Identifying Sepsis Early

Contents

Identifying Sepsis Early Course

Learning Outcomes

Following completion of this course the learner will be able to apply prior and acquired knowledge to carry out the initial assessment and illness severity assessment of a patient with a condition requiring early treatment. In addition the learner will gain the ability to utilise their skills to provide supportive symptom management until a definitive diagnosis has been made and specific treatment is started.

Aims / Objectives

1. **Prioritise care, using:**
   - clinical judgement
   - decision making skills
   - use of guidelines/algorithms
2. **Use Evidence Based Medicine:**
   - work within local and national guidelines and protocols
3. **Show clinical reasoning:**
   - interpret results of investigations
   - recognise own limitations
4. **Appropriate referral of patient:**
   - Illness severity assessment
   - recognise need for specialist assistance
   - communicate with colleagues
   - identify appropriate environment for patient
5. **Personal & Professional Development:**
   - self-awareness i.e. reflection regarding personal performance, effectiveness and capabilities

How does Sepsis affect me and my patients?

Sepsis can occur in any clinical situation. It may be due to a primary infection (e.g. pneumonia) or it may result from clinical interventions for other conditions (e.g. immuno-suppressive drugs, chemotherapy, invasive lines). Patients who are in hospital are at increased risk of certain specific infections. The Identifying Sepsis Early (ISE) programme is concerned with the identification and treatment of established sepsis. The prevention of infection is equally important and there are many complimentary teaching materials available on this topic.

Sepsis usually originates from a localised infection which progresses into an uncontrolled systemic response. It can rapidly lead to acute physiological deterioration with the risk of multiple organ failure and death. Early identification of sepsis with appropriate intervention i.e. oxygen, fluids, antibiotics, and more advanced resuscitation, where indicated, has been shown to improve survival.

The incidence of sepsis is thought to be increasing, possibly as a result of:

- a growing elderly population[1]
- increased use of invasive surgery[2]
- increased incidence of bacterial resistance[2,3]
- increased number of immuno-compromised patients[2,4]
- ➤ sepsis can affect healthy people at any age

The most common infection sites are the lungs, skin, abdomen or urinary tract. Pathogens causing sepsis include:

- aerobic Gram negative bacteria
- aerobic Gram positive bacteria
- anaerobes
- fungi

However, in nearly 45% of cases, microbiological confirmation of the organism is lacking[5]

Important co-morbidities and risk factors for sepsis include:

- diabetes mellitus
- immunodeficiency
- trauma

- burns
- alcohol and substance abuse
- chronic disease (heart, lungs, kidneys, liver)
- haematological disorders
- recent surgery/invasive procedure
- indwelling catheters

These conditions not only increase risk of development of sepsis but can also exaggerate the severity of the process.

Progression of clinical features

Systemic Inflammatory Response Syndrome (SIRS) ➔ Sepsis ➔ Severe sepsis ➔ Death. In some individuals disease progression is rapid over a few hours whilst in others deterioration may take several days.

1. SIRS*

*American College of Chest Physicians and the Society of Critical Care Medicine (ACCP/SCCM) 1990 Consensus Conference

Infection	**SIRS**	Sepsis	Severe Sepsis	Death

A non-specific clinical response including ≥2 of the following:

- Core temperature >38°C or <36°C
- Heart rate >90 beats/min
- Respiratory rate >20/min
- White blood cell count >12,000/mm^3 or <4,000/mm^3 or >10% immature neutrophils

