Sepsis Management
National Clinical Guideline No. 6

Summary

November 2014
Using this National Clinical Guideline

The aim of the National Clinical Guideline is to facilitate the early recognition and appropriate treatment of sepsis in Ireland in order to maximise survival opportunity and minimise the burden of chronic sequelae.

The full version of the National Clinical Guideline is available at:
www.health.gov.ie/patient-safety/ncec
www.hse.ie/sepsis

Recommendations are presented with practical guidance. The recommendations are linked to the best available evidence and/or expert opinion using the grades for recommendations. The National Clinical Guideline recommendations have been cross-referenced where relevant with other National Clinical Guidelines.

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Disclaimer
The Guideline Development Group’s expectation is that healthcare staff will use clinical judgement, medical, nursing and midwifery knowledge in applying the general principles and recommendations contained in this document. Recommendations may not be appropriate in all circumstances and the decision to adopt specific recommendations should be made by the practitioner taking into account the individual circumstances presented by each patient/resident and available resources. The National Clinical Guideline recommendations do not replace or remove clinical judgement or the professional care and duty necessary for each specific patient case. Therapeutic options should be discussed with a clinical microbiologist or infectious disease physician on a case-by-case basis as necessary.
The National Clinical Effectiveness Committee (NCEC) is a Ministerial committee established as part of the Patient Safety First Initiative. The NCEC role is to prioritise and quality assure National Clinical Guidelines and National Clinical Audit so as to recommend them to the Minister for Health to become part of a suite of National Clinical Guidelines and National Clinical Audit.

National Clinical Guidelines which have been quality assured and recommended by NCEC for implementation provide robust evidence-based approaches to underpin or define models of care as appropriate. They provide guidance and standards for improving the quality, safety and cost-effectiveness of healthcare in Ireland. The implementation of clinical guidelines can improve health outcomes, reduce variation in practice and improve the quality of clinical decisions.

NCEC Terms of Reference
- Apply criteria for the prioritisation of clinical guidelines and audit for the Irish health system
- Apply criteria for quality assurance of clinical guidelines and audit for the Irish health system
- Disseminate a template on how a clinical guideline and audit should be structured, how audit will be linked to the clinical guideline and how and with what methodology it should be pursued
- Recommend clinical guidelines and national audit, which have been quality assured against these criteria, for Ministerial endorsement within the Irish health system
- Facilitate with other agencies the dissemination of endorsed clinical guidelines and audit outcomes to front-line staff and to the public in an appropriate format
- Report periodically on the implementation of endorsed clinical guidelines.

In response to the HIQA Patient Safety Investigation Report into Services at University Hospital Galway (2013), the NCEC was requested by the Minister for Health to commission and quality assure a number of National Clinical Guidelines. The National Clinical Guideline for sepsis management is one of these guidelines. The National Clinical Guideline – Sepsis Management has been quality assured by NCEC and endorsed by the Minister for Health for implementation in the Irish healthcare system.

Information on the NCEC and endorsed National Clinical Guidelines is available at www.health.gov.ie/patient-safety/ncec
www.hse.ie/sepsis
Sepsis is common and is a time-dependent medical emergency. It can affect a person of any age, from any social background and can strike irrespective of underlying good health or concurrent medical conditions. International sepsis campaigns that have introduced and promoted an approach to sepsis care based on early recognition of sepsis with resuscitation and timely referral to critical care have reported reductions in mortality from severe sepsis/septic shock in the order of 20-30%.

This National Clinical Guideline is intended to be relevant to all healthcare staff involved in the care of patients who have sepsis. The Guideline Development Group consisted of a subgroup of the National Sepsis Steering Committee with expertise in guideline and early warning score implementation, sepsis management and emergency care. The Guideline Development Group has provided a number of recommendations to assist healthcare staff in the identification and management of patients with sepsis. The full version of the National Clinical Guideline is available at: www.health.gov.ie/patient-safety/ncec; www.hse.ie/sepsis

The recommendations align with the aims of the national sepsis work stream. Key recommendations are linked with other recommendations, practical guidance, roles, responsibilities and processes. The recommendations are linked to the best available evidence and/or expert opinion using the GRADE system for grading recommendations.

This guideline is available to all clinicians in the Republic of Ireland involved in the diagnosis and management of patients with sepsis.

We wish to acknowledge all the members of the National Sepsis Steering Committee and the Guideline Development Group members (Appendix 1) who gave freely of their time and expertise. A special word of thanks to the external expert, Prof. Kevin Rooney, National Clinical Lead on Sepsis, Healthcare Improvement Scotland and Professor of Care Improvement, University of the West of Scotland and the validators Dr. John Bates from the Joint Faculty of Intensive Care Medicine in Ireland and Dr. Christian Subbe, Consultant in Acute, Respiratory and Critical Care Medicine and Senior Clinical Lecturer at the School of Medical Sciences, Bangor University, UK.

Many thanks go to Ms. Clodagh Murray, Library Assistant, HSE South East Library Service, University Hospital Waterford for prompt research support and also to Ms. Grainne Cosgrove, Health Information Unit, Department of Health for providing extensive support regarding HIPE data analysis. We also wish to acknowledge the contribution of the National Cancer Control programme (NCCP) in support of this guideline.

Dr. Fidelma Fitzpatrick, Chair, National Sepsis Steering Committee, November 2014

Dr. Vida Hamilton, National Sepsis Lead, Chair, Guideline Development Group November 2014
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1 Sepsis impact and control

1.1 Introduction
The aim of the National Clinical Guideline is to facilitate the early recognition and appropriate treatment of sepsis in Ireland in order to maximise survival opportunity and minimise the burden of chronic sequelae.

This summary document includes the recommendations for screening and for the diagnosis and treatment of sepsis, severe sepsis and septic shock in the first 6 hours of patient management as well as source control and performance improvement recommendations.

1.2 Definitions
Infection is defined as a pathological process caused by invasion of normally sterile tissue or fluid or body cavity by pathogenic or potentially pathogenic micro-organisms. It is important to point out that, frequently, infection is strongly suspected without being microbiologically confirmed.

Sepsis is the clinical syndrome defined by the presence of both infection and the systemic inflammatory response syndrome (SIRS). However, since infection cannot be always microbiologically confirmed, the diagnostic criteria are infection, suspected or confirmed and the presence of some of the SIRS criteria.

Severe sepsis refers to sepsis complicated by organ dysfunction. In the 8th Edition of the ICD-10-AM/ACHI/ACS1 this is extended to include organ failure. This difference does not affect the guideline diagnostic criteria which identify a minimum level of organ dysfunction beyond which severe sepsis is diagnosed.

Septic shock is defined as severe sepsis with circulatory shock with signs of organ dysfunction or hypoperfusion in the 8th Edition of the ICD-10-AM/ACHI/ACS. The diagnostic criteria in this guideline are applied after 30mls/kg isotonic fluid has been administered to reverse any hypovolaemia and persistent systolic blood pressure <90 mmHg, MAP < 65 mmHg, decrease by 40mmHg from baseline and/or lactate >4 mmol/l.

The sources of sepsis are very consistent in the industrialised world with respiratory sepsis being the most common with rates between 35% and 50%. Table 1 reports the findings of the IMPRESS trial a 24 hour point prevalence study of severe sepsis/septic shock in emergency departments and intensive care units in Europe, the US and Asia which were presented at the European Society of Intensive Care Medicine Annual Congress in September 2014.

<table>
<thead>
<tr>
<th>Table 1 Prevalence of sources of sepsis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory 35%</td>
</tr>
<tr>
<td>Urinary 21%</td>
</tr>
<tr>
<td>Intra-abdominal 16.5%</td>
</tr>
<tr>
<td>Catheter-related blood stream infection 2.3%</td>
</tr>
<tr>
<td>Device-related 1.3%</td>
</tr>
<tr>
<td>CNS 0.8%</td>
</tr>
<tr>
<td>Others e.g. cellulitis, intra-articular 11.3%</td>
</tr>
</tbody>
</table>

1 Australian Modification of ICD-10 incorporating the Australian Classification of Health Interventions and the Australian Coding Standards
1.3 The burden of sepsis in Ireland

Sepsis represents a significant burden on Irish patients and the Irish healthcare service. Currently in Ireland the only method to estimate the incidence of sepsis is through analysis of ICD-10-AM diagnosis codes for hospital discharges recorded in the Hospital Inpatient Enquiry Scheme (HIPE). There is no mechanism to record sepsis in the community. The current analysis of diagnosis codes from HIPE may be an under or over estimation of sepsis incidence as there are a number of ICD-10-AM diagnosis codes which include either sepsis or infection. This is not unusual and in the UK, it is also noted that there may be underestimation of sepsis morbidity due to errors in coding for sepsis.2

While hospital statistics do not capture underlying cause of death data in Ireland, for 2013, up to 60% of all hospital deaths had a sepsis or infection diagnosis with approximately 16% of all hospital deaths designated with a sepsis specific ICD-10-AM diagnosis code. The total number of cases with a diagnosis of sepsis was 8,831 in 2013 and these cases accounted for a total of 221,342 bed days.

In addition, in 2013, the mortality rate of patients with a diagnosis of sepsis who were admitted to an intensive care environment was 28.8%. The corresponding figure for 2011 is 32.4% and 31.3% for 2012. Note however that this data is based on the discharge code of patients who had a diagnosis of sepsis and who were admitted to any type of intensive care environment (including ICU, HDU, CCU etc.) at some point during their hospitalisation. It is not possible to conclude that these patients were admitted to ICU as a result of sepsis, or that sepsis was the cause of death. A multicentre study of intensive care population demographics performed by the Irish Critical Care Trials Group was performed over a ten-week period on the 14 ICUs in the group (both Republic and Northern Ireland) in 2006. This study documented a severe sepsis/septic shock prevalence of 35% and a mortality of 24.6%.3

Current HIPE data is likely to be an underestimate of the true burden of sepsis in Ireland. Patients with sepsis are frequently coded according to their likely site of infection (e.g. pneumonia, urinary tract infection) rather than the systemic diagnosis of ‘respiratory sepsis’ or ‘urosepsis’. The HIPE data for sepsis above represents the number of hospital discharges with any diagnosis (i.e. primary or additional diagnosis) of sepsis using ICD-10 AM codes. The 8th Edition of ICD-10- AM/ACHI/ACS, to be implemented in 2015, has explicit codes for sepsis, severe sepsis and septic shock. Documentation of sepsis, severe sepsis and septic shock in the case notes will facilitate the capture of this data by HIPE. It is anticipated these changes in coding practices will lead to an increase in the recorded burden of sepsis in Ireland.

The average length of stay (ALOS) in 2013 for a patient is approximately 5.59 days, a patient with a sepsis diagnosis has an ALOS of up to 26 days, which is approximately 5 times longer than the average non-sepsis patient stay [children: for 2013, 22.01 with sepsis code vs. 3.08 without sepsis code and in maternity: for 2013, 5.46 with sepsis code vs. 2.61 without sepsis code]. Patients with an associated infection also have an increased ALOS of up to 10 days.

Sepsis is a leading global health and financial burden and is expected to increase further with an aging population. Fixed direct costs associated with the spectrum of sepsis, such as increased ICU LOS, ICU staffing, medications and new technologies are significant. Equally concerning are the indirect costs associated with sepsis such as loss of earnings, productivity and mortality. In fact indirect costs may account for up to 70% of the total costs of sepsis. European studies estimate that a typical episode of severe sepsis will cost a healthcare institution around €25,000. One year healthcare use has also been shown to be elevated after severe sepsis. In addition, long-term

2 An audit performed by the Intensive Care National Audit and Research Centre (ICNARC) conservatively estimated that 102,000 cases of sepsis arises annually in the UK with 36,800 deaths as a result. (Reference: Sepsis management as an NHS clinical priority. Briefing - Professor Sir Mike Richards [Internet]. 2013. Available at: http://www.england.nhs.uk/wp-content/uploads/2013/12/sepsis-brief.pdf)

mortality in previously healthy patients with severe sepsis/septic shock has been shown to be worse than that of those patients with non-septic critical illness and of the underlying general population. See appendix 14 of the full version National Clinical Guideline for more details on the budget impact assessment.

1.4 Adapting the Surviving Sepsis Campaign guidelines

Using the ADAPTE process, the Guideline Development Group recommends the Surviving Sepsis Campaign Guideline and the Sepsis 6 bundle as the guide to the management of sepsis in Ireland. ADAPTE has been advocated internationally as the most appropriate systematic approach to facilitate the adaptation of guidelines to align with the context of each setting and one that fosters valid and high-quality adapted guidelines. This sepsis guideline is the first National Clinical Guideline to use this process.

This guideline represents an adaptation of the International Guideline for the Management of Severe Sepsis and Septic Shock: 2012 (http://www.survivingsepsis.org) and the Sepsis 6 bundle for the initial management of all patients diagnosed with sepsis (http://sepsistrust.org).

