# Shock and Surviving Sepsis


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UHD

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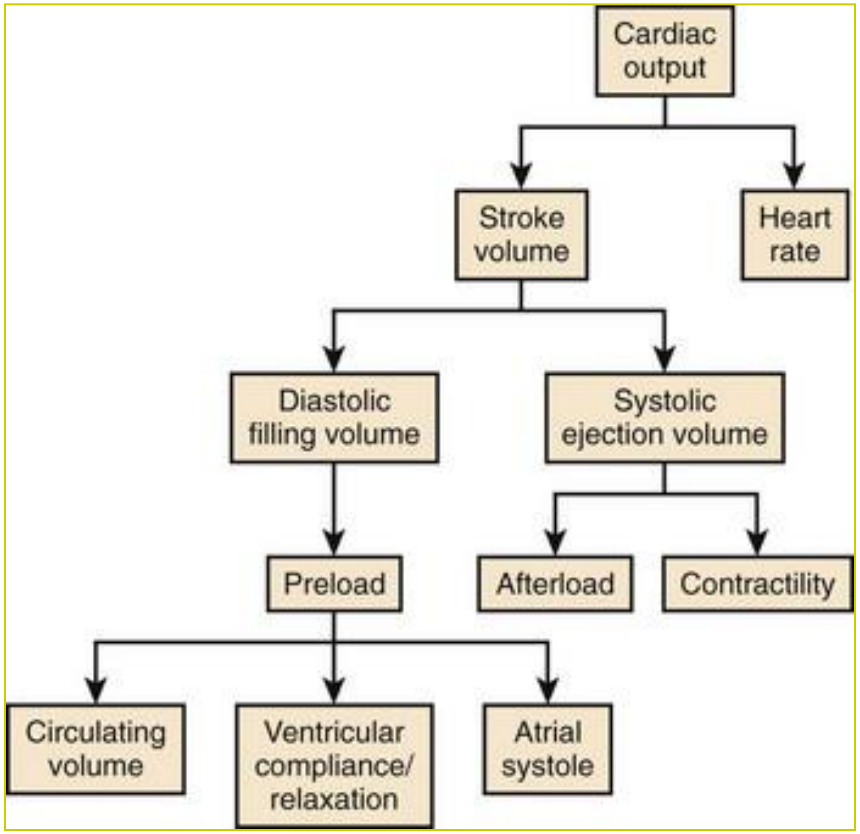
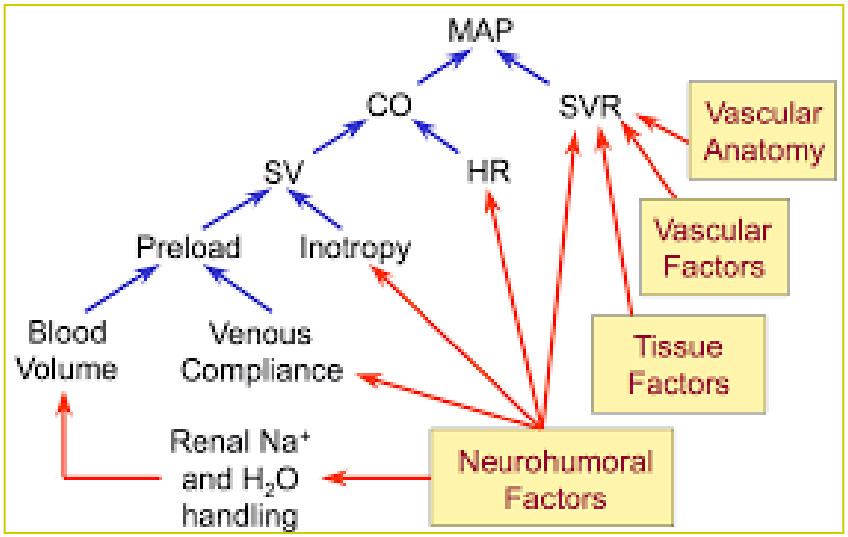
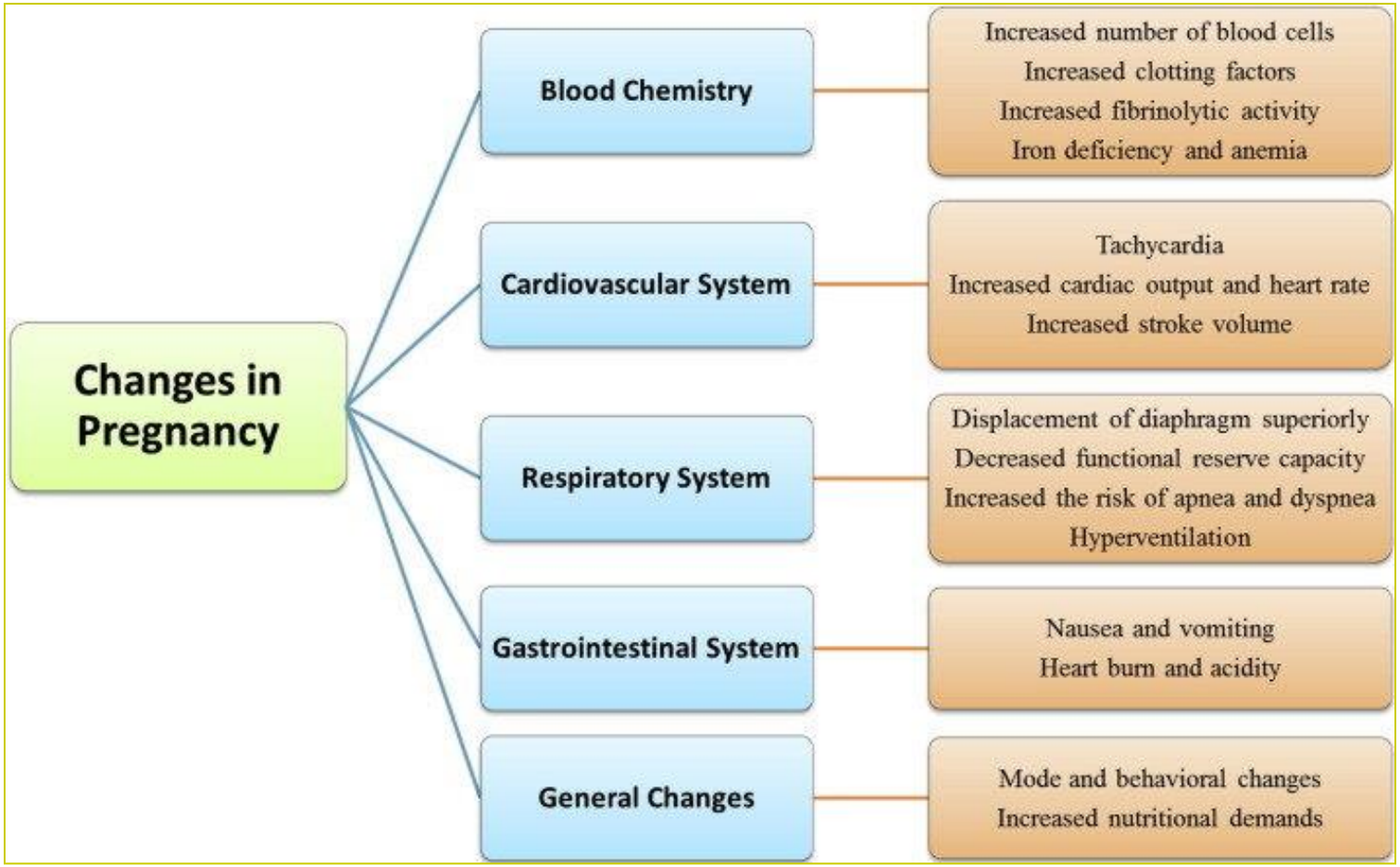
# Normal physiology



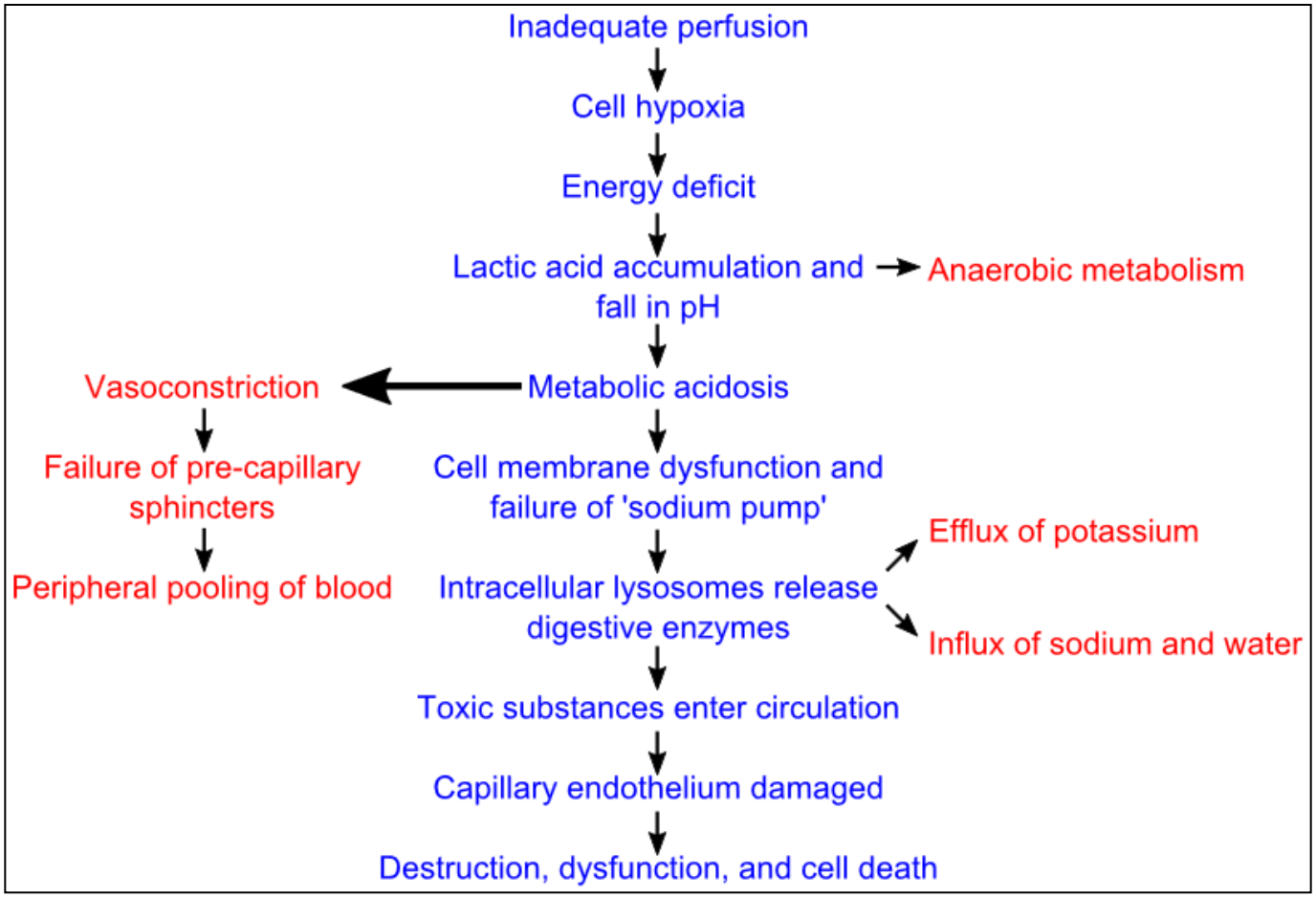
# Changes in Pregnancy



# Shock

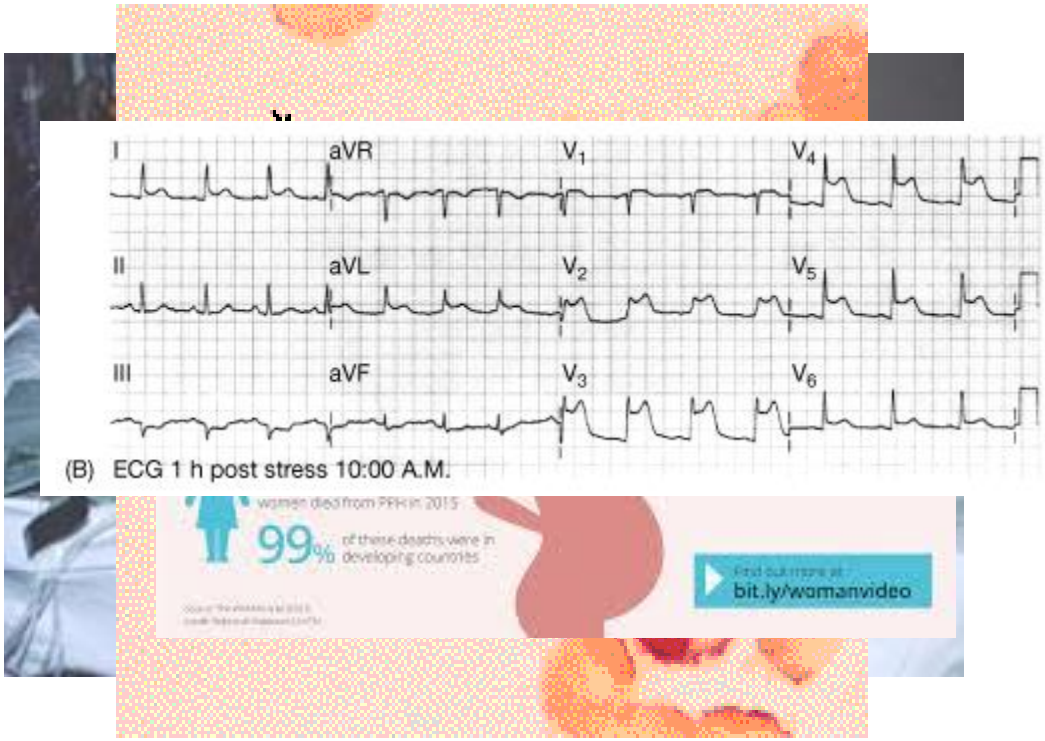
"An abnormal state of the circulation in which oxygen delivery to tissue is inadequate causing cellular hypoxia"