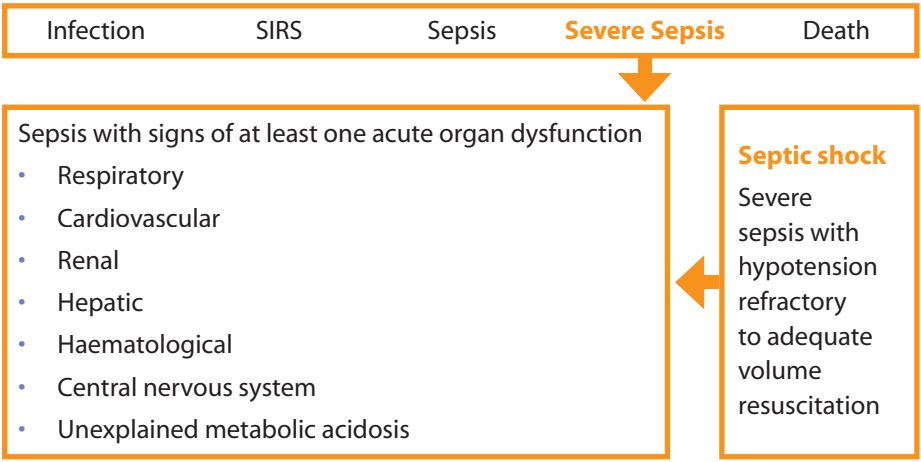
SIRS can be caused by infection, trauma, burns, pancreatitis, and other insults which result in tissue damage

2. Sepsis

Infection	SIRS	**Sepsis**	Severe Sepsis	Death

SIRS with a presumed or confirmed infectious process

3. Severe sepsis



What is happening around the body?

Sepsis can cause major systemic effects; septic shock is the worst of these. The products of the infecting organism e.g. endotoxin or exotoxin, cause the release and activation of inflammatory mediators such as histamine, kinins and complement. Simultaneously there is an induction of cytokines i.e. interleukins and tumour necrosis factor (TNF).

The net result of these changes is to cause a combination of:

- hypoxaemia
- hypovolaemia
- vasodilation and capillary leak
- impaired tissue oxygen utilisation

Respiratory changes

The earliest clinical sign of sepsis is often a rapid respiratory rate. This may be driven by pyrexia, lactic acidosis, local lung pathology, pulmonary oedema , cytokine-mediated effects on the respiratory control centre or a combination of several of these factors. Hypoxaemia occurs as a result of pulmonary pathology, shunting of deoxygenated blood through the lungs (cytokine mediated) or pulmonary oedema secondary to capillary leak.

Circulatory changes

The release of bradykinin and production of cytokines cause normally 'tight' endothelial junctions to become loose resulting in increased vascular permeability with accompanying plasma leak i.e. capillary leak. This leads to hypovolaemia and reduced preload. Bradykinin and some cytokines also cause peripheral vasomotor failure: peripheral blood vessels vasodilate and diastolic blood pressure falls as a result.

- The combination of reduced intra-vascular volume and vasodilatation often produces hypotension.

The body attempts to compensate by increasing the heart rate and mobilising fluid from the interstitial space or blood from the splanchnic circulation, but this is inefficient due to cytokine mediated effects.

Impaired tissue oxygen utilisation

Although the cardiac output may rise in sepsis there is an unhinging of tissue oxygen delivery and requirements. There may be shunting of blood in the micro-circulation, by-passing cells which become hypoxic. There is also cytokine mediated disturbance of mitochondrial oxygen handling: this blocks the progress of oxygen down the normal cascade. These both lead to lactic acidosis, organ dysfunction and ultimately multiple organ failure.

Sepsis: early identification and treatment

Sepsis is a systemic response to infection and a useful clinical definition allows early identification and treatment of patients before organ dysfunction or failure occurs.

Sepsis, requires 2 or more of the following criteria in the presence of suspected or confirmed infection:

- Respiratory rate >20 breaths/min or $PaCO_2$ <4.3kPa
- Heart rate >90 beats/min
- Core temperature <36°C or >38°C
- WBC <4,000 or >12,000 cells/mm^3, or >10% immature forms

In severe sepsis there is associated organ dysfunction, hypoperfusion or hypotension.

Septic shock is broadly defined as severe sepsis with hypotension unresponsive to intravascular volume replacement.

