Sepsis is a medical emergency. Early identification and treatment are essential but many health staff are unable to recognise its signs and symptoms.

### Early identification and treatment of sepsis

#### In this article...

- Anatomy of sepsis
- Signs and symptoms that can help professionals identify sepsis
- Effective sepsis management strategies

**5 key points**

1. Sepsis is one of the leading causes of death in hospital patients worldwide.
2. Patients with severe sepsis will not respond to fluid replacement.
3. Sepsis can be identified during routine observations so nurses play a vital role in spotting symptoms.
4. All patients with sepsis should have a management plan that includes level of observation, review schedule and an escalation plan.
5. Clear guidance on identification and evidence-based interventions is available to support effective and safe care.

**Sepsis** is one of the leading causes of death in hospital patients worldwide and severe sepsis causes around 37,000 deaths in the UK every year (Daniels, 2011). This is more than breast and bowel cancer combined, yet awareness of the condition remains limited. Despite various campaigns and the availability of good evidence for treatment, the death rate associated with sepsis remains high, mainly due to poor identification and delayed interventions.

Defined as “a life-threatening condition that arises when the body’s response to infection injures its own tissues and organs” (Czura, 2011), sepsis can present in any patient and in any clinical setting. As such, all nurses need to be aware of its development, how it can be identified and the care patients need to survive. This article discusses the pathophysiological changes caused by sepsis, how these present in patients and how best to manage sepsis to prevent death or long-term disability.

Chege and Cronin (2007) described early evidence of treatment for sepsis as existing as far back as the early Chinese emperors. However, it was not until 1991 that definitions of sepsis were agreed and later published (Box 1) (Bone et al, 1992). These underpin more recent research and guidance from leading campaign groups such as the Surviving Sepsis Campaign (SSC) and Global Sepsis Alliance. SSC—a partnership of international critical care, medical and emergency care societies—aims to raise awareness and provide guidance based on the best available evidence. In the UK, SSC guidance is being changed to improve both the identification of patients at risk of developing severe sepsis and the delivery of early treatment.

**What is sepsis?**

Although sepsis is mainly caused by bacterial infection, it can be caused by a viral, fungal or even parasitic source (Fig 1). As the infection affects the body’s normal inflammatory response, physiological changes can be seen that aid diagnosis.

Systemic inflammatory response syndrome (SIRS) is a collection of signs that the body is reacting to a range of injuries or illnesses (Box 2), and is not specific to infection. The body may respond by raising the heart or respiratory rate to increase the amount of oxygen—by altering body temperature or increasing white cell production—to overcome infection. Raised blood sugars and new confusion or an altered mental state may be early signs of metabolic stress or hypoxia (Survive Sepsis Organisation, 2009). Although Sepsis occurs when tissue is damaged as the body attempts to fight infection.
BOX 1. DEFINITIONS

- **Systemic inflammatory response syndrome (SIRS)** The systemic inflammatory response to a variety of severe clinical insults. The response is manifested by two or more of the following conditions:
  - Temperature >38°C or <36°C
  - Heart rate >90bpm
  - Respiratory rate >20 breaths/min or PaCO₂ <32mmHg and white blood cell count >12,000/mm³ or <4,000 cells/mm³, or >10% immature (band) forms
  - **Sepsis** The systemic response to infection, manifested by two or more of the following, as a result of infection:
    - Temperature >38°C or <36°C
    - Heart rate >90bpm
    - Respiratory rate >20 breaths/min or PaCO₂ <32mmHg and white blood cell count >12,000 cells/mm³ or <4,000 cells/mm³ or >10% immature (band) forms
  - **Severe sepsis** is associated with organ dysfunction, hypoperfusion or hypotension. Hypoperfusion and perfusion abnormalities may include – but are not limited to – lactic acidosis, oliguria or an acute alteration in mental status
  - **Septic shock** Sepsis-induced with hypotension despite adequate fluid resuscitation, along with the presence of perfusion abnormalities that may include – but are not limited to – lactic acidosis, oliguria or an acute alteration in mental status. Patients receiving inotropic or vasopressor agents may not be hypotensive at the time that perfusion abnormalities are measured
  - **Sepsis-induced hypotension** A systolic blood pressure <90mmHg or a reduction of ≥40mmHg from baseline in the absence of other causes for hypotension
  - **Multiple organ dysfunction syndrome (MODS)** The presence of altered organ function in an acutely ill patient such that homeostasis cannot be maintained without intervention

Adapted from Bone et al (1992)

these responses can have a range of causes, when combined with infection, they could indicate sepsis. The condition is defined by the presence of two or more SIRS signs where infection is suspected or confirmed (Woodrow, 2012).

Sepsis causes complex dysfunction in the body’s inflammatory and coagulopathy pathways, leading to vasodilatation, vessel leakage and increased metabolic demands. This effect increases oxygen demand which, combined with intravascular losses, causes hypoperfusion and ischaemia at cellular levels (Porth, 2005). At this stage, there will be signs of severe sepsis and evidence of organ dysfunction away from the primary source of infection (Box 3).