The purpose of the adaptation is to align these international guidelines with the structures and functions of the Irish healthcare system and to inform pathways of care for patients with sepsis and severe sepsis/septic shock within all Irish medical disciplines. Thus, these adaptations endeavor to be accessible to all disciplines and offer practical guidance on each recommendation and its implementation.

In order to achieve the primary aim of reducing mortality from sepsis in Ireland, clinicians need to have an understanding of sepsis, be able to diagnose it and have systems in place that facilitate the timely treatment and referral of patients for their appropriate care. Thus, this National Clinical Guideline includes explanatory notes on the burden of sepsis and its recognition and treatment. It is recognised that an education programme is vital to ensure successful implementation and that without audit it would be difficult to ensure that the guideline is being achieved. Audit facilitates the identification of gaps in knowledge, resources and capacity that can act as barriers to guideline implementation and once identified these barriers can be addressed. Both education and audit are essential to support the sustainability of the implementation programme.

We are very grateful to the Society of Critical Care Medicine, the UK Sepsis Trust and the Commission for Clinical Excellence, New South Wales for their permission to adapt their work to the Irish healthcare setting. Further information is available at: http://www.survivingsepsis.org; www.cec.health.nsw.gov.au/ and http://sepsistrust.org. It is not the Guideline Development Group’s intent to change the meaning of content rather to make it accessible in the Irish context. Therefore this National Clinical Guideline applies only in the Republic of Ireland.

1.5 Pathway of care for sepsis

From SurvivingSepsis.org, Reproduced with permission copyright © 2014 Society of Critical Care Medicine

The management of the septic patient in the first hour is a time critical emergency and requires a team based approach involving all relevant healthcare staff members. This will have to be adapted for the local context depending on the composition of the team. A patient may present to an emergency department (ED) or other healthcare setting (e.g. a GP practice or specialty assessment area such as an oncology day ward) with sepsis or may develop sepsis during hospital admission. There are essentially 4 steps in the management of patients with sepsis; detection, communication, recognition (and diagnosis), and treatment (resuscitation and referral) (Figure 2). Tools are available as follows: The ISBAR communication tool in appendix 2, adult in-patient sepsis screening tool in appendix 3, an Emergency Department sepsis pathway in appendix 4 and a fluid resuscitation algorithm in appendix 5. These have been adapted for specific patient
groups (e.g., paediatric, maternity) and hospital settings (e.g. ED, wards) and may need to be adapted for other healthcare settings (e.g. pre-hospital care).

Pathways of care for identification and management of patients with sepsis should include a mechanism to trigger sepsis screening to facilitate early recognition, a treatment pathway which includes the Sepsis 6 and a mechanism of risk stratification for the early identification of patients with severe sepsis and septic shock to facilitate referral to critical care. Pathway compliance will be audited and the content and compliance rates reviewed by the National Sepsis Steering Committee and the Health Service Executive (HSE).

This National Clinical Guideline is part of a suite of guidelines that relate to the acutely deteriorating patient. National Clinical Guidelines include:

- National Clinical Guideline No. 1 National Early Warning Score (NEWS)
- National Clinical Guideline No. 4 Irish Maternity Early Warning System (IMEWS)
- National Clinical Guideline No. 5 Communication (Clinical Handover) in Maternity Settings
- National Clinical Guideline - Paediatric Early Warning System (PEWS) – in process
- National Clinical Guideline - Clinical Handover in acute hospitals – in process

National Clinical Guidelines are available at: www.health.gov.ie/patient-safety/ncec

HSE guidance includes:

### 1.6 Diagnostic criteria for sepsis

**Table 2 Infection, documented or suspected, and some of the following:**

<table>
<thead>
<tr>
<th>General variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever (&gt; 38.3°C); ≥ 38°C in pregnancy</td>
</tr>
<tr>
<td>Hypothermia (core temperature &lt; 36°C)</td>
</tr>
<tr>
<td>Heart rate &gt; 90/min or more than two SD above the normal value for age; ≥ 100/min in pregnancy</td>
</tr>
<tr>
<td>Tachypnoea</td>
</tr>
<tr>
<td>Altered mental status</td>
</tr>
<tr>
<td>Significant oedema or positive fluid balance (&gt; 20 mL/kg over 24 hr)</td>
</tr>
<tr>
<td>Hyperglycemia (plasma glucose &gt; 7.7 mmol/L) in the absence of diabetes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inflammatory variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leucocytosis (WBC count &gt; 12,000 μL⁻¹); &gt; 16.9μL⁻¹ in pregnancy</td>
</tr>
<tr>
<td>Leucopenia (WBC count &lt; 4000 μL⁻¹)</td>
</tr>
<tr>
<td>Normal WBC count with greater than 10% immature forms</td>
</tr>
<tr>
<td>Plasma C-reactive protein more than two SD above the normal value</td>
</tr>
<tr>
<td>Plasma procalcitonin more than two SD above the normal value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Haemodynamic variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial hypotension (SBP &lt; 90mm Hg, MAP &lt; 70 mmHg, or an SBP decrease &gt; 40 mmHg in adults or less than two SD below normal for age); MAP &lt; 65 mmHg in pregnancy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organ dysfunction variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial hypoxaemia (PaO₂/FiO₂ &lt; 300)</td>
</tr>
<tr>
<td>Acute oliguria (urine output &lt; 0.5 mL/kg/hr for at least 2 hrs despite adequate fluid resuscitation)</td>
</tr>
<tr>
<td>Creatinine increase &gt; 0.5mg/dL or 44.2 μmol/L</td>
</tr>
<tr>
<td>Coagulation abnormalities (INR &gt; 1.5 or aPTT &gt; 60s)</td>
</tr>
<tr>
<td>Ileus (absent bowel sounds)</td>
</tr>
<tr>
<td>Thrombocytopenia (platelet count &lt; 100,000 μL⁻¹)</td>
</tr>
<tr>
<td>Hyperbilirubinaemia (plasma total bilirubin &gt; 4mg/dL or 70 μmol/L)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tissue perfusion variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperlactatemia (&gt; 1 mmol/L)</td>
</tr>
<tr>
<td>Decreased capillary refill or mottling</td>
</tr>
</tbody>
</table>

WCC = white cell count; SBP = systolic blood pressure; MAP = mean arterial pressure; INR = international normalized ratio; aPTT = activated partial thromboplastin time.


### Severe sepsis

Severe sepsis is defined as sepsis-induced tissue hypo-perfusion or organ dysfunction (any of the following thought to be due to the infection).

- Lactate above upper limits laboratory normal
- Urine output < 0.5 ml/kg/hr for more than 2 hrs despite adequate fluid resuscitation
- Acute lung injury with PaO₂/FiO₂ < 250 in the absence of pneumonia as infection source
- Acute lung injury with PaO₂/FiO₂ < 300 in the presence of pneumonia as infection source
- Creatinine > 176.8 micromol/l
- Bilirubin > 34.2 micromol/l
- Platelet count < 100,000 μL⁻¹
- Coagulopathy (INR > 1.5)
- Sepsis induced hypotension.
Sepsis Management

**Septic shock**

Septic shock is defined as sepsis-induced tissue hypoperfusion persisting after resuscitation with 30mls/kg intravenous isotonic crystalloid fluid as evidenced by:

- Systolic blood pressure < 90 mmHg or MAP < 65 mmHg
- Decrease in systolic blood pressure by 40mmHg from baseline and/or
- Lactate > 4 mmol/l.

**Figure 1 Summary of diagnosis of sepsis**

**Figure 2 Summary of pathway of care for patients presenting with sepsis**
1.7 Detection and recognition of sepsis

The Emergency Department (ED)
It is recommended that patients presenting to the ED with a history suggestive of infection have sepsis screening (use the sepsis screening tool) at triage or the assessment area, according to local procedure and patients with two systemic inflammatory response (SIRS) criteria have a point of care lactate measurement performed. If the lactate is greater than 2 mmol/L or the patient has other signs of serious illness they are escalated directly for medical review.

**ED trigger**

Presenting complaint suggestive of infection or unwell and in at risk group for neutropenia
+ two SIRS criteria + Lactate > 2 mmol/L
OR
Signs of serious illness =
Escalation to medical review

The adult in-patient
The first step in the appropriate management of the adult in-patient with sepsis is timely recognition. Standardised scoring systems have the advantage of reducing inter-clinician variation and alerting them that action is required to prevent further patient deterioration. If a scoring system is being used, it is essential that there are clear links between when to screen for sepsis and a threshold score. The Guideline Development Group recommends that when an adult in-patient has a new National Early Warning Score (NEWS) of 4 (5 if already on supplementary O₂) or higher, as part of the patient review, infection should be considered as a possible cause of the physiological deterioration. If on history and examination, infection is suspected, sepsis screening should be performed.

**Adult in-patient trigger**

New NEWS score of 4 (5 if on O₂) or higher = medical review

**Sepsis screening:**
Infection suspected as cause of physiological deterioration + two SIRS criteria = Sepsis
+ organ dysfunction and/or shock = Severe sepsis/septic shock

Sepsis may also be diagnosed on routine medical examination and by other means.
The maternity patient
Septic shock is relatively uncommon in maternity patients. However, in the period 2006-2008 sepsis was the leading cause of maternal mortality with a rate of 1.13/100,000 deliveries, underpinning this is a much larger burden of morbidity.4

A number of risk factors have been identified that are associated with increased incidence of sepsis and should prompt consideration for sepsis screening if such a patient presents unwell.

**Table 3 Risk factors for the development of sepsis in pregnancy**

<table>
<thead>
<tr>
<th>Non-Pregnancy</th>
<th>Pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 35</td>
<td>Cerclage</td>
</tr>
<tr>
<td>Minority ethnic group</td>
<td>PPROM</td>
</tr>
<tr>
<td>Vulnerable socio-economic background</td>
<td>Retained products</td>
</tr>
<tr>
<td>Obesity</td>
<td>History of group B Streptococcus infection</td>
</tr>
<tr>
<td>Diabetes</td>
<td>History of pelvic infection</td>
</tr>
<tr>
<td>Immunocompromised e.g. Systemic lupus erythromatosis</td>
<td>Group A Streptococcus infection in close contacts</td>
</tr>
<tr>
<td>Chronic renal failure</td>
<td>Amniocentesis</td>
</tr>
<tr>
<td>Chronic liver failure</td>
<td></td>
</tr>
<tr>
<td>Chronic heart failure</td>
<td></td>
</tr>
</tbody>
</table>

The pattern of site of infection is different from the non-pregnant population as are the organisms.

**Table 4 Sources of maternal infection in severe sepsis**

<table>
<thead>
<tr>
<th>Source</th>
<th>Antepartum (%)</th>
<th>Postpartum (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genital tract</td>
<td>20.2</td>
<td>37.2</td>
</tr>
<tr>
<td>Urinary tract</td>
<td>33.6</td>
<td>11.7</td>
</tr>
<tr>
<td>Wound</td>
<td>0.0</td>
<td>14.3</td>
</tr>
<tr>
<td>Respiratory</td>
<td>9.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Other</td>
<td>7.5</td>
<td>9.5</td>
</tr>
<tr>
<td>Unknown</td>
<td>29.9</td>
<td>23.8</td>
</tr>
</tbody>
</table>

Source: Severe Maternal Sepsis in the UK, 2011-2012: A National Case-Control Study
### Table 5 Organisms isolated in severe maternal sepsis

<table>
<thead>
<tr>
<th>Organism</th>
<th>Antepartum</th>
<th>Postpartum</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. Coli</td>
<td>24.6</td>
<td>19.1</td>
</tr>
<tr>
<td>Group A Streptococcus</td>
<td>1.5</td>
<td>13.0</td>
</tr>
<tr>
<td>Group B Streptococcus</td>
<td>9.7</td>
<td>7.4</td>
</tr>
<tr>
<td>Other Streptococcus</td>
<td>4.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Staphylococcus</td>
<td>1.5</td>
<td>9.1</td>
</tr>
<tr>
<td>Mixed organisms</td>
<td>3.7</td>
<td>6.1</td>
</tr>
<tr>
<td>Other</td>
<td>9.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Unknown</td>
<td>3.7</td>
<td>0.4</td>
</tr>
<tr>
<td>No laboratory confirmed infection</td>
<td>41.8</td>
<td>32.9</td>
</tr>
</tbody>
</table>

**Source:** Severe Maternal Sepsis in the UK, 2011-2012: A National Case-Control Study

The physiological changes of pregnancy can mimic the usual SIRS criteria leading to additional difficulties in diagnosis. Some SIRS criteria have been modified in order to allow for this (see tables 2 and 6) but these are pending validation and care needs to be taken to interpret SIRS criteria in the clinical context. The modified SIRS criteria are subject to study by the UK Obstetric Surveillance System and will be amended as further data becomes available.

