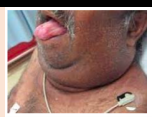
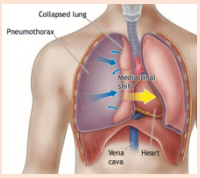
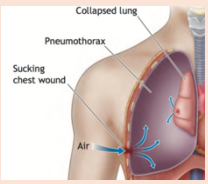
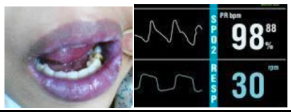
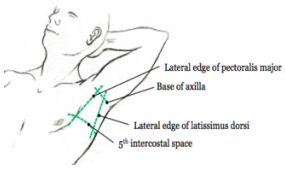
ACUTE CARE – PRIMARY SURVEY – "LOOK, HEAR & FEEL"

	Problem	Look /Listen/Feel	Intervene

Airway	**Direct trauma**
	• Disruption
	• Oedema (later sign due to disruption) 
	Obstruction
	• FB
	• Food vomitus
	• Bloody Vomitus
	• Soft Tissue oedema (haematoma)
	Other reasons for airway
	➢ Decreased LOC
	➢ SEVERE lung pathology
	➢ CO poisoning
	➢ Surgery (RSI = Rapid sequence induction) to prevent risk of **aspiration pneumonia** + **increase FRC**
		• **Appearance** (the sweaty tachypnoic)
		• **Colour** (look grey, pale)
		• **Posture** (LOC)
		• **C-spine immobilise**
		• **Airway obstruction signs**
		  ○ Stridor – swelling in larynx
		  ○ hoarse voice
		• **Signs of imminent airway collapse** (*e.g. severe trauma, burn*)
		  ○ Protruding tongue
		  ○ Drooling
		  ○ Trismus
		  ○ Hypoxia (late sign)
		• **Deteriorating consciousness**
		• **Choking**
		  ○ **5 back blows**
		  ○ **5 chest blows**
			Position
			• **Upright (best) at least 30°** to optimise breathing
			• **L) lateral position if unconscious**
			Prepare + SUCTION ➔ CLEAR AIRWAY
			• Gloved finger + **suction**
			Adjunct airway – centre of mouth to angle of jaw
			• **Manoeuvres** = Chin lift/jaw thrust or neutral in infants
			• Oropharyngeal (**guedel**)/Nasopharyngeal airway
			Intubation → laryngoscope (CI = if NOT fasted)
			• Straighten the airway
			• LMA or ETT (**8.0mm** standard for adult males)
			Surgical Airway (Can't intubate, ventilate, LMA)
			• Cricothyroidotomy OR Tracheostomy
			Maintain in-line immobilisation (C-spine)
			• If LOC / head injuries
			• Manually, sandbags, cervical collar

Breathing Tachypnoea = 1st sign of sepsis and metabolic acidosis	1. **Massive flail ribs** (part of ribs separated from rest of chest wall → ↓↓ LOC/poor resp effort) 2. **Simple** pneumothorax 3. **Massive** haemothorax 4. **Tension** pneumothorax → impaired VR (compresses IVC = distended neck veins) 5. **Open** Pneumothorax 6. **High SCI OR TAMPONADE**  	• **Colour – Cyanosis+** Diaphoresis • **Chest expansion** → asymmetry and reduced • **Accessory muscle + posture** • **↑WoB + ↑RR +↓Sats** (100% sats = CO, methamoglobin) • **Tracheal dev. + abdo breath + distended neck veins** • **Speaking in complete sentences** • Noisy breathing (stridor, wheeze) • **Percussion** (dullness, hyper-resonance, surgical emphysema) • **Auscultate** (BS, Creps, wheeze) 	• **Recheck vitals + trends + meds** • **Max FiO2 → mech. Ventilation** ○ If in doubt = 4L/min Hudson mask (titrate after) • **Needle aspiration → 2nd IC in MCL** • **Tube thoracostomy**: 3-bottle chest drain → **5th IC in MAL → hug lower 6th rib** (avoid neurovascbundle in costal groove superiorly) • **Open pneumothorac ➔ Cover open wound** (3 side occlusive) dressing to let air out but not in 

Circulation
"stop bleeding"
	Bleeding (Big 5)
	1. External (**obs**)
	2. Chest (**CXR**)
	3. Abdomen (**FAST, DPL**)
	4. Pelvis (**PXR**)
	5. Femurs (**Clin. Exam**)
	*Combination
	**DPL = diagnostic peritoneal lavage*
	
	Heart
	• Tension pneumothorax
	• Pericardial tamponade
	• Contusion
	• Infarction
	
		• **Colour (pale, sweaty)**
		• **Warm (distributive), cold (other)**
		• **HR, BP, CRT, JVP**
		• **Urine output**
		• **Fluid overload signs** (raised JVP or distended neck veins, peripheral oedema)
		• **Dehydration signs** (tachycardia, hypoTN, ↑RR, dry MM, reduced skin turgor, altered LOC)
		• **Peripheral Pulse** – quality, regularity
		• Palpate apex beat (best for HF)
		• **Auscultate** (HSDNM)
		Microcirculation
		1. Skin – warmth?
		2. Renal – oliguria?
		3. Brain – hypoxia?LOC?
			1st line = 2x IV or IO access –14-16g cannula
			  1) *Bloods = cultures FBC, Coags (DIC), X-match, ABG*
			  2) IV ABx empirical
			  3) *IVF = crystalloids* **(0.9% NS 500mL bolus),**
			  4) *IVF colloids* **(pRBC – O neg)**
			2. **Pelvic stabiliser**
			3. **Needle thoracostomy / pericardiocentesis**
			ED thoracotomy (REBOA) – *catheter via femoral vein to stop inferior blood flow via balloon inflation*
			4. **Transfer to ICU or monitor on ward**
			  1) *Inotropes / vasopressors*
			Long-term:
			1. **Monitor Fluid balance**
			  ○ **INPUT (IV)**= PO/IVF, NGT
			  ○ **OUTPUT** = IDC, NGT, drains, tubes
			2. **Monitor EUC**

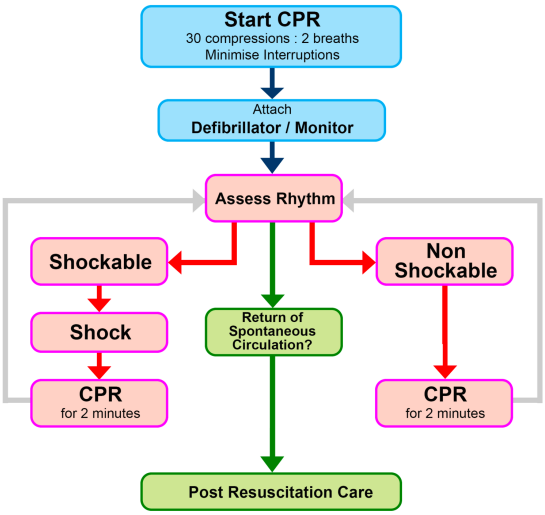
Disability	• **2° brain injury** (due to inadequate oxygenation to brain tissue) → can amplify damage caused by 1° brain injury
	• **INTRA= haematoma, oedema, fitting**
	• **Extra – hypoxia, hypoTN, ↓/↑ CO2, BSL**
	
		• **AVPU → GCS** ≤ 8 (intubate)
		• **Cognition/ behaviour** = orientation to place, person and time.
		• **Eyes** = PEARL, nystagmus, ptosis
		• **Speech** = slurred
		• **Motor (power/tone) /sensation** = Facial asymmetry, seizures, abnormal or absent limb movement
		• **GLUCOSE**
		  ○ **CHECK med** chart (insulin, OHA)
		  ○ **Hypo Sx** (confusion, low BSL, polydipsia, disorientated)
		  ○ **Diaphoresis** (Sweaty, cold, clammy)
			Position
			• C-spine protection
			• Controlled ventilation – prone position
			• Craniotomy (e.g. EDH, SDH) + Neurosurg
			• Closed reduction OR realign fractures
			• Debride ischaemic or contaminated wound
			Medications
			• For sedation
			• Analgesia
			• Anti-emetics

Exposure	1. **Hypothermia**
	2. **Rashes –** location, distribution,, blanching?,
	3. **Thrombin (COAGS) – hidden bleeds**
	  • Check wounds, drains, IDCs
	
		• Take OFF everything
		• Prepare for 2° survey Monitor Temp
		
			• **Remove all clothes**
			  ○ Rashes
			  ○ Skin appearance
			  ○ Abdo exam
			• **Warm fluids, blankets**,
			• **Heat mattress** = bair hugger -3M
			• **Increase room temp.**

Fluid status **Glucose** **Hardware / lines** **Investigations**	• **Urine Output and Glucose** • **Beside = ECG**.(arrythmia) **Urine dipstick** (*UTI, DKA*), **CXR** (*pneumothorax*), **, pelvis X-ray,** (*PELVIC bleed*) • **Bloods = ABG** (check lactates, base excess – cellular function = ischaemia), **IDC** (UO), **NGT** (decompress bowel in SBO/LBO) • **FAST/eFAST** (*fcosu assessment w/ sonography in trauma* ***➔ air/blood in pleural cavity + blood in abdo cavity + heart/liver***) • **2ND Survey → ABx, tetanus prophylaxis**		

ADVANCED LIFE SUPPORT - ALS

Advanced Life Support for Adults



During CPR
Airway adjuncts (LMA / ETT)
Oxygen
Waveform capnography
IV / IO access
Plan actions before interrupting compressions
(e.g. charge manual defibrillator)

Drugs
Shockable
* Adrenaline 1 mg after 2nd shock (then every 2nd loop)
* Amiodarone 300mg after 3 shocks

Non Shockable
* Adrenaline 1 mg immediately (then every 2nd loop)

Consider and Correct
Hypoxia
Hypovolaemia
Hyper / hypokalaemia / metabolic disorders
Hypothermia / hyperthermia
Tension pneumothorax
Tamponade
Toxins
Thrombosis (pulmonary / coronary)

Post Resuscitation Care
Re-evaluate ABCDE
12 lead ECG
Treat precipitating causes
Aim for: SpO2 94-98%, normocapnia and normoglycaemia
Targeted temperature management

What's the worst thing? = 1st dx
AAA, PE, ACS, aortic dissection, GI perforation, tension pneumothorax
- **Always** come up with 3 DDX

Chain of survival

New points:
- C → B → A (NOT abc)
- Cycles are 2 minutely (AVOID interruptions - COACHED)
- **CPR is the MOST IMPORTANT & PROVEN Rx**
  - 30:2 (adults), 15:2 (child) – rate is critical for sufficient preload and cardiac output
  - **Fun Fact:** cough before going into arrest - to increase afterload
- **Early defibrillation is key** – 200J (adult), 4J/kg (child)
- **AVOID XS ventilation**
- **1mg Adrenaline** (after 2nd shock) at 4mins
  - **Nb:** Lower dosage of adrenaline used in anesthetics (25mcg, 50mcg – since potent vasoconstrictor)

Post -resus care (stabilise and transfer care)
- Team-based approach
- 2nd survey = don't forget spine injuries
- AMPLE history + collateral (bystander, ambo)
- **Bloods** = FBC, EUC, LFT, Blood/Urine cultures,
- **Bedside** = **ECG, CXR, Urine dipstick**, BSL, ABG, FAST
- **Imaging –** CT brain/chest/abdo
- **Identify and treat causes**

Keep stable
- **Analgesia** (intranasal fentanyl (child/adult) or morphine (adults)
- **Sedation** (e.g. midazolam, propofol)
- Maintain O2 at 94-98%
- Central Temp, glucose, and CO2 (capnography)

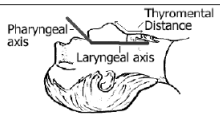
AIRWAY (LEMON)

L – Look externally for characteristics known to cause difficult laryngoscopy (please circle all that apply)

Face	☐ Small jaw ☐ Facial hair	☐ Edema ☐ Prominent Teeth	☐ Loose Teeth ☐ Disfiguring of the Jaw
	☐ Difficult Bag/Mask Ventilation (2 person, use of airway, inability to maintain seal)		
Thorax / Abdomen	☐ Pregnancy ☐ Bowel Obstruction	☐ Massive ascities	☐ Morbid obesity

E – Evaluate the 3-3 Rule:

Mouth opening – 3 finger breadths	☐ yes	☐ no
Thyro-Mental distance – 3 finger breadths	☐ yes	☐ no



M – Mallampati Score

Mallampati Class:_____

O – Obstruction (Is there any condition that can cause obstruction of the airway which would make laryngoscopy and ventilation difficult?)

- ☐ **Tumors**
- ☐ **Stridor**
- ☐ **Congenital Defects (Down's, Goiter, Pierre-Robin Syndrome)**
- ☐ **Other obvious deformity** _____

N – Neck mobility

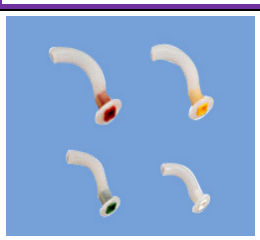
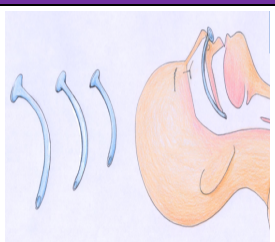
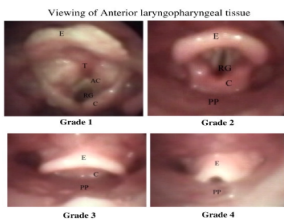
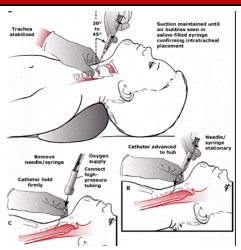
Can the patient move their jaw forward?	☐ yes	☐ no
Can the patient fully bend / extend the head and neck?	☐ yes	☐ no
Is the patient in a cspine collar?	☐ yes	☐ no

Assessment
1. **History**: AMPLE
2. **Exam**: LEMON, LOC, haemodynamics (**LEMON** = should we intubate?)
3. **Risk factors** for difficult airway
   a. Trauma, High BMI
   b. FB, Congenital tumour
   c. Burns

Management
1) Least invasive
2) **Basic manoeuvres** (chin lift with head tilt, or jaw thrust – better for c-spine issue)
   AIM to improve axis – straighten airway
3) **Add adjuncts** (Guedel, NPA, LMA)
4) BVM - **2 person technique**
5) Advanced techniques (I+V)

Vortex
- After best attempt at any airway method (e.g. LMA, BVM or Intubation)
- AIM = stay out of vortex
- Go for cricothyroidotomy (surgical airway)

NB: good sats may NOT mean a good airway

	Airway Adjuncts			Intubation	Surgical airway
					
	Guedel (OPA)	**NPA**	**LMA**	**I+V**	Tracheotomy
Ind	ALS	ALS	Anaesthesia Resus	1) Create airway (blockage) 2) Maintain airway (prevent) 3) Protect airway (LOC) 4) Ventilate (if lung pathology)	- Can't intubate, ventilate, LMA - CI = futile airway, if able to secure airway less invasively
Mx	Angle of jaw to incisors	- Nostril to ear lobe - Lubricate - Can cause blood loss (esp. patient on aspirin)	**Choose correct size** (8mm -males, 7mm - females) - Lubricate		- Cricothyroidotomy - Tracheotomy

PATIENT SAFETY AND QUALITY SCENARIOS

ALS in ED

SCENARIO

1. Arrest called at triage - Alert alarm at triage, everyone goes running
- 60 year old man, walked into ED with wife, arrested in triage area

2. Arrest on arrival into resus - 68 year old man BIBA with severe SOB
- Arrested moments after transfer onto resus bed

3. Bat call – 50 year old female, arrested at a swimming pool
- CPR in progress with ambulance, 2 x Defib delivered so far

4. Code blue call to radiology – 42 year old female found arrested by staff in waiting bay
- Inpatient, 20 minutes post CTPA, was in a waiting area for transfer back to ward

Notes on ED – loud, lots of staff if day time, not enough at night, may need crowd control, team work
Often little is known about the patient

ALS in ICU

SCENARIO

1. Patient is crashing – 62 year old man been in ICU 1 week, becoming more hypoxic
- Diagnosis of progressive interstitial lung disease. Lymphoma + other comorbidities

2. Arrest in cardiothoracic ICU – 74 year old man Day 1 post CABG
- Urgent bedside thoracotomy performed to relieve cardiac tamponade

3. Arrest in a septic patient with severe end stage COPD – limitations of care
- Sudden LOC, no output

Notes on ICU – team work, lots of staff usually, Usually not a total surprise
Usually everything is known about the patient

ALS in Anaesthetics

SCENARIO

1. 31 year old male for laparoscopic gastric sleeve. 110kg otherwise well
- Induction for anaesthetic – midazolam, fentanyl, propofol, rocuronium
- Severe bronchospasm, difficult to ventilate, BP 50/30
- Metaraminol, intubated – no CO2, reintubated with CMAC still no CO2. 100% oxygen
- Adrenaline boluses then infusion, CPR, hand bagged, non shockable
- VF, shock, ECMO 45 min post arrest, output restored
- TF to major ECMO centre

Notes on Anaesthetics – Relatively rare, usually lots of staff depending on what hospital you are in,
Patient is usually well known, full history unless urgent OT

ALS on the wards

SENARIO

1. Arrest team – Code blue called to patient in bed space 5, Ward D
- Code blue called by nursing staff, patient found unresponsive

2. Arrest team – 75 year old lady on the neurology ward, code blue call
- Team present

Notes on the ward – Relatively rare, usually lots of staff come running, can be chaotic initially
Usually history well known to their team, often a delay in getting the full story about the patient as team usually not present and nurse may not know all the details of patient. If you are on the code blue team you will know nothing running into the room

	Scenario #1	Scenario #2
Setting	Busy evening shift in a busy tertiary ED Bed block	
Sx	8yo F BIB mum • Fevers at home, resolved with paracetamol • Mum concerned, child not right • No localising features. No PHx, IUTD • 2 siblings, some contacts unwell with coryza and fevers at school	52 yo F ➢ BIBA decreased LOC (GCS 3), found on park bench ➢ Evidence of head trauma ➢ Likely polypharmacy involved ➢ Patient known to ED and hospital, multiple admissions ➢ Homeless, PHx – Bipolar, T2DM poorly controlled, HT, IHD
Workup	• Exam completely normal • Obs BTF Initially • Increasing RR, Increasing PR, CR prolonged on serial assessment	VBG, US Bloods, CT trauma, Foot Xray
DDx	• FUO - Most likely viral illness. Mother concerned • Obs worsening • Need to consider serious bacterial infection	• Polypharmacy OD – Alcohol, street fentanyl, ICE • Trauma / fall down stairs – Closed head injury, skull fracture ?acute ?old, 1 rib fracture, Ankle closed fracture Weber A • T2DM poorly controlled, BSL elevated 15-20 chronically no acute issues DKA etc
Mx	IVC, IVAB • Admission	• Intubated for control ➔ **ICU admission required** → BUT still needs to have particular specialty to be admitted under **<u>Who to refer?</u>** NO other team wants to take her because of her problems: • **Neurosurgery** = head injury • **Gen med (trauma) or gen surg (**depends on what is available at hospital) -, HTN, polytrauma • **Orthopaedics** – if minor – can be managed as outpatient (rib and Ankle ##) • **Cardiothoracics** • **Endocrine** consult but NOT admitted under – T2DM review for BSL control • **Mental health –** polypharmacy, bipolar, homelessness
Patient safety	➢ Patient looks well ➢ Mother is concerned	• ICU admission required → BUT still needs to have particular specialty to be admitted under (but who with) • Ensuring adequate care regardless of social context and previous healthcare experience (beneficence) → recognise the deteriorating patient since high-risk complex patient
Issues	Potential for missed diagnosis and poor patient outcome ➢ *<u>Importance of monitoring and vitals</u>* ➢ **Always look at trends (changes)** ➢ **Tachypnoea always 1st warning sign** *<u>Importance of listening to parental concern</u>* ➢ They know best Esp for children	• Potential for errors **Challenging interactions#1** (if patient has previously assaulted staff member) • Negotiate and de-escalate with nursing or senior staff who are upset • Report any issues to senior consultant (e.g. if senior team talks down on onto junior doctors) – resolve any issues together in small team discussions • Should not jeopardise or delay patient care – the patient still needs to go to ICU (enforce **Challenging interactions#2** (cannot be admitted under any team) • Escalate issue to senior consultant

ACUTE ILLNESS AND UNDIFFERENTIATED ILLNESS

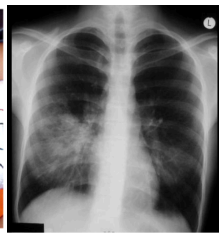
INITIAL APPROACH

1) **ABCDE**
2) **Why are they here? – DDx** (keep broad – narrow down)
3) **Hx- SOCRATES**
4) **Systems Review essential** - Headaches → vision → hearing → CADSPIF → Cough, colds, runny nose → N/V, abdo pain, PR bleeding, altered bowel habit → PV bleeding/discharge → muscle weakness/sensation loss → systemic (UWL, fever, NS, rigors, chills) → rashes/lesions
5) **PMHx / PSHx / Meds** → Have they been taking **meds = partially treated – ABx?** ➔ meningococcal septicemia
6) What does patient and family think?
7) "I don't know what exactly could be causing this but we are going to do everything we can to get to the bottom of this!"