# Shock Pathophysiology



# Types of shock

- Hypovolaemic
- Cardiogenic shock
- Anaphylaxis
- Obstructive
- Neurogenic



# Hypovolaemic Shock

| Class of haemorrhagic shock | | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| Blood loss (mL) | Up to 750 | 750–1500 | 1500–2000 | > 2000 |
| Blood loss (% blood volume) | Up to 15 | 15–30 | 30–40 | > 40 |
| Pulse rate (per minute) | < 100 | 100–120 | 120–140 | > 140 |
| Blood pressure | Normal | Normal | Decreased | Decreased |
| Pulse pressure (mm Hg) | Normal or increased | Decreased | Decreased | Decreased |
| Respiratory rate (per minute) | 14–20 | 20–30 | 30–40 | > 35 |
| Urine output (mL/hour) | > 30 | 20–30 | 5–15 | Negligible |
| Central nervous system/ mental status | Slightly anxious | Mildly anxious | Anxious, confused | Confused, lethargic |

# Hypovolaemia in Pregnancy

- Lots of cardiovascular changes in pregnancy
  - Increased cardiac output
  - Maternal heart rate increases by 12/40
  - Plasma volumes increase 45-50%
  - RBC volume increases 20%
  - Relative anaemia
  - SVR decreases
  - Uterine blood flow increases from 50ml/min to 500ml.min at term

# Major Haemorrhage

Related to SOP B-TRA-P-T00014

If patient born 1996 onwards replace FFP with Octaplas

Definition

Sudden, significant ongoing haemorrhage which if left untreated will cause a loss of 50% blood loss within 3 hours.

**STEP 1**

Site two large bore IV cannulae and take cross match samples commence resuscitation with O Negative blood using a blood warmer. (4 units available in ED fridge)

Recommend Tranexamic acid 1g over 10 minutes then repeat after 10 units

**STEP 2**

Inform Transfusion via **bleep 2073** and say:

**MASSIVE HAEMORRHAGE**

**STEP 3**

Send urgent fully completed blood samples and forms

Cross Match – FBC - Clotting

**DO NOT SEND IN POD**

Send with runner who must then wait for the blood products

**STEP 4**

**Commence resuscitation with Shock Pack 1**

**Aim to maintain: INR/APTR < 1.5 Fibrinogen > 1.5 g/L Platelets > $75 \times 10^9$ /L**

**If patient on warfarin consider Prothrombin Complex Concentrate**

**SHOCK PACK 1**

**4 units suitable red cells**
(Group specific- 15 mins)

**2 units of FFP**
**+**
**2 units of FFP**

**1 ATD Platelets**

**MHP requirement continuing?**

**No** → Notify transfusion and stand down

**Yes** → **Request SHOCK PACK 2**
**Repeat blood tests**

**SHOCK PACK 2**

**6 units suitable red cells**

**4 units FFP**

**1 ATD Platelets**

**2 units Cryoprecipitate**

**MHP requirement continuing?**

**Yes** → Repeat Shock pack 2
**Repeat blood tests**

**No** → Notify transfusion and stand down

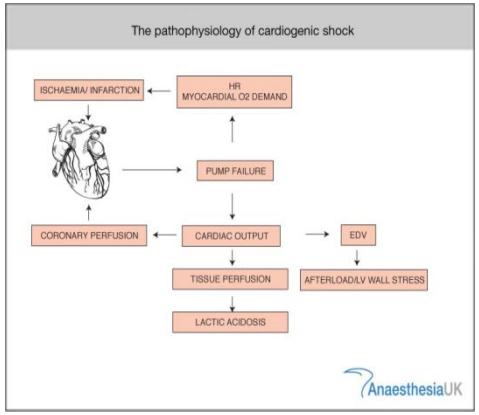
Maintain Ionised $Ca^{2+}$ > 1.0mmol/L (use 10mmol CaCl boluses as required)
Maintain serum $K^+$ < 5.5 mmol/L (use glucose/insulin infusion/boluses as required)

# Cardiogenic Shock

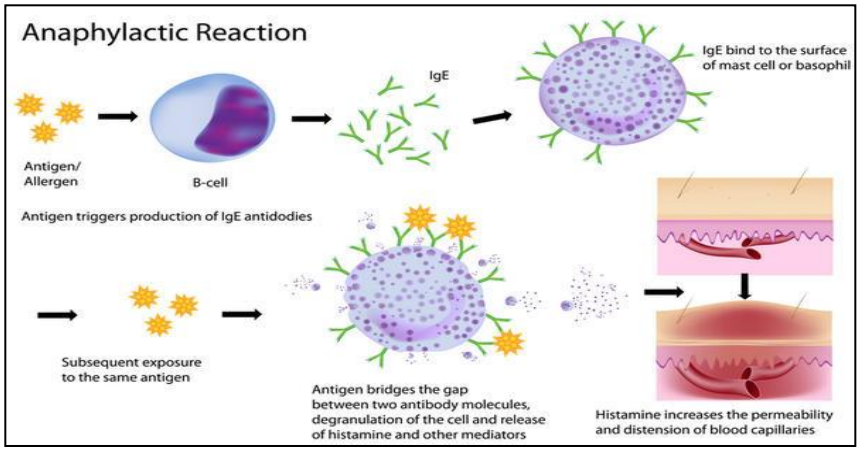
**'Sustained hypotension with inadequate tissue perfusion in spite of adequate left ventricular filling pressure'**

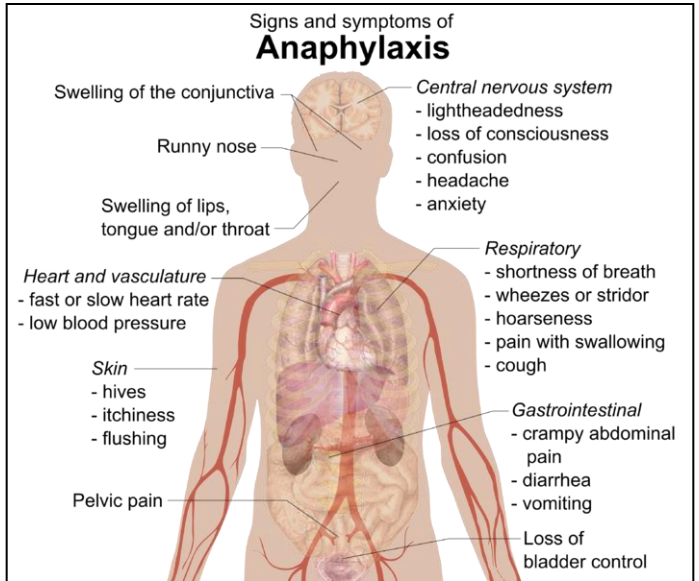
- Distended jugular veins due to increased jugular venous pressure
- Weak or absent pulse
- Pulsus paradoxus in case of tamponade
- Arrhythmia, often tachycardic

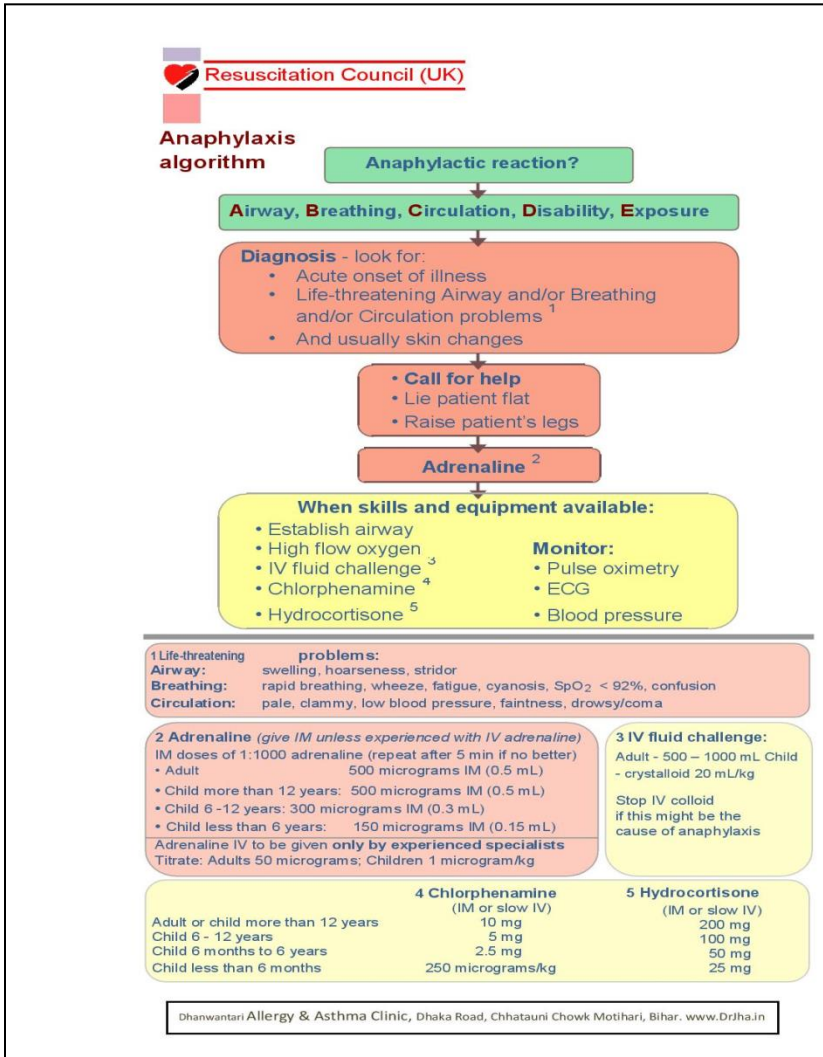
- Causes
  - AMI – mortality >80%
  - Pump failure – L/RVF
  - Mechanical complications
  - Others – myocarditis, cardiomyopathy, contusion, LVOT
  - Drugs
  - Dissection
  - Sepsis