When IMEWS or any other trigger prompts a review of the obstetric patient and history and examination is suggestive of infection, sepsis screening should be performed. Sepsis may also be diagnosed on routine medical examination or by other means; examination of the extended SIRS criteria or other investigations may be required in order to make the diagnosis. Once sepsis is diagnosed the Sepsis 6 should be completed within one hour. Patients need to be risk stratified into sepsis, severe sepsis and septic shock and those with severe sepsis/septic shock referred to critical care as per the local referral pathway and consistent with the Guidelines for the Critical Ill Women in Obstetrics (HSE, 2014).

Please see appendix 6 and appendix 9 in the full version National Clinical Guideline for a list of guidelines relevant to the obstetric patient and for the Irish Maternity Early Warning System (IMEWS) chart.

### Obstetric in-patient trigger

**Sepsis screening:**

IMEWS review

- Infection suspected as cause of physiological deterioration
- 2 SIRS criteria present* = Sepsis
- Presence of organ dysfunction and/or shock = Severe sepsis/septic shock.
*Table 6 Modified SIRS criteria for maternity patients

- Temperature ≥ 38°C or < 36°C
- HR ≥ 100 beats/min
- RR ≥ 20 breaths/min
- WCC > 16.9 μL-1 or < 4 μL-1
- BSL > 7.7 mmol/l (in the absence of diabetes mellitus)
- Altered mental status

The remaining SIRS criteria as per Surviving Sepsis Campaign guidelines are unmodified.

Further information in relation to the National Clinical Guideline No. 4 IMEWS can be found at:
www.health.gov.ie/patient-safety/ncec
http://www.hse.ie/eng/about/Who/clinical/natclinprog/obsandgynaeprogramme/IMEWS

Figure 3 Care pathway for the deteriorated critically ill pregnant woman

- Detection of clinical deterioration, recognition of critical illness
  - Early Warning System
  - Clinical evaluation

- RESPONSE:
  - Multidisciplinary Care Plan
    - Obstetrics
    - Midwifery
    - Anaesthesia/Critical Care
  - Components - ABCDE
    - A - airway
    - B - breathing
    - C - circulation
    - D - Delivery
    - E - Early transfer
  - Consultant-led decision making

- Level 2 Care
  - Location - Delivery Suite, Maternity Hospital
  - Location - High-Dependency Unit, Critical Care Service, General Hospital, mandatory acceptance
  - Requirement - Inter-hospital critical care transport/retrieval

- Level 3 Care
  - Location - ICU, Critical Care Service, General Hospital, mandatory transfer
  - Requirement - Inter-hospital critical care transfer/retrieval
1.8 Communication – ISBAR communication tool

Poor communication has been identified as a contributing factor to adverse incidents where clinical deterioration is not identified or properly managed. The recommended communication tool when communicating in relation to the deteriorating patient, is the ISBAR communication tool (figure 4, appendix 2).

**Figure 4 ISBAR communication tool**

<table>
<thead>
<tr>
<th>ISBAR Communication Tool SAMPLE</th>
<th>Patient Deterioration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify:</td>
<td>You</td>
</tr>
<tr>
<td></td>
<td>Recipient of handover information</td>
</tr>
<tr>
<td></td>
<td>Patient</td>
</tr>
<tr>
<td>Situation:</td>
<td>Why are you calling?</td>
</tr>
<tr>
<td></td>
<td>(Identify your concerns)</td>
</tr>
<tr>
<td>Background:</td>
<td>What is the relevant background?</td>
</tr>
<tr>
<td>Assessment:</td>
<td>What do you think is the problem?</td>
</tr>
<tr>
<td>Recommendation:</td>
<td>What do you want them to do?</td>
</tr>
</tbody>
</table>

Reproduced and adopted with permission from Dr S. Marshall, Monash University, Australia.

1.9 Resuscitation and referral

Once the diagnosis of sepsis has been made it is recommended that Sepsis 6 is performed within one hour.

Patients in whom severe sepsis or septic shock is suspected should be reviewed by a registrar, or more senior medical staff, immediately. **THIS IS A TIME-DEPENDANT MEDICAL EMERGENCY** similar to myocardial infarction, stroke or trauma with a time-critical period within which to maximise the patient’s survival.
If following the Sepsis 6 bundle and after 30mls/kg of fluid has been administered, severe sepsis or septic shock persists (as evidenced by persistent organ dysfunction and/or shock), it is recommended that a critical care review be requested. These patients should be assessed for admission and ongoing treatment in the HDU/ICU setting as required. Patients with raised lactate levels on presentation should have repeat lactate levels performed within three hours. Those with persistent shock should have invasive monitoring and ongoing fluid resuscitation guided by urinary output, repeat lactate and/or ScvO2 measurement and pressor administration, as required, to obtain a MAP > 65mmHg within 6 hours. Critical care input may be requested at any point in the patient’s process of care if the patients’ condition so indicates to manage their airway, breathing and/or circulation.

Once the diagnosis of severe sepsis/septic shock has been made it is recommended that a critical care consultation be requested.

1.10 Source control

Once antibiotics have been administered and the patient fluid resuscitated and haemodynamically stabilised, source control, if required, needs to be addressed. It is recommended that the least physiologically deranging method of achieving adequate control be used.

Patients need to be carefully examined to ensure that drainable foci have been identified. Infected collections, devitalised tissue, lines and devices will act as a persistent source of sepsis until removed as antimicrobials have limited penetration. Source control is also a time-dependent phenomenon in patients with severe sepsis/septic shock with a recommendation of a 12 hour window post stabilisation. Consideration must be given to the logistics of organising this with limited access to interventional radiology and operating theatre time. The time recommendations should be taken into consideration when planning what type of procedure as well as when it is to take place.
National Clinical Guideline recommendations

Table 7 Summary of national recommendations

<table>
<thead>
<tr>
<th>Section</th>
<th>Subsection</th>
<th>Recommendation Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Recommendations 1 to 33 apply to all adult patients.</td>
<td>Recommendations 1 to 4 address the early recognition, initial treatment and risk stratification of patients with sepsis: Screening, Sepsis 6, the 3 hour and 6 hour bundles</td>
<td>1-4</td>
</tr>
<tr>
<td></td>
<td>Recommendations 5 to 33 apply to patients stratified as severe sepsis/septic shock:</td>
<td>5-11 12-19 20-33</td>
</tr>
<tr>
<td></td>
<td>• Initial resuscitation and infection issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Haemodynamic support and adjunctive therapy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Other supportive therapy in severe sepsis</td>
<td></td>
</tr>
<tr>
<td>Paediatric patients</td>
<td>Recommendations 1P to 3P address the early recognition, initial treatment and risk stratification of paediatric patients with sepsis.</td>
<td>1P-3P</td>
</tr>
<tr>
<td></td>
<td>Recommendations 4P to 28P apply to paediatric patients stratified as severe sepsis/septic shock.</td>
<td>4P-28P</td>
</tr>
</tbody>
</table>

Refer to the full version National Clinical Guideline to view all recommendations at: www.health.gov.ie/patient-safety/ncec. Key recommendations are presented in this summary document.

2.1 Key recommendations

2.1.1 Screening, Sepsis 6, 3 hour and 6 hour bundles

Responsibility

Assessment nurse in the Emergency Department (ED): Screen if presenting complaint indicates infection and alert doctor as per ED sepsis pathway.

Ward Nurse: EWS score and alert doctor as per EWS pathway.

Doctor: Patient review and if infection suspected perform sepsis screen.

Hospital Senior Management Team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director and Director of Finance): System resourced to fulfil above duties.

Recommendation 1

Routine sepsis screening of patients who have either:

- A presenting complaint consistent with infection,
- A deteriorating early warning score (EWS) NEWS or IMEWS, or
- Picked up on routine history and examination, or
- By other means;

is recommended to be performed to allow earlier diagnosis and implementation of therapy.

It is recommended that patients undergoing anti-cancer treatment who present unwell and are at risk of neutropenia be treated as sepsis until proven otherwise. Grade 1C
**Practical Guidance**

The Surviving Sepsis Campaign recommends screening for sepsis. Recommendation 1 is the template for screening in Ireland.

**Sepsis** is diagnosed by the presence of systemic inflammatory response (SIRS) criteria due to suspected or proven infection. See appendix 7 in the full version National Clinical Guideline (with Surviving Sepsis Campaign full SIRS criteria).

**Severe sepsis/septic shock** is diagnosed by the persistence of organ dysfunction, inadequate tissue perfusion or hypotension after an initial fluid bolus.

In order to diagnose infection, a history must be taken and clinical examination performed. The clinical manifestations are variable depending on the source of infection, the patient’s baseline health status and the time-course of the illness. Whilst the common sources of infection are respiratory tract, urinary tract, intra-abdominal, device-related, catheter-related, CNS, soft tissue and intra-articular; consideration must be given to situation specific infections such as perioperative, maternity, haematology- oncology, tropical medicine, seasonal infections and outbreaks.

During outbreaks, national recommendations, advice and information updates are circulated by the HSE and the Health Protection Surveillance Centre (HPSC). For further information see [http://www.hpsc.ie/](http://www.hpsc.ie/)

It is not always possible to diagnose infection at the first review. However, as the clinical situation evolves, a system of monitoring and review with the results of investigations is recommended to assist in making a timely diagnosis and to pick up further deterioration.

It is suggested that a patient presenting with a lactate > 4 mmol/L and/or hypotension, of unknown aetiology, should be treated as septic shock, using the Sepsis 6 whilst further investigations to clarify the diagnosis proceed. It has been consistently demonstrated that these patients have an improved outcome with early antimicrobials and fluid resuscitation when the underlying cause is infection. Antimicrobials should be stopped if the cause is subsequently found not to be infection.

**Other patients:** A SIRS response caused by infection defines sepsis; however, in some groups overt signs of sepsis can be a late feature i.e. in infants, the elderly and the immuno-compromised. Patients who are unwell in these groups may require review of the extended SIRS criteria and more senior review in order to make or out-rule the diagnosis. Patients in these groups presenting with organ dysfunction/shock should be treated as severe sepsis/septic shock if the diagnosis is unclear and delay of > 1 hour in confirming the diagnosis is anticipated. If infection is subsequently found not to be the cause antimicrobials should be stopped.

**High Risk Group – Cancer Patients:** Febrile neutropenia is a common complication of cytotoxic chemotherapy. Progression to neutropenic sepsis can result in hospital admissions, treatment delays, dose reductions and death. Patient presentation may be non-specific and the possibility of infection must be considered in any patient undergoing treatment for cancer, particularly cytotoxic chemotherapy, who is unwell and particularly in those who are neutropenic (note: SIRS criteria may not be present).

It is recommended that suspected neutropenic sepsis, defined as a patent at risk of neutropenia who presents unwell, be treated with the Sepsis 6 within one hour of arrival in the hospital.

**Neutropenia** – An abnormal decrease in the number of neutrophils in the blood. Neutropenia is associated with a profound impairment in the inflammatory response, leading to a lack or minimisation of the usual signs and symptoms of infection. Neutropenia is a common problem in oncology patients either following chemotherapy, or less commonly secondary to radiation treatment or marrow infiltration by malignancy. Neutropenia is most likely to occur 10-14 days post-chemotherapy but should remain a consideration after this period. Neutropenic sepsis is diagnosed in patients having anti-cancer treatment who present unwell with a neutrophil count 0.5 x 10⁹ or lower, or less than 1 x 10⁹ with a downward trend.

**Fever** – occurs when a patient has a fever and a significant reduction in their neutrophil counts. The fever may be caused by an infectious agent, and when it is, prompt treatment is required. A patient with febrile neutropenia needs assessment for the possible source, type of infection and treatment until the cause is found or it subsides. The risk of infection increases directly in proportion to the degree of neutropenia and its duration.
Responsibility

It is the responsibility of hospital senior management team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director and Director of Finance and the HSE to ensure that point of care lactate measurement is available to clinicians caring for patients with sepsis.

Recommendation 2

Point of care lactate measurement should be accessible in each Emergency Department, Medical Assessment Unit, Critical Care Unit, Maternity Unit and readily accessible elsewhere within the hospital. Grade 1D

Practical Guidance

In patients with elevated lactate levels, resuscitation can be targeted to normalise lactate as a measure of tissue hypoperfusion. Grade 2C.

Lactate levels can be used to help differentiate severe sepsis/septic shock from sepsis, diagnose cryptic shock which occurs in 13.5 to 25% of septic shock cases, prognosticate on presenting levels and on response to fluid resuscitation. See table 8 for lactate levels associated with percentage mortality.

Septic shock can be present with normal lactate levels and raised lactate levels occur with non-septic conditions, thus lactate levels need to be interpreted within the clinical context.

As with all point of care tests, point of care lactate measurement should be incorporated into the appropriate hospital governance system.