"Sepsis is a dynamic process, with the rapid evolution of physical signs over minutes to hours. Frequent evaluation and careful monitoring of the patient is essential, particularly when there is doubt over the diagnosis."

Green J, Lynn W; JR Coll Physicians Lond 2000;34:418-23

The Identifying Sepsis Early programme will provide you with some guidance in caring for the acutely ill patient, especially those with sepsis. This requires you to recognise, treat, diagnose and support the patient.

Points to remember:

- Acutely ill patients require rapid but careful assessment.
- Initiation of treatment often precedes definitive diagnosis.
- Aim to prevent further deterioration and stabilise the patient.

Four Key elements of emergency management:

1	2	3	4
Acute assessment & primary treatment with immediate investigations & support	Monitoring with frequent re-assessment	Illness severity assessment	Definitive diagnosis & treatment: targeted secondary exam

1 Acute assessment & primary treatment with immediate investigations & support

	Assessment	Action	Investigations
A	Airway and conscious level - Maintaining own airway? Requiring intervention?	i. Open & clear ii. Chin lift, head tilt iii. Airway adjunct iv. Advanced airway - CALL for HELP	Arterial Blood Gas (ABG)
B	Breathing - Look, listen & feel, rate, volume & symmetry, work of breathing & pattern	i. High concentration O_2 (60-100%) ii. Monitor SpO_2 iii. Ventilate if required ➤ O_2 concentration is determined by type of mask as well as flow from wall/cylinder and patients respiratory rate*	Chest X-ray (CXR)
C	Circulation - Pulse rate/volume, rhythm/ character Skin colour & temp Capillary refill Blood pressure	i. Monitor ECG & BP ii. IV access iii. Fluid bolus iv. Vasoactive drugs - CALL for HELP	ECG
D	CNS and Conscious level - AVPU, GCS, pupil reaction Focal neurological signs	i. ABC and consider cause ➤Hypoxaemia should always be treated first.	Glucose Blood cultures
E	Examine & Assess Evidence - Temperature	i. Review TPR, drug & fluid charts ii. Interpret investigations & results	

* Using a fixed performance O_2 system (venturi) allows you to gauge the percentage of O_2 delivered much more accurately. High concentration O_2 is best given using a mask with a reservoir at 15L/min

Investigations

Immediate investigations are those which will influence the acute management of the patient and include:

1. Bloods
    - Arterial blood gas (ABG)

- Full blood count (FBC)
- Urea & electrolytes
- Glucose
- Clotting screen

2. 12 lead ECG
3. CXR
4. Microbiology: appropriate samples should be collected and sent

➤ Venous blood cultures should be taken as soon as possible in patients suspected of having bacteraemia.
Important to establish a microbiological diagnosis, where possible, to ensure appropriate antimicrobial treatment.

➤ Do not delay early empirical antibiotic therapy as this may prove life saving particularly in patients with shock or signs of organ failure.

- Swab all infected sites and send pus samples (remember to send those available at time of surgery).

Culture

- urine
- sputum
- faeces
- cerebrospinal fluid (via lumbar puncture)
- tap pleural and ascitic effusions
- skin scrapings (haemorrhagic lesions)

➤ Where sepsis develops in hospital consider the following as sites of infection:

- intravenous/intra-arterial indwelling catheters
- urinary catheters
- surgical wounds
- pressure sores

➤ Line sites which are inflamed or leaking pus, catheters/venflons must be removed immediately.

- Consider surgical debridement/drainage for infected wound sites.

5. Specialist investigations may be required. The specific choice will be guided by detailed history and examination:
    - Abdominal ultrasound or CT scan
    - Echocardiogram
    - White cell scan
    - Surgical exploration may be necessary (even a negative laparotomy can be helpful)

2 Monitoring & Reassessment

Monitoring

Real-time, continuous monitoring is required to facilitate frequent re-evaluation of the patient's physiological condition. Non-invasive monitoring i.e. ECG, pulse oximetry and BP should be established immediately.