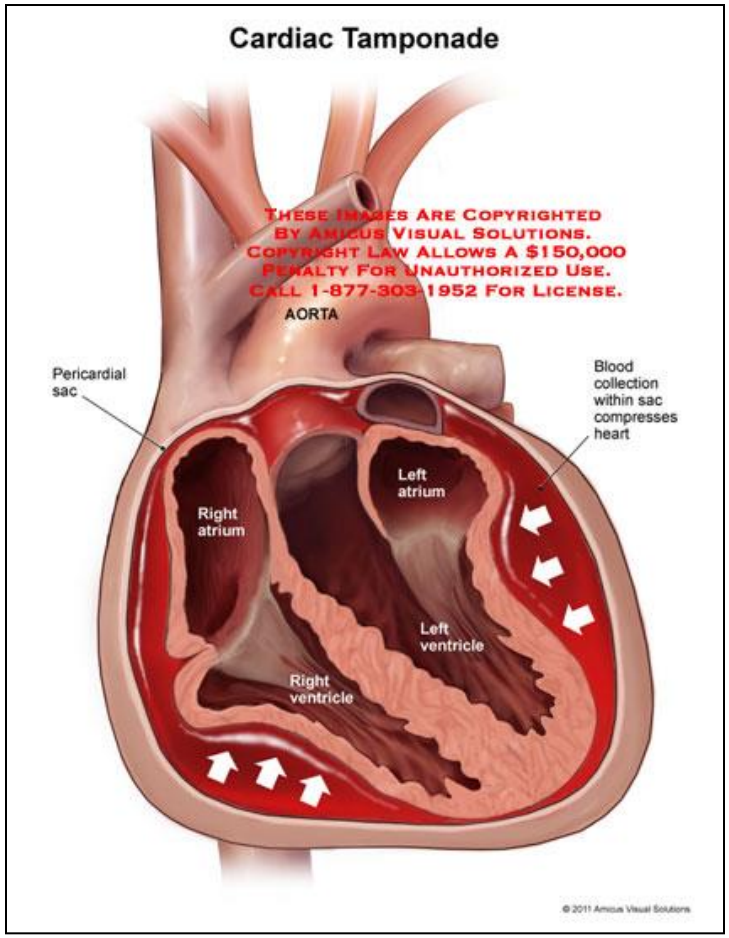
# Anaphylactic Shock

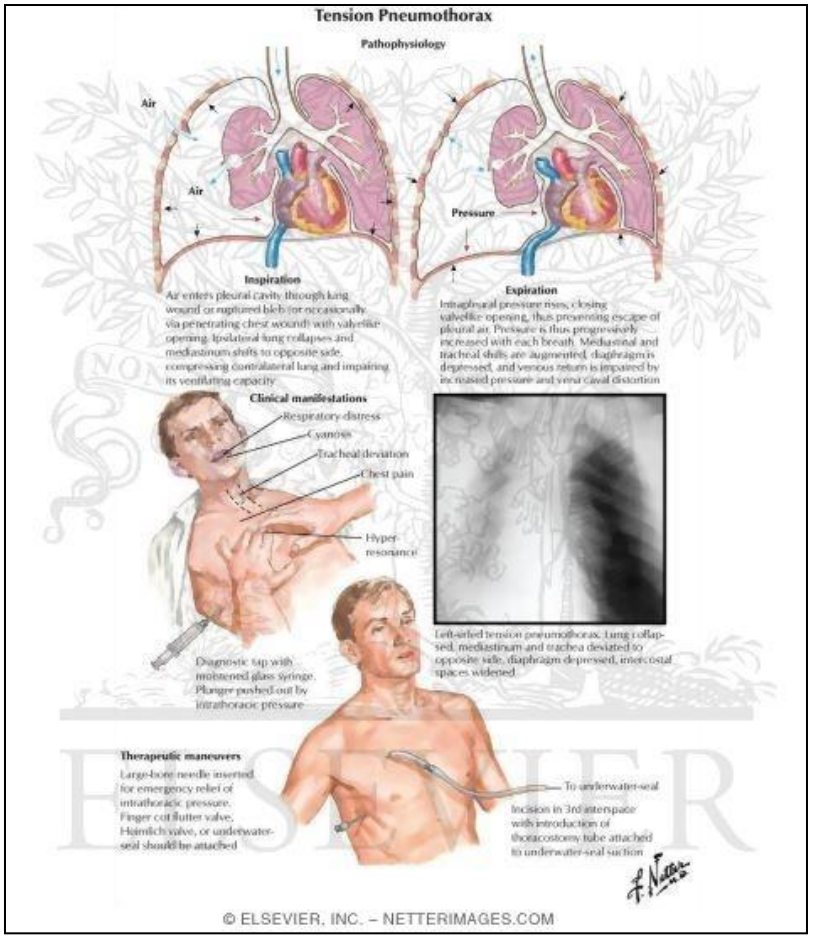


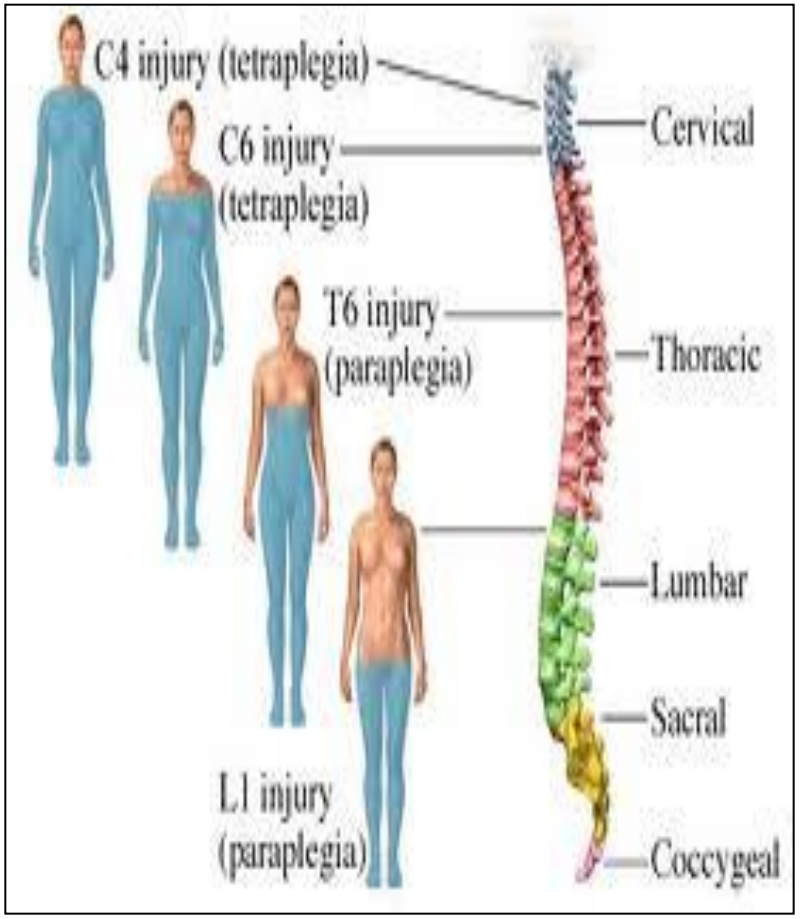



# Cardiac Tamponade/Tension Pneumothorax



# Neurogenic Shock




- Caused by loss of sympathetic tone distal to lesion level
  - vasodilatation

# Treatment of shock

Improve Oxygen Delivery

Oxygen Delivery

=

Cardiac Output

x

$O_2$ content of blood (Hb & $SaO_2$)

# Improve oxygen delivery

- Give oxygen
- Give fluid
- Optimize contractility
- Optimize $O_2$ carrying capacity
- CORRECT the PRIMARY CAUSE

# Sepsis: A continuum

Infection/ Trauma | SIRS | Sepsis | Severe Sepsis

- A clinical response arising from a nonspecific insult, including ≥2 of the following:
  - Temperature ≥38°C or ≤36°C
  - HR ≥90 beats/min
  - Respirations ≥20/min
  - WBC count ≥12,000/mm$^3$ or ≤4,000/mm$^3$ or >10% immature neutrophils

- SIRS with a presumed or confirmed infectious process

SIRS = systemic inflammatory response syndrome.
Bone et al. *Chest.* 1992;101:1644.

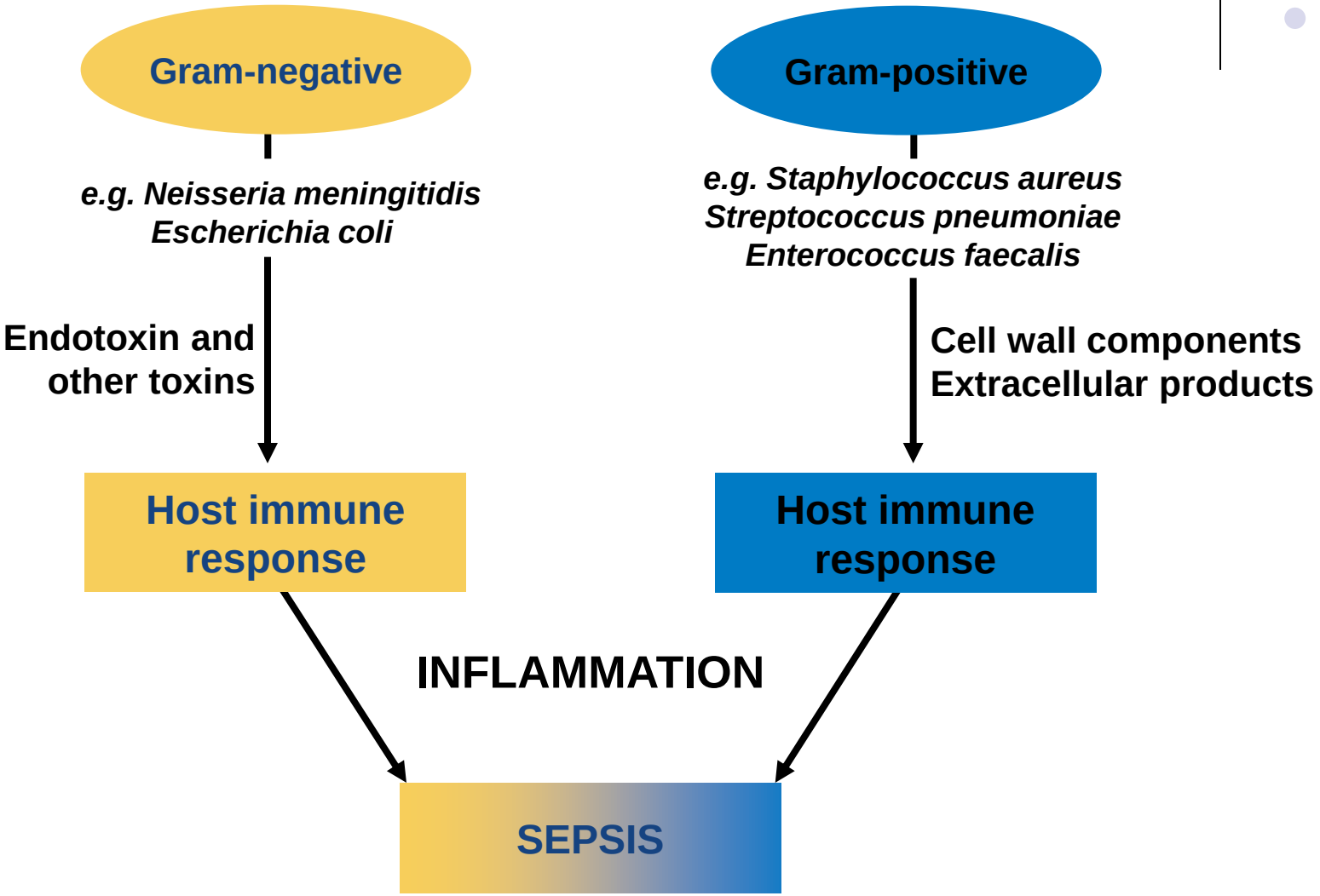
# Definitions

- <u>Systemic inflammatory response syndrome</u>
  - Clinical response to a variety of insults
  - Temp > 38 $^{o}$C or < 36 $^{o}$C
  - Heart rate > 90
  - Resp rate > 20 or $PaCO_2$ < 4.3 kPa
  - WBC <4,000 or > 12,000 / $mm^3$ or > 10% immature forms
- <u>Sepsis</u>
  - Systemic response to infection