Table 8 Lactate levels and associations with percentage mortality

<table>
<thead>
<tr>
<th>Presenting lactate level</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low (0.7 – 1.9)</td>
<td>4.5%</td>
</tr>
<tr>
<td>Intermediate (2 – 3.9)</td>
<td>10.6%</td>
</tr>
<tr>
<td>High (4+)</td>
<td>27.3%</td>
</tr>
</tbody>
</table>

(Data from CEC HIE, Australia N=3851)

Responsibility

It is the responsibility of the attending doctor, nurse and midwife to administer the elements of the Sepsis 6 within the recommended timeframe. If an element cannot be performed due to resource issues i.e. no lactate measurement available, the line manager should be informed with a view to having the deficit addressed.
Recommendation 3
For patients diagnosed with sepsis it is recommended that the Sepsis 6 be performed within one hour. Grade 1C

Sepsis 6 in the Emergency Department when:
Presenting complaint consistent with infection, two SIRS criteria, unwell or lactate > 2 mmol/L
Or
Unwell and in a high risk group for neutropenia

Sepsis 6 in the in-patient when:
Deteriorating NEWS/IMEWS with sepsis screening diagnosed sepsis
Or
In a high risk group for neutropenia
Or
By any other method

### Sepsis 6 in Adults

#### TAKE 3
1. **CULTURES:** Take blood cultures before giving antimicrobials (if no significant delay i.e. >45 minutes) and consider source control.
2. **BLOODS:** Check lactate and full blood count.
3. **URINE OUTPUT:** Assess urine output and consider urinary catheterisation for accurate measurement in patients with severe sepsis/septic shock.

#### GIVE 3
1. **OXYGEN:** Titrate O₂ supplementation to saturations of 94–98% or 88–92% in chronic lung disease.
2. **FLUIDS:** Start IV fluid resuscitation if evidence of hypovolaemia and/or shock. 500ml–1000mls bolus of isotonic crystalloid over 15–30 minutes and give up to 30ml/kg, reassessing after each bolus for signs of hypovolaemia, euvolaemia, or fluid overload.
3. **ANTIMICROBIALS:** Give IV antimicrobials according to local antimicrobial guidelines.

### Practical Guidance
The Sepsis 6 represents the minimum intervention. Other blood tests, cultures or investigations may be required depending on the clinical findings both to assist in making a diagnosis and also to assess the severity of the patients’ illness. Blood tests should be sent marked ‘urgent’ and should be reviewed and acted on in a timely fashion. This also applies to any investigations ordered.

Sepsis 6 does not have to be performed within one hour of review; it is within one hour of the diagnosis of sepsis.

Patients with sepsis can have absolute hypovolaemia, relative hypovolaemia and/or distributive shock. These are diagnosed by measuring heart rate, blood pressure, lactate and urinary output as well as assessing clinical signs of hypoperfusion such as altered mental state, prolonged capillary refill or mottling. Patients with hypovolaemia without hypotension require fluid resuscitation to restore euvolaemia and normal organ perfusion as evidenced by return of normal mentation, skin perfusion, urinary output and lactate levels.

Patients presenting with systolic blood pressure (SBP) < 90mmHg, mean arterial blood pressure < 65mmHg, SBP decrease of 40mmHg from baseline or serum lactate levels > 4mmols/l should receive 30mls/kg of intravenous (IV) isotonic crystalloid fluid in the first hour unless fluid overload develops. If the patient develops signs and symptoms of overload, IV fluid administration should be stopped and vasoactive agents be used to restore SBP to > 90mmHg or mean arterial blood pressure (MAP) to > 65mmHg. After fluid resuscitation with 30mls/kg isotonic crystalloid, hypotension may persist requiring further fluid resuscitation and vasopressors. This is septic shock. Myocardial dysfunction may also occur.
Fluid resuscitation is performed by giving fluid boluses (e.g. 500mls – 1000mls) over a given time period (e.g. 15 – 30 minutes) and the patient’s response assessed by clinical examination after the bolus has been given and a decision made as to whether the patient needs further fluid resuscitation or not. The amount of the bolus and the time period over which it is given, depends on the co-morbidities of the individual patient. Serial measurement of lactate and urinary output measurement can help guide fluid resuscitation.

Sepsis represents a clinical continuum ranging from patients presenting haemo-dynamically stable with no overt fluid deficit as indicated by normal organ function, urinary output and lactate levels who require little or no fluid resuscitation and only maintenance fluids if fasting, through those that have restoration of haemo-dynamics and organ function after fluid resuscitation as demonstrated by normalisation of mental status, skin perfusion, urinary output and lactate and then require only maintenance fluids, if fasting, to those with persistent hypotension and organ dysfunction post initial fluid resuscitation who require critical care input and consideration of invasive monitoring, advanced haemo-dynamic support (e.g. vasopressors) and further guided fluid resuscitation. An example of a fluid resuscitation algorithm is given in appendix 5.

Patients remain under the care of the attending doctor and ward staff pending transfer to another hospital setting (e.g. critical care), with critical care acting in a consultative manner, if required.

**Recommendation 4**

It is recommended that each clinical programme/healthcare facility create or adopt treatment pathways for sepsis care that includes triggers for sepsis screening, facilitates the diagnosis of sepsis, severe sepsis/septic shock, and the treatment, resuscitation and appropriate referral to critical care.

These completed pathways signed by the treating clinician should be included in the patient chart and their presence audited by HIPE as a key performance indicator.

**Practical Guidance**

Examples of pathways for ED presentations and NEWS triggered reviews are included in appendix 4. Pathways should clearly identify the stratification of patients into sepsis, severe sepsis or septic shock, include likely source of infection, if known, and the time first dose antimicrobials were administered. A referral mechanism to critical care for patients with severe sepsis/septic shock should be included.

**Rationale**

The aim of these recommendations is to facilitate the early recognition, prompt treatment and appropriate referral of patients with sepsis and severe sepsis/septic shock, as it has been demonstrated that in jurisdictions where these principles have been applied there has been a sustained decrease in mortality from sepsis (Surviving Sepsis Campaign, ProCESS trial, Australian ICU database, ARISE trial5).

Adopting these recommendations is associated with a decrease in ICU and hospital length of stay and savings in healthcare costs. There is a growing awareness of chronic health issues amongst survivors of severe sepsis/septic shock, it is anticipated that by intervening early in the course of the illness by screening for early recognition and prompt appropriate therapy, this burden of morbidity can be reduced both for patients and the healthcare system.

In 2010, sepsis was identified as the 11th leading cause of death in the U.S and in 2012 as the single most expensive condition treated in hospitals. Audit of US national patient databases has shown sepsis to be a component in two of five in-hospital patient deaths, with most of these patients having sepsis on presentation, and the Irish national database (HIPE) documents an infection/sepsis prevalence of 60% amongst patients with in-hospital death. The high prevalence of this disease justifies intense quality improvement efforts.
Performance improvement and quality assurance can only occur if practice is audited, thus local and national audits should be performed. These can be benchmarked intra- and inter-hospital and internationally. Barriers to implementation of the guidelines need to be reported via line-managers and process/resource change occur to remove/reduce those barriers.

Education in the identification and management of patients with sepsis is a key to ensure guideline implementation. The creation of a sepsis team would facilitate education, implementation and audit, its components depending on the size of the institution serviced.

The signs and symptoms of sepsis are subjective and non-specific with many non-inflammatory disorders having similar presentation, it is important to be aware of the risks of overtreatment as well as under treatment. Thus timelines are from time of diagnosis (not presentation) and audit of sepsis screening will feedback the appropriateness of subsequent therapy and facilitate the tailoring of the education process. An audit of EWS responses would give the incidence of sepsis as the cause for EWS review, insight into over and under treatment and compliance with Sepsis 6.

The publication of this guideline needs to be supported by a robust educational campaign and on-going and embedded sepsis education in the undergraduate and postgraduate medical, midwifery and nursing programmes in order to optimise the recognition of the deteriorating patient, diagnose sepsis and deliver the correct therapy.

Process change and pathway implementation need to be supported by the appropriate resources in order to ensure effective delivery of prompt and appropriate sepsis treatment.
Figure 5 Adult sepsis management algorithm

### National Clinical Guideline: Adult Sepsis Management Algorithm

**Suspected Infection Plus 2 SIRS Criteria = Sepsis**

#### Sepsis 6 in 1 hour

**Give**

1. Oxygen (94-98% SpO2 or 88-92% COPO Patients)
2. IV Antimicrobials (according to local guidelines)
3. Fluids (500mls bolus: give up to 30ml/kg & reassess)

**Take**

1. Blood Cultures
2. Lactate and FBC
3. Urine Output measurement

- If MAP* ≥65mmHg and/or Lactate ≤2mmol/L Document Sepsis
- Fluid resuscitation of 30ml/kg IV in 1 HOUR
- If MAP <65mmHg and/or Lactate ≥4 mmol/L
- Lactate
- If Lactate ≥4mmol/L and/or MAP <65mmHg or organ dysfunction

**This is SEPTIC SHOCK Please document it.**

Continue Fluid Resuscitation. Call Critical Care Medicine

**This is SEVERE SEPSIS. Please document it.**

*MAP: Mean Arterial Pressure

For more information go to on National Clinical Guideline No 6. Sepsis Management go to: www.health.gov.ie/patient-safety/ncec
Responsibility

It is the responsibility of the attending doctor to inform their senior clinician as per local arrangement, when a patient is diagnosed with severe sepsis/septic shock and to administer the 3 and 6-hour bundles. It is their or their delegated authority’s responsibility to assess the patients’ response to the fluid bolus and to prescribe further bolus as appropriate.

Recommendation 5 (3 Hour Bundle)
FOR PATIENTS WITH SEVERE SEPSIS/SEPTIC SHOCK
TO BE COMPLETED WITHIN 3 HOURS OF DIAGNOSIS

1. Complete Sepsis 6 within first hour.
2. Administer a minimum of 30 mL/kg isotonic crystalloid for hypotension or lactate >4mmol/L
3. Assess patient for response to resuscitation by monitoring clinical and haemo-dynamic response, measure hourly urinary output and repeat lactate measurement.

Practical Guidance

The Sepsis 6, which is administered to all deteriorating patients presenting with sepsis, is completed in the first hour with O₂ and antimicrobials given and IV fluid resuscitation underway.

Measuring lactate and urinary output aids the identification of those with severe sepsis/septic shock and these patients should receive 30mls/kg IV isotonic crystalloid fluid guided by their clinical response to fluid resuscitation. Some patients will need more than this to be fluid replete i.e. warm, well perfused, normal mental status, with normal lactate and urinary output.

Patients who develop fluid overload, (signs and symptoms include jugular venous distention, crepitations on chest auscultation, and decreased pulse oximetry readings), should have all IV fluids (boluses and background rate) discontinued until no longer deemed fluid overloaded.

Patients who have persistent organ dysfunction and/or shock after 30mls/kg IV fluid has been administered should have a critical care consultation considered. While some will stabilise with further fluid, others will require advanced cardiovascular support and early referral will facilitate this process. Patients who present extremely unwell may require early critical care input to secure the airway and breathing as well as the circulation.

Clinical handover forms may facilitate the accurate recording of diagnosis, investigations and treatments received and help ensure effective communication between clinical teams and as such their use is suggested. For further information refer to National Clinical Guideline No. 5 Communication (Clinical Handover) in Maternity Services.
Responsibility

It is the responsibility of the critical care team to support the attending doctor in achieving the goals of the 6-hour bundle, if required. The patient remains under the primary care of the initial attending team until transferred to a critical care area (ICU or HDU) or accepted by the critical care team.

Recommendation 6 (6 Hour Bundle)

FOR PATIENTS WITH SEVERE SEPSIS/SEPTIC SHOCK
TO BE COMPLETED WITHIN 6 HOURS OF DIAGNOSIS

1. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥ 65 mm Hg.
2. A sample fluid resuscitation algorithm is suggested as a guide to ongoing fluid resuscitation (see Appendix 5).
3. Re-measure lactate as indicated.

Practical Guidance

The elements of the 6-hour bundle may have to be initiated very early in patients presenting with profound hypotension. The 3 and 6-hour bundles do not have to be performed consecutively but rather according to patient need. However, the elements should be completed within their time frames i.e. Sepsis 6 within the first hour, and the bundles within 3 and 6 hours respectively.

The management of severe sepsis/septic shock is evolving and the ProCESS trial and ARISE trials have shown that CVP (central venous pressure) and ScvO2 (central venous oxygen saturation) measurement are not necessary components in the resuscitation bundle. Central venous access is required for the administration of vasopressors. Further fluid resuscitation trials are in progress and the guideline will be updated as appropriate.
2.1.2 Initial resuscitation and infection issues

A. Initial resuscitation

Responsibility

Fluid resuscitation should be started by the attending clinical team and assisted by critical care as required. Once the patient has been accepted by the critical care team they will take over responsibility for the patient’s on-going resuscitation.

Recommendation 7

Intravenous fluid resuscitation

Quantitative resuscitation of patients with sepsis-induced tissue hypoperfusion should be used (i.e. a fluid bolus given over a pre-determined time period and repeated as required).