Exam	Ix	In ED	ICU	Anaesthetics
1. **Vitals** 2. **CV,** 3. **Resp** 4. **GI exam** 5. **Neurological** 6. **PR., PV and fundoscopy**	**Bedside** 7. CXR, ECG, UA **Bloods** 8. FBC, blood film 9. Coags- INR/PT 10. Group and Hold 11. EUC, CMP 12. LFT, BSL 13. CRP 14. Trop/Lipase/BNP 15. B-HCG 16. VBG, ABG 17. Blood culture /swabs **Imaging** • CT head/chest /AP	18. **Have you excluded life** and limb threatening diagnosis with appropriate certainty? 19. Can the patient go home or should they be admitted 20. Teams to consult **HAVE YOU EXCLUDED LIFE THREATENING** ➢ **Bleed** (perforation) ➢ **Infection** (sepsis) ➢ **Obstruction** (bowel, stroke, ACS)	21. Have you excluded life and limb threats 22. Teams to consult 23. Changes to management **NEED TO KNOW END DIAGNOSIS**	• Can you carry on with surgery • Can the patient continue with prior post op plans or do they need to change **ARE THEY FIT FOR SURGERY?**

CASE SCENARIOS

	64 year old male presents to ED with Chest pain	6 year old child presents to ED with Rash	64 year old male in ICU day 1 post CABG with chest pain	6 year old child in OT mid elective tonsillectomy with rash
Hx	• 1 day of intermittent chest pain, • exertional, associated with sweating, • He is worried about pneumonia	• 2 days of worsening rash, child otherwise well, ?fever yesterday • Petechial rash, widespread especially lower limbs • **Have they been partially treated – ABx?**	• Sudden severe chest pain, • getting worse • Feels unwell, • palpitations, • sweating, • no fever	Urticarial rash, spreading.
Exam	NORMAL – CV, Resp and GI exam	normal	CV and Resp exam Hypotensive, tachycardic, muffled heart sounds, looks unwell.	No airway compromise
Ix	Normal (including CTPA)	Bloods = Plt 8, Other Ix normal	ECG CXR Bloods Bedside echo = tamponade	None
DDx	• ACS • **PE,** • **Aortic dissection** • **Angina** – beware of troponins → crescendo-decrescendo (subcritical stenosis) • AAA • **Pericarditis** • **Pneumonia, pneumothorax** • **Malignancy** • **Pleural effusion / pleurisy** GORD, referred pain	• ITP • HSP • Meningococcal	Cardiac tamponade	Post-ABx EBV Anaphylaxis allergy
Plan Post Ix	• Admit for Further tests as dx uncertain (e.g. ECG, CXR, d-dimer, imaging) • ECHO – cardiomyopathy • Cardio r/v (or resp)	• Admit • Consult Paeds	• Tamponade needs urgent intervention • Pericardiocentesis	• allergy – needs close monitoring for anaphylaxis



VITALS ARE VITALS

	Reduced	Higher
RR	*CNS depression* ➢ **Centrally acting depressants** (opioids, BZDs, alcohol) – overdoses or withdrawals ➢ **CNS** = Raised ICP, stroke, SCI injury ➢ Electrolyte imbalances ➢ OSA ➢ Hypothyroidism ➢ Sedation	➢ **Pulmonary** – AOO, asthma, COPD, pneumonia, CHF, PTX, ➢ **Cardiac** – PE, ischaemia, tamponade, ➢ **Haem** – aneamia ➢ **Endocrine** – hyperthyroidism, pheo ➢ **Metabolic** – acidosis (MUDPILE), severe AKI, CO poisoning ➢ **Neuro** – post-ictal status epilepticus, brain tumours,
BP	➢ **Arrythmias** – bradycardias, tachycardias, fibrillation ➢ **Structural HD** – valve, IHD, tamponade, HOCM, primary pulmonary HTN ➢ **Hypovolaemia** – haemorrhage, V + D, diuretics, burns, pancreatitis , diaphoresis (insensible losses) ➢ **Systemic vasodilatation** – sepsis, anaphylaxis, neurogenic, ANS dysfunction ➢ **Obstructive** – massive PE, tension PTX, tamponade ➢ **Metabolic** – hypoadrenalism (Addisonian crisis), hypothyroid ➢ **Drugs** – BB, CCB, digoxin, opiates, TCA, valproic acid	**Non-compliance with anti-HTN + REDCAP** ➢ **Renal –** RAS, nephroblastoma ➢ Endocrine (Conn's, thyrotoxicosis, Cushing's, acromegaly, pheo, congential adrenal hyperplasia) ➢ Drugs – interactions, OD, withdrawal ➢ Coarctation of aorta ➢ Pregnancy – pre-eclampsia ➢ OSA ➢ Malignant HTN, malignant hyperthermia, Neuroleptic malignant
HR	➢ Physiological – well trained athletes ➢ Hypovolemic shock - haemorrhage ➢ Cardiac = Arrythmia – Heart block (2nd, 3rd, sick sinus syndrome, CHD) ➢ Infection = endocarditis ➢ Drugs – PSNS stimulation (vasovagal syncope, carotid sinus massage, valsalvre) or SNS inhibition (BB, ➢ Endocrine = hypothyroidism ➢ Electrolytes – hyper/hypoK ➢ Hypothermia ➢ Raised ICP (Cushing's reflex)	➢ Pain ➢ Constipation ➢ Exercise ➢ Cardiogenic – Tamponade, ACS, ➢ Resp – PE, PTX ➢ Sepsis, infection ➢ Drugs – SNS (cocaine, ICE) – ingestion, OD, withdrawal ➢ Endocrine = hyperthyroidism, pheo, hyper/hypoglycemia ➢ Anxiety / Panic attack (
Sats	➢ **V/Q mismatch** = PE, PTX, Pneumonia, APO, ACS, tamponade, hypovolaemic shock ➢ **Diffusion issue** = APO, pneumonia, ILD ➢ **L→ R shunting** = ➢ **Reduced FiO2** – high altitude, ➢ **voluntary hypoventilation** ➢ **other** – anaemia, sepsis, foreign body	*Always check for (**cyanosis with normal Sats*** ➢ nail polish ➢ carboxyHb ➢ CO poisoning (smoke inhalation, suicidal attempts) *High sats:* ➢ Hyperbaric O2 chamber ➢ Hyperventilation - ?Panic attack (Dx of exclusion)

Temp	*Exposure*
	➢ Post-operative
	➢ Post-drown
	➢ Post burns
	
	Late sepsis
	➢ **Cold sepsis**
	➢ Hypovolaemic, cardiogenic
	➢
		Environment / exposure
		➢ Athletes / marathon runner
		➢ Heat stroke
		Medical cause
		➢ Infection / sepsis
		  o Distributive shock – anaphylaxis neurogenic, sepsis
		➢ Drug – reaction / withdrawal
		  o malignant hyperthermia
		➢ Menopause
		➢ Vasculitis
		➢ Malignancy
		➢ Thyrotoxicosis

GCS	*BRAIN* ➢ stroke – haemorrhagic (EDH, SDH, SAH), clot ➢ SoL – abscess, hydrocephalus, mass ➢ Epilepsy *Out of brain* ➢ Sepsis ➢ Drug ➢ Electrolytes – low Na, K, PO4, ➢ BSL	*Hyperactive* ➢ Normal? ➢ Endocrine = hyperthyroidism ➢ Metabolic = ADHD, Mania - bipolar

Things we don't check:

- **Colour** - pale, sallow, jaundiced, well perfused
- **Diaphoresis** – abnormal
- **Posturing** – tripoding, supine, prone, sitting up
- **Exposure** – abdomen, and everywhere else – rashes, bruises, wounds, drains, lines

Making a consult over the phone

- What is the purpose?
  - *Admission – pick the correct team!!! – escalate to bosses if there is an obstruction*
  - *Cpnsult*
  - *Advice*
  - *Do they need to see/review the patient?*
- Does not necessarily need a full history
  - E.g. emergency – e.g. a kid that needs tubing OR we need help now!!
- Aim to be honest, big responsibility
- Understand that the receiver will always want to help

COMMON PRESENTATIONS

	CHEST PAIN	SOB	ABDO PAIN	ALTERED LOC	CRAZY PATIENT
RF	• HC, HTN, DM, • Vascular disease, • inflammatory conditions • Smoking • Drug use (cocaine) • Recent surgery	• **HC, HTN, DM,** • **Vascular disease,** • **Autoimmune** • **Smoking** • **Drug use** (marijuana – PTX – THC abuse) • **Hx of resp. illness.**	• Vascular RF = ischaemic, • **Previous bowel surgery** • Smoker, EtOH • Autoimmune • Sexually active • Blood thinners (anti-coags)	• **Hx of Fits/epilepsy** • **Prodrome –** syncope, chest pain, weakness • **T2DM** – hypoglycemia • **Organ failure** • **Vascular RF** • **Drug and alcohol hx** • **Recent illness**	**Red flag signs** • Known mental health Dx • Drug and alcohol abuse • DM • History of malignancy • Cardio-resp or neuro diagnosis • Older age (> 40yo)
Exam	• Vitals • Sweaty, colour, position, pain • Murmurs • Lung sounds • Calf tenderness (DVT) • Signs of HF (S3, JVP, oedema) **Radiation to R) arm more specific for MI**	• Vitals • Sweaty, colour, position, pain • Murmurs • Lung sounds • Calf tenderness (DVT) • Signs of HF (S3, JVP, oedema)	**Give Analgesia to assist** ➢ Vitals ➢ Sweaty, colour, position, pain ➢ **CV/Resp exam** ➢ **Hernia** – *grey/Cullen, liver stigmata* ➢ **Genitals** – *testicles, perineum* ➢ **Cough/Jump test** - ++ *peritonism* ➢ **Palpation** – *rebound / percussion tenderness* ➢ **Sign** (murphy's, Rosving's) ➢ **Peripheries**	➢ **Vitals** → Postural BP (vasovagal) ➢ **Sweaty, colour, position, pain** ➢ **Exposure** → Signs of trauma → sites of infection → rashes ➢ **Abdo exam**	***ENSURE SAFE BEFORE DOING*** 1. **1st episode of psychosis** 2. **Acutely agitated or aggressive patient** 3. **Delirium (fluctuating LOC)** 4. **Known MH diagnosis attending for review** (must medically clear)
Ix	***Bedside*** ➢ ECG – serial ➢ UA ***Bloods*** ➢ FBC, EUC, CMP ➢ TFT ➢ Troponin/BNP ➢ D-dimer ➢ **CRP** ➢ Lipase ➢ B-HCG ***Imaging*** ➢ Mobile CXR ➢ Cardiac ECHO ➢ CTPA ➢ CT chest ➢ Doppler LL USS	***Bedside*** ➢ ECG – serial ➢ UA ***Bloods*** ➢ FBC, EUC, CMP ➢ Troponin/BNP ➢ D-dimer ➢ **CRP (infection)** ➢ Lipase ➢ ABG / VBG ***Imaging*** ➢ Mobile CXR ➢ Cardiac ECHO ➢ CTPA ➢ CT chest ➢ Doppler LL USS	***Bedside*** ➢ ECG – serial ➢ CXR ➢ Urine B-HCG ***Bloods*** ➢ FBC, ➢ EUC, CMP ➢ LFT ➢ CRP ➢ Lipase ➢ **Serum B-HCG (ectopic)** ***Imaging*** ➢ CT AP ➢ FAST / POCUS ➢ US ***OTHER*** ➢ Stool culture M/C/S + O/C/P ➢ Urine culture M/C/S ➢ Genital swabs M/C/S	***Bedside*** ➢ ECG – serial ***Bloods*** ➢ FBC, WCC ➢ Blood film (schistocytes for TTP) ➢ EUC, CMP ➢ LFT ➢ CRP ➢ VBG - BSL ➢ TFT ➢ **Coags** ➢ **Blood culture** ➢ Drug levels – paracetamol, EtOH ➢ ***Imaging*** ➢ CT brain → MRI, LP ➢ XR - fractures ➢ EEG ➢ POCUS	**When to do full work up?** ➢ 1st psychotic episode ➢ Old pt w/ delirium/ agitation ***Bedside*** ➢ Vitals – postural BP ➢ ECG – serial ➢ UA ***Bloods*** ➢ FBC, EUC, CMP ➢ LFT, BUN ➢ VBG, CRP, BSL ➢ TFT ➢ B12, Folate, Vit D ➢ ESR ➢ Syphilis, HIV ➢ Drug levels – panadol, EtOH ***Imaging*** ➢ CT brain +/- contrast((SOL, bleed) ➢ LP **Other** ➢ MSE – *thought content, suicidal ideation, persecutory delusions* ➢ MMSE
DDx	**RED FLAGS** • ACS • PE • Aortic dissection (diastolic murmur, tearing pain) • Angina – subcritical stenosis (crescendo-decrescendo) **SEMI-URGENT** • Pericarditis • Tamponade • Pneumonia, • Pneumothorax • Pleural effusion / pleuritis **COMMON** • GORD • Abdo pathology (referred pain) • Chest wall pain • Costochondritis • rib #	**RED FLAGS** • ACS • PE • Aortic dissection • **Foreign Body** • **Anaphylaxis** • **Tension pneumothorax** **SEMI-URGENT** • CCF • Tamponade • AOO = COPD, asthma • APO • Pneumonia • Simple Pneumothorax **DO NOT MISS** • Anemia • Toxins /ODs (opiates, BZDs, marijuana) • NMD	**Bowel** ➢ SBO, volvulus ➢ Ischemia, incarceration, strangulation, AAA ➢ Any perforation / rupture (E.g. AAA) ➢ Gastritis, Gastric ulcer, perforated oesaphagus ➢ Diverticulitis, appendicitis, abscess ➢ IBD **Organ** ➢ **Hepatitis** ➢ **GB** = stones, cholecystitis, cholangitis, ➢ **Pancreatitis,** ➢ **UTI, Renal colic, stones** ➢ **Splenic rupture** ➢ **AAA** **Gender-specific** ➢ Ectopic, endometriosis, adnexal mass/abscess ➢ Ruptured ovarian cyst ➢ Testicular /ovarian torsion **Other** ➢ AMI ➢ RLL or LLL Pneumonia ➢ DKA ➢ HyperCa	**BRAIN ISSUE** ➢ **Trauma** ➢ **Vascular** – ICH, SAH ➢ **Stroke** ➢ **CNS infection** ➢ **Raised ICP - SoL (cushing's)** ➢ **Seizure (post-ictal)** **DIMEVENT (NON=Brain)** • **Drugs** (OD, withdrawal, interactions – EtOH, BZD, opiates, anti-psychotics) • **Infection** (UTI, cellulitis, meningitis, encephalitis) • **Metabolic** (Low Na, low BSL, ureamia – AKI, hepatorenal syndrome, UGIB) • **Endocrine** (Hypoglycemia, hyperglycemia esp. HHS, thyrotoxicosis, myxodema coma, Addisonian crisis, hypoadrenalism – prolonged steroid usage) • **Vascular** – stroke, HTN, vasculitis, cavernous sinus thrombosis (veins) • **Epilepsy** – post-ictal, meds, non-convulsive status epilepticus • **Nutrition** – Vit D, folate, B12, B1 deficiency • **Toxins, trauma, TTP**	➢ 1st presentation = psychosis ➢ Delirium = fluctuating LOC + elderly patient **Infection (any sepsis)** ➢ AOM, Meningitis ➢ Pneumonia ➢ UTI, cellulitis, pressure sores (nec. Fasciitis) **Metabolic** ➢ BSL ➢ Electrolytes ➢ Hepatic enceph ➢ Thyrotoxicosis **Neurological** ➢ CVA ➢ Seizure ➢ Post-ictal seizure ➢ SAH, ICH, SDH ➢ CNS mass **Cardiopulmonary** ➢ AMI, PE, hypoxia ➢ CO2 narcosis ➢ CCF **Drug related** ➢ Anti-emetics, anti-histamines, anti-PD ➢ Anti-psychotics ➢ TCA ➢ Withdrawal **Other – DO NOT MISS** ➢ **Pain** ➢ **Constipation / retention**
Risk stratify	• Well's score • PERC for PE	• Well's or PERC	• Alvarado score	• PECARN (for children)	➢ 4-AT – orientation, alertness, fluctuating LOC

Mx	**Exclude Big 3 – give Mx**
	• **ACS** = PCI or anti-platelets or anti-coag
	• **Aortic dissection** – permissible hypoTN with BB (contact cardiothoracics)
	If not ACS
	• Serial ECG and troponin
	• Observation
	• Consider D/C
	• **24-hr holter monitor**
	• **ECHO**
	• **DASS-21 (MH)**
		ABCDE – ensure airway patent
		• Avoid lying flat – let patient position themselves
		• Avoid over-oxygenation in COPD
		• **NIV for COPD and APO**
		Medical
		• **Bronchodilators** – wheeze (AOO)
		• **1st line = GTN patch**– CCF, APO **(or Furosemide 2nd line)**
		• **Early ABx** – if infective resp. symptoms
			• **Keep NBM (or last meal)**
			• **A –** airway patent
			• **B –** adequate FiO2
			• **IVC – bloods**
			  ○ **IVF** (NS, hartmann)
			  ○ **Analgesia** (1g IV/PO Panadol (2/5-5mg IV morphine) (5mg endone PO Intranasal fentanyl
			  ○ **High-dose PPI**
			• **D – GCS, BSL**
			Refer accordingly
			➢ Gen Surg registrar (urgent if peritonism)
			➢ Gastro
			➢ Urology
			➢ O+G
			➢ Vascular
				• **A – airway patent**
				• **B – adequate** FiO2
				• **IVC – bloods**
				  ○ IVF (NS, hartmann)
				  ○ Support
				  ○ ABx (if sepsis)
				  ○ Ionotropes
				• **D – GCS, BSL**
				  ○ **Thrombolytics**
				  ○ **CVA /interventions**
				  ○ **Antidotes** for OD (e.g. naloxone, flumazenil)
				  ○ **Give 5mg midazolam for non-convulsive epilepticus to wake them up**
				Refer accordingly
				• Neurosurg consult
				• Neurologist
				• Endocrinologist
				• Geriatrics
					Full work up and investigations?
					➢ 1st psychotic episode
					➢ Old pt w/ delirium/ agitation
					If known MH dX ➔ medically clear
					➢ No further Ix
					➢ Await MH review
					➢ Document
					➢ Avoid premature diagnostic closure
					General Mx for acutely aggressive pt:
					1) **Attempt to de-escalate** (offer drink, family support)
					2) **Do NOT stand in their way** (protect yourself, others & patient)
					3) **PO/IM/IV medical sedation** (5-10mg diazepam PO = Valium) ➔ required post-monitoring for GCS in resus room
					4) **Physical sedation = Security** → restrain w/ 5-point immobilization

B – BREATHING & ANAESTHETICS

APPROACH TO RESPIRATORY DISTRESSED PATIENT

Assessment		DDx
Prepare	• Ask (patients, family, paramedics) • Medical records, call GP practice or physician who know patient	**Common causes of respiratory distress** • Pneumonia • AOO (X-COPD, X-asthma, FB, anaphylaxis, bronchospasm) • APO • PE • Pneumothorax (tension) • Severe hypoxemia **Other DDx (ACUTE VS CHRONIC)** • **Heart** (tamponade, ACS, pericarditis, LV dysfunction, shunting, arrythmias) • **NMD** (MG, DMD, paralyzing agent – rocuronium, phrenic nerve palsy) • **Chest wall** (obesity, scoliosis, pectus excavatum) • **CNS depression** (narcotics, stroke, SCI) • **Poisons / toxins**
End-of bed (always look)	• Position (tripod, supine) • Vitals (fever) • Diaphoresis • Pallor	
Respiratory signs (always look)	• O2 requirement • RR • Accessory muscles • Chest expansion • Wheeze, creps	
Systems	• CVS – murmurs, JVP, pulses • Abdo – mass, tenderness, distended	

Risk Stratifying Tool for pneumonia

	Use	Outcome
CURB-65	**Predictor of 30 day mortality**	• Confusion (AMTS <=8), Urea >7, RR >= 30, BP (<90/<=60), Age >=65 • 0-1 (outpatient), 2 (hospital), 3 (ICU)
Pneumonia severity index	Predictor of short-term mortality (higher discriminatory power than CURB-65)	• **20 variables** (demographics, co-morbidities, physical exam, vitals) • Investigations also needed (BSL, ABG, CXR)
SMARTCOP	**Need for MV or vasopressor**	• **S**BP <90 , **M**ultilobar CXR, **A**lbumin <35, **R**R > 25, **T**achy >125 • **C**onfusion, **O**xygen pO2 < 70mm Hg, **p**H < 7.35, **S**ats <94%
PERC rule	**Exclude PE**	•

INDICATIONS FOR AN ABG!