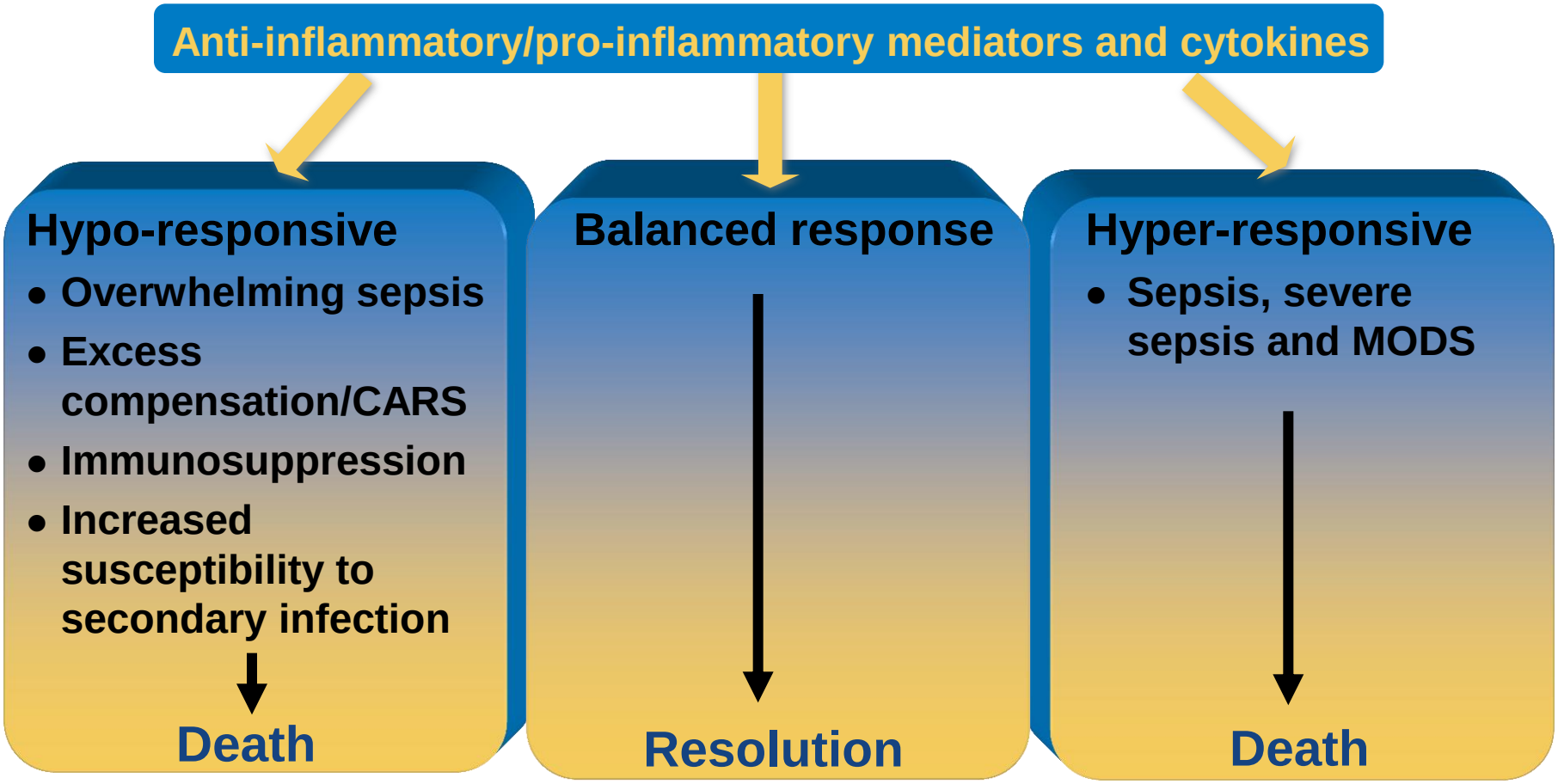
# Definitions

- Severe sepsis
  - Sepsis associated with organ dysfunction, hypoperfusion or hypotension (SBP < 90 mmHg)
  - Includes lactic acidosis, oliguria or acute alteration in mental state
- Septic shock
  - Sepsis with hypotension despite adequate fluid resuscitation, with abnormal tissue perfusion

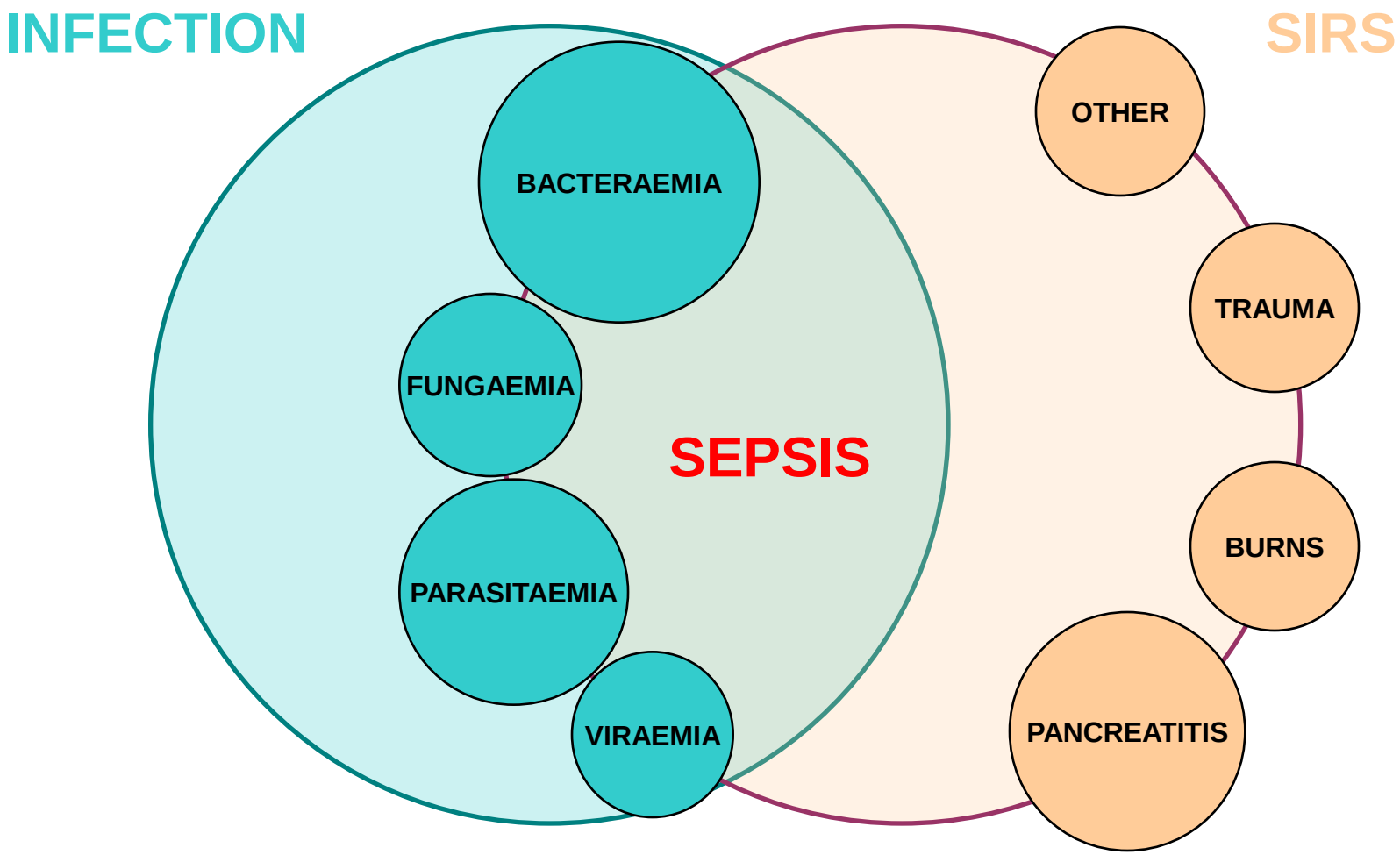
# Bacterial pathogens in sepsis



# Loss of inflammatory control



# Infection, SIRS and Sepsis



“Except on a few occasions the patient appears to die from the body’s response to infection rather than from the infection itself.”

William Osler, The Evolution of Modern Medicine, 1904.

- In the UK
  - 37,000 die each year from sepsis (Health Service ombudsmen) cf. 35,000 from lung cancer and 16,000 bowel cancer
  - 28 day ICU mortality 32.7%
  - >1/3 admissions to ICU's (approx £1900/day)
  - 1/7 hospital deaths are due to sepsis
  - Estimated cost to NHS in England £1.8 billion per year
  - Overall mortality up to 35%
  - Significant morbidity in survivors
  - NHS England has identified it as a priority

# Surviving Sepsis

Surviving Sepsis Campaign®

Surviving Sepsis

Search | Search

- About the Campaign
- About Sepsis
- Background
- Campaign Update
- Chart Review Database
- Educational Opportunities
- Getting Started
- Glossary
- Guidelines
- How to Improve
- Industry
- Links
- Severe Sepsis Bundles
- Tools
- What You Should Know
- Why Implement the Campaign

Chart Review Database | Guidelines | Bundles | Patient & Family Information | Request More Info | Join The Community

## WELCOME TO THE SURVIVING SEPSIS CAMPAIGN WEBSITE

### Introduction

The Surviving Sepsis Campaign (SSC), an initiative of the European Society of Intensive Care Medicine (ESICM), the International Sepsis Forum (ISF), and the Society of Critical Care Medicine, was developed to improve the management, diagnosis, and treatment of sepsis. The agreement among the three societies and funding for the campaign came to a conclusion on December 31, 2008 (view final newsletter). ISF has officially withdrawn from the SSC however, ESICM and SCCM continue to collaborate maintaining this website and the database so that all associated materials remain as resources. This unprecedented global effort to reduce death from sepsis was accomplished through the guidance and support of the three collaborating societies and their members. The Institute for Healthcare Improvement worked with campaign leadership to lend expertise in reinforcing the campaign as a quality improvement initiative.

### Aim

The SSC aimed to reduce mortality from sepsis via a multi-point strategy, primarily:

- Building awareness of sepsis
- Improving diagnosis
- Increasing the use of appropriate treatment
- Educating healthcare professionals
- Improving post-ICU care
- Developing guidelines of care
- Facilitating data collection for the purposes of audit and feedback

### Current Status of Campaign

While the campaign has officially concluded, this web site will remain an active resource through 2011 to provide information and resources for patients, healthcare professionals, and the general public. Ongoing support for hospitals implementing the bundles in the US is available through SCCM's Paragon Program.

### How to Connect with Colleagues

Worldwide, a community of colleagues is available by using the campaign list serve. Click on the "Join the Community" tab on this homepage or here to subscribe or unsubscribe to the list serve at any time. The SSC database can be directly downloaded from this site by clicking on the manual/database tab. Discs for 3.0 version are available; however, shipping charges will apply. Please note that complete instructions have been provided for installation and use of the database including how to print reports and what to do when installing the system on a network. Those instructions should be read in full before attempting to install the database. Note password retention is the responsibility of the user. Very limited support for the database is available by sending an email to info@survivingsepsis.org. Hospitals may continue to submit data to the central database.

# Guidelines for Management of Severe Sepsis and Septic Shock

**Surviving Sepsis Campaign** This is a summary of the Surviving Sepsis Campaign *International Guidelines for Management of Severe Sepsis and Septic Shock: 2008*, condensed from *Dellinger RP, Levy MM, Carlet JM, et al: Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock. Intensive Care Medicine (2008) 34:17-60.*

This version does not contain the rationale or appendices contained in the primary publication. The SSC guidelines do not cover every aspect of managing critically ill patients, and their application should be supplemented by generic best practice and specific treatment as required. Please refer to the guidelines for additional information at www.survivingsepsis.org

Strength of recommendation and quality of evidence have been assessed using the GRADE criteria, presented in brackets after each guideline.
For added clarity:
◆ Indicates a Strong recommendation or "we recommend"
◇ Indicates a weak recommendation or "we suggest"

*This pocket guide is distributed by the ESICM*

EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE

January 2008

**SSC Guidelines have been endorsed by**

*American Association of Critical-Care Nurses*
*American College of Chest Physicians*
*American College of Emergency Physicians*
*Canadian Critical Care Society*
*European Society of Clinical Microbiology and Infectious Diseases*
*European Society of Intensive Care Medicine*
*European Respiratory Society*
*International Sepsis Forum*
*Japanese Association for Acute Medicine*
*Japanese Society of Intensive Care Medicine*
*Society of Critical Care Medicine*
*Society of Hospital Medicine*
*Surgical Infection Society*
*World Federation of Societies of Intensive and Critical Care Medicine.*
*Participation and endorsement by German Sepsis Society and Latin American Sepsis Institute.*

## Initial resuscitation (first 6 hours)

- Begin resuscitation immediately in patients with hypotension or elevated serum lactate >4mmol/l; do not delay pending ICU admission. (1C)
- Resuscitation goals: (1C)
  - Central venous pressure (CVP) 8–12 mm Hg*
  - Mean arterial pressure ≥ 65 mm Hg
  - Urine output ≥ 0.5 mL.kg$^{-1}$.hr$^{-1}$
  - Central venous (superior vena cava) oxygen saturation ≥ 70%, or mixed venous ≥ 65%
- ◇ If venous $O_2$ saturation target not achieved: (2C)
  - consider further fluid
  - transfuse packed red blood cells if required to haematocrit of ≥ 30% and/or
  - dobutamine infusion max 20 µg.kg$^{-1}$.min$^{-1}$

  * A higher target CVP of 12-15 mmHg is recommended in the presence of mechanical ventilation or pre-existing decreased ventricular compliance.