➤ Machine-derived BP measurements can often be inaccurate at extremes of BP and when tachycardias (especially AF) are present.

Re-assessment

Repeat ABCDE assessment frequently and assess response to treatment by constant clinical observation and uninterrupted monitoring.

3 Illness severity assessment

To ensure the effective and safe management of the acutely ill patient assessing the severity of their illness allows you to make key decisions i.e.

i. What level and speed of intervention is required?

ii. Is senior help required immediately and, if so, whom?

iii. Where should the patient be nursed/observed e.g. a ward, HDU, ICU?

iv. What, if any, organs are failing?

➤ Severe sepsis is a trigger for early referral to an Intensive Care Unit

➤ Base deficit is very important and can be used as a guide to illness severity [+3 to –3 = normal, -5 to –10 = moderate, -10 or worse = severely ill]

➤ Lactate >4mmol/L indicates severity

4 Definitive diagnosis & treatment

Specific treatment can be instituted once the ABCDEs have been stabilised. Investigations and blood results can help in reaching a definitive diagnosis.

Assess the need for surgery or drainage of source.

Targeted secondary examination & specialist investigations

Obtain a more detailed history to help identify factors for acquiring infection, clues to infection sites which should assist in guiding you in your choice of empirical antimicrobial therapy. Remember to consider hospital-acquired infection.

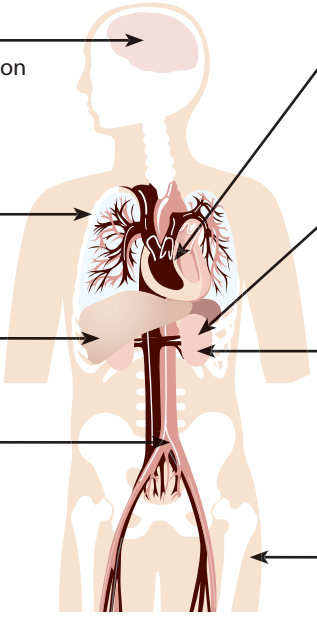
History

Symptoms in sepsis can be non-specific with some cases presenting early and others late in the disease continuum.

Important questions to ask:

- is there underlying immunosuppression?
- what medications does the patient take?
- has the patient had antibiotics recently?
- are there any microbiological samples already in lab? e.g. urine sent by GP
- has the patient had previous hospitalisation?
- has the patient had recent surgical procedures?
- has the patient had indwelling prosthetic devices?
- has the patient travelled abroad recently?
- has the patient had contact with animals?
- has the patient come in contact with another person with similar symptoms?

Examination and investigation findings in severe sepsis: general



Central Nervous System
Altered consciousness/confusion

Cardiovascular
Tachycardia
Hypotension
Prolonged capillary refill
Warm or cool peripheries

Respiratory
Tachypnoea
Hypoxaemia

Renal
Oliguria
Anuria
(ensure catheter patent)

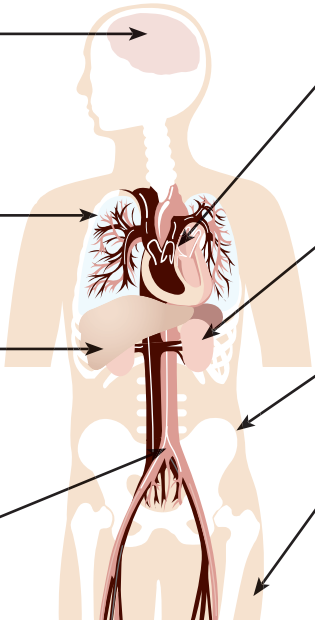
Gastro Intestinal
Abnormal LFT's
Reduced albumin

Metabolic
Lactic acidosis
Hypo/hyperglycaemia
Hypocalcaemia

Haematology
WBC abnormal count\forms
DIC
↓Reduced platelets
↑Increased PT/APTT
↑Increased D-dimer
↓Reduced fibrinogen