Sepsis-induced tissue hypoperfusion is defined in this National Clinical Guideline as hypotension or blood lactate concentration ≥ 4 mmol/L persisting after initial isotonic crystalloid fluid challenge of 30mls/kg. Goals during the first 6 hours of resuscitation include:

- SBP > 90mmHg or MAP > 65mmHg or within 10% of known baseline and not clinically deemed hypoperfused
- SBP > 90mmHg or MAP > 65mmHg, fluid replete/overloaded* and on vasopressors

 Grade 1B (29)

(see appendix 5 sample fluid resuscitation algorithm)

 Or

- Central venous pressure 8–12 mm Hg
- Mean arterial pressure (MAP) ≥ 65 mm Hg
- Urine output ≥ 0.5 mL/kg/hr
- Central venous (superior vena cava) or mixed venous oxygen saturation 70% or 65%, respectively. Grade 1B

Practical Guidance

Clinical hypoperfusion diagnosed by, but not limited to SBP < 90, MAP < 65, lactate > 4, mottled skin, oliguria, altered sensorium.

Fluid replete/overloaded is defined in this National Clinical Guideline as a clinical diagnosis. Signs and symptoms of overload include jugular venous distention, crepitations on chest auscultation, and decreased pulse oximetry readings. Discontinue all IV fluids (boluses, background rate) once this occurs, until no longer deemed fluid overloaded.

The ProCESS trial demonstrates no mortality or morbidity difference between EGDT, protocol-based standard therapy and usual care. It should be noted that usual care in the study institutions resulted in mortality rates of 18.9% and care should be taken in translating these findings into less resource intensive institutions. For this reason a simplified initial fluid resuscitation algorithm is offered as an alternative to early goal-directed therapy as a guide to initial fluid resuscitation (Appendix 5).
B. Diagnosis

Responsibility
It is the responsibility of the clinician administering the first dose of antimicrobials to ensure that blood cultures have been taken first. However, taking cultures should not lead to a delay in administering antimicrobials beyond the one hour time frame. In different institutions, different personnel take the cultures and institutional practices should be followed.

Recommendation 8
Appropriate cultures should be taken before antimicrobial therapy is started, as long as there is no significant delay (> 45 mins) in the start of antimicrobial(s). Grade 1C

At least two sets of blood cultures (both aerobic and anaerobic bottles) should be obtained before antimicrobial therapy with at least one drawn percutaneously and one drawn through each vascular access device, unless the device was recently (<48 hrs) inserted. Grade 1C

Practical Guidance
The taking of blood cultures represents the minimum requirement in terms of microbiological sampling. Samples from all potentially infected sites should be sent for analysis. Blood cultures must be taken using an aseptic technique to avoid contamination and in order to be clinically useful.

Imaging studies should be performed promptly to confirm a potential source of infection. UG

C. Antimicrobial therapy

Responsibility
The attending nurse, midwife or doctor should administer the antimicrobials according to availability in order to ensure the one hour time frame is achieved.

Recommendation 9
Administration of effective IV antimicrobials should occur within the first hour of recognition of septic shock (Grade 1B) and severe sepsis without septic shock, Grade 1C.

Responsibility
The attending doctor and followed up by the responsible team.

Recommendation 10
- Initial empiric antimicrobial therapy of one or more antimicrobials that have activity against all likely pathogens (bacterial and/or fungal or viral) and that penetrate in adequate concentrations into tissues presumed to be the source of sepsis is recommended. Grade 1B
- Local antimicrobial prescribing should be followed to guide best choice of empiric antimicrobial therapy. This is to ensure that the antimicrobial chosen is appropriate for the local epidemiology.
- The antimicrobial regimen should be reassessed daily for potential deescalation as outlined in the ‘Start smart, then focus’ national antimicrobial prescribing care bundle. Grade 1B
Practical Guidance

Empiric antimicrobial prescribing: Antimicrobial prescribing should be based on locally approved guidelines, the patients’ history of colonisation/infection with antimicrobial resistant organisms and the site of infection as determined clinically.

- Antiviral therapy is suggested to be initiated as early as possible in patients with severe sepsis or septic shock of suspected viral origin. Grade 2C
- Antimicrobial agents should NOT be used in patients with severe inflammatory states determined to be of non-infectious cause. UG

Antimicrobials should be reviewed after 24-48 hours by a senior clinician and rationalised based on culture results and clinical response as outlined in the national antimicrobial prescribing care bundle. Due to the increasing incidence of antimicrobial resistant organisms in Ireland it may be helpful to discuss empiric antimicrobial therapy choices with a clinical microbiologist/Infectious diseases physician.

Combination Therapy: The Surviving Sepsis Guideline Development Group suggest combination empirical therapy for neutropenic patients with severe sepsis, Grade 2B, and for patients with difficult-to-treat, multi-drug resistant bacterial pathogens such as Acinetobacter and Pseudomonas spp. Grade 2B.

Duration of antimicrobial therapy: Empiric combination therapy should NOT be administered for more than 3–5 days. Deescalation to the most appropriate single therapy should be performed as soon as the antimicrobial susceptibility profile is known. Grade 2B

Duration of therapy of typically 7–10 days is suggested. This is dependent on the source of infection and the clinical response to therapy. Longer courses may be appropriate in patients who have a slow clinical response, undrainable foci of infection, bacteraemia with S. aureus; some fungal and viral infections or immunologic deficiencies, including neutropenia. Grade 2C

D. Source control

Responsibility

It is the responsibility of the attending team to organise and review appropriate investigations in order to attempt to identify the source of infection and to request review by the appropriate clinical team for the consideration of drainage of drainable foci (e.g. from surgery or interventional radiology).

Recommendation 11
It is recommended that a specific anatomical diagnosis of infection requiring consideration for emergent source control be sought and diagnosed or excluded as rapidly as possible, and intervention be undertaken for source control within the first 12 hours after the diagnosis is made, if feasible. Grade 1C

Practical Guidance

When infected peripancreatic necrosis is identified as a potential source of infection, it is suggested that definitive intervention is best delayed until adequate demarcation of viable and nonviable tissues has occurred. Grade 2B

When source control in a severely septic patient is required, the effective intervention associated with the least physiologic insult should be used (eg, percutaneous rather than surgical drainage of an abscess). UG

If intravascular access devices are a possible source of severe sepsis or septic shock, they should be removed promptly after other vascular access has been established. UG
E. Performance improvement

**Recommendation 12**
Hospital-based performance improvement efforts should be carried out on the diagnosis, treatment and referral of patients with severe sepsis. UG

**Responsibility:**
It is the responsibility of the HSE and hospital managers to put in place processes to facilitate the implementation of this guideline and associated clinical pathways.

It is the responsibility of the HSE and senior hospital management to ensure that clinicians have access to appropriate education resources in order to be able to be compliant with the National Clinical Guideline.

It is the responsibility of clinicians to avail of these resources to ensure their familiarity with the management of the deteriorating patient with sepsis.

It is the responsibility of the National Clinical Lead for the Sepsis Workstream and the National Sepsis Steering Committee to advise the HSE and the Department of Health on the necessary process change and requirements for sepsis pathway implementation and audit.

It is the responsibility of hospital management and HSE to resource the audit of compliance with sepsis screening, including the audit of key performance indicators such as time to first dose antimicrobials, incidence of bacteraemia, incidence of blood culture contamination, total antimicrobial dispensing, and rates of C. difficile infections.

It is the responsibility of the diagnosing clinician to document sepsis, severe sepsis and septic shock and the origin of same, if known, in the medical chart. It is the responsibility of hospital management and HSE to audit the incidence of sepsis, severe sepsis, septic shock and mortality from same, as documented in the patients medical chart. It is the responsibility of the diagnosing clinician to document sepsis, severe sepsis and septic shock and the origin of same, if known, in the patient case notes and death certificate.

**Practical Guidance**
To track improvements in the management of patients with sepsis, the level of compliance with elements of Sepsis 6, especially time to first dose antimicrobials, should be monitored on an ongoing basis as part of a ward/unit/directorate quality sepsis improvement programme.

Each ward/unit/directorate should agree a measurement plan for sepsis that is practical and aligns with other measurements for improvement. The measurement strategy needs to reflect the reality that patients can present with sepsis on admission or develop sepsis while in hospital. It should also include consideration of measurement of some balancing measures (see section 3.7 of the full version National Clinical Guideline). Sources of data can include the patient’s medical notes, medication chart, observation/early warning score chart, and fluid balance chart. Patients with a terminal illness should NOT be excluded unless a decision not to escalate care clearly excludes further active treatment with antimicrobials or IV fluids in the ward setting.
F. Infection prevention

Responsibility: Hospital Senior Management Team (e.g. CEO, Director of Nursing/Midwifery, Clinical Director and Director of Finance. Action to be performed by ICU nurse or delegated person.

Practical Guidance
It is suggested that oral chlorhexidine gluconate be used as a form of oropharyngeal decontamination to reduce the risk of ventilator-associated pneumonia in ICU patients with severe sepsis. Grade 2B

Subject to update as per the ventilator associated pneumonia (VAP) prevention bundle.


National Clinical Guideline No. 2 Prevention and Control of Methicillin Resistant Staphloccus Aureus (MRSA)

National Clinical Guideline No. 3 Surveillance, Diagnosis and Management of Clostridium difficile in Ireland
Special considerations in paediatrics

2.2.2 Special considerations in paediatrics

In childhood, sepsis is defined as evidence of the systemic inflammatory response syndrome (SIRS) in the context of suspected, or confirmed, bacterial, viral or fungal infection.

The diagnosis of SIRS in children has been modified from the diagnostic features in adults and is dependent on the presence of certain paediatric specific criteria.

SIRS is a response to a stimulus, which results in two or more of the following:

- Temperature > 38.5°C or < 36°C
- Heart rate > 2 SDs above normal, or bradycardia in children < 1 year old (< 10th centile for age)
- Respiratory rate > 2 SDs above normal (or pCO<sub>2</sub> < 4.25Kpa)
- Leukocyte count > 12,000 cells/mm<sup>3</sup>, < 4,000 cells/mm<sup>3</sup>, or > 10% band forms
- Hyperglycaemia
- Altered mental status
- Hyperlactaemia
- Increased capillary refill time (CRT)

Other important definitions in paediatric sepsis include:

Severe sepsis is sepsis and organ hypoperfusion (raised lactate, oliguria, prolonged CRT, reduced mental status) or organ dysfunction* (disseminated intravascular coagulopathy (DIC), acute respiratory distress syndrome (ARDS), acute renal failure (ARF)).

*Organ dysfunction criteria

Respiratory:

\[ \text{PaO}_2 / \text{FiO}_2 < 300 \text{ in the absence of cyanotic heart disease or pre-existing lung disease} \]

\[ \text{Or} \]

\[ \text{PaCO}_2 > 6.5 \text{ kPa or 20mmHg over baseline PaCO}_2 \]

\[ \text{Or} \]

Proven need for \text{FiO}_2 > 0.5 to maintain saturations > 92% 

\[ \text{Or} \]

Need for nonelective invasive or noninvasive mechanical ventilation

Neurological:

\[ \text{Glasgow coma score (GCS) < 11} \]

\[ \text{Or} \]

Acute change in mental status with a decrease in GCS > 3 points from abnormal baseline

Haematologic:

\[ \text{Platelet count < 80,000/mm}^3 \text{ or a decline of } > 50\% \text{ in platelet count from the highest value recorded over the previous 3 days (for chronic haematology/oncology patients)} \]

\[ \text{Or} \]

International normalised ratio > 2

Renal:

\[ \text{Serum creatinine > 2 times upper limit of normal for age or 2-fold increase in baseline creatinine} \]

Hepatic:

\[ \text{Total bilirubin > 4 mg/dl (not applicable for newborn)} \]

\[ \text{Or} \]

ALT 2 times upper limit of normal for age
Septic shock is sepsis and cardiovascular organ dysfunction.

**Cardiovascular dysfunction**

Despite administration of isotonic fluid bolus > 40ml/kg in 1 hour:

- Decrease in BP (hypotension) < 5th percentile for age or systolic BP > 2 SD below normal for age

Or

- Need for vasoactive drug to maintain BP in normal range (dopamine > 5 μg/kg/min or dobutamine, adrenaline or noadrenaline at any dose)

Or

Two of the following:

- Unexplained metabolic acidosis: base deficit < 0.5 MEq/L, increased arterial lactate > 2 times the upper limit of normal, oliguria i.e. urine output < 0.5mls/kg/hr
- Prolonged capillary refill > 5 seconds
- Core to peripheral temperature gap > 3°C

**Infection:** A suspected or proven (by positive culture, tissue stain, or polymerase chain reaction test) infection caused by any pathogen OR a clinical syndrome associated with a high probability of infection. Evidence of infection includes positive findings on clinical exam, imaging, or laboratory tests (e.g. white blood cells in a normally sterile body fluid, perforated viscous, chest X-ray consistent with pneumonia, petechial or purpuric rash, or purpura fulminans).

