

Item

Investment required	Saving
There are not believed to be any funding implications/convergence costs.	There are no savings.

Executive Summary

1. Strategic Context

The service specification for ECMO for severe respiratory failure is an additional product from the Adult Critical Care CRG and replicates the current standards and outcomes which were commissioned when this service was retendered in 2012.

Extracorporeal life support is used to replace the function of failing lungs due to acute lung injury or acute respiratory distress syndrome (ARDS). These are life threatening conditions initiated by a broad range of clinical diagnoses (including infection and trauma) but characterised by acute lung inflammation causing pulmonary oedema, refractory hypoxia, refractory hypercapnoea and reduced lung compliance. ECMO may also be used to support patients with other causes of potentially reversible severe respiratory failure.

ECMO is a form of support rather than a treatment and its aim is to maintain physiological homeostasis to allow the lung injury or infection to recover. This usually requires a support time of between five and fourteen days. Some patients may require ECMO support beyond fourteen days. Venous-venous ECMO (VV) is preferred for adult respiratory failure when cardiac function is adequate or mildly depressed. Hybrid VVA or VA ECMO (Venous-Arterial) may be necessary for some patients. Patients on ECMO usually require anticoagulation with heparin or an alternative anticoagulant due to use of an extracorporeal circuit. Therefore ECMO is usually contraindicated in patients with a recent intracranial bleed, trauma (particularly with head injury), or recent surgery or bleeding from the GI tract.

ECMO is a bridge to recovery for these patients, and reversibility of the presenting condition is a key-criteria for inclusion in the service. Bridging to lung transplant is not part of this service specification.

There are currently 5 designated National Centres providing ECMO for severe respiratory failure to patients of 16years or older. Each centre must also fulfil the separate service specification for adult critical care and be members of a Critical Care Operational Delivery Network.

2. Summary

The proposed ACC Service Specification 2014/15; ECMO for severe respiratory failure (Appendix 1) outlines the following key areas:

- Population needs including national and local context and evidence base
- Outcomes including linking to the NHS Outcomes Framework and other key service and patient outcomes

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- Scope of the service including aims and objectives of the service, care pathway, admission to and discharge from the service, acceptance and exclusion criteria and any clinical and service interdependences
- Details of existing national standards and highlights specific service standards

The service and the standards that are described in the document are based on the current national tender to which the service was commissioned and are in existence in the 5 designated centres. As such no financial pressure is anticipated.

The Service Specification has been developed and agreed by the ACC CRG which includes representation from clinicians, patient and carer representatives and affiliated organisations. In addition it was also circulated to the Registered Stakeholders list for informal comments and feedback.

3. Recommendation

The ACC CRG recommends the ACC Service Specification:ECMO for severe respiratory failure for approval by CPAG, in advance of a full public consultation.

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25th September 2013

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Item

Appendix 1

Add service spec

7) National Health ServiceによるECMO の位置づけ

D16/S(HSS)/a

2013/14 NHS STANDARD CONTRACT

FOR EXTRA CORPOREAL MEMBRANE OXYGENATION SERVICE FOR ADULTS WITH RESPIRATORY FAILURE

PARTICULARS, SCHEDULE 2 – THE SERVICES, A – SERVICE SPECIFICATION

Service Specification No.	D16/S(HSS)/a
Service	Extra corporeal membrane oxygenation service for adults with respiratory failure
Commissioner Lead	
Provider Lead	
Period	12 months
Date of Review	

1. Population Needs

1.1 National/local context and evidence base

Context

Extracorporeal life support is used to replace the function of failing lungs due to acute lung injury or acute respiratory distress syndrome (ARDS). These are life threatening conditions initiated by a broad range of clinical diagnoses (including infection and trauma) but characterised by acute lung inflammation causing pulmonary oedema, refractory hypoxia and reduced lung compliance.

Evidence Base

The first ECMO trial was conducted in the USA in the 1970's and showed no survival benefit. There was a further trial in the 1980s using a modified form of ECMO called ECCOR (Extra Corporeal Carbon Dioxide Removal). This also failed to show benefit. The most recent evidence, which did show benefit, includes a case control study from Leicester reported in 1997, the Conventional Ventilation or ECMO for Severe Adult Respiratory Failure (CESAR) Trial (2001-2006) reported in 2009 and conducted in the UK and the results of a case comparison study carried out during the swine flu pandemic in 2009/2010 (in press).

The CESAR trial recommended transferring adult patients with potentially reversible

severe respiratory failure whose Murray score exceeds 3.0 or who have a pH of less than 7.20 on optimal conventional management, to a centre with an ECMO-based management protocol to significantly improve survival without severe disability.

At the end of December 2010, the Department of Health commissioned an expert review of adult hypoxia published the best practice guidance: *The Management of Severe Refractory Hypoxia in Critical Care in the UK in 2010*. The recommendations proposed the development of a tiered model of advanced respiratory care. During a period of high demand (December 2010 and January 2011), the National Specialised Commissioning Team (NSCT) worked closely with the provider centres and critical care network leads to develop a system of triaging referrals from local hospitals through the tertiary high volume intensive care units in that region. The role of the identified tertiary intensive care units (ICU) was to provide advice on management of the case and, where appropriate, ensure onward referral to the national adult respiratory ECMO service.

References:

Zapol WM, Snider MT, Hill JD et al. Extracorporeal membrane oxygenation in severe acute respiratory failure. A randomised prospective study. *JAMA* 1979; 242:2193-2196.