Skin
Abnormal temperature

Clinical findings in severe sepsis: looking for the source



Central Nervous System
Headache
Neck stiffness
Photophobia

Respiratory
Consolidation
Pleural effusion

Gastro Intestinal
Abdominal pain/tenderness
Diarrhoea

Haematology
Neutropenic (primary)

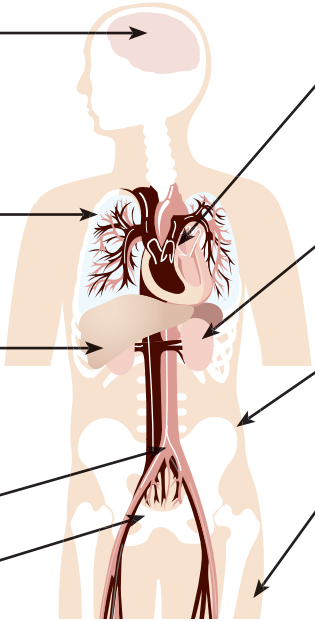
Cardiovascular
New murmur

Renal
Dysuria
Loin pain
Haematuria

Joints
Swelling/redness/
tenderness

Skin
Cellulitis
Petechial rash
Splinter haemorrhages
Wounds
Cannulae/lines

Diagnosis in severe sepsis



Central Nervous System
Meningitis
Encephalitis
Sinusitis
Cerebral abscess

Respiratory
Pneumonia
Empyema
Bronchiectasis

Gastro Intestinal
Peritonitis
(upper or lower perforation)
Appendicitis
Cholecystitis
Diverticulitis

Haematology
Neutropenic sepsis

Gynaecological

Cardiovascular
Endocarditis

Renal
UTI
Pyelonephritis

Joints
Septic arthritis

Skin
Cellulitis
Meningococcal sepsis
Endocarditis
Line sepsis
Wound infection

Antibiotic Management

Empirical antibiotic regimens depend on the likely cause of infection: if there is a collection of pus/fluid or disrupted viscus surgical intervention is necessary.

Suspected site of infection	Regime
Respiratory Community acquired pneumonia	Ceftriaxone plus clarithromycin Consider amoxicillin or benzylpenicillin for CAP
Urinary tract: pyelonephritis	Co-amoxiclav or ceftriaxone +/- gentamicin
Suspected meningococcaemia	2G Ceftriaxone or cefotaxime
Infected IV , IVDU site - *Staphylococcus aureus* suspected	Flucloxacillin Consider Vancomycin if MRSA likely
Neutropenic patients	Piperacillin- tazobactam + gentamicin and seek urgent consultation with oncology, haematology or ID
No obvious source	Ampicillin + gentamicin + metronidazole

This is an example of antibiotic choice but reference should be made to local guidelines/protocols.

- Penicillin allergies – discuss with microbiology if alternative antibiotic choice is not straightforward
- Cephalosporins have similar structure to penicillin and cross hyper-sensitivity will occur in approx 10%
- Consider giving clindamycin to patients presenting with septic shock associated with community-acquired skin sepsis (cellulitis, necrotising fascitis) – discuss with microbiology/ID.