A. Recognition of Sepsis

The timely recognition of sepsis is a challenge for all paediatric staff. Clinical history and physical examination may reveal features in keeping with infection or some of the diagnostic criteria of SIRS. Some groups of children have an increased risk for sepsis including:

- Children younger than 3 months
- Children with chronic disease
- Children with immune deficiency, immunocompromise, asplenia or an incomplete vaccination record
- Children who have recently had surgery.

Keeping a high index of suspicion for sepsis in all children with signs of infection, risk factors or features of SIRS is the key to early diagnosis. The use of a Paediatric Early Warning Score (PEWS) highlights some of these features and facilitates their recognition and communication. A National Clinical Guideline PEWS is in development. If sepsis is suspected then tests that may confirm the diagnosis, should be performed. In addition, early management should commence as outlined in the “paediatric Sepsis 6”.

**Recommendation 1P**

Sepsis screening should be used on all paediatric patients either presenting unwell or deteriorating whilst an in-patient as evidenced by deteriorating early warning scores (PEWS) or picked up on routine history and examination or by other means. **Grade 1C.**

Sepsis is diagnosed by the presence of SIRS criteria due to suspected or proven infection.

**Recommendation 2P**

Once the diagnosis of sepsis has been made it is recommended that the ‘paediatric Sepsis 6’ be performed within 1 hour, **Grade 1C.** The paediatric Sepsis 6 has been adapted from the adult Sepsis 6 and reflects some differences in priorities of management in the septic child.
Paediatric Sepsis 6

<table>
<thead>
<tr>
<th>GET 3</th>
<th>GIVE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. IV or IO assess and take bloods</td>
<td>1. High flow oxygen</td>
</tr>
<tr>
<td>• Blood culture</td>
<td></td>
</tr>
<tr>
<td>• FBC</td>
<td></td>
</tr>
<tr>
<td>• Glucose &amp; treat if low</td>
<td></td>
</tr>
<tr>
<td>• Blood gas</td>
<td></td>
</tr>
<tr>
<td>2. Urine output measurement</td>
<td>2. IV fluids</td>
</tr>
<tr>
<td></td>
<td>• Aim to restore circulating volume</td>
</tr>
<tr>
<td></td>
<td>• Titrate 20mls/kg isotonic fluid over 5-10mins</td>
</tr>
<tr>
<td></td>
<td>• Repeat if necessary</td>
</tr>
<tr>
<td></td>
<td>• Caution for fluid overload</td>
</tr>
<tr>
<td></td>
<td>• Monitor for crepitations or hepatomegaly</td>
</tr>
<tr>
<td>3. Early senior input</td>
<td>3. Broad spectrum antimicrobials</td>
</tr>
<tr>
<td></td>
<td>Within 1 hour</td>
</tr>
</tbody>
</table>

**Practical guidance**

As with the adult Sepsis 6, this represents the minimum intervention. Other blood tests, cultures or investigations may be required depending on the clinical scenario. Blood tests must be sent marked urgent and must be reviewed and acted upon in a timely fashion. This also applies to any investigations ordered.

The key difference between the adult and paediatric Sepsis 6 is the emphasis on early input from senior clinicians/specialists. In addition to senior clinical support at the bedside early involvement of Paediatric Intensive Care Unit (PICU) support is encouraged. Where PICU support is not on site a national 24 hour hotline is available for urgent referrals providing advice and arranging transfer. The national number is 1890 213 213.

**Recommendation 3P**

It is recommended that each healthcare facility create or adopt a treatment pathway for paediatric sepsis care that includes triggers for sepsis screening, facilitates the diagnosis of sepsis, severe sepsis/septic shock, and the treatment, resuscitation and appropriate referral to critical care.

These completed pathways should be included in the patient chart and their presence audited as a key performance indicator.

Pathways should clearly identify the stratification of patients into sepsis, severe sepsis or septic shock, include likely source of infection, if known, and the time first dose antimicrobials were administered. The paediatric Sepsis 6 should be included in the pathway.
**Recommendation 4P**

*To be complete within 3 hours Grade 1C*

1. Complete the paediatric Sepsis 6
2. Measure lactate level
3. Fluid resuscitate for hypotension or lactate > 4 mmol/l with 20mls/kg isotonic crystalloid boluses - remember hypotension is a late sign in paediatric sepsis
4. Consider early mechanical ventilation if fluid resuscitation is > 40-60mls/kg*
5. Consider early use of inotropes and vasopressors for fluid refractory hypotension
6. Correct hypoglycaemia
7. Correct hypocalcaemia

*Rationale.*
Due to low functional residual capacity, young infants and neonates with severe sepsis may require early intubation; however, during intubation and mechanical ventilation, increased intrathoracic pressure can reduce venous return and lead to worsening shock if the patient is not volume loaded.

**Practical guidance**
In patients presenting with severe sepsis/septic shock the 3 hour bundle is to be completed. This consists of the Sepsis 6, fluid resuscitation, antimicrobials, correction of electrolytes and early use of mechanical ventilation and inotropes unless shock is reversed.
*Follow ACCM-PALS Guidelines.*

**Recommendation 5P**

*To be complete between 3 and 6 hours*

1. Continue fluid resuscitation: obtain CVP measurement to guide; aim for > 8mmHg
2. Measure ScvO₂
3. ScvO₂ < 70% (cold shock): Transfuse HbG > 10g/dl; optimise arterial saturation through oxygen therapy, ventilation; consider adding milrinone 0.25 – 0.75 mcg/kg/min iv/io (intravenous or intraosseus) titrating to desired effect
4. ScvO₂ > 70% (warm shock): Noradrenaline 0.1 – 0.2 mcg/kg/min iv/io infusion, titrate to desired effect; consider vasopressin 0.2 – 2 mU/kg/min infusion titrated to desired effect
5. Remeasure blood gas and lactate
6. Consider adrenal insufficiency: hydrocortisone 2mg/kg (max 100mg) iv/io bolus; obtain baseline cortisol; if unsure, consider ACTH stimulation test; duration depends on response and laboratory evaluation

---

The following apply to paediatric patients with severe sepsis/septic shock and act as a guide to implementation of the International Guidelines for the Management of Patients with Severe Sepsis and Septic Shock: 2012 in Ireland.

Reproduced with permission of Dr. Joseph Carcillo, MD.
B. Initial resuscitation

**Recommendation 6P**
For respiratory distress and hypoxaemia it is suggested to start with face mask oxygen or if needed and available, high flow nasal cannula oxygen or nasopharyngeal CPAP (NP CPAP). For improved circulation, peripheral intravenous access or intraosseus access can be used for fluid resuscitation and inotrope infusion when a central line is not available. If mechanical ventilation is required then cardiovascular instability during intubation is less likely after appropriate cardiovascular resuscitation, recognising that neonates/infants may require early intubation and ventilation.

*Grade 2C*

**Recommendation 7P**
Therapeutic end points of resuscitation should be targeted. *Grade 2C*
These include:
- Heart rate normalised for age,
- Capillary refill of ≤2 seconds,
- Normal blood pressure for age,
- Normal pulses with no differential between peripheral and central pulses,
- Warm extremities,
- Urine output >1mL.kg⁻¹.hr⁻¹,
- Normal mental status,
- CVP > 8mmHg
- ScvO₂ saturation >70%
- Cardiac index between 3.3 and 6.0L/min/m²

**Recommendation 8P**
For the management of septic shock, *Paediatric Intensive Care Unit Ireland recommends ACCM – PALS guidelines which is recommended by the Society of Critical Care Medicine.*

**Recommendation 9P**
It is recommended to evaluate for and reverse pneumothorax, pericardial tamponade or endocrine emergencies in patients with refractory shock. *Grade 1C*

C. Antimicrobials and source control

**Recommendation 10P**
Empiric antimicrobials should be administered within one hour of the identification of severe sepsis. Blood cultures should be obtained before administering antimicrobials when possible but this should not delay administration of antimicrobials. The empiric drug choice should be changed as epidemic and endemic ecologies dictate (e.g., H1N1, MRSA, chloroquine resistant malaria, penicillin-resistant pneumococci, meningococcal sepsis, recent ICU stay, neutropenia). *Grade 1D*

**Practical guidance**
The empiric drug choice should be tailored to age specific diseases e.g. neonates and group B streptococcus.

**Recommendation 11P**
The use of clindamycin and anti-toxin therapies is suggested as appropriate treatment for toxic shock syndromes with refractory shock. *Grade 2D*

**Recommendation 12P**
Early and aggressive infection source control is recommended. *Grade 1D*
**D. Fluid and electrolyte resuscitation**

**Recommendation 13P**
In the industrialised world with access to inotropes and mechanical ventilation, it is suggested that initial resuscitation of hypovolaemic shock begins with infusion of isotonic crystalloids or albumin with boluses of up to 20mL/kg crystalloids (or albumin equivalent) over 5-10 minutes, titrated to reversing hypotension, increasing urine output and attaining normal capillary refill, peripheral pulses and level of consciousness without inducing hepatomegaly or crackles/crepitations.

If hepatomegaly or crackles exist then inotropic support should be implemented, not fluid resuscitation. In non-hypotensive children with severe haemolytic anaemia (severe malaria or sickle cell crises) blood transfusion is considered superior to crystalloid or albumin bolusing. **Grade 2C**

Target serum calcium levels > 1.0mmol/l

**E. Inotropes/vasopressors/vasodilators**

**Recommendation 14P**
Peripheral inotropic support is suggested to be used until central venous access can be attained in children who are not responsive to fluid resuscitation. **Grade 2C**

**Recommendation 15P**
It is suggested that patients with low cardiac output and elevated systemic vascular resistance states with normal blood pressure should be given vasodilator therapies in addition to inotropes. **Grade 2C**

It is recommended that inotropes be started if there is no adequate haemodynamic response to fluid boluses totalling 40-60mls/kg.

**F. Extracorporeal membrane oxygenation (ECMO)**

**Recommendation 16P**
It is suggested that ECMO should be considered for refractory paediatric septic shock and respiratory failure. **Grade 2C**

**G. Corticosteroids**

**Recommendation 17P**
It is suggested that timely hydrocortisone therapy be given in children with fluid refractory, catecholamine resistant shock and suspected or proven absolute adrenal insufficiency. **Grade 1A**
H. Blood products and plasma therapies

**Recommendation 18P**
There are similar haemoglobin targets for children as in adults. However, during resuscitation of shock with low superior vena cava oxygen saturation shock (<70%), haemoglobin levels of 10g/dL are targeted. After stabilization and recovery from shock and hypoxaemia then a lower target >7.0g/dL can be considered reasonable. **Grade 1B**

**Recommendation 19P**
Similar platelet transfusion targets in children as in adults are suggested. **Grade 1B**

**Recommendation 20P**
It is suggested that plasma therapies should be used in children to correct sepsis-induced thrombotic purpura disorders, including progressive disseminated intravascular coagulation, secondary thrombotic microangiopathy and thrombotic thrombocytopenic purpura. **Grade 2C**

I. Mechanical ventilation

**Recommendation 21P**
It is suggested that lung protective strategies should be used during mechanical ventilation. **Grade 2C**

Practical guidance
Consider early mechanical ventilation in refractory shock as per ACCM-PALS guidelines.

J. Sedation/analgesia/Drug toxicities

**Recommendation 22P**
The use of sedation with a sedation goal should be used in critically ill mechanically ventilated children with sepsis. **Grade 1D**

**Recommendation 23P**
Drug toxicity should be monitored because drug metabolism is reduced during severe sepsis, putting children at greater risk of adverse drug-related events. **Grade 1C**

K. Glycaemic control

**Recommendation 24P**
It is suggested that hyperglycaemia should be controlled using a similar target as in adults of ≤10mmol. Glucose infusion should accompany insulin therapy in newborns and children because some hyperglycaemic children make no insulin whereas others are insulin resistant. **Grade 2C**
L. Diuretics and renal replacement therapy

**Recommendation 25P**
It is suggested that diuretics should be used to reverse fluid overload once shock has resolved and if unsuccessful then continuous venovenous haemofiltration (CVVH) or intermittent dialysis to prevent >10% total body weight fluid overload should be considered. **Grade 2C**

M. Deep Vein Thrombosis (DVT) prophylaxis

**Recommendation 26P**
There is no recommendation on the use of DVT prophylaxis in prepubertal children with severe sepsis.

N. Stress ulcer (SU) prophylaxis

**Recommendation 27P**
There is no recommendation on the use of SU prophylaxis in prepubertal children with severe sepsis.

O. Nutrition

**Recommendation 28P**
Enteral nutrition is advised to be given to children who can be fed enterally and parenteral feeding in those who cannot. **Grade 2C**
3 National Clinical Guideline development processes

3.1 Aim and scope of the National Clinical Guideline
The aim of the National Clinical Guideline is to facilitate the early recognition and appropriate treatment of sepsis in Ireland in order to maximise survival opportunity and minimise the burden of chronic sequelae.

3.2 Methodology
The full methodological process for the ADAPTE process is outlined in the full version National Clinical Guideline.

3.3 Budget impact of this National Clinical Guideline
The budget impact analysis supports the National Clinical Guideline recommendations. The complete budget impact is described in the full version National Clinical Guideline, Appendix 14.

