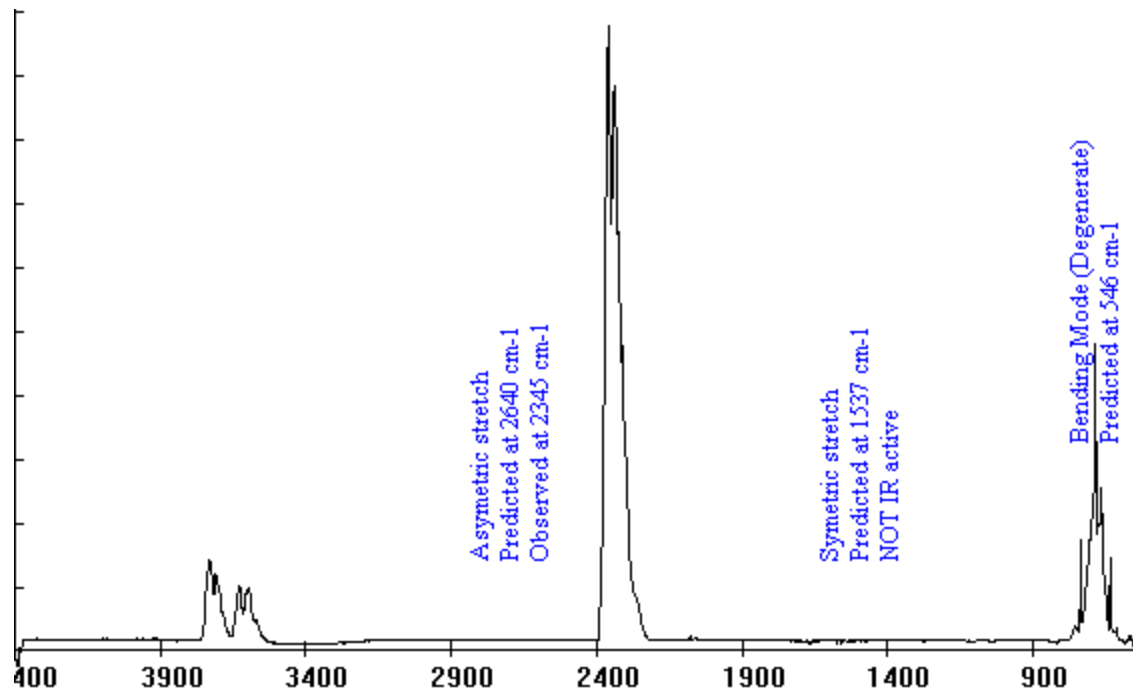


http://science.widener.edu/svb/ftir/ir_co2.html

CO₂ Measurement



IR Absorption

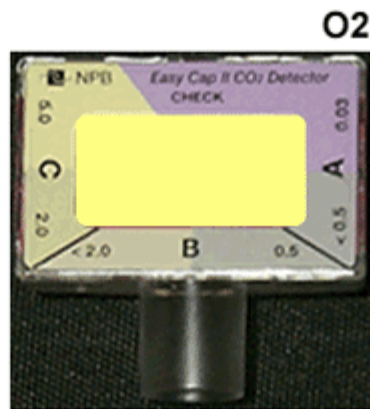


http://science.widener.edu/svb/ftir/ir_co2.html

CO₂ Measurement



Intubation “Cap”



Purple: Problem

Tan: Think

Yellow: Golden

Carbon dioxide dissolves slightly in water to form a weak acid called carbonic acid, H₂CO₃

Pulse Oximetry: SpO₂



Method:

Clip probe onto appendage, read saturation percentage or a full plethysmograph

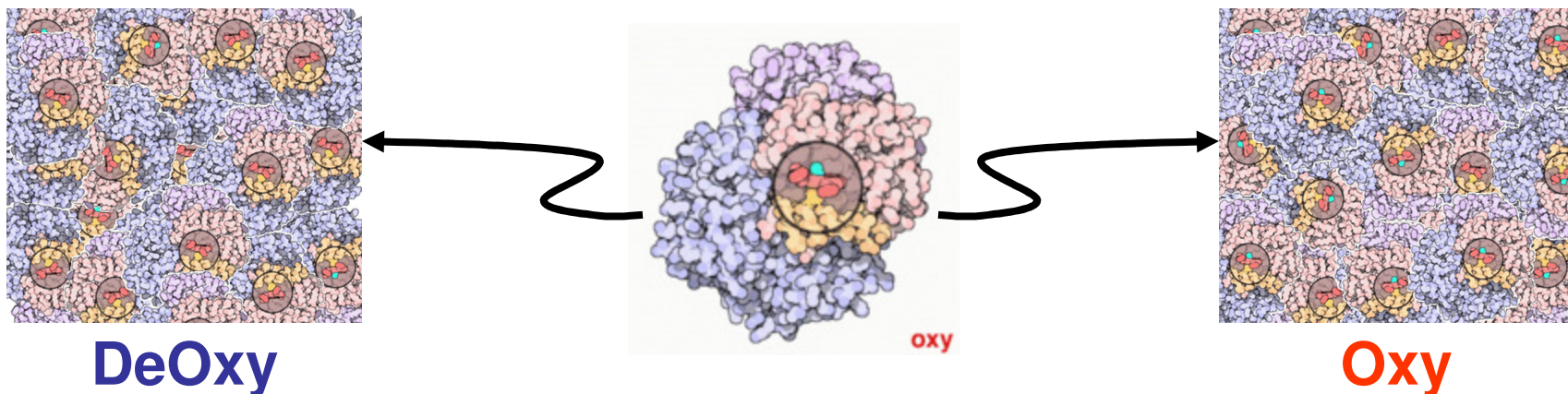
Concerns:

- Chronic Obstructive Pulmonary Disease (COPD)
- Emphysema
- Asthma

Pulse Oximetry: SpO₂



Saturation of Peripheral Oxygen



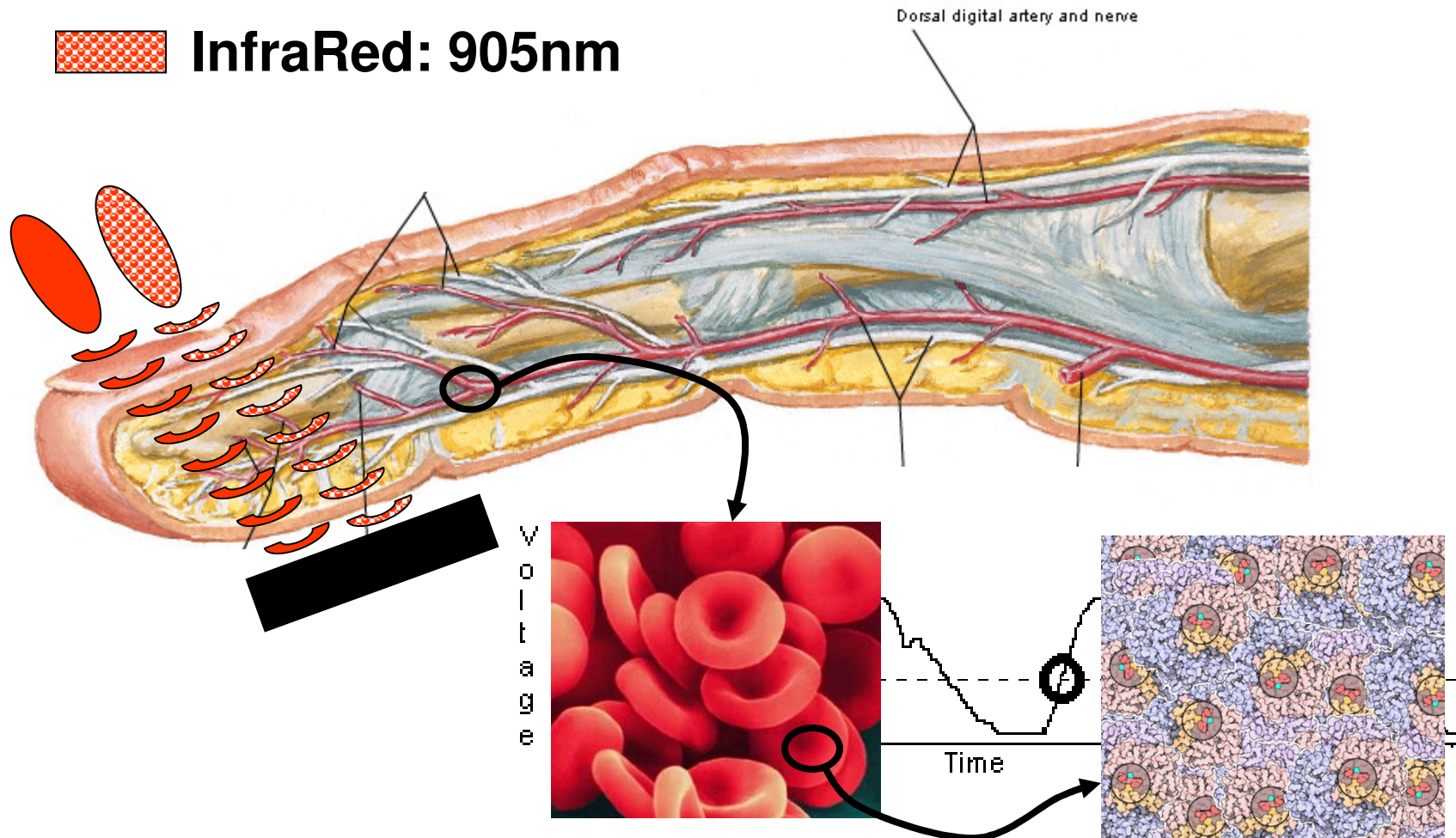
150,500,000,000,000,000,000
hemoglobin molecules in
100 ml of whole blood

[http://www.acronymfinder.com/Saturation-of-Peripheral-Oxygen-\(SPO2\).html](http://www.acronymfinder.com/Saturation-of-Peripheral-Oxygen-(SPO2).html)

Pulse Oximetry: SpO₂



-  Red: 660nm
-  InfraRed: 905nm



Conclusion



- The Human Body is Wondrously Complex
- Humans send out signals
- Smart humans can diagnose sick humans by detecting and analyzing said signals

Questions?