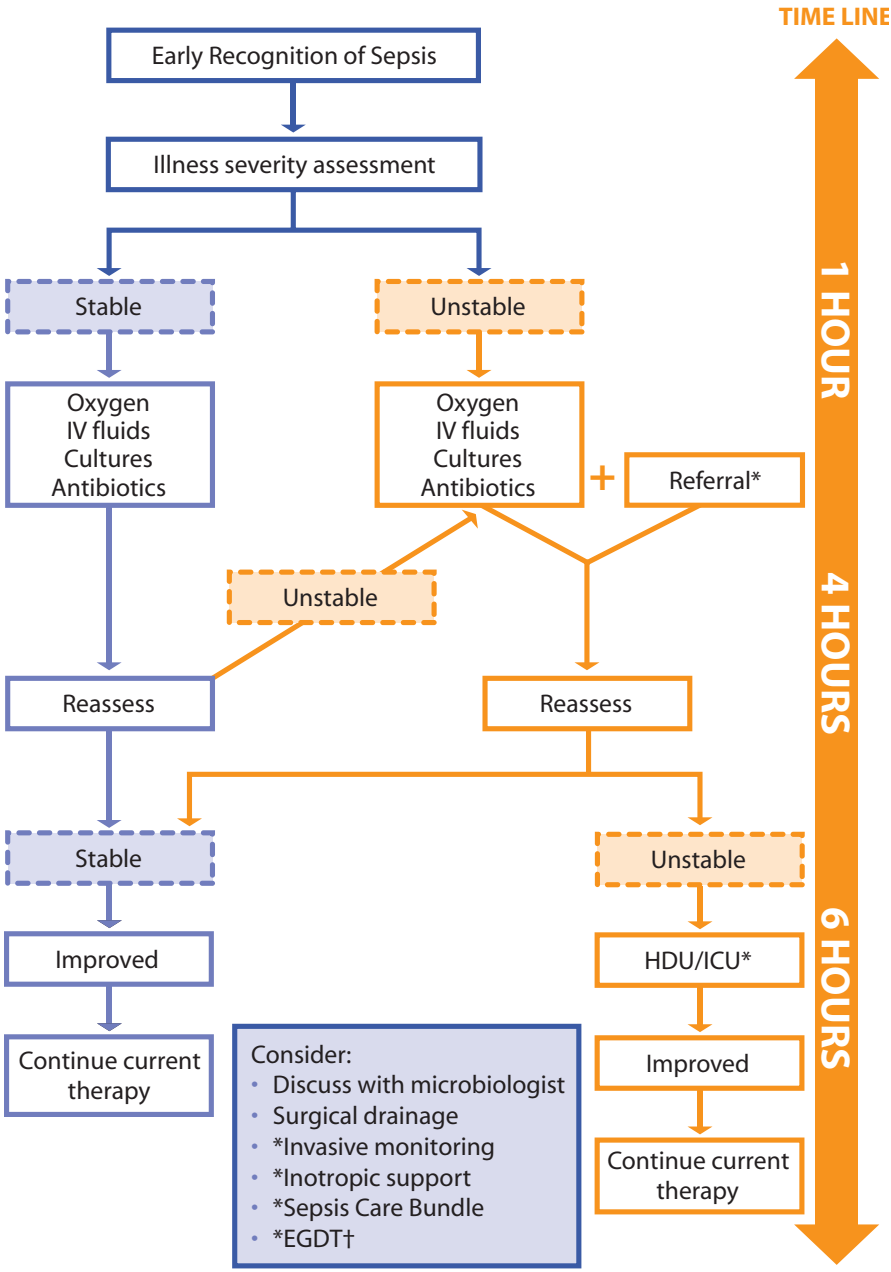
General Management

In all patients ensure:

- Analgesia
- Nutrition
- Pressure care

and consider DVT prophylaxis and stress ulcer prophylaxis.