Why	What	Common Indications
Rapid Results	• Haemoglobin	• Haematemesis • Unexplained haemodynamic instability
	• Sodium • Potassium	• Life threatening hyperkalaemia • Severe hyponatraemia
Assess Respiratory status	• pO2	• Technical issues • Abnormal Hb • Severity assessment
	• pCO2	• NIV / Intubation • Ventilator adjustment • Extubation
Assess Acid-base status	• HCO3 / B.E	• DKA • Renal failure • Overdose
	• pH	• Assess degree of compensation
Specific tests	• Lactate	• Shock • Type B
	• Ionised Calcium	• Massive transfusion • Rhabdomyolysis

DETERMINE DIAGNOSIS – INVESTIGATIONS

Bloods	• **FBC** (Hb, WCC, plts, Hct) • **EUC** (Na, K, eGFR, Cr, Urea) , • **LFT** (albumin) • **Coags,** • **D-dimer** • **CRP**	**Specific Heart Ix** ➢ Troponin (beware ONLY raised after 2 hrs) ➢ BNP ➢ ECG ➢ TTE / TOE
Microbio	• **Blood culture** • **Sputum** (? Induced vs tracheal aspirate vs bronchoscopy) • **Viral swab** • **Urine** **Beware of contaminants** • Coag negative staph in blood • Mouth flora or candida in sputum	**Specific Lung Ix** ➢ ABG ➢ CXR ➢ US ➢ CT ➢ CTPA ➢ Bronchoscopy

Test	Advantages	Limitations
ABG / VBG	• Rapidly available • Venous ok if pCO2 normal) • Measure of severity • "Occult" hypercarbia	• Does not frequently guide initial management • Painful / Stressful for patient
CXR	• Rapidly available • Cornerstone for diagnosis (**must compared with previous CXR)**	• Sensitivity and specificity Inter-interpreter variability
CT	• Pulmonary Emboli • Cancer • More sensitive and specific for other causes	• Patient needs to lie flat (bad if haem compromised) • Contrast allergy or impaired AKI (DM, CKD) • Radiation load • Resource burden
US	• Rapidly available • Concurrent assessment of heart and lungs • Broad division (Airways disease, Interstitial, Pleural)	• Appropriate training required • Incorrect interpretation
Bronchoscopy	• More sensitive for less common pathology • More likely to tailor ABx • Possible therapeutic benefit	• Well enough to tolerate or be intubated • Complications (hypoxia, aspiration, pneumothorax)

RESPIRATORY CARE MX – (1) Supportive Care + RESUS → (2) ABCDEFG → (3) Therapy Goals

1) **Supportive care and Rx symptoms** (SOB, chest pain, vomiting) → FiO2, analgesia, anti-emetics
2) Ensure adequate **oxygenation & ventilation** (CO_2 elimination)
   a. What's the goal? - $PaCO_2$, pH or clinical end-point
   b. Methods improving ventilation? → control FIO2, NIPPV, intubation
   c. Correct reversible pathology – bronchospasm, sedative toxicity
3) Optimise **haemodynamics + fluid status**
   a. HTN (High LV afterload – APO)→ SL/IV GTN
   b. HypoTN (?shock → hypovolaemic, obstructive) → IVF
   c. Arrythmias (Atrial tachycardia esp. in acute resp. failure) → rate and rhythm control)

Goals of therapy
1) Burden on patients/family
   a. uncomfortable support NOT treatment
   b. prevents patients from communicating
2) Prognosis in those with resp. failure with advanced disease –
   a. burden of care,
   b. likelihood of survival
   c. perceived QoL`

	Minimally invasive	Flow Rate	FIO2 (%)	Indication for use
	Nasal Cannula/Prongs	1-4 **L/min** (turned up in ED)	25-35	• Minimal resp. distress (≈90%) • **Inverse rule (FiO2 ∝ 1/flow) ➔ Lower FiO2 for greater WOB** • Less claustrophobic, low cost, can eat and speak
	Simple Face Mask	5-10 **L/min**	40-60	• Moderately hypoxic • Risk of CO_2 retention
	Venturi Mask blue – white- orange – yel -red-green (2 ------4 ------6 ------8 – --10 --15)	2-10 **L/min)** [adaptor]	24-60% (fixed(	• COPD patients (i.e. avoid CO_2 retention) = loss of hypoxic drive to breath • Transition to non-rebreathing mask in emergency or it patient is not well
	Non-Rebreathing Mask *Reservoir bag MUST be inflated + tight fit needed	15 **L/min**	> 60%	Oxygen reservoir to give higher FiO2 with *adequate ventilation* **Mainly for** • Post-cardiac or respiratory arrest, • Severely hypoxic patient
	Hi Flow Nasal Cannula *"humidified O2 delivery under pressure"*	≤60 **L/min**	Up to 100% (hard to titrate)	• Low level prep → applied nasally or via tracheostomy • Humidifier replicates humidifying effect of nose • **Matches inspiratory flow rate even with increased WOB** • Aims to reduce subjective WOB and SOB
	Bag-Valve- Mask Resuscitator	15 **L/min**	>0.8	**Key principles:** • **Almost always Need adjunct** → nasopharyngeal or oropharyngeal (Guedal) airway or BOTH • optimize patient position **(inc. bed height)** **Difficult BVM causes = BONES** (a) **B**eard = impedes a good seal (b) **O**bese (c) **No** teeth = loss of facial architecture – (but easier intubation) (d) **E**lderly (e) **S**leep Apnea / Snoring
	Non-invasive PPV (CPAP, BPAP)	Adjustable **L/min**	Fixed FiO2 (up to 100%)	**CPAP** / **T1RF**: Constant pressure → alveolar recruit ➢ PREVENT airway collapse ➢ ↑↑ atelectasis + alveolar Vent. ➢ Reduces LV afterload **BIPAP** / **T2RF (X-COPD)**: IPAP (air forced into lungs) + expiratory PEEP (prevent collapse ➢ Reduces inspiratory effort ➢ Increased tidal volume and CO_2 clearance **Relative CI** ➢ Facial trauma ➢ Recent surgery (URTI, upper GIT) ➢ Reduced LOC ➢ Aspiration risk (obtunded pt) ➢ Pneumothorax ➢ Signs of RV strain
	Mechanical ventilation OR Tracheostomy (emergency)	**Adjustable** Control FiO2, RR, TV, Peak flow rate, PEEP	100%	• **Endo-tracheal tube** = **definitive airway** to maintain airway patency • **LMA (laryngeal mask airway)** = **non-definitive airway** *Dynamic manoevres (e.g. prone position)* • reduces lung compression by adjacent organs • improves ventilation and perfusion PLUS improves oxygenation and secretion clearance

******Fraction of Inspired Oxygen (FiO2) concentration ≈ (Flow Rate x 4) + 21 (FiO2 in room air)******

	WHAT IS IT?	INDICATIONS	SIDE EFFECTS
Anti-microbials	**Infection** / **Organisms** / **Anti-microbial** **CAP** / Streptococcus, Haemophilus, Moraxella / Ceftriaxone **Atypical** / Mycoplasma, Legionella, Chlamydia / Azithromycin **Hospital Acquired** / • Resistant Gram-ves (psudeomonas) / **Tazocin** • MSSA vs MRSA / Vancomycin **Chronic lung disease** / Pseudomonas / **Tazocin** **Immunocompromised** / • Neutropenic / **Tazocin** & gentamicin • PJP / Bactrim • Fungal (e.g. aspergillosis) / Antifungal • Viral reactivation (CMV) / Valganciclovir **Viral** / Influenza / Oseltamivir **Abscess** / Usual + Anaerobes / **Tazocin**		• Anaphylactic reaction • AKI – intrinsic ATN (esp. aminoglycosides)
Bronchodilators	**INHALED** • Neb SABA (salbutamol 5mg) • Neb SAMA (ipratropium 0.5mg) **SYSTEMIC** • IV Salbutamol (only if PO not tolerated) • IV/IM adrenaline • IV $MgSO_4$ • Aminophylline • Ketamine	• Viral induced wheeze • Acute exacerbation of AOO (asthma, COPD) • Anaphylaxis • SMC relaxation for severe exacerbations • Intubation or to tolerate NIV	• **SABA** – Tachycardia, tachyphylaxis, lacteamia • **Ipratproum** – antichol /(anxiety, tachycardia, dry secretions) • **$MgSO_4$ / aminophylline** = flushing, hypoTN
Chest drains	• Needle - 2nd ICS, MCL • Finger thoracostomy • Aspiration ONLY • Pleural caths	• Tension pneumothorax ➔ URGENT decompression 2nd ICS, MCL • Pleural effusion (exudate, transudate, malignancy, empyema) • SOB/hypoxeamia • Haemothorax ➔ REQUIRES a drain	• Re-expansion pulmonary oedema • Pneumothorax • Infection (pleuritis) • Adjacent organ damage (liver, RA)
Diuresis	• Furosemide 20-80 mg IV • **"Dry lungs are happy lungs"**	• APO • Cor pulmonale	• Hypovolaemic shock (absolute CI) • AKI or hypoTN (relative CI)
Expectoration	• Chest Physiotherapy • Mucolytics • Humdification via HFNO • Bronchoscopy	• CF / Bronchiectasis • Pneumonia • well enough to tolerate or intubated	•
Fibrinolysis	**SHOULD DO CTPA 1st is possible!!!** • Tissue plasminogen activator (TPA) • Alteplase / Tenecteplase	• **Confirmed massive PE** (Haemodynamic instability) • **Probable massive PE too unstable for imaging** • **Submassive PE** (Right heart strain) • **Syncope** (stroke, ACS) → CT brain to exclude ICH prior	• Bleeding risk – internal bleed, or haemorrhagic stroke
Glucocorticoids	• **Oral pred or IV hydrocortisone, O/IV dexamethasone** *If tolerating oral meds and gut working oral and IV have equivalent efficacy*	• **Exacerbation of asthma/COPD ➔** *reduce hospital stay* • **Anaphylaxis** • Exacerbation of **steroid responsive lung disease** (Fibrosis, Allergic Alveolitis, Pulmonary Vasculitis +/- autoimmune) • Consider in **COVID-19 and CAP ➔**	**Acute complications of steroids**: • HIGH BSL • Fatigue / weak • Immunosuppressed • delirium/psychosis

ABG INTERPRETATION

How to interpret ABG/VBG?

1) Check pt details and ALWAYS CHECK OTHER RESULTS (**Hb, lactate, BSL, K**)
   a. Circle HIGH and LOW values
2) **Is it venous or arterial**? → *Do I need ABG or VBG?*
   a. *If ventilating/sepsis* = ***need ABG***
   b. *If chronic lung disease/DKA* = ***VBG + SaO2***
   c. ***DO NOT*** *DO* ***ABG*** *ON ROOM AIR IF PATIENT IS HYPOXIC*
3) **If resp. acidosis → check A-a gradient** (diffusion issue?)
   a. High A-a = lung issue (NOT CNS)
4) **If NO resp. or metabolic cause ➔ check Base Excess (-2.5 to +2.5)**
   a. < -2 = acidosis
   b. > 2 = alkalosis
   c. Is there another cause of the acidemia or alkalemia?
5) **If metabolic acidosis → check Anion Gap to determine if:**
   a. (1) **intrinsic loss** (i.e. renal, DKA, Lactate) or
   b. (2) **extrinsic acid** (e.g. methanol, anti-freeze)
6) **Respect buffering** (HCO_3 may be normal) → ECF (HCO_3) Blood (Hb), ICF (PO_4) buffering
7) **Summarise findings**

This patient Is a_____aemic Due to a primary _____ ____osis With partial/full _____ compensation

Severity of T1RF: P:F ratio or S:F ratio [ONLY from ABG]

P:F ratio = $\frac{PaO2}{FiO2}$ or $\frac{satsO2}{FiO2}$

In ARDS = <300 (mild), <200 (moderate), < 100 (severe)

A-a gradient (difference b/w o2 conc. in alveoli and arterial system)

$$\text{A-a gradient} = P_{AO2} - PaO2 \cong \frac{Age}{4} + 4$$

$$P_{AO2} = FiO2 \times (P_B - P_{H20}) - \frac{PaCO_2}{RQ}$$

Cause for hypoxia	A-a gradient	Corrected with high FIO2?	Causes
Low FIO2	Normal	Yes	High altitude, hypoxic gas mixture
Hypoventilation	Normal	Yes	Residual anesthetic, muscle relaxants
Diffusion	Elevated	Yes	Interstitial lung disease
V/Q mismatch	Elevated	Yes	Mucus plug, pulm embolism, COPD
Shunt	Elevated	No	Atelectasis, ARDS

First formula:

Anion gap=Na^++K^+−(Cl^-+HCO_3^-)

Second formula:

Anion gap=Na^+−(Cl^-+HCO_3^-)

Value of Anion Gap

normal:

8 - 12 mEq/L (if without potassium)

12 - 16 mEq/L (if potassium is given)

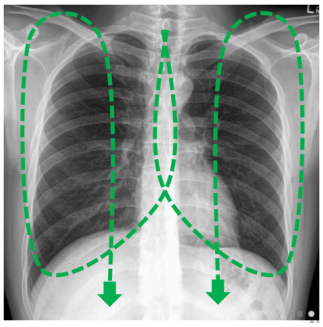
Is there an anion that is NOT measured? E.g. albumin

$$H^+ + HCO_3^- \rightleftarrows H_2CO_3 \rightleftarrows CO_2 + H_2O$$

Metabolic acidosis = uses up HCO3 ➔ Low HCO3 on ABG/VBG

	pH	pCO_2	HCO_3^-	Cause
Normal	7.35-7.45	35-45mmHg	22-26 mmHg	
Resp. acidosis	↓	↑	**Normal (ACUTE)** *mainly from intracellular Hb, PO4 buffering ↑ (CHRONIC) * ↑↑ 1mM HCO3 = ↑↑ 10mmHg PaCO2 (occurs after 24 hrs w/ max response at 3-4 days)	↑VCO2 (↑CO2 production) / ↓V_A (↓Alv ventilation) **Acute**: • Fever • Increased catabolism ○ Sepsis ○ Steroids ○ Burns ○ Pancreatitis • Thyrotoxicosis / • **APO, pneumonia (T2RF + raised A-a)** • **CNS depression** = *Narcotics / opiates, Post-op Sedatives*, stroke, SCI • **Upper airway obstruction** (aspiration, laryngospasm after intubation, anaphylaxis) • **Hypoventilation (T2RF + normal A-a)** • **Mechanical ventilation** (hypoventilation, permissive hypercapnia) **Chronic**: • Metabolic acidosis (CKD) / • **Upper airway obstruction** (OSA) • **Chest wall deformities** (scoliosis, pectus excavatum, rib fracture) • **X-Lung disease** (COPD, asthma) • **NMD** (MG, DMD, neuropathy) • **Obesity hypoventilation syndrome**
Resp. alkalosis	↑	↓	**Normal (ACUTE)** *mainly from intracellular Hb, PO4 buffering (within 10mins – max response at 6 hrs) ↓ (chronic) ↓↓ 5mM HCO3 = ↓↓ 10mmHg PaCO2 (from 6 hrs to 2-3 days)	**CNS**: • Pain • Agitation / Panic = ↑PO_2 • Encephalopathy (ureamia, hepatic, infective) **Lung**: • **PE, pneumothorax → ↓PO_2** • **XS ventilation** (mechanical) → good V, poor Q • **High altitude** – Mt Everest • **Compensatory Kussmaul** – DKA **Other**: • **VERY ILL = Sepsis!!!** • Drugs – salicylates • Progesterone
Metabolic. Acidosis (L TKR)	↓	↓ **Expected PaCO2 = last 2 digits of pH** (for resp. compensation)	↓	**High anion gap metabolic acidosis (HAGMA)**: **Toxins → MUDPILES** 1. **Lactate** • IV adrenaline • Metformin 2. **Urate or XS H+** (RENAL FAILURE) • XS PO4, suplhate, Hippurate • Type 1 RTA • rhabdomyolysis 3. **Ketones** • DKA (T1DM, SU, Insulin) • Starvation state (AN) • Alcoholic 4. **Alcohol (toxins)** *Ethylene glycol (anti-freeze) = osmolar gap **Pyroglutamic acid = XS N-acetyl cysteine **Normal anion gap metabolic acidosis (NAGMA)**: 1. **Increase Cl** (**negative** UAG) • NaCl • TPN 2. **GI HCO3 loss** (**negative** UAG) • Small bowel (diarrhoea) • Stoma output • Pancreatic / biliary loss /drains 3. **Renal HCO3 loss** (**positive** UAG) • RTA • Acetazolamide • HypoAldo (spironolactone) • compensation
Metabolic. alkalosis	↑	↑	↑	• *Above Stomach loss* = **VOMITING, NGT/NPA aspiration** • **Exogenous HCO_3^-** = Overcorrection IV or Milk alkali syndrome (XS Mylanta – antacids) • ***K+ depletion*** ➔ Cushing, diuretic +/- diarrhoea • ***HyperALdo*** ➔ *Conn's , cirrhosis, HF, loop and thiazides*
Mixed acid base	• Mixed metabolic acidosis/alkalosis • Mixed metabolic and respiratory			• Lactic acidosis/DKA with vomiting (met acid + alkalosis) • Salicylate poisoning (met acid + resp. alkalosis)

CXR Checklist [PA = good, AP = crAP!]