3.4 External review
The Guideline Development Group sent this National Clinical Guideline for review to Dr. John Bates, Consultant in Anaesthesia and Intensive Care, Galway University Hospital and Dr. Christian Subbe, Consultant in Acute Respiratory and Critical Care Medicine, School of Medical Sciences, Bangor university, UK. Further details are outlined in the full version National Clinical Guideline.

3.5 Procedure for update of National Clinical Guideline
The Guideline Development Group agreed that that it will review its publication on a three-yearly basis and update as appropriate, in accordance with the Surviving Sepsis Campaign and international best evidence. Therefore, this guideline will be reviewed again in 2017.

3.6 Implementation of National Clinical Guideline
The implementation plan is outlined in detail in the full version National Clinical Guideline.

3.7 Audit criteria
To ensure that this guideline positively impacts on patient care, it is important that it is audited. Audit is recommended to support continuous quality improvement in relation to the implementation of the National Clinical Guideline. The roll out of the National Intensive Care Audit database will contribute to the collection of accurate data on patients with severe sepsis/septic shock including hospital origin (i.e. ED or ward), mortality rates and sources of infection.

Primary outcome: Mortality outcome of 20-30% in patients with severe sepsis/septic shock
Number of deaths in patients with severe sepsis and septic shock
Number of patients with severe sepsis and septic shock

Secondary outcome:
- Reduced ICU length of stay
- Reduced hospital length of stay.

More detail on the audit process requirements, roles and responsibilities are outlined in the full version National Clinical Guideline.
Appendices

Appendix 1: Guideline Development Group

Terms of Reference:
The Sepsis Steering Group was formed in July 2013 with the aim of developing a framework to improve awareness and recognition of sepsis in the pre-hospital and hospital environments.

Specifically, the Sepsis Steering Group aims to:

In the pre-hospital environment:
- Use available data and consensus definitions to establish a robust, reproducible system of identifying patients with or at risk of sepsis, severe sepsis and septic shock in the pre-hospital environment.
- Create guidelines in the administration of therapies specific to sepsis in the pre-hospital environment. Disseminate by sharing existing good practice regarding sepsis recognition tools and pathways.
- Create new and develop existing education materials and electronic materials and recognition tools
- Make recommendations to relevant bodies to implement these guidelines nationally.
- Develop metrics and data sets to allow the HSE and partner organisations to monitor performance

In secondary care:
Use available data and consensus definitions to establish a robust, reproducible system of identifying patients with or at risk of sepsis, severe sepsis and septic shock in the hospital environment.
- Disseminate by sharing existing good practice regarding sepsis recognition tools and pathways
- Develop metrics and data sets to allow the HSE and partner organisations to monitor performance
- Create new and develop existing education materials and electronic materials and recognition tools

Organisationally:
- Engage and work with relevant bodies, medical colleges and professional health related organisations to embed standards for sepsis recognition and care.

Ultimately, the Sepsis Steering Group will aim to inform, provide the tools for benchmarking and provide guidance on the national implementation of sepsis recognition and immediate therapy.
### Membership

Full details of membership including contributions, affiliations, representative bodies and conflicts of interest are outlined below.

<table>
<thead>
<tr>
<th>Member</th>
<th>Title</th>
<th>Role</th>
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<tbody>
<tr>
<td>Fidelma Fitzpatrick</td>
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<td>Chair</td>
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<td>National Clinical Lead on Sepsis Healthcare Improvement Scotland</td>
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<td>Áine Carroll</td>
<td>National Director Clinical Strategy and Programmes</td>
<td>Honorary member</td>
</tr>
<tr>
<td>Philip Crowley</td>
<td>National Director Quality and Patient Safety</td>
<td>Member</td>
</tr>
<tr>
<td>Vida Hamilton</td>
<td>NCP for Anaesthesia Representative</td>
<td>Member</td>
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<td>Lead of the NCP for Acute Medicine</td>
<td>Member</td>
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<td>Eilish Croke</td>
<td>National Lead for Early Warning Score Project</td>
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<td>Michael Turner</td>
<td>Lead of the NCP for Obstetrics and Gynaecology</td>
<td>Member</td>
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<tr>
<td>Michael Power</td>
<td>Lead of the NCP for Critical Care</td>
<td>Member</td>
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<tr>
<td>Frank Keane</td>
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<td>Member</td>
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<td>National Ambulance Service</td>
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<td>Lead of the NCP for Emergency Medicine</td>
<td>Member</td>
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<tr>
<td>Nora O’Mahony</td>
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<td>Member</td>
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<td>Linda Dillon</td>
<td>Patient advocacy representative</td>
<td>Member</td>
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<td>Representative for primary care</td>
<td>Member</td>
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<tr>
<td>Colm Henry</td>
<td>Clinical Director representative</td>
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<td>Declan McKeown</td>
<td>Public Health Doctor Representative Health intelligence</td>
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<td>Niamh Appleby</td>
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<td>CEO/Hospital manager representative</td>
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<td>Member</td>
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<td>Idowu Akingbagbohun</td>
<td>Administrative Support</td>
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</table>
Paediatric Guideline Development Group: Dr. Cathy McMahon, Consultant Paediatric Intensivist, Our Lady's Children's Hospital, Crumlin, Dr. Dermot Doherty, Consultant Paediatric Intensivist, Children's University Hospital, Temple Street. The National Sepsis Steering Committee are very grateful for their expert input into the development of the paediatric guideline.

Conflict of Interest
Membership of the Guideline Development Group was voluntary and the work was not funded by any public or private agency.

Professor Kevin Rooney, Consultant in Anaesthesia and Intensive Care Medicine Royal Alexandra Hospital and Professor of Care Improvement at University of the West of Scotland wishes to declare that in the last 5 years, he has received research grants and income from consultancy work from Abbott Point of Care but that he has no other conflicts of interest.

No conflicts of interest were declared by any other members of the Guideline Development Group.
## Appendix 2: ISBAR communication tool – patient deterioration

<table>
<thead>
<tr>
<th>ISBAR Communication Tool SAMPLE</th>
<th>Patient Deterioration</th>
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</thead>
<tbody>
<tr>
<td><strong>I</strong> Identify</td>
<td><strong>Identify:</strong> You Recipient of handover information Patient</td>
</tr>
<tr>
<td><strong>S</strong> Situation</td>
<td><strong>Situation:</strong> Why are you calling? (Identify your concerns)</td>
</tr>
<tr>
<td><strong>B</strong> Background</td>
<td><strong>Background:</strong> What is the relevant background?</td>
</tr>
<tr>
<td><strong>A</strong> Assessment</td>
<td><strong>Assessment:</strong> What do you think is the problem?</td>
</tr>
<tr>
<td><strong>R</strong> Recommendation</td>
<td><strong>Recommendation:</strong> What do you want them to do?</td>
</tr>
</tbody>
</table>

Reproduced and adopted with permission from Dr S. Marshall, Monash University, Australia.
Appendix 3: Adult in-patient sepsis screening tool

**Sepsis Screening Form**

( ALWAYS USE CLINICAL JUDGEMENT )

Complete this form and apply if the National Early Warning Score (NEWS) is ≥ 4 (5 on supplementary O2), or if infection is suspected.

<table>
<thead>
<tr>
<th>CLINICIAN TO COMPLETE THIS SECTION</th>
<th>Date:</th>
<th>Time:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEWS:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name of Doctor contacted:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Doctor must review within 30 mins (use ISBAR). DOCTOR TO COMPLETE REMAINDER OF THIS DOCUMENT AS APPROPRIATE.

**Are any 2 or more modified Systemic Inflammatory Response Syndrome (SIRS) criteria present?**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory rate &gt; 20 bpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart rate &gt; 90 bpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WCC &lt; 4 or &gt; 12 x 10^9/L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature &lt;36 or &gt;38.3°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acutely altered mental status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactate &gt; 2 mmol/L (in the absence of diabetes mellitus)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**+ INFECTION SUSPECTED**

Note: Some groups of patients, such as older people, may not meet the modified SIRS criteria, even though infection is suspected. Where this occurs check for signs of organ dysfunction and raised biomarkers such as C-reactive protein (CRP).

**Has a decision been made NOT to escalate care (excluding further treatment)?**

- **NO** proceed
- **YES** do not proceed

**SEPSIS SIX – aim to complete within 1 hour**

1. Blood cultures before giving antibiotics
   - Do not delay antibiotic administration >1 hour if blood cultures are difficult to obtain. Send samples from potentially infected sites eg. sputum, urine, wounds, WC/CVC. Consider source control.
2. Lactate and FBC
3. Urine output measurement

Laboratory tests must be requested as EMERGENCY and aim to have results available and acted on within the hour.

**Look for signs of organ dysfunction:**

- Systolic BP < 90 or Mean Arterial Pressure < 65 or Systolic BP more than 40 below patient’s normal
- New need for oxygen to achieve saturation > 90%
- Lactate > 2 mmol/L (following administration of fluid bolus)
- Urine output < 0.5ml/kg for 2 hours – despite adequate fluid resuscitation
- Acutely altered mental status
- Glucose > 7.7 mmol/L (in the absence of diabetes)
- Creatinine > 177 micromol/L
- Bilirubin > 34 micromol/L
- PET > 1.5 or aPTT > 60s
- Platelets < 100 x 10^9/L

Any organ dysfunction: **THIS IS SEVERE SEPSIS**

- Registrar or Consultant to review immediately.
- Reassess frequently in 1st hour.
- Consider other investigations and management

**Look for signs of septic shock**

(following administration of fluid bolus)

- Lactate > 4 mmol/L
- Hypotensive (Systolic BP < 90 or MAP < 65)

If either present: **THIS IS SEPTIC SHOCK**

Critical care consult required.

- Consultant referral
- Consider transfer to a higher level of care
- Critical care consult requested

A critical care review may be requested at any point during this assessment, but is required for patients with Septic Shock. In a hospital with no critical care unit, a critical care consult must be made and transfer to a higher level of care considered, if appropriate, following the consult.

<table>
<thead>
<tr>
<th>Doctor's Name:</th>
<th>MCRN:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
<td></td>
</tr>
<tr>
<td>Time:</td>
<td></td>
</tr>
</tbody>
</table>

File this document in patient notes - Document management plan.
Appendix 4 Emergency department sepsis pathway

Emergency Department Sepsis Pathway

ADULT PATIENTS  There is separate sepsis criteria for women in pregnancy

CLINICIAN TO COMPLETE THIS SECTION

Date:  
Clinician’s Name:  
Clinician’s Signature:  
MCRN/NMBI PIN:  

INFECTION SUSPECTED +

any 2 or more modified Systemic Inflammatory Response Syndrome (SIRS) criteria present

- Respiratory rate > 20 (bpm) / Hypoxia
- Heart rate > 90 (bpm)
- WCC < 4 or > 12 x 10^9/L
- Temperature <36 or >38.3 (°C)
- Acutely altered mental status
- Bedside glucose >7.7mmol/L

Note: Some groups of patients, such as older people, may not meet the modified SIRS criteria, even though infection is suspected. Where this occurs check for signs of organ dysfunction and raised biomarkers such as C-reactive protein (CRP)

☐ YES. THIS IS SEPSIS

Sepsis Six Regimen must be completed within 1 hour

TAKES 3

SEPSIS SIX – aim to complete within 1 hour

- 1. Blood cultures before giving antimicrobial
  Do not delay antibiotic administration >1 hour if blood cultures are difficult to obtain. Send samples from potentially infected sites eg. sputum, urine, wounds, IV/ICVC. Consider source control.
- 2. Lactate and FBC
- 3. Urine output measurement

Laboratory tests/investigations must be requested as EMERGENCY and aim to have results available and acted on within the hour

GIVE 3

- 4. O₂ (94-98% SpO₂ or 88-92% in Chronic Lung Disease patients)
- 5. IV fluid resuscitation
  (500ml bolus - give up to 30ml/kg) & reassess
  (target systolic BP>100/MAP>65)
  Monitor response to IV fluids and titrate to effect
- 6. IV antimicrobials according to local guidelines
  Time Given:  

Look for signs of organ dysfunction:

- Systolic BP < 90 or Mean Arterial Pressure < 65 or Systolic BP more than 40 below patient’s normal
- New need for oxygen to achieve saturation > 90%
- Lactate > 2 mmol/L (following administration of fluid bolus)
- Urine output < 0.5ml/kg for 2 hours – despite adequate fluid resuscitation
- Acutely altered mental status
- Glucose > 7.7 mmol/L, (in the absence of diabetes)
- Creatinine > 177 micromol/L
- Bilirubin > 34 micromol/L
- PTR > 1.5 or aPTT > 60s
- Platelets < 100 x 10^9/L

Any organ dysfunction: THIS IS SEVERE SEPSIS

Registrar or Consultant to review immediately.