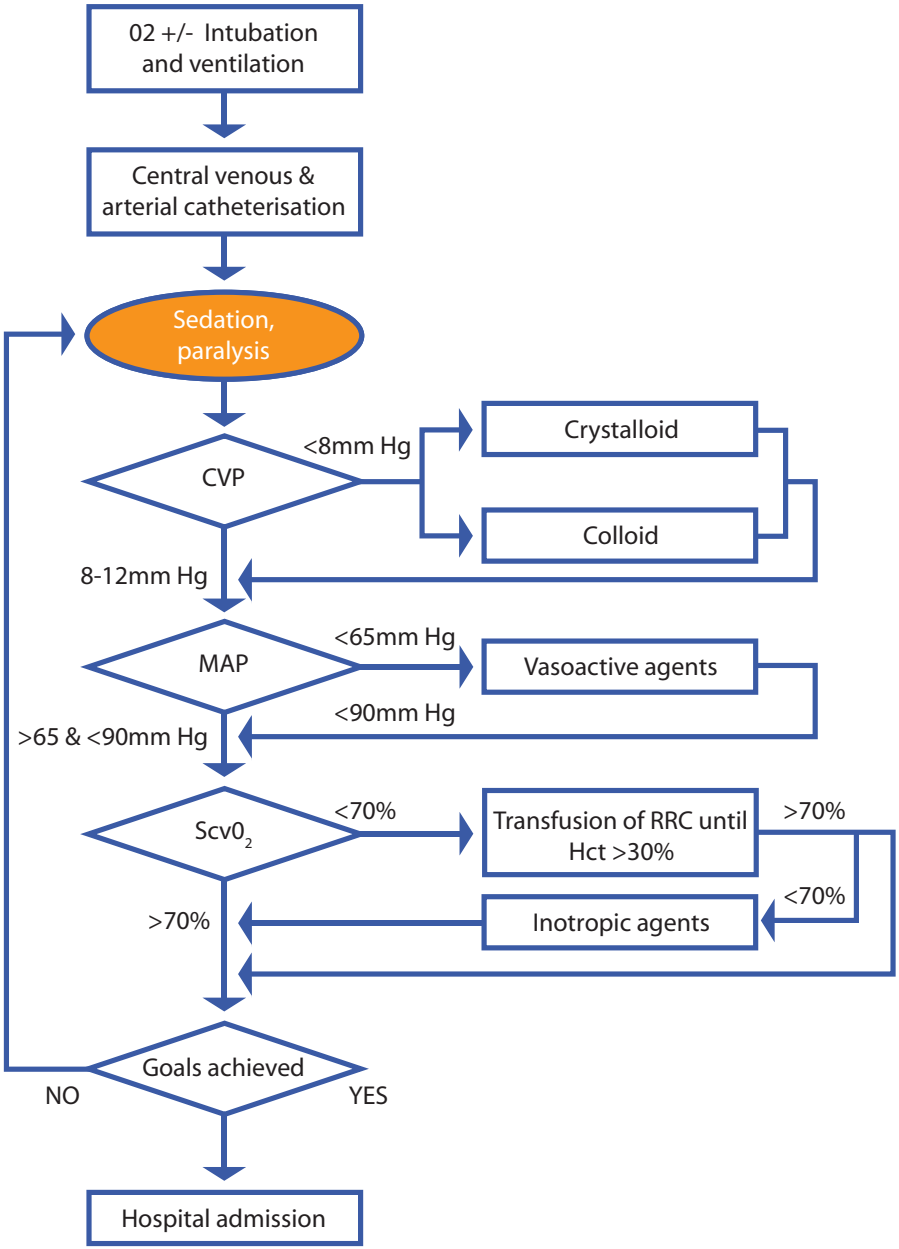
Fundamental Sepsis Management



† EGDT - Rivers E, et al: 'Protocol for Early Goal-Directed Therapy'. *N Engl J Med* 2001

Advanced Sepsis Management

Early Goal Directed Therapy



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Useful links

MeRec Briefing - **www.npc.co.uk/merec.htm**

Surviving Sepsis campaign - **www.survivingsepsis.org**

Scottish Intensive Care Society - **www.scottishintensivecare.org.uk**

Advances in Sepsis - **www.advancesinsepsis.com**

International Sepsis Forum - **www.sepsisforum.org**

Institute for Healthcare Improvement - **www.ihi.org/ihi/topics/criticalcare/sepsis**

Meningitis Research Foundation - **www.meningitis.org**

For further information contact the Scottish Clinical Simulation Centre - www.scsc.scot.nhs.uk tel:01786 434480

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