First pass

Trachea

Mediastinum

Cardiac borders

Costophrenic angles

Soft tissues

Bones

Below diaphragms

Review areas

Pneumomediastinum

Retrocardiac

Apices

Below diaphragm

1. **Intro** (Pt Name, DOB, date, projection, quality → RIPE)
   a. **Rotation –** medial border of clavicle heads equidistant to spinous process
   b. **Inspiration** – see 6 anterior ribs, MCL
   c. **Position** – supine, erect, lateral, decubitus
   d. **Over-exposure (black)**, under exposure (white) – VERTEBRAE JUST VISIBLE BEHIND HEART
2. **AIRWAY- tracheal/mediastinal deviation (*? patient rotation*) OR obvious masses**
3. **BREATHING –** lung fields, pleura, hilar region
   a. **Air** (?**pneumothorax**, emphysema)
   b. **Fluid /meniscus sign**(? **Effusion**)
   c. **Consolidation** (?**infection**)
   d. **Lobar collapse**
   e. **Lesions** (e.g. **malignancy, abscess**)

   Pleura
   - Pleural plaques (?asbestosis)
   - Calcification

   Hilum
   - Bilateral enlargement (?sarcoid)
4. **BONES/BREAST SHADOW**
   a. Obvious fractures- clavicles, flail ribs
   b. Scoliosis, lytic lesions
   c. METs
   d. Pectus excavatum
5. **CIRCULATION**
   a. ***Cardiomegaly 2° to HF*** *(> 50% cardiothoracic ratio – adults, > 65% infants)*
   b. *Heart border (R = RA, L = LV)*
   c. *Aortic knuckle should be visible*
   d. *Mediastinal width (>8cm = **aortic dissection**)*
6. **DIAPHRAGM**
   a. **high riding** – phrenic nerve palsy, DMD, MND, MG
   b. **Flattening –** obstructive lung disease (emphysema, asthma)
   c. Air under diaphragm – pneumoperitoneum (abdo perforation)
   d. Blunting costophrenic angles – pleural effusion
7. **EXTRA DEVICES**
   a. **CENTRAL LINE** = internal jugular vein → CVS and cavo-atrial junction
   b. **NGT** =below diaphragm at tip of stomach
   c. **PICC line** = peripheral → cavo-atrial junction
   d. **Portocath** = Subclavian vein → cavo-atrial junction
   e. **ETT** = mouth →3-5cm above carina (level of aortic knuckle)
   f. **Chest drain** = in pleural space
   g. **ECG electrodes**
   h. **Sternal wires (previous open heart surgery)**

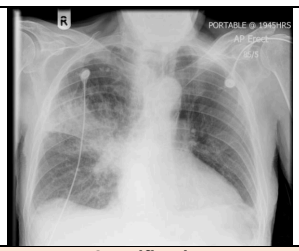
Key knowledge:

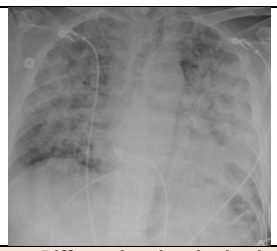
- [**BLACK**: air > fat > soft tissue > bone [WHITE]
- *Describing abnormality*:
  - **Density** (relative to what?, uniform vs patchy?)
  - **Left vs Right** (Which zone?)
  - **Anatomical position** (pleura vs parenchyma)
  - **Size + borders**
- **MOBILE CXR →** LARGE HEART + SEVERE ROTATION

Summarise

- **This is an erect PA CXR of ____ showing ____. To complete my analysis, I would examine previous films and ascertain the clinical hx**
- **My ddx ____.**
- **Investigations I would order ____**

Common presentations/DDx





Opacification (NOT just infection)	**Diffuse alveolar shadowing**
• Non-uniform opacification indicating substance in **alveoli** • **air-bronchograms** (visible bronchioles penetrating consolidated area)	**Alveolar oedema caused by fluid filling the alveoli and small airways** ➢ may typically see "bat wing's distribution"

DDx: for opacification

- **Fluid** (pus, serous, blood)
- **Infection** / Pneumonia
- **Atelectasis** / collapse
- **Mass**/ Cancer
- **Trauma** / contusion
- **Infarction**
- **Emboli**

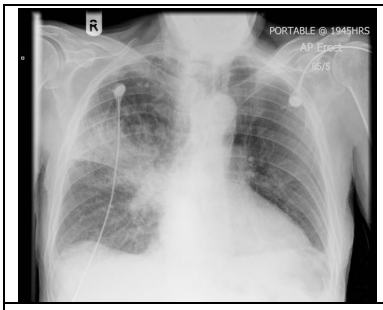
Basic	**Extended**
➢ Pneumonia (viral – COVID atypical, pHP) ➢ APO ➢ Pulm. Fibrosis	➢ Pulm. Haem ➢ Extrinsic allergic alveolitis ➢ Vasculitis ➢ Lymphangitis ➢ Miliary pattern (TB, old chicken pox)

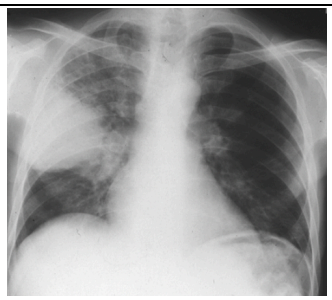
Opacity	Pathology	Opacity (L)	Pathology
R paratracheal stripe	RUL Ant. Mediastinum	Aortic knuckle	LUL
R heart border	RML	L heart border	Lingula
R hemidiaphragm	RLL	Left hemidiaphragm	LLL

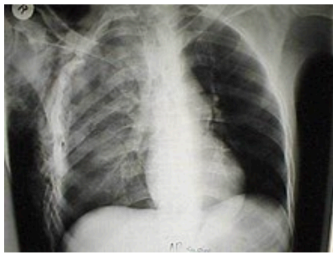
***Nb: Can have mixed pathology (both lobes affected)**

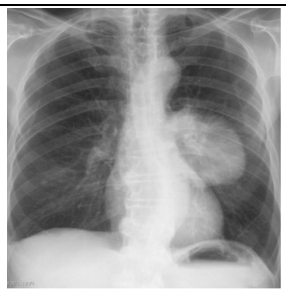
Pneumonectomy	• No lung markings • Mediastinal and tracheal shift	
Pneumoperitoneum	• Perforated viscous • Post-op laparotomy	
WHITE-OUT	**White out of mediastinum:** • Towards = collapse • Away = effusion • Middle = both	**Other causes = ARDS** • Sepsis, • trauma, • DIC, • burn, • O2 toxicity, • fat embolism

COMMON PRESENTATIONS

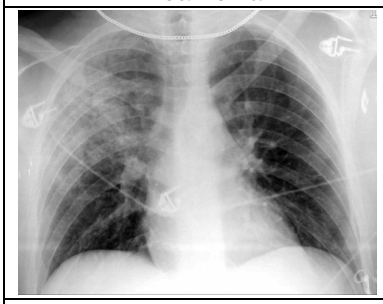


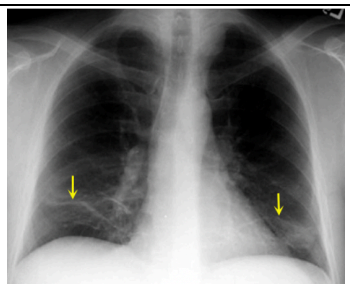


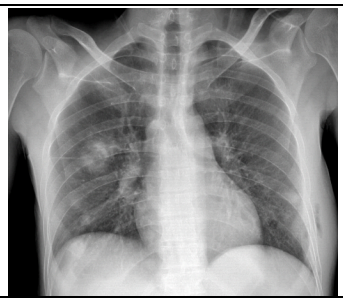


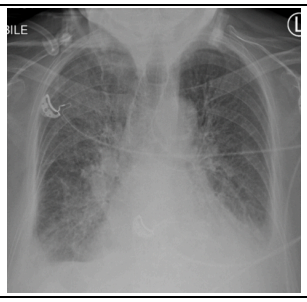


Pneumonia | **Infarction** | **Trauma** | **Cancer**









Haemorrhage

Atelectasis

- Affected lobe is smaller
- Raised diaphragm ipsilateral
- Structures moved towards collapse

Cause: obstructive, pneumothorax

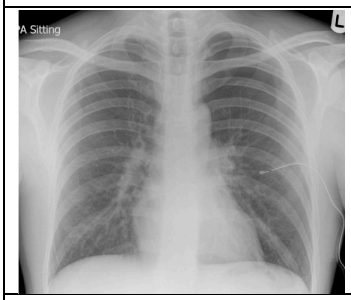
Emboli

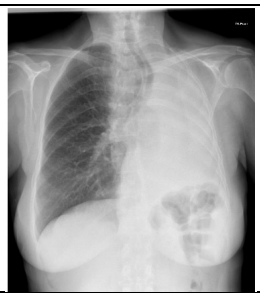
APO

- **A**lveolar shadowing (bat wing)
- Kerley **B** lines (i.e. *lymphatic congestion in lateral lower edge*)
  - *Kerley A – apical,*
  - *Kerley C - central*
- **C**ardiomegaly
- Upper lobe venous **D**iversion
- **E**ffusion

Rx:

1) GTN
2) NIV ventilation
3) Diuresis w/ furosemide (if BP stable)





Pneumothorax

- Best on expiration film
- Absent lung markings
- Mediastinal shift
- Surgical emphysema?

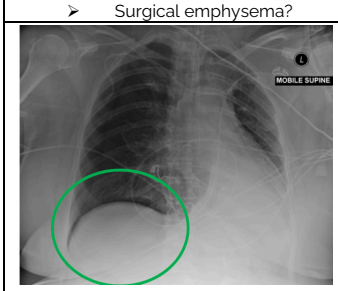
Tension pneumothorax`

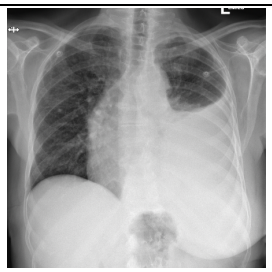
- **Cannula 2nd IC MCL**
- **Finger thoracostomy**
- **Chest drain**

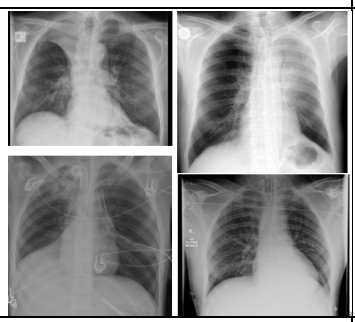
- **Surgical emphysema**

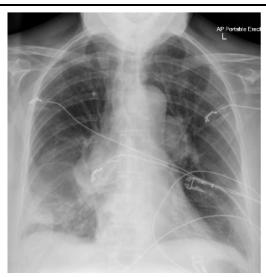
Effusion vs mass

-









Supine pneumothorax`

- Deep sulcus sign
- Lung edge
- Mach effect

L) pleural effusion

- Dense opacification + Blunting CP angles + Meniscus sign
- ***Transudate*** *(nephrotic, liver, CCF e.g. dilated CM, thyroid, ovarian - Meig's, enteropathy)*
- ***Exudate*** *(PE, infection, infarction, inflammation, neoplasm, TB)*

General Rx

- **Pleural tap –** send for cytology, LDH, pH, protein, glucose
- **Chest drain**

Lobar Collapse

- **Endoluminal (sputum, blood)**
- **Luminal (cancer, infection e.g. acute bronchitis)**
- **Extraluminal (LN, cancer)**

General Rx

- Early Abx (e.g. augmentin)
- Chest PT
- CT to exclude malignancy

Focal infiltrate in HTN and smoker

- Pneumonia AND
- Cancer

General Rx

- Early ABx for CAP (7-10 day benPen 1g tds PO)
- Repeat CXR to confirm resolution

C- CIRCULATION / SHOCK

Diagnosis of shock

Shock is a cellular state of hypoperfusion

Hx	• **Collapse, syncope** • **Signs of End-organ hypoperfusion** (chest pain, confusion, abdo pain, oliguria) • **Compensatory signs –** WoB, kussmaul, polydipsia
Exam	• **Witals → ↑RR, ↑HR, ↓BP, Sats, Temp** • **Warm - Capillary refill time, pallor, diaphoresis** • **Wet /dry (fluid status) –** oliguria, MM, bibasal crackles, oedema • **With it - GCS/Confusion / Drowsiness**
Tests	• **Wactate - Lactate (VBG) – good to monitor to response of treatments** • **CRP**

Non-invasive tests	Semi-invasive tests	Invasive tests
• **Existing monitoring** – Sats, ECG • CXR • TTE • Impedance	• **Arterial Line** • TOE • Oesophageal doppler	• **PICCO** – trans-pulmonary thermodilution • **Swann-Ganz** – right heart thermodilution • CVO2/MVO2

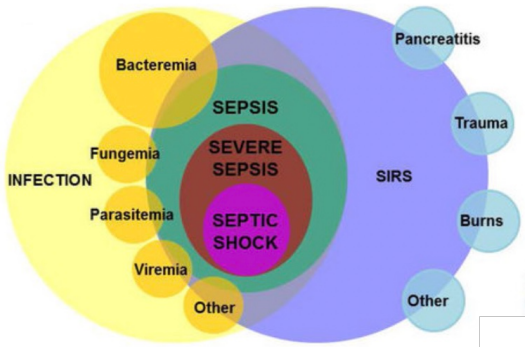
General Acute Mx of shock

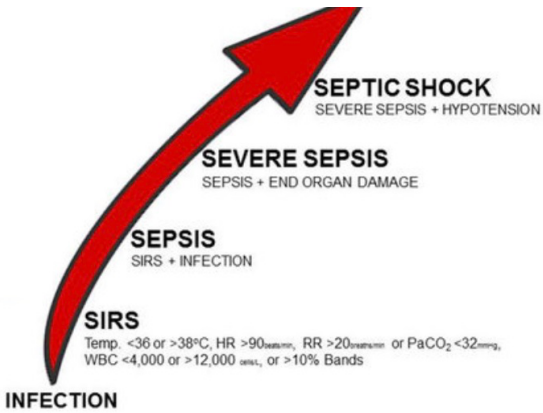
1) Triage - CAT1-5
2) Transfer to appropriate area (e.g resus, bed)

A	**Unconscious / Procedures**
B	**High work of breathing → sats , RR, FiO2**
C	**Arrythmias / Cold or warm peripheries** ➢ **ECG** ➢ **IV Access x2 → Bloods – FBC, EUC, LFT, troponin, VBG, culture M/C/S** ➢ **USS – FAST** ➢ **UA** **Optimize hemodynamics** **1. Check if fluid responsive 1st** a. **Straight leg raise, calf pump or lie supine to increase VR** **2. Restore intravascular volume "like for like"** a. **IVF crystalloids** vs **colloids (alternate each day – reduce acidosis)** b. **Listen to chest for APO –** *bibasal crackles* → ***consider reducing fluids and adding FiO2*** 3. **Maintain BP with vasopressors MAINLY** → target MAP > 65, SBP >90 **4. Assess and optimize CO** **5. Decide when to stop (e.g. not working or APO) → DO CXR!!**
D	**Delirium – 4AT**
E	**Bleeding, Melaena, Hypothermia – check foo rashes**
G	**Hypoglycemia, , abdo exam,**

Types of shock + Mx

SIRS	**(at least 2 of these to meet criteria)** 1. Body temp >38°C or <36°C, 2. HR > 90/min 3. RR > 20/min or PaCO2<32mmHg 4. WCC >12.0 x 10^9/L or <4.0 x 10^9/L	*Pathophysiology*: 1) Raised pro-inflammatory mediators (IL-1,6 and TNF-a from macrophages activates neutrophils, platelets and endothelial cells) → DIC + increased vascular permeability 2) Raised acute phase proteins (buy time) 3) HypoTN, hypoperfusion, hypoxia
Sepsis	• Life-threatening organ dysfunction caused by a dysregulated host response to infection	
Severe Sepsis	• Sepsis + evidence of organ dysfunction (e.g. hypoxia, oliguria, AKI, Coag dysfn, hypoTN, raised lactate > 2mM, thrombocytopenia)	
Septic Shock	• Sepsis + arterial BP drop causing organ hypo-perfusion ➢ Systolic BP < 90 (DESPITE adequate fluid resus) ➢ Raised lactate > 4mM	
Septicaemia	• Bacteria enters bloodstream triggering sepsis (e.g. meningococcemia)	
Bacteraemia	• Bacteria in the bloodstream. May or may not cause SIRS or sepsis.	
Risk factors	• Extremes of age (<1 yo or > 75 yo) • Chronic conditions (e.g. COPD and diabetes) • Chemo, immunosuppressants and steroids • Recent surgery, trauma or burns • Pregnancy or peripartum • Indwelling devices (e.g. catheters and central lines)	





qSOFA score

IF SCORE > 1 THEN INVESTIGATE FOR PRESENCE OF ORGAN DYSFUNCTION AND INCREASE FREQUENCY OF MONITORING

Sequential Organ Failure Assessment → measure mortality in ICU

- Quick **SOFA** (≥ 2 of the following = **HIGH** Mortality
- GCS < 15, RR >=22, sBP <100
- Febrile
- Reduced UO- cloudy urine

Define sepsis and specific definitions within sepsis

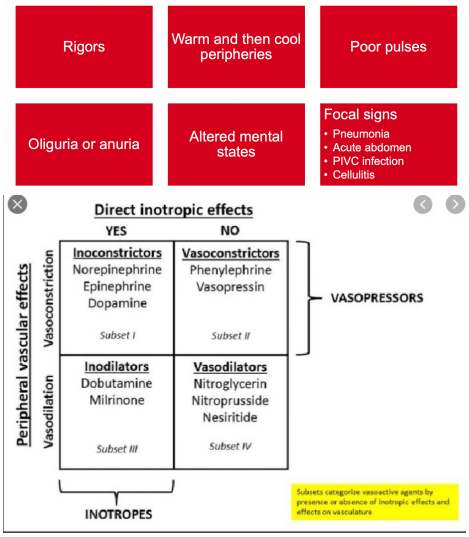
Sepsis Risk factors

- Male
- Diabetes (risk factor for any disease)
- Race
- Co-morbidities
- ***Immunosuppressed*** – post-transplant, immunosuppressants, HIV,
- Genetics
- Age

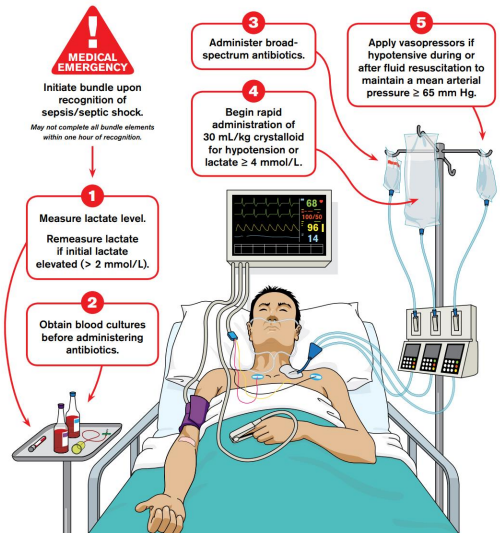
Sepsis Pathway:

1. **Dx early** (check vitals)
2. **Airway + FiO2**
3. **IV access** – blood culture + baselines (*FBC, EUC, LFT, CRP, BSL, X-MATCH, COAGS*) + lactate (*VBG*)
4. **Early Abx** (within 1 hr)
5. IV fluid bolus (shock) – 250-500mL NS/Hartmann/plasmolyte
6. **Find source (examine top-toe)** → Dx samples (if time) - pus, sputum, urine
7. **Restore haemodynamics** (fluid balance + UO monitor + vasopressors)

Clinical signs



Management (Ix)