Consider other investigations and management

(ALWAYS USE CLINICAL JUDGEMENT)

Look for signs of septic shock

(Following administration of fluid bolus)

- Lactate > 4 mmol/L
- Hypotensive (Systolic BP < 90 or MAP < 65)

If either present: THIS IS SEPTEC SHOCK

Critical care consult required

- Consider transfer to a higher level of care
- Critical care consult requested

A critical care review may be requested at any point during this assessment, but is required for patients with Septic Shock. In a hospital with no critical care unit, a critical care consult must be made and transfer to a higher level of care considered, if appropriate, following the consult.

Doctor’s Name:  
Doctor’s Signature:  
MCRN:  
Date:  

Time Completed:  

File this document in patient notes - Document management plan.
**Sepsis Antibiotic Prescription**

<table>
<thead>
<tr>
<th>Source (tick all that apply)</th>
<th>Respiratory</th>
<th>Urinary</th>
<th>Abdominal</th>
<th>Cellulitis</th>
<th>CNS</th>
<th>Other</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Antibiotic</th>
<th>Dose</th>
<th>Route</th>
<th>Time</th>
<th>Signature</th>
<th>MCRN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Sepsis Fluid Resuscitation Prescription**

<table>
<thead>
<tr>
<th>Date:</th>
<th>Fluid</th>
<th>Volume</th>
<th>Rate</th>
<th>Assessment</th>
<th>Signature &amp; MCRN</th>
<th>Time</th>
<th>Sign &amp; PIN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sodium Lactate or Normal Saline 0.9%*</td>
<td>500 mLs</td>
<td>15 Mins</td>
<td>Hypotensive, Replete or Overloaded</td>
<td>Start</td>
<td>Signature 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>Signature 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium Lactate or Normal Saline 0.9%*</td>
<td>500 mLs</td>
<td>15 Mins</td>
<td></td>
<td>Start</td>
<td>Signature 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>Signature 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium Lactate or Normal Saline 0.9%*</td>
<td>500 mLs</td>
<td>15 Mins</td>
<td></td>
<td>Start</td>
<td>Signature 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>Signature 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sodium Lactate or Normal Saline 0.9%*</td>
<td>500 mLs</td>
<td>15 Mins</td>
<td></td>
<td>Start</td>
<td>Signature 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Finish</td>
<td>Signature 2</td>
<td></td>
</tr>
</tbody>
</table>

* V Tick infusion of choice  
Use Normal Saline 0.9% in patients with hyperkalaemia

---

**Patients with Severe Sepsis / Septic Shock** who develop respiratory compromise should not be managed with diuretics.

Consider using an infusion pump for fluid management for patients at risk of respiratory compromise.
THINK SEPSIS
For Adult Emergency Department Patients

Suspected or confirmed infection?

Does the patient have TWO of the following (SIIRS criteria)?
- Heart rate > 90 beats per minute
- Respiratory rate > 20 breaths per minute
- Temperature > 38°C or < 36°C
- Altered Level of consciousness
- Glucose > 7.7mmol/L (no diabetes)
- WCC < 4 or > 12 X 10⁹/L
- Caution in immunocompromised patients they may not mount typical SIIRS response

 Likely source of infection?
- Chest?
- Urinary?
- Abdomen?
- Skin/bone?
- Unknown?

Yes

Systolic blood pressure < 90 mmHg or Lactate > 2

High risk of severe sepsis/septic shock

At Risk of Neutropenia & Unwell
High risk for sepsis

Escalate immediately to Senior EM doctor
Sepsis 6 < 1hr
Transfer to Resus or high obs area

Critical Care consult if patient fails to respond or there is on-going concern.

Manchester Triage System
Deteriorating Patient

Yes

This is SEPSIS

Commence Sepsis Pathway (place in chart)

No

Risk of uncomplicated sepsis
- Needs hourly review
- Continue sepsis pathway
- Do not return to Waiting Room
- Hourly vital signs until review by treating clinician
- Commence Sepsis 6 if sepsis diagnosis confirmed by treating clinician

PLEASE NOTE:
- This algorithm applies to all adult patients.
- Apply caution regarding temperature data if anti-pyretic medication has been taken.
- Consider Infection Prevention and Control requirements.

Version 1 October 2014
Appendix 5 Sample fluid resuscitation algorithm for the adult patients with sepsis

**Fluid resuscitation algorithm for adults with sepsis**

**SBP <90mmHg or MAP <65mmHg, Lactate >2mmol/L**

Give bolus 500mls isotonic crystalloid over 15 minutes and reassess.
(Repeat lactate after 2 litres and if shock is persistent consider CRITICAL CARE)

- **Fluid overloaded**
  - Increasing respiratory rate
  - Decreasing O₂ saturations
  - JVP distension
  - Crepitations

- **Euvolaemia* or no longer fluid responsive**

- **SBP <90 mmHg**
  - MAP <65mmHg, and/or
  - Lactate >2mmol/L
  - Despite adequate fluid resuscitation

- **SBP >90 mmHg**
  - MAP >65mmHg, and/or
  - Lactate <2mmol/L
  - Continuous monitoring

- **MAP:** Mean Arterial Pressure, **SBP:** Systolic Blood Pressure

* Euvolaemia can be difficult to assess in patients with distributive shock, the patients in the ProCESS and ARISE trials received, on average between 4 and 5 litres of isotonic crystalloid fluid in the first 6 hours, of this 30mls/kg and 34mls/kg of IVT was administered in the first hour respectively.

For more information go to on National Clinical Guideline No 6. Sepsis Management go to: www.health.gov.ie/patient-safety/ncec
Appendix 6: IMEWS Chart

For the most up-to-date version of the IMEWS chart see: http://www.hse.ie/eng/about/who/clinical/natclinprog/obsandgynaeprogramme/imews and http://www.health.gov.ie/patient-safety/ncec

Irish Maternity Early Warning System (IMEWS) Escalation Guideline

**ALL IMEWS TRIGGERS**
Consider context and complete full clinical assessment. Implement measures to reduce triggers if appropriate. Complete a full set of observations on IMEWS immediately. Inform the Midwife in charge.

**1 YELLOW**
Repeat full set of observations on IMEWS after 30 and before 60 minutes.

**2 YELLOWS OR 1 PINK**
Call the obstetrician to review. Repeat a full set of observations after 30 minutes.

**>2 YELLOWS OR ≥2 PINKS**
Call the obstetrician and request immediate review. Repeat a full set of observations within 15 minutes or monitor continuously.

**ALL IMEWS TRIGGERS**
Liaise with the Midwife in charge. Document all communication including:
- Redefined plan of care
- Ongoing frequency of observations

**IMPORTANT:**
1. If concerned about a woman, escalate care regardless of triggers.
2. If action is not carried out as above, CMM/Midwife in charge must contact the senior obstetrician on duty.
3. Document all communication and management plans in notes.

**CONSIDER MATERNAL SEPSIS**
Are 2 or more of the following SIRS criteria present?
- Temperature ≥38°C or ≤36°C
- Respiratory rate ≥20 breaths per min
- Heart rate ≥100 beats per min
- White cell count ≥16.9 or ≤4.0 x 10^9/L
- Bedside glucose ≥7.7 mmol/L (in the absence of diabetes)
- Acutely altered mental status

**AND**
If infection is suspected after medical review

**Intervention: within one hour COMPLETE SEPSIS 6**
1. Appropriate cultures*
2. FBC +/- lactate
3. Start urine output chart
4. Maintain O₂ (94-98%)
5. Consider IV fluid bolus**
6. IV antibiotics

*e.g. blood, wound, vaginal swab, urine etc
**exercise caution in presence of pre-eclampsia
### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>IMEWS Trigger</th>
<th>Normal Values</th>
<th>Yellow Zone</th>
<th>Pink Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory rate (bpm)</td>
<td>11-19</td>
<td>≥20-24</td>
<td>≤10 or ≥25</td>
</tr>
<tr>
<td>SpO₂ (%)</td>
<td>96-100</td>
<td>-</td>
<td>93%</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>36.0-37.4</td>
<td>37.5-37.9 or 37.1-37.9</td>
<td>≤35 or ≥38</td>
</tr>
<tr>
<td>Maternal HR (BPM)</td>
<td>60-99</td>
<td>50-59 or 100-119</td>
<td>≤50 or ≥120</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td>100-119</td>
<td>90-99 or 140-159</td>
<td>≤90 or ≥160</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>50-80</td>
<td>40-49 or 90-99</td>
<td>≤40 or ≥100</td>
</tr>
<tr>
<td>AVPU Alert</td>
<td>-</td>
<td>Voice, Pain or Unresponsive</td>
<td></td>
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</tbody>
</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Woman’s Name:</th>
<th>Date of Birth:</th>
<th>Healthcare Record No:</th>
<th>Document Number (eg. 1, 2):</th>
<th>Booking BP:</th>
<th>Gestation at Booking (weeks):</th>
</tr>
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</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Year:</th>
<th>Date:</th>
<th>Time:</th>
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<tbody>
<tr>
<td>2022</td>
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#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Maternal HR Rate</th>
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<tbody>
<tr>
<td>120</td>
</tr>
<tr>
<td>110</td>
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<tr>
<td>100</td>
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<td>90</td>
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<td>80</td>
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<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Systolic Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
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</tbody>
</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Diastolic Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
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<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
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<tr>
<td>80</td>
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<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Protein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glucose</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Pain Score 0-10</th>
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<tbody>
<tr>
<td>Pain Score</td>
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</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Alert (A)</th>
<th>Voice (V)</th>
<th>Pain (P)</th>
<th>Unresponsive (U)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>V</td>
<td>P</td>
<td>U</td>
</tr>
</tbody>
</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Total Yellow Zones</th>
<th>Total Pink Zones</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

#### IMEWS Triggers Key

<table>
<thead>
<tr>
<th>Initials</th>
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<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
## Appendix 7: Glossary of terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMR</td>
<td>Antimicrobial resistance</td>
</tr>
<tr>
<td>CCU</td>
<td>Coronary care unit</td>
</tr>
<tr>
<td>CNS</td>
<td>Central Nervous System</td>
</tr>
<tr>
<td>CSP</td>
<td>Clinical Strategy and Programmes, HSE</td>
</tr>
<tr>
<td>CVP</td>
<td>Central Venous Pressure</td>
</tr>
<tr>
<td>DoH</td>
<td>Department of Health</td>
</tr>
<tr>
<td>ED</td>
<td>Emergency department</td>
</tr>
<tr>
<td>ESRi</td>
<td>The Economic and Social Research Institute</td>
</tr>
<tr>
<td>GDH</td>
<td>Glutamate dehydrogenase</td>
</tr>
<tr>
<td>GP</td>
<td>General practitioner</td>
</tr>
<tr>
<td>HCAI</td>
<td>Healthcare-associated infection</td>
</tr>
<tr>
<td>HCW</td>
<td>Healthcare worker/healthcare staff</td>
</tr>
<tr>
<td>HDU</td>
<td>High dependency unit</td>
</tr>
<tr>
<td>HIPE</td>
<td>Hospital Inpatient Enquiry Scheme</td>
</tr>
<tr>
<td>HPA</td>
<td>Health Protection Agency</td>
</tr>
<tr>
<td>HPSC</td>
<td>Health Protection Surveillance Centre</td>
</tr>
<tr>
<td>HIQA</td>
<td>Health Information and Quality Authority</td>
</tr>
<tr>
<td>HSE</td>
<td>Health Services Executive</td>
</tr>
<tr>
<td>IDSA</td>
<td>Infectious Disease Society of America (IDSA)</td>
</tr>
<tr>
<td>ICU</td>
<td>Intensive care unit</td>
</tr>
<tr>
<td>IMEWS</td>
<td>Irish Maternity Early Warning System</td>
</tr>
<tr>
<td>IV</td>
<td>Intravenous</td>
</tr>
<tr>
<td>IPC(T)</td>
<td>Infection prevention and control (team)</td>
</tr>
<tr>
<td>LOS</td>
<td>Length of stay</td>
</tr>
<tr>
<td>MAP</td>
<td>Mean arterial pressure</td>
</tr>
<tr>
<td>MEWS</td>
<td>Maternity Early Warning Score</td>
</tr>
<tr>
<td>NEWS</td>
<td>National Early Warning Score</td>
</tr>
<tr>
<td>NCP</td>
<td>National Clinical Programme</td>
</tr>
<tr>
<td>PEWS</td>
<td>Paediatric Early Warning Score</td>
</tr>
<tr>
<td>PPIs</td>
<td>Proton pump inhibitors</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomised controlled trial</td>
</tr>
<tr>
<td>SAC</td>
<td>Scientific advisory committee</td>
</tr>
<tr>
<td>SCC</td>
<td>Surviving Sepsis Campaign</td>
</tr>
<tr>
<td>ScvO$_2$</td>
<td>Central venous oxygen saturation</td>
</tr>
<tr>
<td>SPHM</td>
<td>Specialist in Public Health Medicine</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>UFH</td>
<td>Unfractionated heparin</td>
</tr>
<tr>
<td>UK</td>
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