In a patient with sepsis from a urinary tract infection, some changes to renal function might be expected, but not abnormal blood clotting or lactate levels. Low blood pressure and dehydration is commonly seen in patients with sepsis, but will generally respond to fluid replacement.

Patients with severe sepsis who do not respond to this treatment are in septic shock. If not actively managed, this leads to refractory hypotension, tissue ischaemia, circulatory collapse and multi-organ failure.

Patients at greatest risk of sepsis often have multiple comorbidities so treatment needs to be considered carefully. For example, patients with chronic respiratory disease presenting with a chest infection may have abnormal vital signs because of their long-term condition or because they have developed sepsis and may not tolerate high-flow oxygen as part of the sepsis treatment protocol.

**Identification of sepsis**

Identifying sepsis early is key to survival but is still the greatest challenge facing effective sepsis management (Slade et al, 2003). By undertaking routine clinical observations, nurses play a vital role in identifying sepsis. Any patient presenting with two or more SIRS and a suspected infective source is deemed to have sepsis and needs further screening for signs of organ dysfunction (severe sepsis) and risk of mortality.

Simple screening tools are widely used to identify patients with sepsis (Fig 2). Some organisations have successfully implemented routine screening of all admissions; others screen in the emergency department. It is important to remember that SIRS is not always caused by infection and may be present for a range of medical reasons. Good clinical assessment, history taking and investigation will ensure accurate diagnosis and help to estimate the severity of the illness.

Certain populations are at greater risk of sepsis and should be more closely assessed and monitored for deterioration. Young children, frail older people or those with multiple comorbidities may not have the same capacity to fight infection as the general population. Those with long-term invasive devices, such as urinary catheters or cannulae, are equally at risk. Chemotherapy and other anti-cancer treatments...
increase the risk of neutropenic sepsis so this should be considered in all patients who become unwell following these treatments (National Institute for Health and Clinical Excellence, 2012). National early warning scores (Royal College of Physicians, 2012) and robust escalation protocols help identify and manage deterioration. Nurses need to understand what resources are available in their organisation to help identify patients whose health is deteriorating.

**Sepsis management**

The majority of research evidence on sepsis is limited to severe sepsis and septic shock – there is little on uncomplicated sepsis. Patients with sepsis need immediate intervention to determine severity and prevent deterioration to severe sepsis.

The use of care bundles is recommended by the SSC and other international sepsis forums. Care bundles bring together a small number of interventions that, when undertaken together and reliably, improve patient outcomes (Institute for Healthcare Improvement, 2012). SSC guidance presents two bundles for severe sepsis and septic shock, with actions to be delivered within three hours and six hours of identification (previously known as the “Resuscitation and Management bundles”) (Dellinger et al, 2013). Daniels et al (2010) developed the “Sepsis Six” care bundle, which was shown to improve delivery of reliable care across a range of clinical settings; endorsed by the College of Emergency Medicine and the SSC, it is now used in many UK hospitals. Sepsis Six (Box 4) consists of three investigations and three interventions that all patients with sepsis should receive within one hour of identification. Most of the actions can be started by nursing staff while waiting for a medical response, and aid prompt, effective decision-making. All patients with severe sepsis should be reviewed by critical care staff for further interventions.

Each element of the Sepsis Six bundle can create a significant challenge for clinical teams so it is worth looking at each in detail. Staff should review each element and reflect on its implication in everyday practice. Organisations may use the Sepsis Six approach or have their own protocols so it is important to check local policies.

**Bloods (including lactate)**

If sepsis is suspected, full blood count, clotting, renal function, liver function tests, C-reactive protein and arterial blood gas (to ascertain lactate level) should be taken. Low haemoglobin will reduce the delivery of oxygen to tissues so should be urgently identified and treated, while a raised white cell count is a strong indicator of infection and is used as part of the initial screening for sepsis. A raised lactate, though not specific to sepsis, provides clear evidence of metabolic compromise and development of severe sepsis.

Monitoring changes in lactate, and identifying improvement or deterioration, is linked to sepsis prognosis and is a good indicator of the impact of treatment.

**Blood cultures**

Two sets of blood cultures are recommended to improve microbial identification and sensitivity and, therefore, antibiotic choice. Cultures should be taken from separate sites at the same time and should include one from each intravenous device in place for more than 48 hours. Cultures should also be taken from other sources, for example sputum or urine.

**Urinary output**

Fluid balance is a good indicator of circulating volume and renal function, and therefore essential for good sepsis management and the prevention of acute kidney injury. Insertion of a urinary catheter is the “gold-standard” for accurate measurement of urinary output but may increase infection risk.

**Oxygen**

Contrary to recent guidance for oxygen therapy (O’Driscoll et al, 2008), patients with sepsis need high-flow oxygen until there is clear evidence (from the blood gas) that no hypoperfusion exists. Careful consideration needs to be given to those with chronic lung disease who may not tolerate high levels of oxygen.