Case 1 32 y BIBA + palpitations (sudden onset)	Case 2	Case 3
• Straight to Resus - BP 120/70 - PR 180 regular -RR20 - Sats99%RA - Afebrile - Glucose 6.2 • Has had similar episodes all self resolved • All other examination normal	• Straight to Resus - BP 80/60 - PR 180 regular - RR35 - Sats99%RA - Temp 39.6 - Glucose normal • Dry skin, • **Warm and mottled peripheries** – • Becoming drowsy and confused • Looks sick	• Straight to Resus - BP 180/120 - PR 180 regular RR35 - Sats99%RA - Temp 40.2 • Sweaty • Tremulous • Confused
SVT **Causes** hypovolemic shock → reduced diastolic filling time • low EDV → low SV → low CO • reduced coronary artery filling = STEMI	**Septic shock (febrile)** Possible underlying SVT?	**Thyroid storm (high output state)** • Confused & increased demand (everything elevated) • ↓ BP = septic shock

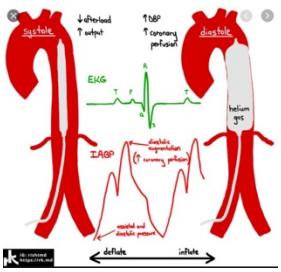
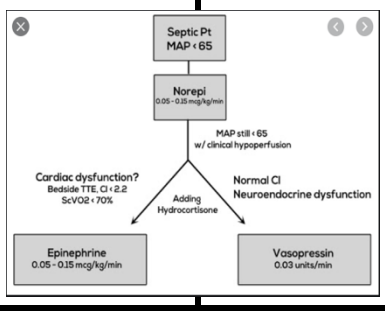
SHOCK QUESTIONS

A 19-year-old male is brought to the hospital after sustaining an abdominal injury while playing rugby. He is complaining of left upper abdominal pain and has some bruising over the same area. His pulse is 140/min and his BP is 100/82mmhg.	A 82 year-old male is brought to the hospital after a high speed mva. He has no pain. His pulse is 55/min and his bp is 100/82mmhg.	52 year old lady with intermit mild chest pain radiating to her right arm and back. Onset 1 hour before presenting to the emergency department. Came to ed because it "just didn't feel right" • Obs – pr 105, bp 110/60 • Afebrile • Rr 20 sats 95% ra • Glucose normal • Cool peripheries	24 year old. Presenting with period pain. • Obs – pr 105, bp 125/80 • Afebrile • Rr 20 sats 97% ra • Glucose normal • Cool peripheries
What is the type of shock? **Hypovolaemic – splenic rupture?**	***What is the type of shock?*** • 1st Hypovolaemic – insufficient information – likely on BB due to his age causes **false HypoTN** • 2nd Neurogenic (distributive) – cannot assume immediately	***Cardiogenic shock (post-MI)*** • Obstructive – PE, pneumothorax • PANIC ATTACK? ***Investigations*** • Serum cardiac markers – troponin, CK-MB ECG – sinus tachycardia (no ST elevation) → most likely PE • CXR - pneumothorax • CTPA – PE (+ d-dimer, V/Q perfusion)	***Hypovolaemic shock*** • Ruptured ectopic pregnancy • Look well then rapidly deteriorate ***Ix:*** **B-HCG, FBC, EUC, ESR/CRP, BSL**

SESPIS QUESTIONS

Case 2	Case 3	Management of case 3	
A 62 Year Old Female Presents With Fever Of Unknown Origin. BP 100/60 PR 120. RR 20 MILDLY CONFUSED, GCS 14,. **WHAT IS HER SHOCK INDEX** 1.2	26 year old, personal trainer, lover of sandals BAT call – collapse at home, febrile, confused • BP 100/70 • PR130 • Fever to 39.8 • Sats 89% RA • Warm, dry peripheries **History from girlfriend Meg** ➔Recent arrow to left foot, in between sandal straps	Comp.?	• Sepsis, severe sepsis • Multiorgan dysfunction – ARDS, Mental status • Source – foreign body
		Rx	1. Airway - nonrebreather (inc. COPD) – low sats + SOB 2. Antibiotics – ceftriaxone (check guidelines – e.g. flu) 3. IV fluids – Hartman's → NA 4. Pressors – Noradrenaline Source control - steroids?

Types of shock + Mx

Shock type	Hypovolaemic	Cardiogenic	Distributive			Obstructive
			Neurogenic	Septic	Anaphylactic	
Cause	**Haemorrhagic** • **(**big 5 → chest, abdo, external, long bone, pelvis) **> Aortic dissection** **> UGIB/LGIB** **> mallory Weiss / Boorheave** **> menorrhagia** **Non-haemorrhagic** • **Electrolyte imbalance** (V + D, Dehydration, insensible losses, pancreatitis) • **Burns** • **Inadequate intake (**long lie / immobility)	**Electrical** • **Tachyarrhythmia** - AF + RVR, VT/VF (AF → ↓ EDV → ↓CO by 20%) • **Bradyarrhythmia** - complete HB, BBB • **Drugs =** BB, CaB, digoxin, sotalol, amiodarone **Structural** • **Myocardium** = Dressler, CHF, CMP free wall rupture, myocarditis • **Valvular =** AS, endocarditis (IE), AR, valve rupture, papillary muscle rupture	• *paraplegia,* • *acute SCI* • *spinal anaesthesia)* **SNS inactive – no signals sent to brain → vasodilation of SVR**	**40% mortality rate** • Bacteria - Gram +ve/-ve • Fungi • Virus • Protozoa • Causes pain (if attacks nerves) **Other distributive causes:** ➢ **Endo**: Adrenal / thyroid / vasopressin insufficiency ➢ **Electrolytes**: CMP, EUC ➢ **Toxins –** alcohol ➢ **Drugs –** Metformin, serotonin syndrome, aspirin	• Drugs (ACEi, C1 esterase def., anaesthetics) • Food / bites • Idiopathic **DDx (SCRAM)** ➢ Scrombotoxin ➢ Carcinoid ➢ Red-man syndrome ➢ Alcohol-related ➢ Medullary carcinoma of thyroid ➢ Acute GORD ➢ Dystonic reaction	**↓preload + ↑afterload** (↓venous return) • Tension pneumothorax • Massive PE • Cardiac tamponade (blood, serous fluid) • Pleural effusion • Air embolism
CR	Long + Cool/dry		Short + Warm/dry (due to vasodilation)			Long + Cool/dry
HR	↑↑↑	↓↓↓	↓↓↓	↑↑↑	↑↑↑	↑↑↑
CO:SVR	CO < SVR	CO < SVR	CO > SVR "heart squeezing hard but high distribution/leaky BVs makes it difficult to perfuse organs"			CO < SVR
Ix	• FBC (blood loss) • EUC • CXR • Pelvic XR (pelvic #) • eFAST (abdo)	***Examination*** • murmurs ***ECG signs:*** • AMI signs, LVH, SVT ***CXR = Acute pulmonary oedema*** ***ECHO –*** *determine need for fluids vs ionotropes*	• Sphincter dysfn • Paraesthesia • Weakness • **Signs opposite to typical shock**	**3 tests:** ➢ Blood lactate (VBG(➢ 2x sets Blood cultures ➢ Urine output **3 treatments:** ➢ O2 (maintain 94-98%) ➢ Empirical broad spectrum Abx ➢ IVF +/- inotropes (maintain MAP >65 mmHg)	• **Rash** (urticaria) • **Wheeze** • **Gut pain, Oedema, Angioedema** – IgE released → mast cell degranulate → histamine → vasodilation -	***Tension PTX*** • Distended neck veins • Dev. trachea ***Beck's Δ (tamponade)*** • HypoTN • Muffled heart sounds • Distended veins
Rx/Mx	*Acute Mx:* • **Warm IV bolus NS** (500mL in < 15 mins) – lower if elderly • **Vasopressors (↑ SVR)** • **TXA** • **Group + X-match (pRBC with O neg)** *Surgical Mx:* • Surgical /radiological / endoscopic surgery → trauma, blood loss, intra-abdominal issue • Embolise bleeding vessel • Endoscopic clipping (variceal bleeds) **Maximizing oxygen delivery → maintain tissue perfusion** **1) Target MAP >65** **2) normalise lactate** **3) CVP monitoring** **4) Target CPP = 50–70 mm Hg (as per BTF guidelines)** 5) Intubation, ventilator (if ≤30 cmH₂O) 6) Transfusion (if Hb < 70, plt < 20) High vol. hemofiltration in severe met acidosis or renal failure	• **Ionotropes** MAINLY (e.g. dobutamine, adrenaline) to increase cardiac output **Fluid challenge rarely useful (NOT fluid responsive)* To improve diastolic filling of coronary arteries and reduce afterload • **Mild hypothermia can improve neuro outcome of STEMI** • CT Angiography • PCI - stents • Thrombolysis  *intra-aortic balloon • TOO HIGH = block L SCA • TOO LOW = block renal flow (pre-renal)	Check for bleeding 1st (? spinal trauma) e.g. may be bleeding out but is on a BB ↓ (1) Rule **OUT** hypovolaemic shock ↓ (2) Rule **OUT** drugs and poisons (e.g. opioid, nitrate, BB) ↓ (3) AVOID over rehydration with fluids) ↓ (4) Beware that vasopressors reduce BP	**Hemodynamic resus (SEPSIS 6)** • **Treat within 1 hour** • **IV fluids crystalloids 20mL/kg** ○ NS vs Hartmann ○ Monitor acid-base • **Vasopressors** ○ **1st line:** NORAD, metaraminol, vasopressin ○ **adrenaline** (for arrhythmias or splanchnic ischaemia) **Early Abx (within 1 hr after cultures)** • Local guidelines – **vancomycin, tacozin** → narrow spectrum (after culture result) • *Source control* = debride, remove, drain septic source, repair perforation **Maximizing oxygen delivery → maintain tissue perfusion** **1) Target MAP >65** **2) normalise lactate** **3) CVP monitoring** **4) Target CPP = 50–70 mm Hg (as per BTF guidelines)** 5) Intubation, ventilator (if ≤30 cmH₂O 6) Transfusion (if Hb < 70, plt < 20) 7) High vol. hemofiltration in severe met acidosis or renal failure	• **Stop source/allergen** • **Lie flat** • **IM adrenaline (500mcg – adults) (300mcg - >6 yo, pregnant) (150mcg < 6yo)** • **High flow FIO2** • **Monitor IV fluid** (if hypoTN) • **IV/IM hydrocortisone 200mg of 4mg/kg** **For children CPR:** • 1-hand (≤ 8) • 2-hand (> 9) • Chest compress (100-120bpm) • 15 comp/2 breaths for all children  	***Bedside*** • ECG - Right heart strain (for massive PE) – T wave inversion in INFERIOR LEADS AND V1-3) • CXR = Pneumothorax • PE = thrombolysis (TPA agents) +/- embolectomy • PTX = needle decompression • Tamponade = percardiocentesis

5) Cervical shock – Missed M/C → HypoTN in high -B-HCG women → need to remove POC (Avoid XS fluid resus)

6) High Output Heart Failure shock (XS Vasodilatation + XS O2 demand → chronic ↑CO → chronic ↑preload + ↓SVR)

- beri-beri (systemic vasodilatation),
- thyroid storm (thyrotoxicosis),
- obesity
- Myeloproliferative disorder

- severe, anaemia
- Paget's disease
- Cirrhosis
- AV fistulas

Medications to optimize MAP = Guarding the Perfusion Pressure

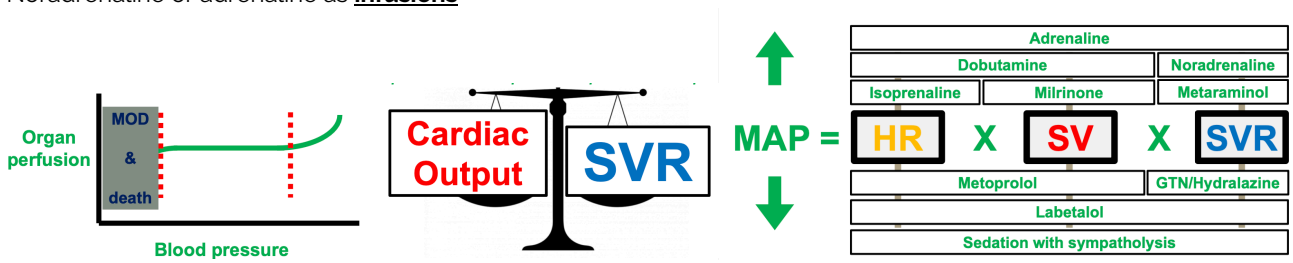
General Principles

- Ensure adequate organ perfusion (MAP) to prevent end-organ dysfunction (MOD and death)

Don't forget to treat the underlying cause e.g.

- **Fluids** → hypovolaemic shock
- **Thrombolysis** (streptokinase) → massive PE
- **PCI** → cardiogenic shock due to MI
- **Adrenaline** → anaphylaxis

Use vasoactive agents to maintain Blood Pressure

- Typically Mean Arterial Pressure (MAP) > 65 mmHg)
- Metaraminol in **boluses or infusion**
- Noradrenaline or adrenaline as **infusions**
- 

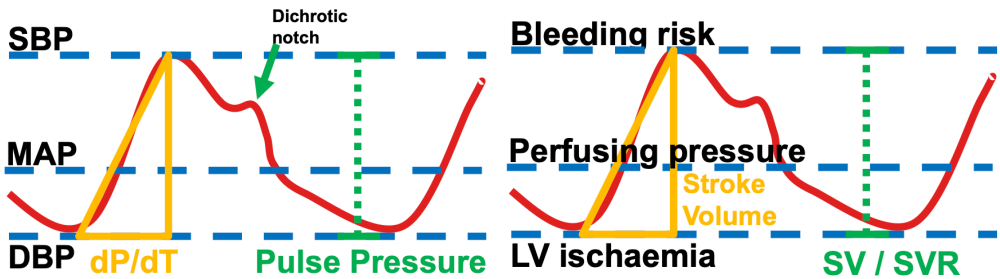
* ***Excessive*** *increases in either CO or SVR does* ***NOT*** *restore normal organ perfusion despite adequate blood pressure*

	MoA / drug class	HR (chronotropy)	SV (inotrope)	SVR
Positive chronotropy				
Isoprenaline (synthetic)	B-agonist			
Atropine, glycopyrrolate	Anti-cholinergic			
Negative chronotropy				
Labetalol	NSBB + alpha blocker			
Diltiazem	CCB			
Digoxin, amiodarone	**Anti-arrythmias**			
Negative chronotropy + inotropy				
Metoprolol	Cardio-Selective BB			
Verapamil	CCB – avoid in HF or LVF			
Positive inotropy				
Dobutamine (Catecholamine)	B agonist + chronotropic +)			vasodilator
Milrinone (PD3E inhibitor)	intracellular Ca2+ + some chronotropic			
Levosimendan (PD3E inhibitor)				
Positive inotropy + Vasopressor				
Adrenaline (Catecholamine)	B agonist (low dose), A – agonist (high dose) Anaphylaxis, hypoTN			High dose
Vasopressor – alpha agonists				
Noradrenaline (vasopressor)	**a1 agonist - ONLY via central line IV**		High dose – due to high SVR increasing LV afterload to reduce SV	
Metaraminol (vasopressor)	**a1 agonist -** peripheral IV or bolus – causes reflex bradycardia and tachyphylaxis**)**			
Vasodilators				
GTN, hydralazine	**Nitric oxide donors**			
Amlodipine, Clivedpine	**CCB**			
Prazosin	**a-Blocker (beware of postual HypoTN and reflex tachycardia)**			
FINAL RESORT				
Sedatives	**Sympatholysis – bradycardia and vasodilitaiton**			

CARDIAC MONITORING

	What?	Why?	How?
ECG	• Rate • Rhythm • ST segments • PR / QT intervals	• Arrhythmias • Ischaemia • Drug toxicity • Electrolytes	• Repeat 12 lead • Continuous
Blood pressure	• SBP • DBP • MAP • Pulse pressure • Variations with respiration	• Vasopressor requirement • • Risk of deterioration	• NIVBP • Arterial line
Cardiac Output	• Cardiac Index • ?volume responsiveness • ?volume overload	• Assessment • Response to therapy • Guide therapy	• ECHO • Pulse Contour • Thermodilution

ARTERIAL LINE



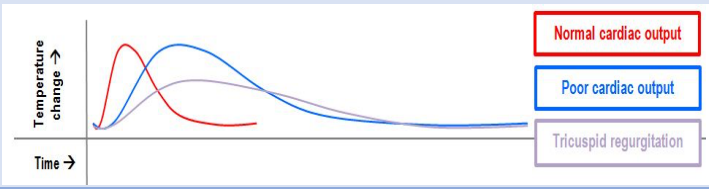
	Advantages	Limitations

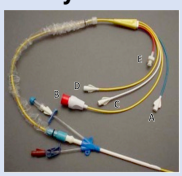
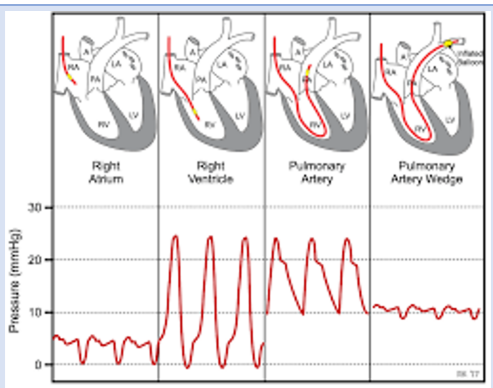
Non-invasive	• Instantly available
	• Avoids complications of arterial line
		• Limited time cycle (i.e 1 per minute)
		• If required frequently
		  • Irritating (sleep etc)
		  • • Bruising
		• Cannot be done over PICC lines

Arterial line	• Continuous monitoring • Phlebotomy
	• Monitor lactate
	• Additional information
	  • Cardiac Output
	  • Respiratory variation
		• **<u>Complications</u>**
		  • Insertion (arterial injury)
		  • Distal ischaemia
		  • Exsanguination
		• SBP and DBP may be unreliable
		• Limit patient mobility

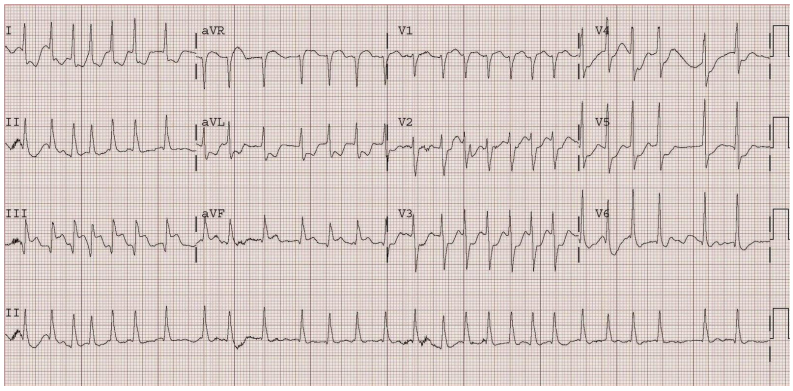
CARDIAC OUTPUT MONITORING

	Procedure	Waveform

Thermodilution CO	• **Cold saline injected into central vein**
	• Measures temp. change in anterograde BV
	  • Pulm. Artery (R heart)
	  • Femoral artery
	• Area under curve = inversely proportional to CO
		

Pulse Contour Analysis - PiCCO	• **Uses femoral artery line and upper body CVC** • Check the trends	
Pulmonary artery catheter 	• Gold standard of CO monitoring • Uses pressure transducer and thermistor in pulmonary artery *<u>Complications</u>* ➢ Ruptured pulmonary artery ➢ VT	

GENERAL ARRYTHMIA MX:



PC: 65 M w/ 3 hrs of palpitations, light-headedness, chest pain appearing pale and diaphoretic