## Diagnosis

- Obtain appropriate cultures before starting antibiotics provided this does not significantly delay antimicrobial administration. (1C)
  - Obtain two or more blood cultures (BCs)
  - One or more BCs should be percutaneous
  - One BC from each vascular access device in place >48 hours
  - Culture other sites as clinically indicated
- Perform imaging studies promptly in order to confirm and sample any source of infection; if safe to do so. (1C)

## Antibiotic therapy

- Begin intravenous antibiotics as early as possible, and always within the first hour of recognising severe sepsis (1D) and septic shock. (1B)
- Broad-spectrum: one or more agents active against likely bacterial/fungal pathogens and with good penetration into presumed source. (1B)
- Reassess antimicrobial regimen daily to optimise efficacy, prevent resistance, avoid toxicity & minimise costs. (1C)
- ◇ Consider combination therapy in Pseudomonas infections. (2D)
- ◇ Consider combination empiric therapy in neutropenic patients. (2D)
- ◇ Combination therapy no more than 3-5 days and de-escalation following susceptibilities. (2B)
- Duration of therapy typically limited to 7–10 days; longer if response slow, undrainable foci of infection, or immunologic deficiencies. (1D)
- Stop antimicrobial therapy if cause is found to be non-infectious. (1D)

## Source identification and control

- A specific anatomic site of infection should be established as rapidly as possible (1C) and within the first 6 hours of presentation. (1D)
- Formally evaluate patient for a focus of infection amenable to source control measures (eg: abscess drainage, tissue debridement). (1C)
- Implement source control measures as soon as possible following successful initial resuscitation. (1C)
- ◇ Exception: infected pancreatic necrosis, where surgical intervention best delayed. (2B)
- Choose source control measure with maximum efficacy and minimal physiologic upset. (1D)
- Remove intravascular access devices if potentially infected. (1C)

## Fluid therapy

- Fluid-resuscitate using crystalloids or colloids. (1B)
- Target a CVP of ≥ 8mmHg (≥12mmHg if mechanically ventilated). (1C)
- Use a fluid challenge technique while associated with a haemodynamic improvement. (1D)
- Give fluid challenges of 1000 ml of crystalloids or 300–500 ml of colloids over 30 minutes. More rapid and larger volumes may be required in sepsis-induced tissue hypoperfusion. (1D)
- Rate of fluid administration should be reduced if cardiac filling pressures increase without concurrent haemodynamic improvement. (1D)

## Vasopressors

- Maintain MAP ≥ 65mmHg. (1C)
- Norepinephrine or dopamine centrally administered are the initial vasopressors of choice. (1C)
- Epinephrine, phenylephrine or vasopressin should not be administered as the initial vasopressor in septic shock. (2C)
  - Vasopressin 0.03 units/min maybe subsequently added to norepinephrine with anticipation of an effect equivalent to norepinephrine alone.
- Use epinephrine as the first alternative agent in septic shock when blood pressure is poorly responsive to norepinephrine or dopamine. (2B)
- Do not use low-dose dopamine for renal protection. (1A)
- In patients requiring vasopressors, insert an arterial catheter as soon as practical. (1B)

## Inotropic therapy

- Use dobutamine in patients with myocardial dysfunction as supported by elevated cardiac filling pressures and low cardiac output. (1C)
- Do not increase cardiac index to predetermined supranormal levels. (1B)

## Steroids

- ◇ Consider intravenous hydrocortisone for adult septic shock when hypotension remains poorly responsive to adequate fluid resuscitation and vasopressors. (2C)
- ◇ ACTH stimulation test is not recommended to identify the subset of adults with septic shock who should receive hydrocortisone. (2B)
- ◇ Hydrocortisone is preferred to dexamethasone. (2B)
- ◇ Fludrocortisone (50 µg orally once a day) may be included if an alternative to hydrocortisone is being used which lacks significant mineralocorticoid activity. Fludrocortisone is optional if hydrocortisone is used. (2C)
- ◇ Steroid therapy may be weaned once vasopressors are no longer required. (2D)
- Hydrocortisone dose should be <300mg/day. (1A)
- Do not use corticosteroids to treat sepsis in the absence of shock unless the patient's endocrine or corticosteroid history warrants it. (1D)

## Recombinant human activated protein C (rhAPC)

- ◇ Consider rhAPC in adult patients with sepsis-induced organ dysfunction with clinical assessment of high risk of death (typically APACHE II ≥ 25 or multiple organ failure) if there are no contraindications. (2B); 2C for post-operative patients)
- Adult patients with severe sepsis and low risk of death (eg: APACHE II <20 or one organ failure) should not receive rhAPC. (1A)

## Blood product administration

- Give red blood cells when haemoglobin decreases to <7.0 g/dl (<70 g/L) to target a haemoglobin of 7.0 – 9.0 g/dl in adults. (1B)
  *A higher haemoglobin level may be required in special circumstances (eg: myocardial ischaemia, severe hypoxaemia, acute haemorrhage, cyanotic heart disease or lactic acidosis)*
- Do not use erythropoietin to treat sepsis-related anaemia. Erythropoietin may be used for other accepted reasons. (1B)
- ◇ Do not use fresh frozen plasma to correct laboratory clotting abnormalities unless there is bleeding or planned invasive procedures. (2D)
- Do not use antithrombin therapy. (1B)
- ◇ Administer platelets when: (2D)
  - counts are <5000/mm3 (5 X 109/L) regardless of bleeding.
  - counts are 5000 to 30,000/mm3 (5- 30 X 109/L) and there is significant bleeding risk.
  - Higher platelet counts ≥ 50,000/mm3 (50 X 109/L) are typically required for surgery or invasive procedures.

## Mechanical ventilation of sepsis-induced acute lung injury (ALI)/ARDS

- Target a tidal volume of 6ml/kg (predicted) body weight in patients with ALI/ARDS. (1B)
- Target an initial upper limit plateau pressure ≤30cm$H_2O$. Consider chest wall compliance when assessing plateau pressure. (1C)
- Allow $PaCO_2$ to increase above normal, if needed to minimise plateau pressures and tidal volumes. (1C)
- Positive end expiratory pressure (PEEP) should be set to avoid extensive lung collapse at end expiration. (1C)
- ◇ Consider using the prone position for ARDS patients requiring potentially injurious levels of $FiO_2$ or plateau pressure, provided they are not put at risk from positional changes. (2C)
- Maintain mechanically ventilated patients in a semi-recumbent position unless contraindicated. (1B)
  - ◇ Suggested target elevation 30 - 45 degrees. (2C)
- ◇ Non invasive ventilation may be considered in the minority of ALI/ARDS patients with mild-moderate hypoxemic respiratory failure. The patients need to be haemodynamically stable, comfortable, easily arousable, able to protect/clear their airway and expected to recover rapidly. (2B)
- Use a weaning protocol and a spontaneous breathing trial (SBT) regularly to evaluate the potential for discontinuing mechanical ventilation. (1A)
  - SBT options include a low level of pressure support with continuous positive airway pressure 5 cm $H_2O$ or a T-piece.
  - Before the SBT, patients should:
    - be arousable
    - be haemodynamically stable without vasopressors
    - have no new potentially serious conditions
    - have low ventilatory and end-expiratory pressure requirement
    - require $FiO_2$ levels that can be safely delivered with a face mask or nasal cannula
- Do not use a pulmonary artery catheter for the routine monitoring of patients with ALI/ARDS. (1A)
- Use a conservative fluid strategy for patients with established ALI who do not have evidence of tissue hypoperfusion. (1C)

## Sedation, analgesia, and neuromuscular blockade in sepsis

- Use sedation protocols with a sedation goal for critically ill mechanically ventilated patients. (1B)
- Use either intermittent bolus sedation or continuous infusion sedation to predetermined end points (sedation scales), with daily interruption/ lightening to produce awakening. Re-titrate if necessary. (1B)
- Avoid neuromuscular blockers where possible. Monitor depth of block with train of four when using continuous infusions. (1B)

## Glucose control

- Use IV insulin to control hyperglycaemia in patients with severe sepsis following stabilisation in the ICU. (1B)
- ◇ Aim to keep blood glucose <8.3 mmol/L (150 mg/dl) using a validated protocol for insulin dose adjustment. (2C)
- Provide a glucose calorie source and monitor blood glucose values every 1-2 hours (4 hours when stable) in patients receiving intravenous insulin. (1C)
- Interpret with caution low glucose levels obtained with point of care testing, as these techniques may overestimate arterial blood or plasma glucose values. (1B)

## Renal replacement

- ◇ Intermittent haemodialysis and continuous veno-venous haemofiltration (CVVH) are considered equivalent. (2B)
- ◇ CVVH offers easier management in haemodynamically unstable patients. (2D)

## Bicarbonate therapy

- Do not use bicarbonate therapy for the purpose of improving haemodynamics or reducing vasopressor requirements when treating hypoperfusion-induced lactic acidaemia with pH ≥ 7.15. (1B)

## Deep vein thrombosis (DVT) prophylaxis

- Use either low-dose unfractionated heparin (UFH) or low-molecular weight heparin (LMWH), unless contraindicated. (1A)
- Use a mechanical prophylactic device, such as compression stockings or an intermittent compression device, when heparin is contraindicated. (1A)
- ◇ Use a combination of pharmacologic and mechanical therapy for patients who are at very high risk for DVT. (2C)
- ◇ In patients at very high risk LMWH should be used rather than UFH. (2C)

## Stress ulcer prophylaxis

- Provide stress ulcer prophylaxis using H2 blocker (1A) or proton pump inhibitor (1B). Benefits of prevention of upper GI bleed must be weighed against the potential for development of ventilator-acquired pneumonia.

## Consideration for limitation of support

- Discuss advance care planning with patients and families. Describe likely outcomes and set realistic expectations. (1B)

*Prepared on behalf of the SSC by Dr Jeremy Wilson & Professor Julian Bion*

# BUT…..

- Surviving sepsis stopped in 2012 and failed to reach its final targets of reducing death from sepsis

- However, many hospitals continue the legacy of sepsis 6 and protocolised care for diagnosis and treatment of sepsis

# severe sepsis

## adult management pathway

complete for ALL patients with:
MEWS 2 or more & suspected infection

Disclaimer: This is a clinical template, clinicians should always use clinical judgement when assessing individual patients.

Full name:
DOB:
Unit ID:
Or attach sticker

| | Time | Name |
|---|---|---|
| Triage | | |
| Dr clerking | | |

**SIRS criteria (2 or more – please tick)**

- ☐ Fever >38 C or hypothermia <36 C
- ☐ Tachycardia >90 beats/minute
- ☐ Tachypnoea RR>20 breaths/min
- ☐ WBC >12 or <4 x10⁹ /L

Y →

**Clinical Focus of Infection (any - please state)**

- ☐ Pneumonia
- ☐ Abdo/Biliary
- ☐ Meningitis/CNS
- ☐ Rash
- ☐ Urinary/ Renal
- ☐ Bone/Joint/Spine
- ☐ Skin/ soft tissue
- ☐ Surgical Wound
- ☐ Device infection (catheter, line..)
- ☐ Endocarditis
- ☐ Chills, rigors, no focus
- Other: ☐ Neutropenia, Chemotherapy

Y →

**2 SIRS criteria AND evidence of infection:**
your patient has
**SEPSIS**

**Evidence of new organ dysfunction (any – please tick)**

- ☐ Lactate >2 SysBP <90 MeanAP <65
- ☐ Acutely altered mental status
- ☐ Hypoxia (SpO2 <90% on air or $O_2$)
- ☐ Oliguria < 0.5 ml/kg/hr or Cr > 177
- ☐ Platelets <100
- ☐ Bilirubin >35
- ☐ INR >1.5

| | |
|---|---|
| Time: | |
| SBP | |
| MAP | |
| Lactate #1 | |

Y →

**SEPSIS plus organ dysfunction:**
your patient has
**SEVERE SEPSIS**
Time:

N →

**URGENT!** within 1 hour

ABCDE approach [1]

| | Time: |
|---|---|
| 1. high flow oxygen | |
| 2. fluids (up to 20ml/kg) | |
| 3. blood cultures | |
| 4. iv antibiotics prescribed | |
| given | |
| 5. alert middle grade | |

**Treat sepsis**
**Observe closely**
Use a written physiological monitoring plan
Consider referral to Critical Care Nurse Outreach

N →

**Reassess post bolus**

| | |
|---|---|
| Time: | |
| SBP | |
| MAP | |
| Lactate #2 | |

SBP <90, MAP <65 or lactate >4 ?