**Fluids**

Fluid resuscitation is essential to prevent hypotension and improve cardiac output and therefore tissue perfusion. Many

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**FIG 2. CHFT SEPSIS SCREENING TOOL**

<table>
<thead>
<tr>
<th>Sepsis confirmed by &gt;2 clinical signs and indication of infective source</th>
<th>Yes</th>
<th>2. Is the history indicative of an infection in any of these areas?</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Are &gt;2 of the following signs present?</td>
<td>Temperature &gt;38.3°C or &lt;36°C</td>
<td>Invasive device infection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heart rate &gt;90bpm</td>
<td>Lungs/pneumonia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Respiratory rate &gt;20 breaths/min</td>
<td>Abdomen, acute infection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>White cells &lt;4 or &gt;12g/L</td>
<td>Wound infection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>New altered mental state</td>
<td>Skin/soft tissue inflammation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blood glucose &gt;7.7 (not diabetic)</td>
<td>Endocarditis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Urinary tract or kidney infection</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brain/meningitis/encephalitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Obstetric or gynaecological infection</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bone or joint infection</td>
<td></td>
</tr>
</tbody>
</table>

If the previous considerations indicate sepsis, commence the Sepsis Six care bundle and contact the doctor and critical care outreach team.

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**BOX 3. SIGNS OF ORGAN DYSFUNCTION**

**Severe sepsis**

- Central nervous system: Acutely altered mental status
- Cardiovascular system: Systolic <90 or mean <65mmHg
- Respiratory: $\text{SpO}_2$ >90% only with new/more oxygen
- Renal: Creatinine >177µmol/L or urinary output <0.5ml/kg/hr for 2 hrs
- Hepatic: Bilirubin >34µmol/L
- Bone marrow: Platelets <100
- Hypoperfusion: Lactate >2mmol/L
- Coagulation: international normalised ratio >1.5 or partial thromboplastin time >60 seconds

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**Fluids**

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patients with sepsis are significantly dehydrated so high levels of fluid resuscitation are often needed. The SSC currently recommends 30ml/kg of crystalloids for patients with hypotension or raised lactate (>4mmol) (Dellinger et al, 2013). Lower volumes of fluid, given in intermittent boluses, should be considered in uncomplicated sepsis and reviewed regularly for efficacy. Lower volumes should also be considered for those with active heart or renal failure.

**Antibiotics**

Broad-spectrum antibiotics should be given within one hour of sepsis being identified, having checked patient allergies. Antibiotic choice will depend on the probable source of infection, local policy and may involve discussion with microbiology. Antibiotic therapy should be reviewed daily to reduce toxicity, risk of resistance and cost (Dellinger et al, 2013).

**Management plan**

It is essential to evaluate the response to treatment and an ongoing management plan. This should include level of observation, review schedule and an escalation plan. Clear escalation supports decision making for the whole team, setting out who should be contacted and when. A plan should be made for the whole team, setting out the roles and creating a plan of care, whether for referral, escalation or even end-of-life. Organisations have approached the work differently: some have created sepsis teams, others sepsis coordinators, or use tools that make reliable identification and treatment easier across all teams.

**Sepsis care in the future**

Sepsis prevalence is increasing, though it is unclear whether this is the result of better diagnosis or due to population change. The work of the SSC and other global forums has generated increasing interest in reducing the number of deaths caused by sepsis. With an ever-increasing workload and the introduction of healthcare-based targets, alongside staffing shortages and a lack of appropriate beds, there is much pressure on health staff to perform at higher levels of efficiency and to recognise patients who are potentially unwell or whose health is deteriorating while still providing high-quality care (McClelland, 2007).

Resources are now available for pre-hospital and community settings (Box 5), which will further improve timeliness of diagnosis and treatment. Research is aimed at finding blood markers that are sensitive to sepsis progression and effective treatments for severe sepsis and septic shock.

**Conclusion**

Sepsis is a leading cause of death and harm. Nurses are pivotal in spotting patients who are unwell or deteriorating, and in initiating life-saving treatments. Clear guidance on identification and evidence-based interventions is available to support effective and safe care. With the help of simple tools and robust escalation systems, it is possible for all staff to intervene early to prevent harm and significantly reduce mortality.

**Box 5. National and International Resources**

- Surviving Sepsis Campaign: www.survivingsepsis.org
- The UK Sepsis Trust: www.sepsistrust.org
- Global Sepsis Alliance: www.globalsepsisalliance.com
- Sepsis and VTE NHS Education for Scotland: www.knowledge.scot.nhs.uk/sepsisvte/sepsis.aspx
- 1000 Lives Plus (Wales): www.100livesplus.wales.nhs.uk

**References**


Institute for Healthcare Improvement (2012) Using Care Bundles to Improve Health Care Quality. tinyurl.com/IHI-bundles


Royal College of Physicians (2012) National Early Warning Score (NEWS): Standardising the Assessment of Acute-Illness Severity in the NHS. tinyurl.com/RCP-EarlyWarning