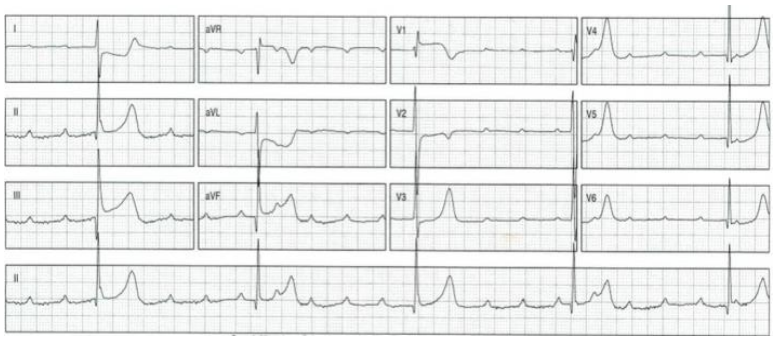
Working out

1. **Fast AF**
2. **Inferior ST elevation**
3. **Anterolateral ST depression**

Dx = myocardial ischaemia with unstable rapid AF

Mx:

1. Rate control – BB, CaB
2. Rhythm control
3. ACS treatment - PCI → BB, aspirin, statin, clexane



PC: 42 F w/ altered mental state and PMHx of epilepsy presents with bradycardia and hypotension

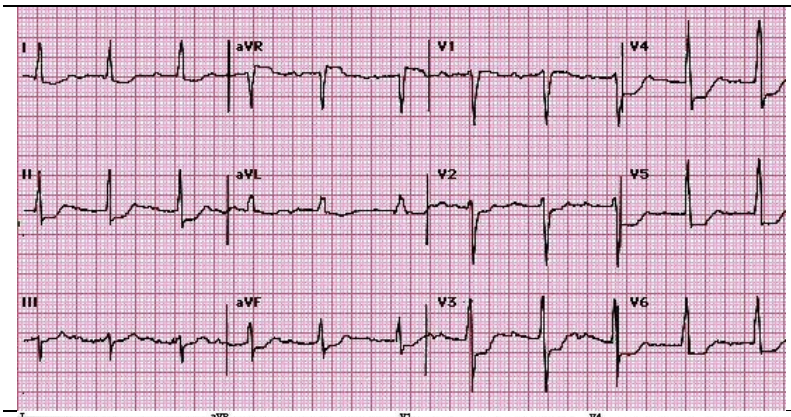
Working out

1. **Complete heart block**
2. Inferior ST elevation
3. Lateral ST depression

Dx = inferior MI associated with complete heart block

Mx:

1. Speed up rhythm
2. PCI



PC: 85 M w/ coffee ground vomit since AM and severe epigastric pain

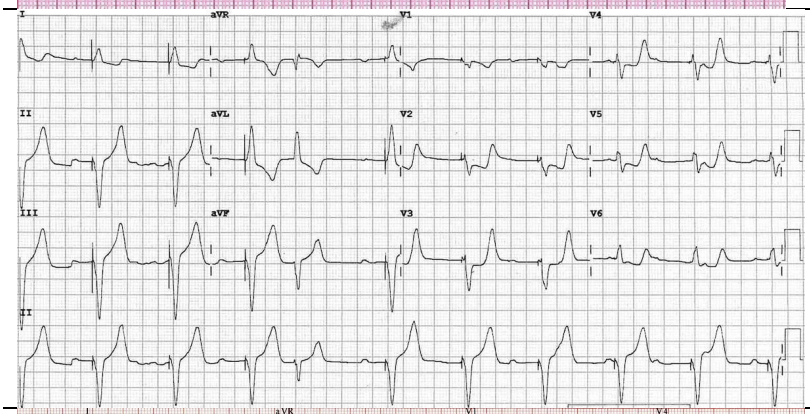
Working out

1. **Sinus rhythm**
2. ST elevation in AVR
3. Global ST depression

Dx = diffuse endocardial ischaemia secondary to UGIB

Mx:

1. Wide bore IV access
2. Check Hb and transfuse > 80
3. PPI and endoscopy



PC: 55 F called Ambo due to chest pain. Now confused and unable to give history

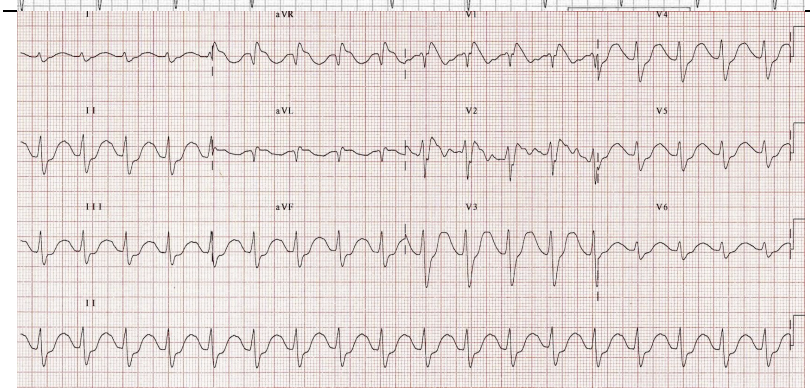
Working out

1. **Complete heart block**
2. Left axis and LBBB morphology
3. Abnormal ST depression V2/3

Dx = Acute MI

Mx:

1. ACS protocol
2. PCI



PC: 25F found unconscious by boyfriend – intubated by paramedics but remains paralysed

Working out

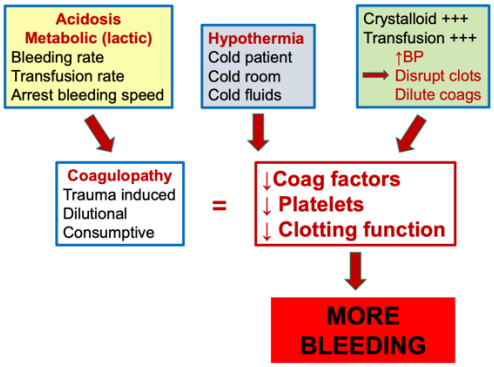
1. **Sinus tachycardia**
2. RAD
3. Broad QRS (RBBB morphology)
4. Prolonged QT interval

Dx = Na channel blockade OD

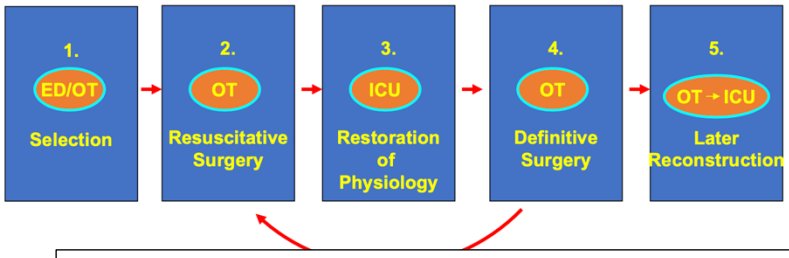
Mx:

1. Give IV $NaHCO_3$

PREVENTING DIC



DAMAGE CONTROL = STAGED SURGERY



- **Resuscitative surgery** → *sufficient surgery to control bleed / contamination (from orifices) and resect obvious ischaemic structures (e.g. small bowel, limb)*
- **Stop cosmetic surgery (e.g. stomas, generating anastomoses)** → *just stable organs up e.g. packing → minimise abdo compartment syndrome, infection*
- **Complete definitive surgery OR later reconstruction (e.g. suture)**

MASSIVE TRANSFUSION PROTOCOL (MTP)

Indications

- **pRBC = gold standard = Minimise crystalloid** (e.g Hartmann's, NS
- **hydrocort 200mg** prior to blood transfusion to prevent ADR

Group (O neg) to replace:

- 50% BV loss in 3hrs
- 100% BV loss in 24 hrs

No trauma	**4u pRBC + 2U FFP**
Trauma	**PLUS TXA**
Fibrinogen < 1g.L	**PLUS Cryoppt (clotting factors)**
Plt < 50	**PLUS Plts**

Target / Goals

- *Temp > 35*
- *ABG = >7.2, BXS >-6, Lactate < 4*
- *Ionised Ca = >1.1mM*
- *Plt = > 50*
- *Hb = depends on haem status*
- *INR ≤ 1.5*
- *PT/APTT = <1.5x normal*
- *Fibrinogen > 1g/L*

- Restore perfusion
- Correct cell hypoxia
- Prevent MOF
- Support Haemostasis
- Avoid A/E

Complications of MTP = *fever, chills headache*

	Acute	Delayed
Immune	Haemolytic (DARK URINE)	Haemolytic
	TRALI → ARDS	Alloimmunisation
	Febrile non-haemolytic (MOST COMMON)	Posttransfusion purpura
	Allergic	GVHD
Non-Immune	Bacterial contaminate (ESP. PLT TRANFUSION WHICH ARE KEPT AT ROOM TEMP_	BBV (hep B/C/HIV)
	Circulatory overload (TRACO)	Fe overload
Don't miss	Electrolyte (hypo/hyperk) (HypoCa = citrate in soln increases excretion of Ca)	
	Coagulopathy	
	Hypothermia	

When to give blood products?

Whole blood (pRBC + FFP) = 530mL (235mL + 295mL)

Product	Dosage (paediatrics)	Indication
pRBC • O neg = universal donor; • AB positive = universal acceptor	1 unit/bag (300ml) = 10g/L rise required. • 235mL of 530mL • **Raises** K and lactate • **Decreases** Ca	**Hydrocort 200mg prior to blood transfusion to <u>prevent ADR</u>** • **Hb <100** and high risk of myocardial ischemia • Severe anaemia (e.g. **Hb<70)** • **Major active bleeding and Hb<100**
Plts	10ml/kg (1 unit ~ 60mL. 1 pooled bag = 5 units) • 295mL of 530mL • **Raises** K and lactate • **Decreases** Ca	• **<10** • **<20 and high risk** (fever, neutropenia, antibiotics, risk of intracranial haemorrhage) • **<50 and active bleeding** or requires invasive procedure • **<80 and requires neurosurgery** or ophthalmic surgery • Plt function defects and bleeding (regardless of plt count)
FFP • AB is the universal FFP donor, (no antibodies in plasma)	• 10 – 20 ml/kg (1 bag ~ 230mL)	• **INR >1.5 <u>PLUS</u>** needs invasive procedure • **INR >1.5 <u>PLUS</u>** actively bleeding (e.g. massive transfusion protocol, post-bypass surgery)
Cryoppt	5-10 ml/kg (1 bag ~ 20mL) contains ➢ Fibrinogen (factor 1) ➢ Factor, 8, 13 ➢ VwF and Fibronectin *Thawed FFP then extracting ppt	• fibrinogen <1.0 and actively bleeding (e.g. massive transfusion protocol) • **DIC (main indication)** • hereditary hypofibrinogenemia, • haemophilia, • VWF disease
Factor 7	• 90 mcg/kg	• rescue therapy if ongoing haemorrhage despite correction of pH and temperature, blood products to correct coagulopathy and no clear surgical cause
Prothrombin (F 9) complex:	1mL/kg (25units/kg)	• warfarin overdose (alternative to FFP)
TXA acid:	100mg/kg then 10mg/kg/hr	Massive haemorrhage (PPH, Menorrhagia, GIB)
Granulocyte concentrate		Neutropenic sepsis

D – DISABILITY – COMMON PRESENTATIONS #1

- **Anatomical (FRONT to back)–** sinusitis, eye (glaucoma), scalp tenderness (GCA), brain infection, raised ICP (IIH, SoL), neuralgias, neck-related (referred pain), ear-related (otitis media), muscle related
- **Red-flag** – stroke, bleed, infection (fever), sudden onset headache, LOC
- **Non-related** – migraines, TTH, cluster

	Headache	CNS infection	Seizure
Hx	• Sudden, exertional onset • New headache in > 50 yo • FND (vision, speech, weakness, sensation) Check **location** and **acuity/time-course** ➢ Eyes, - slit-lamp ➢ Ears - otoscope	• New onset headache • Fever, rigors, chills • N/V • Photophobia • Neck stiffness (can be just mild) • FND • Confusion / encephalopathy • Non-blanching maculopapular rash • Kernig's and Brudzinski's sign **Have they been taking any ABx?** **Are there any leg pain?**	**Collateral hx** • How were they before? • Prodrome – triggers, systems review • Event – witness, situation, WILD Sx • Post-event – recovery time, symptoms
RF	• **Pro-coagulant states** (e.g. pregnancy, SLE, cancer, sarcoid, vasculitis) • **Meds** (blood thinners, immune suppressors, recent ABx) • **Illicit drug screen** (stimulants e.g. cocaine)	• **Prodrome illness** & **ENT infections** – URTi, otitis media, orbital cellulitis • **Immunosuppressed** (T2DM, chemo, ATSI) • **Partially treated infection** – persistent headache despite ABx from GP • Trauma • Age • Recent Procedures	• Hx of epilepsy • Recent illness • Known intracranial lesion

DDx	• ICH, SAH
	• CNS infections
	• GCA - **palpate TMJ**
	• Malignancy
	• **Eye pathologies** (Optic neuritis, acute angle closure glaucoma),
	• **IIH**
	• **Trigeminal neuralgia**
	• Vertebral artery dissection ➔ **palpate vertebral artery sinuses**
	• Cerebral venous thrombosis
		• **Meningitis** – B/V/F (MOSTLY viral)
		  ○ **children -** Strep, pneumo, Neisseria, HiB, GBS
		  ○ **Elderly** → strep, Neisseria, gram - ve
		• **Encephalitis** – B/V/F
		• Brain **abscess**
		• **Epidural abscess**
		
		DDx: - *may present asymptomatically*
		➢ **Meningococcal sepsis (**bacteria in blood without any signs of meningism**)**
		➢ **Meningitis (**infection of meninges without non-blanching purpuric rash**)**
			BATH TIME
			➢ Brain lesion
			➢ Alcohol/drugs withdrawal
			➢ Trauma
			➢ Hereditary
			➢ Toxins
			➢ Infection
			➢ Metabolic (BSL, Na, K)
			➢ Epilepsy
			
			DDx of reduced LOC (AEIOU – TIPS)
			➢ Acidosis / alcohol
			➢ Epilepsy
			➢ Infection
			➢ Overdose
			➢ Ureamia
			➢ Trauma
			➢ Insulin
			➢ Psychiatric
			➢ Stroke
			
			Other DDx:
			➢ Syncope (cardiogenic, vasovagal)
			➢ Psychogenic
			➢ Febrile convulsion (6/12 – 6 years)
			➢ Dehydration

Ix	• **Bloods** – FBC, EUC, LFT, CRP, ?INR **Imaging** • CT within 6 hrs to exclude SAH • MRI • Carotid artery doppler • Slit-lamp examination • LP	• **Bloods** – FBC, EUC, LFT, CRP, cultures • **Imaging** – brain CT/MRI	• **ECG –** monitor source of seizures • **Urine B-HCG** • **Bloods** - FBC, EUC, CMP, VBG (lactate), Prolactin, BSL, B-HCG • **MRI** • **EEG**
Mx	Neurosurgical consult ➢ Decompress bleed	**ABCDE** • **EARLY** Empirical ABx – IV 2g (50mg/kg) ceftriaxone • Bloods - FBC, EUC, LFT, CRP, cultures M/C/S • Dexamethasone within 1hr of ABx • CT before LP (avoid tonsillar herniation due to intracranial mass) **Consider** • Benzylpenicillin • Acyclovir • Vancomycin • Tacozin	**Crowd control → ABCDE** 1. A – maintain patent airway and keep patient on side (jaw thrust, Guedel) 2. Make sure to expose everything!!! **Most fits/seizures self-resolve**. If seizure > 5mins then consider medical treatment 1. 1st line = BZD 2. 2nd line = Repeat BZD 3. 3rd line = **Keppra** or phenytoin 4. 4th line = give what was NOT given already 5. 5th line (infusions) = midazolam, propofol, thiopentone **Safety netting** ➢ No driving ➢ NO operating heavy machinery ➢ Swimming ➢ Baths ➢ Caution with heights

A Case

JASMINE

- 32 year old – Severe headache
- 1 week post partum
- G5P5
- Obstetric Hx complicated by severe HT
- C sec for HT at 34 weeks
- Epidural for C sec
- D/C for 4 days
- Since last day in hospital has had nausea, feeling generally unwell
- Worsening severe headache

A Case

MOHABIK

- **32 year old male -** Headaches for 1 week
- Moderate, not worst headache ever
- Wakes at night with pain
- Wakes at night to vomit
- Pain worse in the morning
- No neurology
- Pain completely resolves with paracetamol

A Case

AJ

- 8 year old boy
- Fevers 1/7
- 1st Seizure at home self terminated
- Seizure in ED
- No PHx,
- 1 uncle with epilepsy
- No meds
- No allergies
- IUTD

	CVA	ICH	Vertigo/Dizziness
Sx	➢ LOC ➢ FND	Sudden onset FND, reduced LOC, photophobia Headache (thunderclap, exertional)	Is it vertigo or dizziness? ➢
RF	• Vascular-pathology – T2DM, anti-coags	• Trauma • Meds - Anti-coag usage	
DDx	➢ Stroke / TIA ○ Ischaemic ○ Haemorrhagic ➢ Hypo/hyper electolytes, BSL ➢ Epilepsy / seizures ➢ MS, Migraine ➢ Intracranial infection / mass ➢ Syncope	➢ Stroke /CVA ➢ Syncope	DDx for dizziness ➢ Head, heart, vessels, systemic DDx for vertigo • Peripheral – BPPV, Vestibular Neuronitis, Meneire's , Stroke • Central = Mass, ICH/CVA, MS, Migraine, meds
Ix	• Bloods – FBC, EUC, LFT, CRP **Imaging** • CT within 6 hrs to exclude SAH • MRI • Carotid artery doppler • Slit-lamp examination	• Vitals • ECG + CXR • Bloods – FBC, EUC, LFT, CRP, COAGs, Group and hold **Imaging** • CT brain ○ Non-contrast (if after 6 hrs) ○ Contrast (if suspected SAH) ○ CT arch CoW (aneurysm?) ○ CT arch from neck (vertebral dissection) • MRI • Carotid artery doppler	• **Head impulse** – vestibulo-ocular reflex • **Nystagmus** ○ **Central** (absent, vertical, continuous and bidirectional) ○ **Peripheral** – present, horizontal, unidirectional • **Test of skew** – cover/uncover test • **Dix**-hallpike • **Imaging** – CT vs CT CoW vs MRI • **Bloods** – troponin, septic screen, VBG, BSL
Mx	**Refer to local guidelines based on Mx** 1. Call stroke team urgently 2. Urgent Imaging → CT, CTA, perfusion 3. Thrombolysis if within 4.5 hours 4. Clot retrieval (salvageable tissue depends on size of vessel occluded) **Non-urgent intervention** ➢ **MDT** ➢ Monitor BP ➢ Aspirin ➢ Anti-coags (e.g. heparin)	**SAH** ➢ **Support** – maintain normal EUC, O2, temp, glucose ➢ **Maintain BP** 90-140 ➢ **Reduce ICP** – analgesia, HOB 30 deg, anti-emetics for N/V ○ **Consider mannitol**, hyperventilation if unresponsive ➢ **Consult neurosurg** **ICH** ➢ As above with NO strict BP control **SDH (elderly fall – check GCS)** ➢ Consult neurosurg ➢ More time as usually more stable (do not suddenly pop) **EDH (period of lucidity)** ➢ Urgent – risk of rapid deterioration ➢ Consult neurosurg for rapid decompression (burr-hole washout)	**1st line = Sx control** ➢ Prochloperazine ➢ Promethazine *check for allergies **Treat cause** ➢ BPPV – Epley ➢ Vestibular neuronitis – prednisone ➢

A Case

21 year old Sebastian presents to country hospital
- Severe sudden onset headache, BP 140/90, PR 115
- Take and Hx and Ex