Y →

your patient has
**SEPTIC SHOCK**
30% predicted mortality

N [2] →

alert consultant:
Is organ support suitable?
(NICE CG50)
Time:

Y →

**URGENT referral to CRITICAL CARE**
(Bleep 2001)
Time called:
Time arrived:

Notes:
1. Further guidance on initial care duties – see over
2. Ensure that the reason for treatment limitation is documented in medical record

Developed by:
Drs Coffey, Grandison, Schuster-Bruce, Isaac, Taylor.
Based on NICE & NCEPOD guidance and Surviving Sepsis Campaign, CCOG 2009

Severe Sepsis Pathway v 4.7 December 2009. The Royal Bournemouth and Christchurch Hospitals NHS Foundation Trust

# SEPSIS / SEVERE SEPSIS SCREENING TOOL

## Please tick the boxes relevant to your patient

**Are any two of the following SIRS criteria present?**

- ☐ Temperature <36 or >38.3 °C
- ☐ WCC >12 or <4 x $10^9$ $L^{-1}$
- ☐ Heart rate >90bpm
- ☐ Respiratory rate >20 $min^{-1}$

**If YES, patient has SIRS**

**Does your patient have a history or signs suggestive of a new infection?**

for example:

- ☐ Cough/ sputum/ chest pain
- ☐ Abdominal pain/ distension/ diarrhoea
- ☐ Line infections (please see page 4)
- ☐ Endocarditis
- ☐ Dysuria
- ☐ Headache with neck stiffness
- ☐ Cellulitis/ wound infection/ septic arthritis

**If YES, patient has SEPSIS**

**Any signs of organ dysfunction?**

- ☐ SBP < 90mmHg or MAP < 65mmHg
- ☐ Urine output < 0.5ml.$kg^{-1}$.$hr^{-1}$ for 2hrs
- ☐ INR > 1.5 or aPTT >60secs
- ☐ Bilirubin >34 µmol.$L^{-1}$
- ☐ Lactate > 4mmol.$L^{-1}$
- ☐ New need for oxygen to keep $SpO_2$ >90%
- ☐ Platelets < 100 x $10^9$ $L^{-1}$
- ☐ Creatinine > 175 µmol.$L^{-1}$

**If NO**

**Treat for SEPSIS**

- ☐ Oxygen
- ☐ Blood cultures
- ☐ IV antibiotics
- ☐ Fluid therapy
- ☐ Reassess for SEVERE SEPSIS with hourly observations/MEWS /inform Outreach

**If YES**

**Patient has SEVERE SEPSIS**

Start SEVERE SEPSIS CARE PATHWAY

See Overleaf

## MEDICAL EMERGENCY

# Severe Sepsis Protocol (Care Pathway)
# The First Hour (Initial Phase)

**Document to be kept in patient's notes please**

Patient Name _____ Ward _____ Date _____

**Affix addressograph, if available**

Hospital No _____

| **POSITIVE: Time Zero $T_0$:** | | **Time** | **Initial** | **Reason not done OR Result** |
|---|---|---|---|---|
| **1. Give high flow oxygen:** | | | | |
| **2. Blood cultures:** Consider other cultures as clinically indicated. | | | | |
| **3. IV antibiotics:** consider urgent advice from a Microbiologist & aim to de-escalate later. Pls tick the antibiotic(s) given on pg 4. | | | | |
| **4. Fluid resuscitation:** if hypotensive give boluses of 0.9% saline or Hartmann's 20ml.kg$^{-1}$ up to a max. of 60ml.kg$^{-1}$ | | | | |
| **5. Initial serum lactate:** Perform ABG (preferred) OR send sample to lab (grey top) | | | | **Lactate** mmol.L$^{-1}$ |
| **6. Check haemoglobin** to keep >7g.dL$^{-1}$. Aim >9g.dL$^{-1}$ if history of CVS disease. | | | | **Hb** g.dL$^{-1}$ |
| **7. Insert urinary catheter:** Commence hourly fluid balance | | | | |

**PLUS**

| | | | | |
|---|---|---|---|---|
| Patient must have been seen by own SpR/Consultant. **Consider Pt's co-morbidities and functional status with regards to suitability for invasive management *and/or Critical Care.*** | | | | |

***If not suitable, please tick box*** ☐
***and record in notes reasons for non-suitability***
***If not suitable for invasive management, please do not proceed to next page***

1hr time check:

All steps completed Yes ☐ No ☐

Name ..... Signature .....

Grade ..... Bleep .....

R Mahroof & G Craig, DCCQ; S Ramamoorthy & J Hartley, ED; P Featherstone MAU - November 2008 QAH v1

# MEDICAL EMERGENCY

## Severe Sepsis Protocol (Care Pathway)
## 6 Hour Resuscitation Bundle

**Document to be kept in patient's notes please**

Patient Name _____ Ward _____ Date _____
**Affix addressograph, if available**
Hospital No _____

| **POSITIVE:** **Time $T_0$ +1hr:** | | **Time** | **Initial** | **Reason not done OR Result** |
|---|---|---|---|---|
| **1. Re-check** Lactate & BP | | | | **Lactate** mmol.L$^{-1}$<br>**BP Result** / |
| 2. Is the lactate >4 mmol.L$^{-1}$<br>Yes ☐ No ☐<br>**Yes:** ensure 60ml.kg$^{-1}$bolus of Hartmann's given<br>**No:** continue less aggressive fluid resuscitation & observe closely/MEWS. | | | | |
| 3. Is the patient in shock ?<br>Yes ☐ No ☐<br>*Systolic BP<90mmHg, MAP<65mmHg or a drop of systolic BP>40mmHg*<br>If Yes,<br>a) please request Critical Care to review &<br>b) proceed to insert a central venous catheter in **jugular or subclavian vein**, see below. | | | | **BP Result** /<br>Time referred :<br>Time seen : |
| 4. Aim to achieve a CVP>8mmHg with fluid resuscitation<br>CVP >8mmHg achieved → → → | | | | Note time: |
| 5. Check central venous oxygen saturation, $ScvO_2$ (via distal port of CVC (brown))<br>*Must not be femoral* | | | | **$ScvO_2$ Result** % |
| 6. Check haemoglobin. Transfuse if Hb<7 g.dL$^{-1}$ | | | | **Hb** g.dL$^{-1}$ |
| 7. If **$ScvO_2$ <70% AND Hb>7** g.dL$^{-1}$ *contact Critical Care for inotrope/vasopressor support.*<br>(If $ScvO_2$ >70%, continue 6hr resus bundle) | | | | |

**Aim to repeat serum lactate and $ScvO_2$ measurements by end of 6hr bundle**

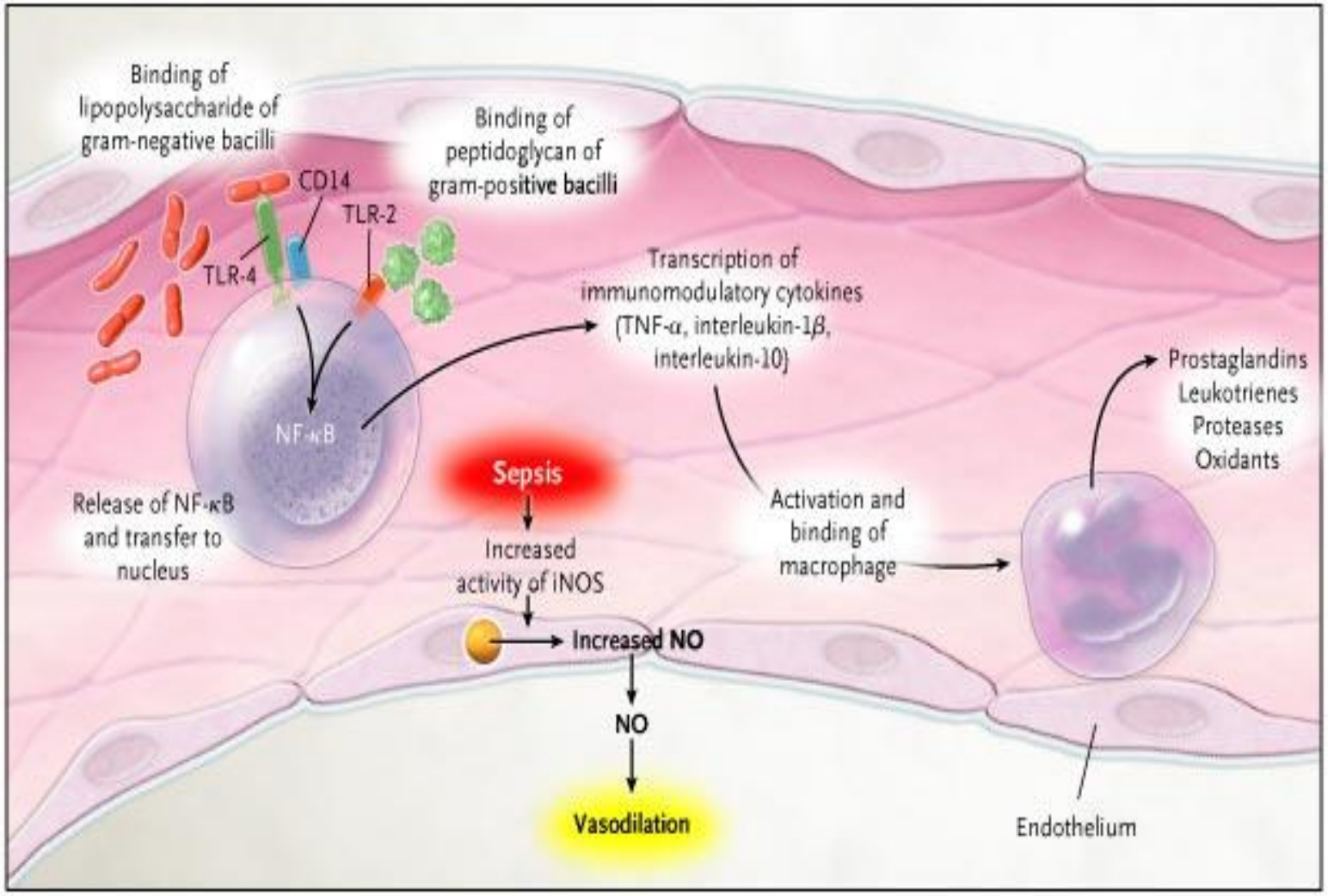
6hr time check:

All steps completed Yes ☐ No ☐

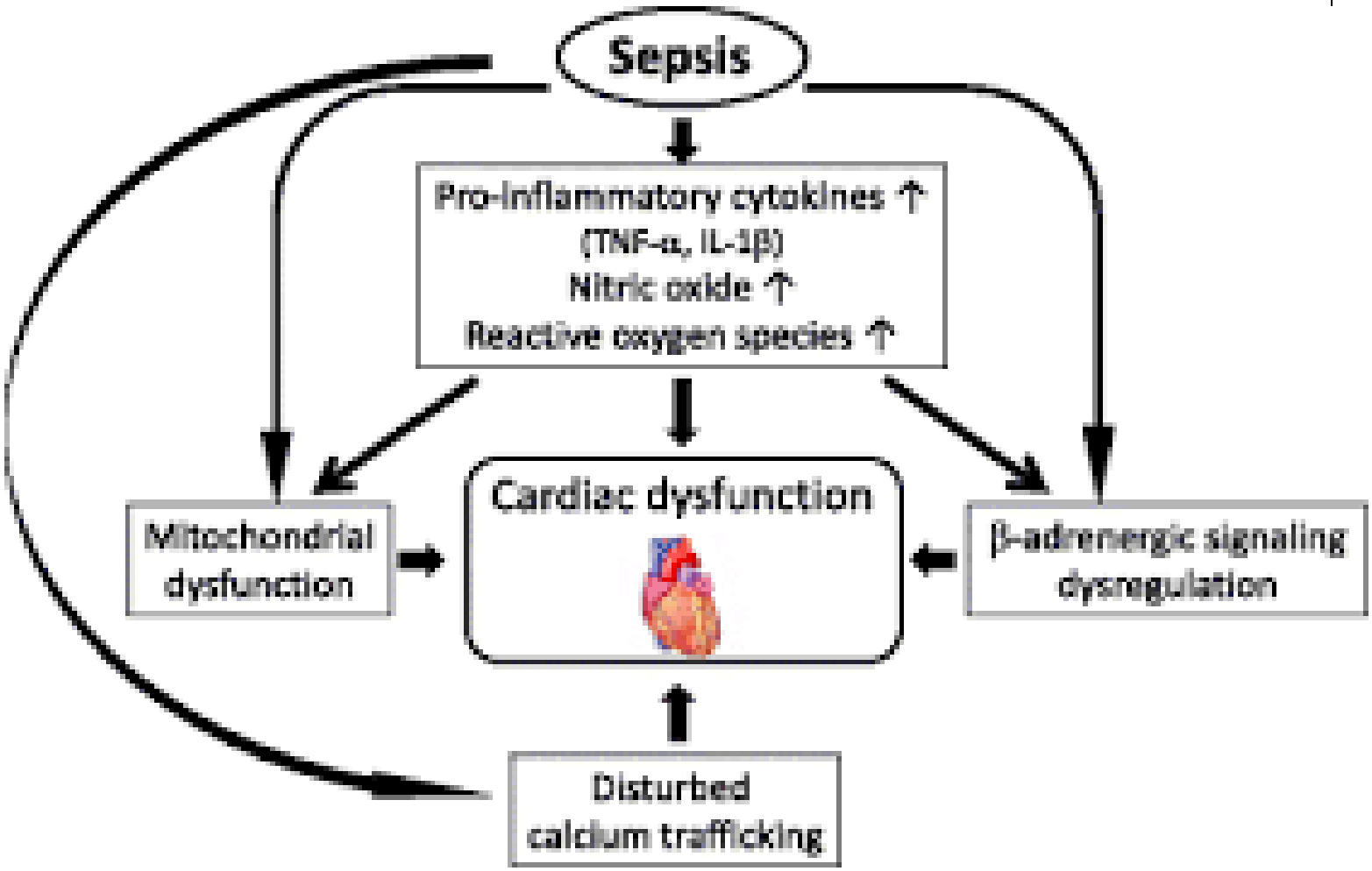
Name ..... Signature .....
Grade ..... Bleep .....

R Mahroof & G Craig, DCCQ; S Ramamoorthy & J Hartley, ED; P Featherstone MAU - November 2008 QAH v1

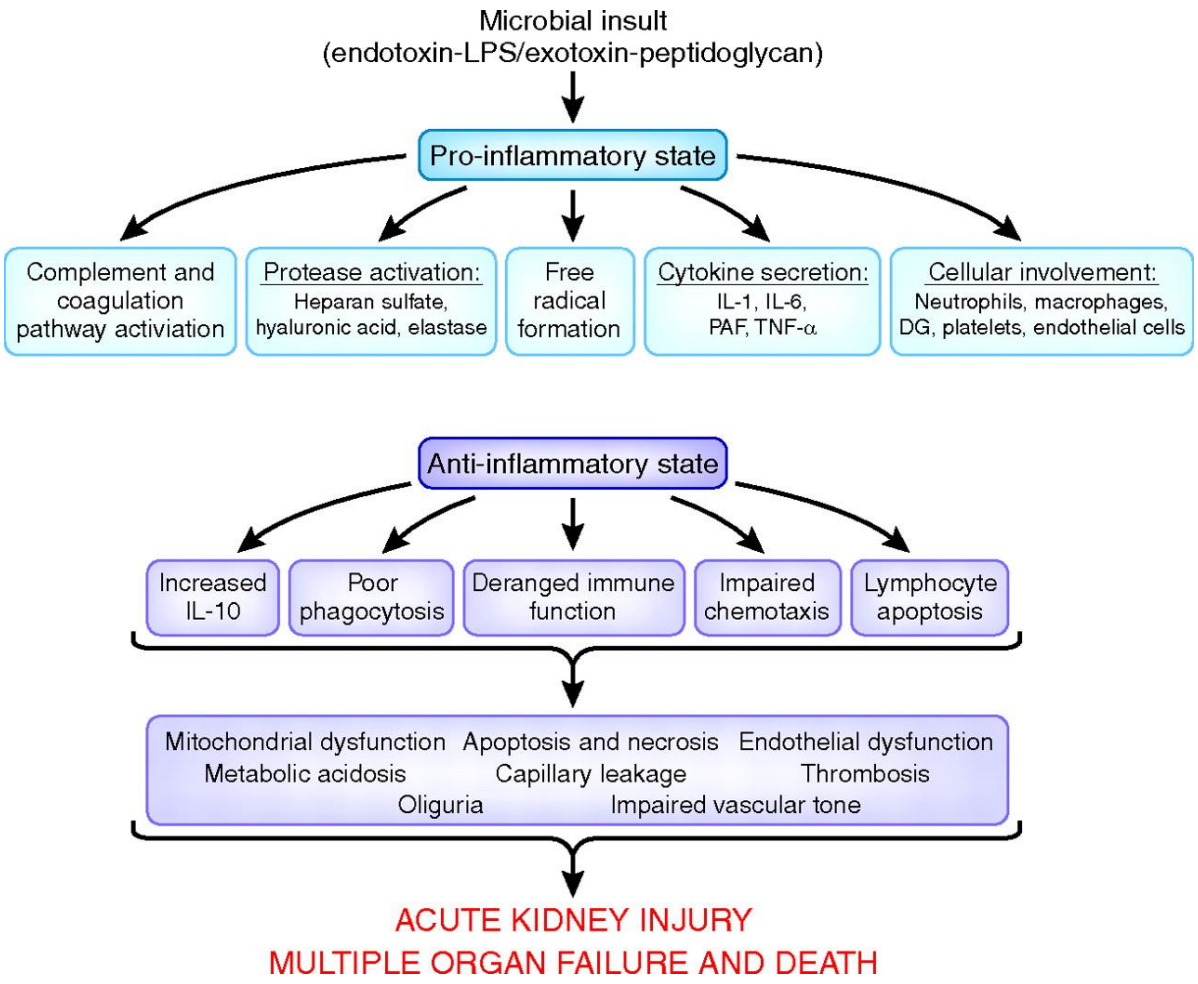
# Vascular Changes in sepsis



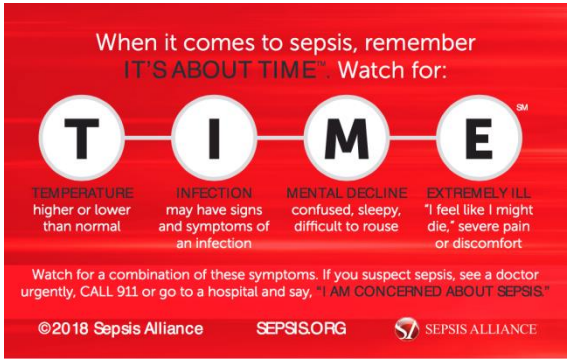
# Cardiac problems in sepsis



# Kidney problems and sepsis



# Clinical manifestations of sepsis



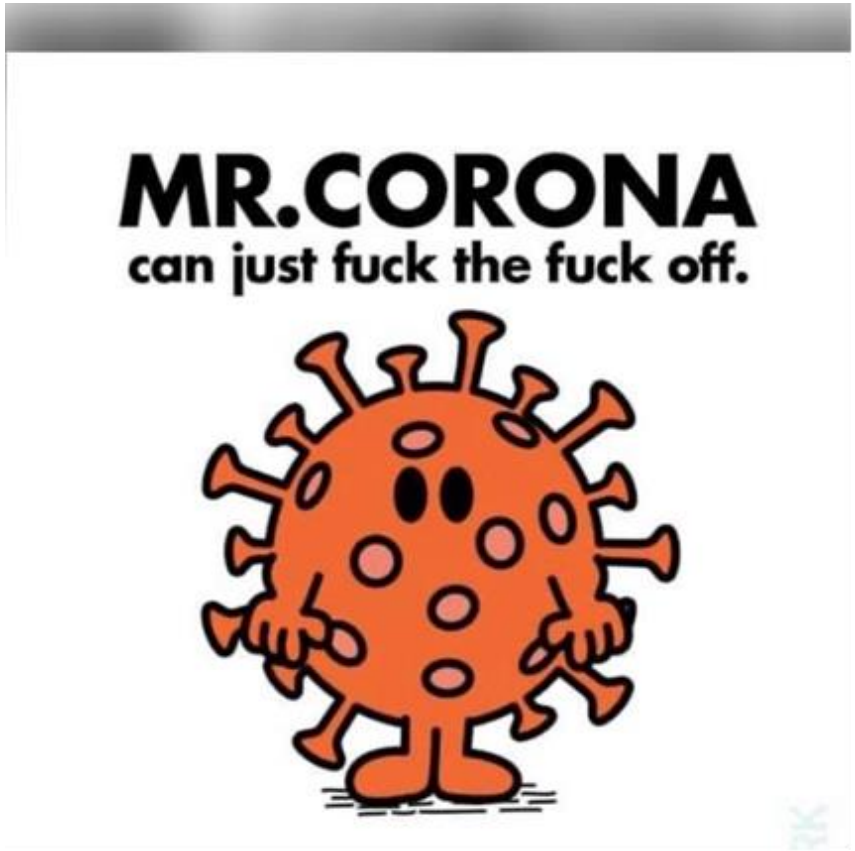


- Tachypnoea
- Altered conscious level
- Temp/hypothermia
- Delayed capillary refill

- HYPOTENSION IS PRETERMINAL SIGN IN FIT PEOPLE

# Covid-19

- Changed knowledge of Critical Care
- Rapidly evolving knowledge
- Causes inflammation of lungs
- Treatment mostly supportive
  - Dexamethasone
  - Remdesivir
  - Ongoing trials



# Issues in sepsis

- Rx with broad spectrum antibiotics
- Take cultures – blood/urine/sputum
- Administer fluid resuscitation
  - Give 500ml crystalloid and reassess

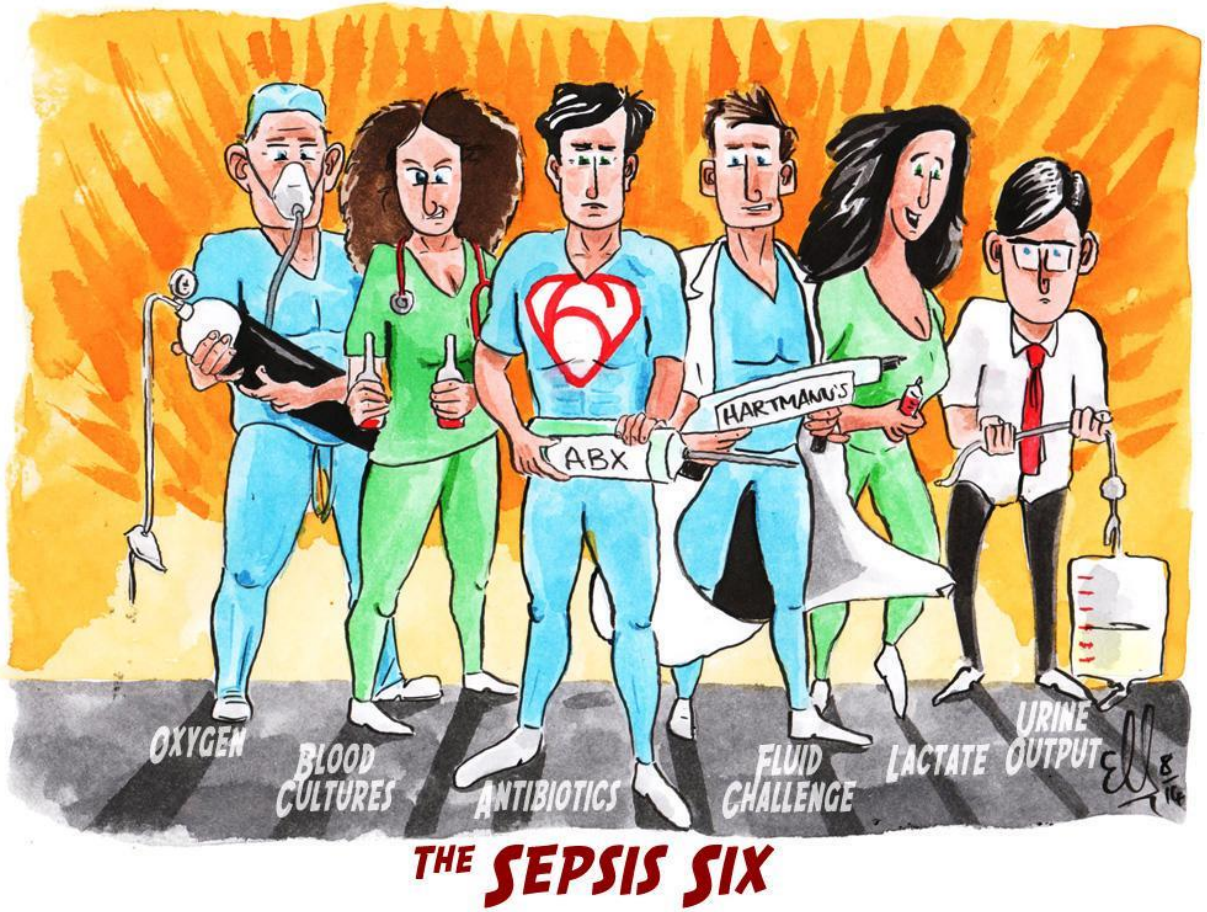
# Treatment priorities

- Monitor response to fluids
  - BP/UO/Lactate
- Refer to Critical Care Team/Outreach as necessary