Manage this patient, DDx
- Patient transferred to neurosurgical team big city center, BP 130/85, PR 95
- Every imaging you can think of CTs, MRI, body scans, contrast, PET
  - Small lesion basal ganglia, possibly slow growing malignancy, ?calcified bleed from birth

Manage this patient, DDx
- Managed on wards for headaches, BP 160/95, PR 95
- Agitation, request hot showers, family aggressive and confrontational
- Lignocaine infusion for headache, mental health team involved
- TF back to country hospital

Manage this patient, DDx
- Unable to get repeat imaging TF to slightly less country hospital with the ability to MRI
- Sweaty, BP 170/100, PR 120, afebrile, request hot shower

Manage this patient

D – ULTRASOUND TIPS #1

SCENARIO	QUESTIONS	USS ACTIONS
CARDIAC ARREST	• Is it reversible? (4 H's and 4 T's) • Are both lungs ventilating	• Heart (tamponade, LVH, or reduced contractility) • Lungs • Elsewhere - IVC, AAA, free fluid
SHOCKED PATIENT	• Why is patient in shock? • Do they need fluids?	• Anterior lungs – wet, dry, chunky? • IVC – full or empty • Heart • Elsewhere - IVC, AAA, free fluid
BREATHLESS PATIENT	• Why are they breathless?	• All of the lungs – wet, dry, chunky? • IVC • Heart • Scan for DVT – upper femoral/lower femoral, popliteal or below knee

C	**Continue Compressions and Echo**
O	**Oxygen Away**
A	**All Else Stand Clear**
C	**Charge Defibrillator**
H	**Hands Off Compressions**
R	**Rhythm Check/Record Echo**
E	**Echo Off**
D	**Deliver Shock** *OR* **Dump Charge**

7 GOLDEN RULES FOR USS

1. **'Resus-only' (**critically unwell: shocked / breathless / peri-arrest to elicit US signs of some diseases e.g. massive PE or pneumonia)
2. **Clinical Diagnosis BEFORE US (e.g.** FBC with Hb = 4)
3. **Only ask questions that you can answer**
4. **Repeat scans are crucial (change over time)**
5. USS are NOT 100% accurate
6. **When in doubt, be a doctor (clinical picture > USS findings)**
7. **. A fool with a stethoscope will be a fool with an ultrasound**

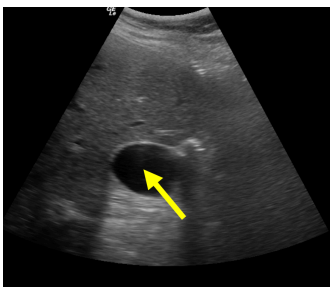
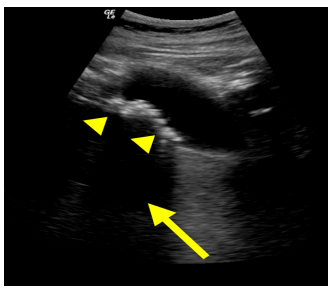
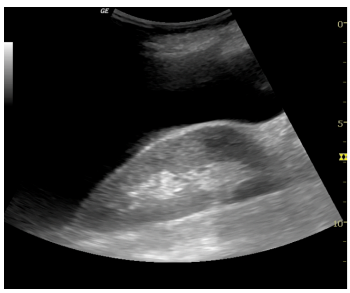
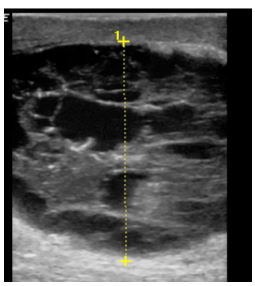
WHICH PROBE TO USE?

Probe type	**Curved (curvilinear) array**	**Linear array**	**Sector (Phased) array**
Indication & preset	**Deep tissue visualisation** • **Lung** (pneumothorax, effusion) • **Heart** (subcostal window) • **Abdomen** (abdo, eFAST, AAA, early pregnancy) • **IVC**	**Superficial tissue visualisation** • Lung pleural surface ONLY • **Vascular access** (vascular / venous preset)	• **Lung** (pneumothorax, effusion) • **Heart** (subcostal window) • **Between ribs** (Cardiac present – Nb: image wrong way around)

TIPS TO IMPROVE IMAGE

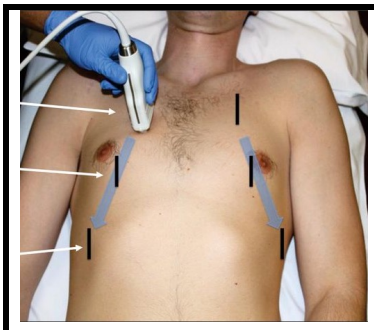
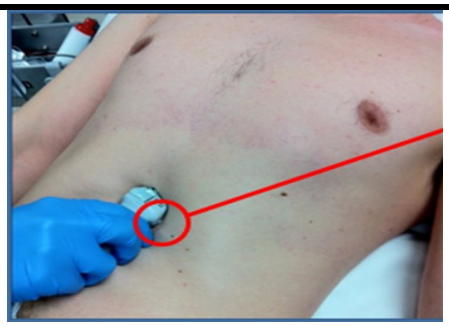
1) Use **MORE gel** (reduce reflection at surface of skin)
2) DARK room
3) Correct patient position
4) Right probe and preset
5) Correct probe orientation
6) Set depth (deeper than structure you're scanning)
7) Set adequate gain (fluid just appears black – to differentiate between fat and fluid)
8) **Highest frequency = better resolution (low frequency = for obese patients)**

Interpretation of images:

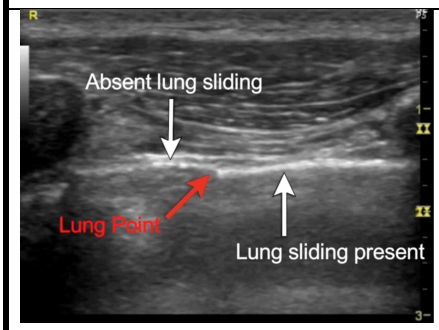
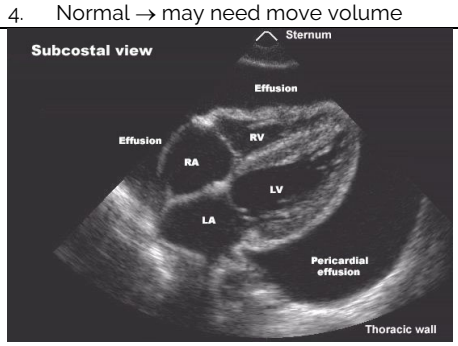
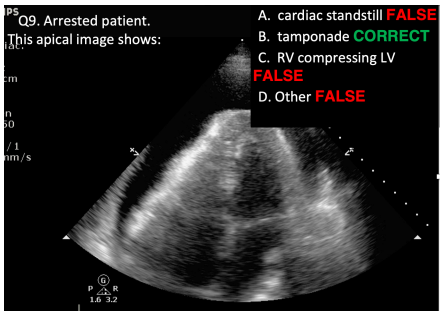
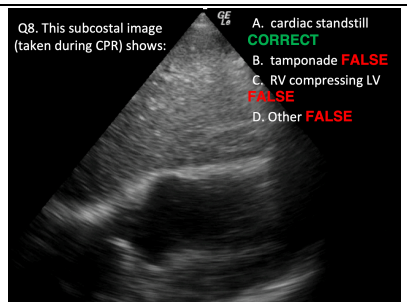
			
Bile in GB = black (anechoic) **Below brighter** = posterior acoustic enhancement	Stones in GB (HYPER echoic) Casts posterior acoustic **shadow**	Ascites (simple fluid) (kidney is below)	SC abscess
Curved probe	**Curved probe**	**Curved probe** = Paracentesis – watch out for ➢ Inferior epigastric arteries ➢ diaphragm	**Linear probe**

*__BEWARE OF anisotropy (esp. nerves)__ ➔ specific orientations to better visualise structures

D – ULTRASOUND TIPS #2

		
Lung USS	**Cardiac USS**	**Vascular Access**
Curvilinear	Sector probe (to fit b/w ribs) ➢ subcostal position	➢ Linear probe ➢ Use BP cuff as tourniquet ➢ **Always use LONGER cannulas**

• **Pneumothorax** (NO lung sliding)
• **Fluid/effusion (image 2)**
  ○ B lines
  ○ Rockets and comets
	<u>For critically unwell patients</u>
	1. Check Heartbeat
	2. Effusion → ?tamponade
	3. RV bigger than LV → big PE
	4. Normal → may need move volume
		➢ Cannulation of difficult veins

 	  **Tamponade**	 **Cardiac Standstill**

In ALS → Use either curvilinear or sector probe (whichever convenient) → aim to rule out 4 H's and 4 T's

D – MANAGING DIFFICULT SITUATIONS -→ "SPIKES"

Setting

- Turn off phone
- Sit on chair
- Make sure the patient is with a supportive person
- Avoid presumptions

Consider your patient

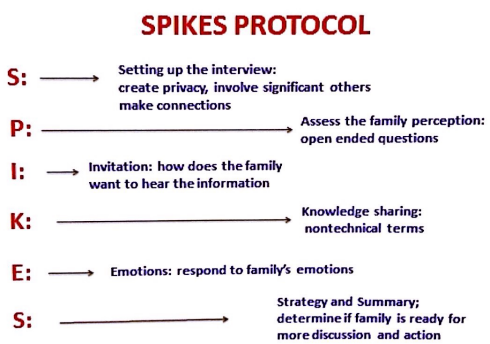
- Know their name!
- Review there notes prior to any discussions, know as much as you can know

Consider your audience

- Are you talking to a patient?
- Know who you will be addressing if possible before meeting

Consider your news

- Is it a complete shock?
- Should you use a "warning shot". Tell them what you want think to know first, before anything shocking
- People will forget everything you said after the bad news breaks → **<u>need to see the word death or your mum/dad/son is dying</u>**



: **<u>On the phone</u>**

- ➢ Do not say patient had died on the phone
- ➢ Please come in as ____ is critically unwell.

<u>Finishing up</u>

- ➢ Offer social worker support
- ➢ Give time to process

E - TRAUMA: Primary Survey

What is a trauma patient?

- **High impact** = MVA, MBA, Plane crash,
- **Penetrative** = Stabbing, shooting
- Significant fall (esp. elderly)

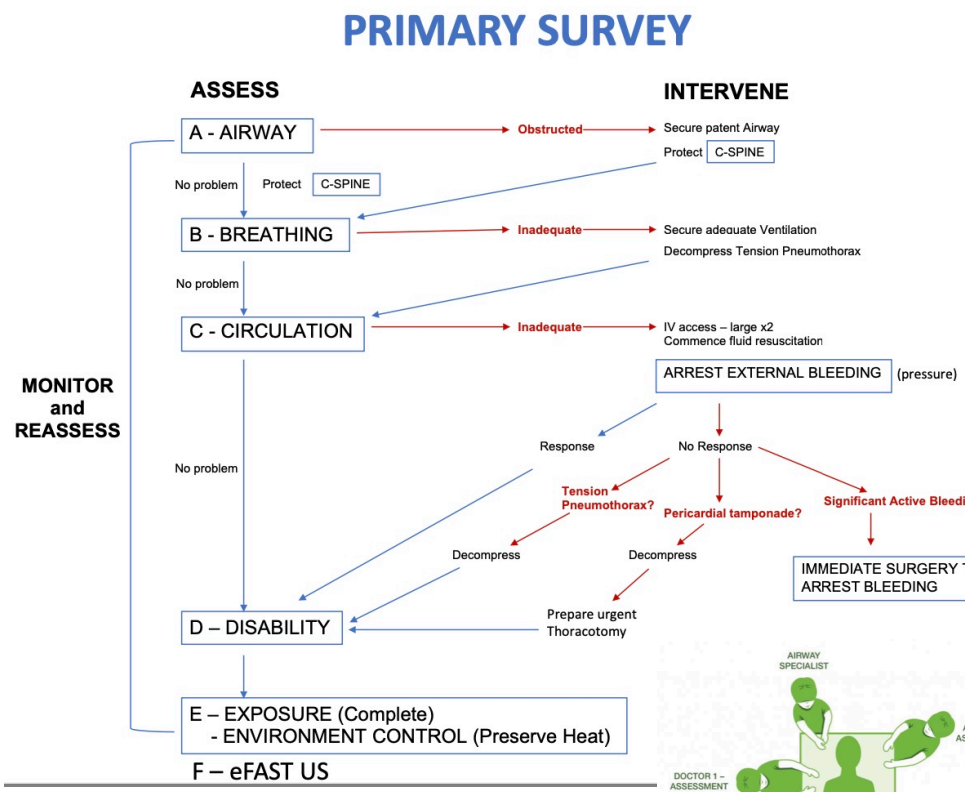
What do I consider?

- Collateral hx (ambos, police, bystanders)
- AMPLE
  - Allergies, meds, PMHx (diabetes, vascular, collagen diseases),
- What happened before event? During trauma? And after? (i.e. what was given as Rx)

Groups	Special Considerations	Intervention
Children	• Leading cause of death • Immature, anatomic/ mechanical features • Vigorous physiologic response • Limited physiologic reserve • Consider: *Size, dosage, equipment, SA, and psychology*	• **A**: Larynx anterior and cephalad, short tracheal length • **B**: Chest wall pliability (**contusions may not present**) • **C**: Vascular access, fluid volume, vital signs, and urinary output • **D**: Vomiting, seizures, and diffuse brain injury • **MSK**: Immature skeleton, fracture patterns

Pregnancy	• Anatomic/ physiologic changes modify response to injury
	• Need for fetal assessment
	• 1st Priority: **Maternal resuscitation**
	  ○ Identify early shock
	  ○ X-ray mother
		• Gestation and position of uterus
		• Physiologic anaemia
		• ↓ Pco2
		• ↓ Gastric emptying
		• Supine hypotension
		• Isoimmunization (Anti-D for Rh -ve mothers)
		• Sensitivity of fetus

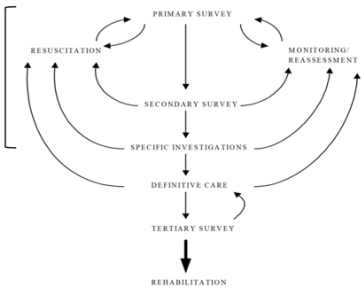
Elders	• 5th leading cause of death • Diminished physiologic reserve and response • *Co-morbidities*: Diseases/ Meds	
med	• BB may hide tachycardia • **Intoxicated**	Drug screen Safety of myself and others
athletes	• normal HR when actually tachycardic	Low threshold to admit to ICU



MULTI TRAUMA

ACUTE MANAGEMENT

INITIAL ASSESSMENT

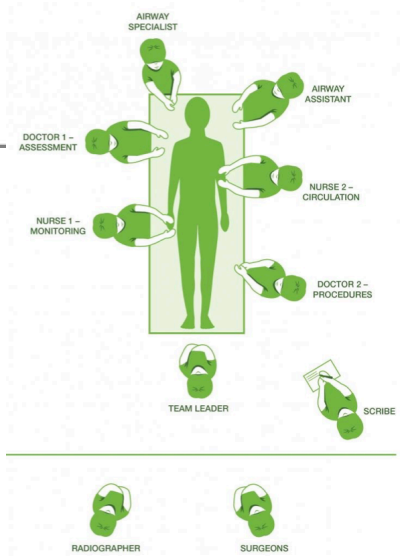


BEWARE: Trauma-induced coagulopathy (TIC)

- **Acute traumatic coagulopathy (ATC)**
  - Hyperfibrinolysis
  - Fibrinogen loss
  - Plt dysfunction/disaggregation
- **Resuscitative coagulopathy (iatrogenic)**
  - Due giving too much fluid free of coagulation factors
- **Prothrombotic phase**

Solution

- **Reduce crystalloids** → 1:1:1 ratio → RBC:plt :plasma
- **Permission hypotension** (i.e. accept low borderline BP)
- **Damage control surgery**
- **Blood & coags**



E - Secondary Survey – "Top to toe"

History

- **A** Allergies
- **M** Medications
- **P** Past illnesses / Pregnancy
- **L** Last meal
- **E** Events / Environment

GCS	Clavicles	Hips	Shoulders
Scalp	Chest wall	Thighs	Upper arms
Ears (incl TMs)	Chest movement	Knees	Elbows
Eyes (incl pupils/ acuity/fundi)	Breath sounds	Legs	Forearms
Facial bones	Heart sounds	Ankles	Wrists
Mouth	Abdomen	Feet	Hands
Neck	Pelvis		Fingers
C-spine			

Back (incl spine) and flanks (log roll)
Perineum
Genitalia
Rectal exam
Urinalysis

Exam

1. **Head → ENT → Neck (uncover any c-cover)**
2. **Chest -**
3. **Abdo**
4. **Pelvis**
5. **Extremities (upper → lower)**

Seek the following:

- **Bleeding**
- **Swelling** (incl. haematoma)
- **Tenderness**
- **Lacerations** (incl. entry/exit)
- **Deformity** (bones)
- **Discolouration**
- **Crepitus** (incl. subcutaneous)
- **Pulse - Ischaemia** (limbs)
- **Functional impairment**
  - Neurological (power, tone, reflexes)
  - Viscera (lungs, heart, GIT)
  - MSK

Do the following:

1) Stop bleeds

- IVF,
- pressure on wound,
- pelvic binders,
- reduce fractures with traction

2) Stop pain = Analgesia (IV morphine)

3) Stop infection

- ABx or tetanus prophylaxis,
- Sterile pads on wounds

Adjunctive things to do:

- Photo major wounds
- Bedside → UA, ECHO
- Bloods
- Imaging → X-ray, CT
- Invasive → Bronchoscopy, oesophagoscopy
- **Do NOT delay transfer to 3° hospital (trauma centre)– bring relevant imaging and results**

***NB: Tertiary survey avoids MISSED injuries → (repeat 1°, 2°, relook at imaging/tests etc.)**

- **Within 24 hrs** (repeat primary and secondary survey and any imaging) ➔ PROCEED TO NEW IMAGING
- **DO NOT MISS** ➔ Mild TBI, PNI, C-spine #, bowel injury, knee ligament ruptures, acromioclavicular dislocation

Trauma Triaging

Multi-tasking: Do it once and do it correctly!

- Get line in and bloods prior to hx – get ALL the tubes
- Prepare lubricants for DRE for PR bleeding
- Vag speculum exam for PV bleeding

Causes

- **Blunt** (road accidents, fall, blast)
- **Penetrating** (stab/impale, gunshot)
- **Burns**
- **Electrocution**
- **Chemical**

***Combination of above**

- Don't be distracted from the occult → what is most life-threatening?

Good trauma system

- Minimise time from injury to care
- Prioritise patient's threat to life and disability

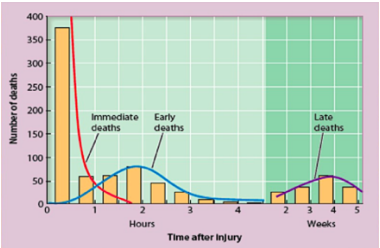
Preparation crucial

- Get team ready & wear protective equipment (e.g protect against BBV – Hep B/C, HIV)

Timeframe for multi-trauma:

- **1st hr** = critical initial assessment & resus
- **2nd hr** = definitive care
- **Treat the cells**! ➔ STOP ISCHAEMIA (hypoperfusion) ➔ INFARCT (cellular response to ↓perfusion

Trimodal Death distribution



TRAUMA SERVICES PLANNING

- Population
- Trauma frequency
- Existing resources
- Transport times
- Geo-political issues
- *Major Trauma Services/Hospitals* (e.g. John Hunter, St George, RPA)

REGIONAL TRAUMA CARE SYSTEMS

- **Pre-hospital services**
  - Transport
  - Communication
- **Acute hospital services**
- **Rehabilitation services**
- **Interhospital transfer processes**
- **Specialist centres:**
  - **Burns**
  - **SCI**

TRAUMA SERVICE COMPONENTS

Need good communication b/w:

- Emergency Medicine
- Surgery
- Intensive Care/Anaesthetics
- Operating Suite
- Radiology
- Blood Bank
- Allied Health
- Rehabilitation

Trauma Team

- Emergency Medicine Registrar
- 3 RN's from Emergency Department
- ICU Registrar
- Trauma Fellow
- Trauma Nurse Co-ordinator
- Surgical Registrar
- Radiographer
- Social Worker
- Blood bank on standby

What do I do?

- **PREHOSPITAL TRIAGE** – who goes where?
- **Hospital**? Who needs the Trauma Team?
- **Mass casualty**? – who gets the resources?

- 1st half of anybody's life – **more likely to die from injury** (i.e. road crash, burns, drowning) than from any other cause
- **> 65 yo = Most deaths due to falls and suicide**

PREHOSPITAL TRIAGE (MIST)

- Patient's name, age and sex
- **Mechanism**
  - All Penetrating
  - MVA
  - fall from standing height)
- **Injuries** (obvious)
  - Beware low impact injuries for elderly
- **Signs** (Vital)
  - Pulse, BP, RR , GCS (at scene, on arrival and current)
- **Treatment required**
  - **IVF, ABx (*tetanus?*), Analgesia**
  - **FBC, EUC, COAG, x-match**
  - **XR, CT, ECG, ECHO, FAST**

Activation Criteria for T/F to MAJOR TRAUMA Centre: "HANDOVER"

(1) Introduce self and location

(2) Brief History of patient and Injury:

- MVA ejected from vehicle/fatality
- Pedal cyclist, motor cyclist or pedestrian hit by a car or truck
- Fall from height > 5 m
- Inter-hospital transfer

(3) What were the injuries?:

- **Open/closed Fracture** to ≥2long bones
- **Soft tissue injury**
- **Bleeding**
- **Crush injury or limb amputation**
- **Any Penetrating injury** (e.g. PT, haemothorax)
- **Burns to airway or smoke inhalation** (or > 15% BSA adults, > 10% BSA children)

(4) Vitals and What was done?

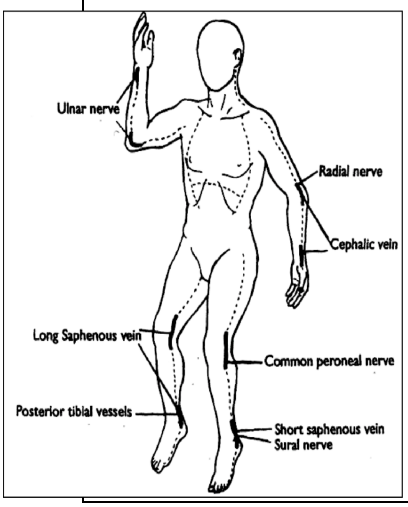
- A = adjuncts
- B = HM, Bag-valve, Ventilator
- C = Fluids, peripheral stimulation
- D = GCS, c-spine
- E – splinter? Reductions?

Trauma Day – Fractures and Splinting

Hx

- **AMPLE**
- **Co-morbidities** (DM, collagen and vascular disease)
- **Events** (before, during, after)

  E.g. *broken collarbone + hidden c-spine injury*



Exam

- **Give analgesia 1st**
- Vitals

Look at EVERYTHING

- Site *e.g. femur # → assume 1L blood loss*
- Deformity
- check for **OTHER wounds (e..g punctures)**
- above and below joint

Feel

- vascular – distal pulses
- neuro -sensation

Move

- ROM – passive vs active
- Pain out of proportion (compartment syndrome)

Measure (mark out)

- Swelling
- Limb length
- Special tests

Ix

Bloods

- **FBC** (Hb)
- **VBG** (lactate and Hb)
- **Group and hold** (if sig. bleed)
- **EUC, LFT** – baseline if OT required

Imaging

- **XR (may miss fractures!!)**
  1. **Check cortex**.
  2. **Bony alignment**/dislocation
  3. **Lipo-haemathrosis**
  4. **Avulsion #** - fragments of bone pulled off by tendon/ ligaments
  5. **Fat pad** (sail sign – esp. elbow – blood pushing away bone)
  6. **Effusions**
  7. **Salter-Harris #** in kids
  8. **Check above and below**
- **USS** (? If foreign body, fluid) – use lots of gel to minimise need to apply XS pressure
- **CT – if *not sure on XR (****esp. wrist, comminuted #, scapula, ribs****)***
- **MRI** (ligaments, scaphoid #, knee)

Describing fractures

1) **Pt name, gender, age, incident, dominant hand and occupation (*e.g. pianist, surgeon*)**
2) **Open/closed**
3) **Location** (left/right vs proximal/distal/mid)
4) **Fracture type** (oblique, TV, spiral, greenstick, impacted, comminuted)
5) **Angulation** (direction of tilt of distal fragment)
6) **Fluid?**
7) **Neurovascular intact?**
8) **AMPLE** – fasting status
9) **Health insurance**

General Mx

- Plaster (e.g. Sydney sandwich & backslabs)
- Avoid dirty objects with open wounds
- Avoids objects that splinter

Anterior Fat pad sign of supracondylar fracture

Closed Spiral L) mid-humerus #

Closed Comminuted L) proximal-mid femur with medial displacement

Wrist injury with Dorsal displacement of wrist bones (empty cup = lunate bone = "crescent moon sign")

Trauma Day – Trauma Wounds & Minor Injuries

Hx

- **AMPLE**
- **Co-morbidities** (DM, collagen & vascular disease)
- **Events** (before, during, after) (fall, bite, penetrating object)
- **Is wound dirty or clean**? (is it from sterile place – water, dirt, raw chicken, FB, cats/dog bites)
- **Associated injuries?** (how much bleeding?, sensation loss, SOB cosmetic issues for young women - nipple)
- **Occupation –** impact on work (e.g. surgeon, driver)

Exam

- **Give analgesia 1st**
- Vitals

Look

- Site & depth
- shape & borders
- exudative (infective)
- erythema (oedema)
- colour

Feel

- tenderness (bone, soft tissue)
- warm to touch
- neuro -sensation
- vascular – distal pulses

Move

- ROM – passive vs active
- Joint **above and below**
- **Pain out of proportion (beware sown up wound)**

Measure (mark out)

- Depth and size

Ix

Vitals

Bloods

- FBC (Hb)
- VBG (lactate and Hb)
- CRP
- EUC, LFT and CMP (if ABx req)
- ?Septic screen (blood cultures)

Imaging

- **XR**
  - EXCLUDE fractures
  - Osteomyelitis
  - Foreign body
- **USS (?** If foreign body if *NOT* radioopaque)
- **CT** (details of bone)
- **MRI** (ligaments)

Reference:

1) **Plastics** (e.g. nipple wound)
2) **Ortho** – hand surgeon

General Mx

1) Good **EARLY** cleaning w/ 0.9% NS → *remove any MSSA, MRSA*
2) **If very painful** → use local LA in 50mL syringe (avoid injecting into arterioles)
3) **Remove any clot/dirt** to see the wound w/ cleaning
4) **Stop any bleeding**
   - Clean to find source of bleed
   - apply pressure with gauze
   - Adrenaline
   - Haemocoagulant dressing
   - $AgNO_3$ sticks or cautery
5) **Keep wounds covered** with suitable dressings

Types of dressings (definitive care)

- **Wet (w/ 0.9% NS)** – *non-stick, duoderm (ulcers), mepilex, bactigras (paraffin based – create nice seal)*
- **Dry** - *Melolin*
- **Padding** – *Combine (*
- **Secure with crepe (E.g. turban for scalp bleed)**

Trauma Day – Trauma and Burns

Hx

- **AMPLE**
- **Co-morbidities** (DM, collagen and vascular disease)
- **Events** (before, during, after)
  - **ISOLATED trauma** (house fire)
  - **Polytrauma burn + other injuries** (car accident/car fire or explosion)
  - **Substance inhalation** (cyanide due to burning plastics, CO - soot)
- **Duration of burn**
- **Mechanism**
  - Domestic steam (<100°)
  - Industrial steam (>100°)
  - Fat (>250°)
  - Open flame (>500°)
  - Electrical 240V
  - Chemical)

Exam + general Mx

1. **Personal and staff PPE** + decontaminate patient
2. **Remove items** (clothing, jewellery) as they retain heat
3. **Cool burn** (cool running water → 20 mins)
4. **Simultaneous ABCD**

A	**Check for signs of airway burn ➔ oedema ➔ req early intubation** (*they get worse before getting better*) ➢ Singed facial hair (loss of eyebrow, beard, nasal hair) ➢ Soot in airway ➢ **Beware of sore throat or Hoarse voice**
B	**Inhalation injury may extend into trachea and lungs** ➢ Causes local/systemic inflammation → ARDS ➢ **High mortality rate → *consider Asthma, COPD, existing lung disease*** ➢ **Rx: respiratory support**
C	**Burn affects circulation in 2 ways** 1. **Systemic inflammation** = oedema and loss of intravascular volume (hypovolemia) ➔ **Aggressive IVF – Parkland Formula** a. **Calculate %TBSA → rule of 9's** 2. **Burn depth** a. Burn erythema – bad sunburn b. Partial thickness c. Full-thickness d. Circumferential *Bloods* → Check ABG → for CO poisoning
D+E	• **GCS, BSL, Analgesia** (GCS affected by ketamine, sedation) ○ **Check movement / sensation (? SCI)** • **Thermoregulation** → use warm fluids, dressing, and warm with bair hugger 40°C (burn patients quickly become cold) • **Moisture Regulation** → dressing (reduce evaporation to minimise hypovolaemia)

Additional Mx

Take photo of burn (with consent)

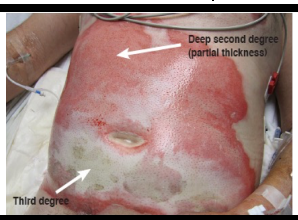
- **1st aid Dressing** (e.g. glad plastic wrap – single sheet)
  1) Deroof blisters
  2) Cover all burn
  3) Barrier to infection
  4) Improve pain and temp. regulation as prevents air touching burned skin
- **Analgesia** (IV morphine)
- **ADT** (tetanus)
- **IDC** -measure UO
- **+/- NGT** - if intubated
- **Avoid ABx – causes harm in burns**

Transfer to definitive care – refer EARLY

- **Dedicated burn units** = Concord (non-trauma) RNSH (adult + trauma), Westmead (paeds, adults + trauma)
- **Inpatient**
  1) Adult > 20%, children > 10%
  2) Facial / intubated
  3) Electrical/ chemical
  4) Suspected NAI
- **Outpatient**
  1) Full thickness of hand, feet, perineum
  2) Does NOT need inpatient Mx
- **Depth of burn** can last for **7-14 days** depending on initial Rx (first aid + resus)

Burn erythema (1st deg)
Bad sunburn • **Painful** • No scarring **Rx: aloe vera!!, burnaid**

Partial Thickness (2nd deg)
• Blisters (less deep) • Cherry red (more deep) • **Blanches** • **Hair Intact** • **Painful** (dermal pain nerves injured)



Full thickness (3rd deg)
• Pale • Feels like leather, • does NOT blanch, • hair loss • **Painless (cutaneous nerve "killed")**

Circumferential Full thickness
• **ALL the way around** • Loss of dermal compliance (flexibility) • **Skins becomes like a tourniquet causing ischaemic limb, SOB (torso)**

Trauma Day – BURNS calculating resuscitation fluids

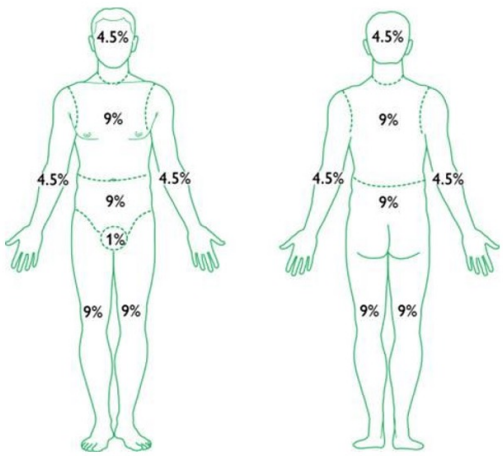
Steps

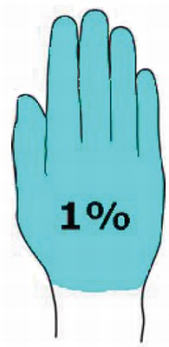
1. **Calculate %TBSA** – Adults ≥ 20% or child ≥ 10%
2. **Parkland's formula** (see below)
3. **IVF** – Hartmann's (**to minimise K loss)**
4. **Check IDC – urine output**

2-4ml x (ideal) weight (kg) x %TBSA
- 50% in first 8 hrs
-50% in next 16 hrs
titrate to urine output – adult = 0.5ml/kg/hr

What happens if it does not work? Eschar?

- **Eschar** = tough, inelastic mass of burnt tissue (secondary from full thickness circumferential burns)
- **Compartment syndrome** = **eschar + swelling (i.e. circumferential burns)**
  - Vascular compromise of limb (distal ischaemia)
  - Impending / actual respiratory compromise
- **Treat with escharatomy**
  - Life-saving procedure – improve blood flow
  - Incise tissue along predefined escharotomy lines





Rule of 9's:

***ONLY** includes 2nd and 3rd degree burns

**Not used for children (which uses rule of 5's)

Case Study: Acute Trauma:

1. **A 26 yr old healthy man was riding a motorcycle which collided with an SUV. He has just been brought to hospital by ambulance. He seems alert, appears pale and distressed and is complaining of severe pain in his R leg. His vital signs are P 120, BP 100/80, RR 20/min. The ambulance officers report that he has swelling and deformity of his right thigh and that his right foot is pale and cold. He also has laceration to his L upper arm, to which a dressing and bandage have been applied to stop bleeding.**

DDx	Mx
• Haemorrhagic shock secondary to Shaft of femur # • Nb: NOF# = Shortened leg + ER **Key findings** • Hypotension – hypovol. • Tachycardia - compensating for hypoTN to maintain CO R) Pale/cold foot → ischemic foot (risk of amputation) • Vascular injury = Suggests bleed from superficial femoral artery which drains down into popliteal artery	Get help – surgical reg A – patent B – breath sounds, FiO2 (NP) C – IV Access (2x large bore cannulas) o IVF – 500mL 0.9% NS o Bloods – FBC, EUC, LFT, COAG + GROUP + X-MATCH o IV Analgesia - morphine o IV anti-emetics - D – GCS and BSL E – Secondary survey → hypothermia (need warm blankets) ➢ **Traction on leg to straighten shortened segments of femur** (prevents ischaemia and compartment syndrome) ➢ **Angiography + stent OR ORIF (restore femur alignment)** ➢ Maintain pressure on bandage dressing until haem stable

2. **A 18yr old young woman was crossing the road when hit by a car travelling at about 50km/hr. She was thrown sideways and impacted the guard rail on the side of the road. She has been complaining of abdominal pain during her ambulance transport to the hospital. En route she has been a bit confused, BP has fallen from 110 syst to 90. She looks quite pale and her hands are cool and clammy while her vital signs are P130, BP 85/60, RR 28/min. Her airway is clear and her chest looks and sounds normal (i.e. equal breath sounds on both sides) but her abdomen appears a bit distended and is quite tender across the upper region.**

DDx	Mx	Other Mx
Haemorrhagic shock secondary to: • Haemothorax • Intra-abdo bleed • Long-bone # • Pelvic # • External losses **Key findings** • **Confused** o ?brain injury o ?Cerebral hypoxia o ?EtOH/drugs • HypoTN → pale/cool → **Vasoconstriction and peripheral shutdown** • Tachypnoea • Abdo distension	Get help – resus bay A – patent B – breath sounds, FiO2 (NP) C – IV Access (2x large bore cannulas) o IVF – 500mL 0.9% NS o Bloods – FBC, EUC, LFT, COAG + GROUP + X-MATCH o **O -ve (universal donor blood)** → while waiting for donor blood D – GCS assessment and BSL E – Secondary survey → hypothermia (need warm blankets) ➢ CXR – tension pneumothorax + multiple rib #, intrapleural bleed ➢ Pelvic XR – hip # and long bone # o **Pelvic ring binder** ➢ eFAST → assess internal abdominal trauma + pericardial and pleural cavity o mobile mesenteries (transvere, sigmoid, small bowel mesentery) o spleen or liver rupture ➢ Seek additional ICU help → insertion of chest drain	Consider: 1. ***Urethral bleed*** → DRE → check prostate position (high-riding) → urethrogram **BEFORE** IDC or SPC 2. ***CT angiogram*** via descending aorta → identify extravasation 3. ***MTP protocol*** (pRBC : plt : FFP) → >4 U blood required

3. **While removing a fallen tree branch from his roof, a 73 yr old man fell about 3 metres from a ladder and landed on the ground on his right side. He was able to get up but noted sharp pain in his right chest when he breathes. As he began to feel short of breath, an ambulance was called to bring him to hospital. He is alert but anxious and slightly cyanotic around his mouth. His airway is clear but his RR is 30/min, while his other vital signs are P120/min and irregular and BP 100/70. There is a crackling sensation to palpation and auscultation over his right chest and breath sounds are difficult to hear on that side but seem normal on the left side.**

DDx	Mx
• Tension Pneumothorax (spot diagnosis) • Rib # → subcutaneous emphysema • Pulmonary Embolism • TBI – EDH/SDH **Key findings** • **Irregular - ?AF history** o ?anti-coag = worsens bleed o ?BB = hides tachycardia • **Tension pneumothorax** : o Distended neck veins o Deviated trachea o **Cyanosis - reduced O2 supply** o Hypotension – hypovol. • **Crackle sensation** = subcutaneous emphysema (RF for pneumothorax) ➔ NO management needed	Get help – resus bay *A – patent* *B – absent breath sounds, FiO2 (NP)* C – **IV Access (2x large bore cannulas)** o IVF – 500mL 0.9% NS o Bloods – FBC, EUC, LFT, COAG + GROUP + X-MATCH **D – GCS assessment and BSL** E – **Secondary survey → hypothermia (need warm blankets)** ➢ CXR 1st – tension pneumothorax + multiple rib # CXR 1st before inserting chest drain (safely) = large 32Fr gauge → drains both and liquid/blood → connect it to underwater sealed drainage (3 bottle system) ➢ Pelvic XR – hip # and long bone # ➢ Non-contrast CT head ➢ Seek additional ICU help → insertion of chest drain

4. **Woman aged 33yrs was struck in the head and knocked unconscious by a baseball during a regional competition. She appeared to recover quickly but 10 minutes later she collapsed and has been rushed to hospital. She has a patent airway and is breathing normally. Vital signs are P 90, BP 110/70, RR 15/min. She responds to painful stimuli but not to voice. She has mild swelling over the left temporal area of her head. After Primary and Secondary Surveys, there do not appear to be any other** injuries.

DDx	Mx	Other Mx
• Extra-Dural haemorrhage (classic presentation of lucid interval following injury) – middle meningeal artery **Key findings** • Direct witnessed TBI + Lucid interval	*Emergency !! (as primary and secondary survey completed)* ➢ contact Radiology to request urgent non-contrast CT brain ➢ contact Neurosurgical reg and OT staff– update need for OT ready after non-contrast CT brain ➢ If ***regional*** ➔ call tertiary hospital immediately → may receive guidance for burr-hole	*What can be done now?* ➢ NBM ➢ FiO2 + IV fluids → aim to avoid any hypoxia and brain ischaemia ➢ Check for dilated pupils / headaches / fluid chart ➢ Check meds for anti-coags/anti-plts ➢ Plan for craniotomy → evacuate haematoma