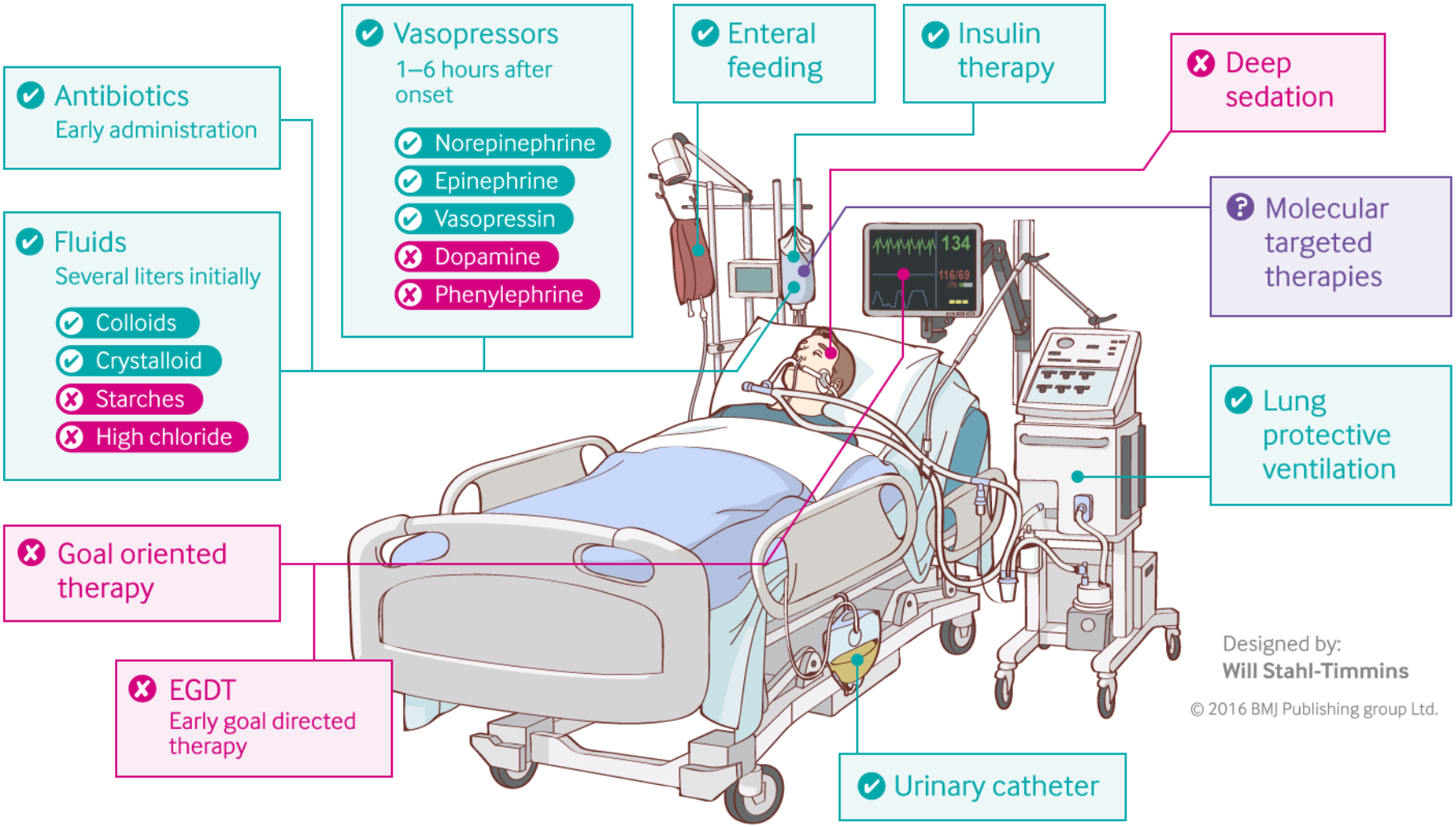
# Vasopressors

- If necessary start vasopressors – increase SVR, rising BP
  - These counteract the vasodilation
  - Normally metaraminol/ephedrine until CVC
  - Then noradrenaline
  - Possibly add in steroids +/- vasopressin
- May need inotropes – increase hearts ability to pump (dobutamine/adrenaline)
- Rarely resort to other drugs (methylene blue)

# The sepsis six



# Treating sepsis: the latest evidence



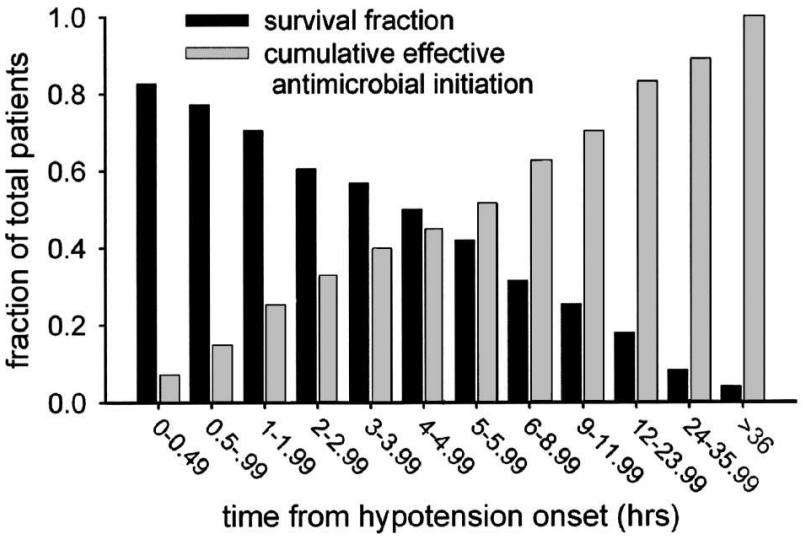

Designed by:
**Will Stahl-Timmins**

# Urgent antibiotics

- Kumar trial
  - >2000 patients
  - Antibiotics < 1 hr after hypotension 20% mortality
  - Antibiotics > 6 hrs = 58% mortality
  - 7.6% reduction in survival/hr until effective Ab therapy up to 6 hrs
  - Only 50 received Abs < 6 hours!

Kumar Crit Care Med 2006

**Figure 1. Cumulative effective antimicrobial initiation following onset of septic shock-associated** hypotension and associated survival. The x-axis represents time (hrs) following first documentation of septic shock-associated hypotension. *Black bars represent the fraction of patients surviving to hospital*
discharge for effective therapy initiated within the given time interval. The *gray bars represent the* cumulative fraction of patients having received effective antimicrobials at any given time point.



The New England Journal of Medicine

# EARLY GOAL-DIRECTED THERAPY IN THE TREATMENT OF SEVERE SEPSIS AND SEPTIC SHOCK

EMANUEL RIVERS, M.D., M.P.H., BRYANT NGUYEN, M.D., SUZANNE HAVSTAD, M.A., JULIE RESSLER, B.S., ALEXANDRIA MUZZIN, B.S., BERNHARD KNOBLICH, M.D., EDWARD PETERSON, PH.D., AND MICHAEL TOMLANOVICH, M.D., FOR THE EARLY GOAL-DIRECTED THERAPY COLLABORATIVE GROUP*

One RCT showed improved survival in patients aggressively resuscitated to preset goals in the first 6 hours ( mortality 46.5 to 30.5%)

- CVP 8 – 12 mm Hg (12 – 15 with IPPV)
- MAP >65 mm Hg
- Urine output >0.5 ml/kg/hr
- Central venous or mixed venous saturation > 70%

Treatment initiated in Emergency Department
Treated by Emergency Physician with Critical Care consultation
EGDT vs ST for 6 hours only
Used ScvO2 – surrogate marker for SvO2 in EGDT group

# EGDT/ Rivers

- BUT  inner city Detroit and low venous sats
- Australian retrospective study showed mortality WITHOUT EGDT 30%
  - ie same as ‘standard’ group in rivers

  ( Bellomo Melbourne group Crit Care 06)

No one has managed to get similar results

# rhAPC –

- Antithrombotic, profibrinolytic, anti-inflammatory actions
- Prowess trial – showed amazing reduction in sepsis mortality
- Now proven incorrect and withdrawn

- NO WONDER DRUG SINCE

# Bottom Line!

URGENCY

- ? Golden hour(s)
- View same as MI/trauma

- FROM FRONT DOOR, not just ICU
- Do basics well
- URGENT fluids/ antibiotics and source control/ get MAP up

# New for 2016

- Q-SOFA…..

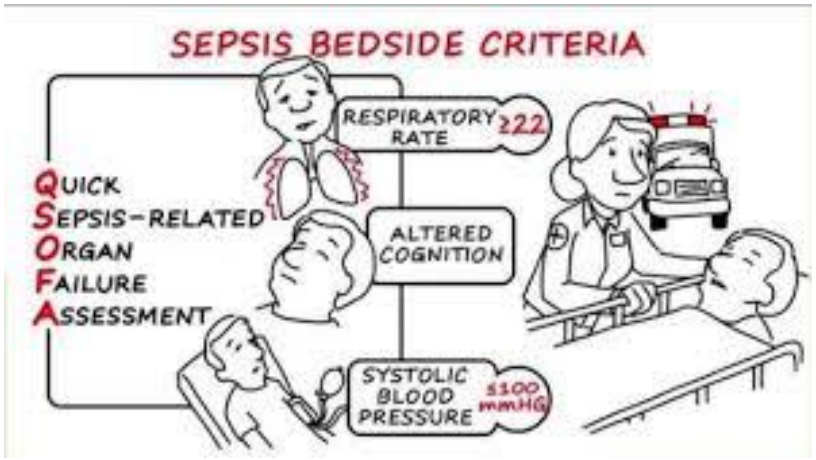
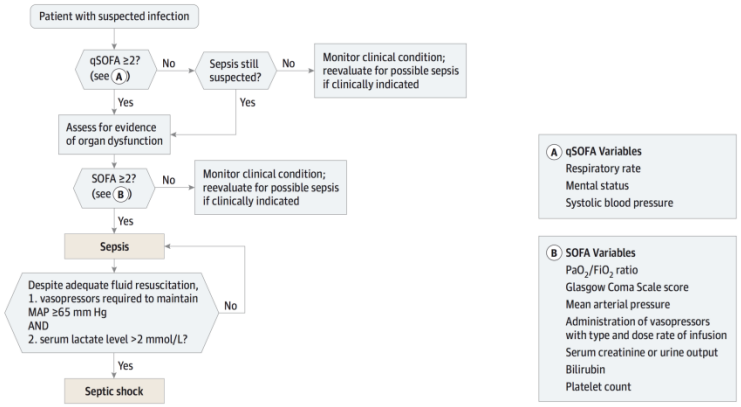



**Figure. Operationalization of Clinical Criteria Identifying Patients With Sepsis and Septic Shock**




The baseline Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score should be assumed to be zero unless the patient is known to have preexisting (acute or chronic) organ dysfunction before the onset of infection. qSOFA indicates quick SOFA; MAP, mean arterial pressure.

# Any questions……