Morris AH, Wallace CJ, Menlove RL, et al. Randomized clinical trial of pressure-controlled inverse ration ventilation and extracorporeal CO₂ removal for adult respiratory distress syndrome. *American Journal of Respiratory Critical Care Medicine* 1994; 149:295-305.

Peek GJ, Moore HM, Moore N, Sosnowski AW, Firmin RK. Extracorporeal membrane oxygenation for adult respiratory failure. *Chest*. 1997 Sep; 112(3):759-64.

Peek GJ, Mugford M, Tiruvoipati R, Wilson A, Allen E, Thalanany MM, Hibbert, CL, Truesdale A, Clemens F, Cooper N, Firmin RK, Elbourne D; CESAR trial collaboration. Efficacy and economic assessment of conventional ventilatory support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR): a multicentre randomised controlled trial. *Lancet*. 2009 Oct 17;374(9698):1351-63.

Moronke A, Noaha, Giles J. Peek, Simon J. Finney, Mark J. Griffithsb, David A. Harrison, Richard Grieved, Zia Sadiqued,, Jasjeet S. Sekhone, Danny F. McAuley, Richard K. Firmin, Christopher Harvey, Jeremy J. Cordingley, Susanna Price, Alain Vuylsteke, David P. Jenkins, David Noble, Roxanne Bloomfield, Tim S. Walsh, Gavin D. Perkins, David Menon, Bruce L. Taylor, Kathy M. Rowan: Extracorporeal Membrane Oxygenation for Severe Adult Respiratory Failure Secondary to 2009 H1N1 Influenza A: a case-matched study. **In press**.

2. Scope

2.1 Aims and objectives of service

Aim

To commission an adult respiratory ECMO service to meet the needs of critically ill patients with potentially reversible severe respiratory failure in whom ECMO support is clinically appropriate and who fulfil the eligibility criteria for the service.

Respiratory ECMO provision will be within a tertiary level ICU which is able to provide expert advice on the diagnosis and management of potentially reversible severe respiratory failure and is part of the wider critical care network.

It is expected that the service will be delivered through a number of providers to ensure patients have equity of access and receive parity of service. Except in exceptional circumstances, the ECMO centre should retrieve all patients who are accepted for treatment/consideration of ECMO.

Objectives

Each provider will:

- provide a high quality and comprehensive service for all eligible referred patients aged 16 years and over
- meet the national standards for respiratory ECMO, as a minimum, and participate in their on-going development
- have the expertise to manage patients with potentially reversible severe respiratory failure through the use of the most up-to-date clinical practice
- be able to provide ECMO in cases which meet the eligibility criteria with each centre able to meet minimum volume standards
- manage services during both anticipated seasonal pressures or unanticipated surges in demand
- rapidly admit, assess and treat all patients (aged 16 years and over) who are clinically eligible
- provide ECMO within a tertiary level intensive care unit which has expertise in the specialist management of patients with acute respiratory failure including and the ability to support patients with multi-organ failure
- when necessary, collaborate with other national providers of adult ECMO to minimise potential delays in patients accessing respiratory ECMO care
- have the capacity to safely retrieve patients from referring hospitals to the receiving ECMO centre
- make arrangements for the safe repatriation of patients from the ECMO centre to an appropriate hospital near their home
- be able to provide safe mobile ECMO for patients who are clinically eligible, within 12 months of commencing the service

- collaborate and participate with all other national providers of adult ECMO to provide a national “surge” in capacity if required
- collaborate and participate with all other national providers of adult ECMO in joint audit and service development
- register with the Extracorporeal Life Support Organisation (ELSO), submit data according to agreed ELSO deadlines, and achieve survival rates equivalent to the best in the world.

2.2 Service description/care pathway

Service description

The service is commissioned to provide extracorporeal life support to patients with potentially reversible severe respiratory failure in an adult population (aged 16 years or over). However, there may be rare exceptions when a patient aged between 16 and 18 is more appropriately admitted under the paediatric respiratory ECMO service.

Extracorporeal life support is used to replace the function of failing lungs due to acute lung injury or acute respiratory distress syndrome (ARDS). These are life threatening conditions initiated by a broad range of clinical diagnoses (including infection and trauma) but characterised by acute lung inflammation causing pulmonary oedema, refractory hypoxia and reduced lung compliance.

ECMO is a form of support rather than a treatment and its aim is to maintain physiological homeostasis to allow the lung injury or infection to recover. This usually requires a support time between five and fourteen days. On occasions, it may be necessary to extend ECMO support beyond fourteen days.

Venous-venous ECMO is preferred for adult respiratory failure when cardiac function is adequate or mildly depressed.

Patients on ECMO require anticoagulation with heparin due to use of the extracorporeal circuit. The main contraindications for ECMO support relate to the possibility of bleeding so are usually contraindicated in patients with a recent intracranial bleed, trauma (particularly with a head injury) or recent surgery or bleeding from the GI tract. Weight over 125 kg can be associated with technical difficulty in cannulation, and the risk of not being able to achieve an adequate blood flow based on patient size.

Care Pathways

The adult respiratory ECMO service care pathway encompasses:

- referral and acceptance of patients who fulfil eligibility criteria for service (**see section 3.1**)
- specialist retrieval
- assessment (up to a maximum of 48 hours)
- treatment - by provision of extracorporeal life support using a standard

protocolised pathway of care

- post treatment support (post decannulation up to a maximum of 48 hours)
- end of life care.

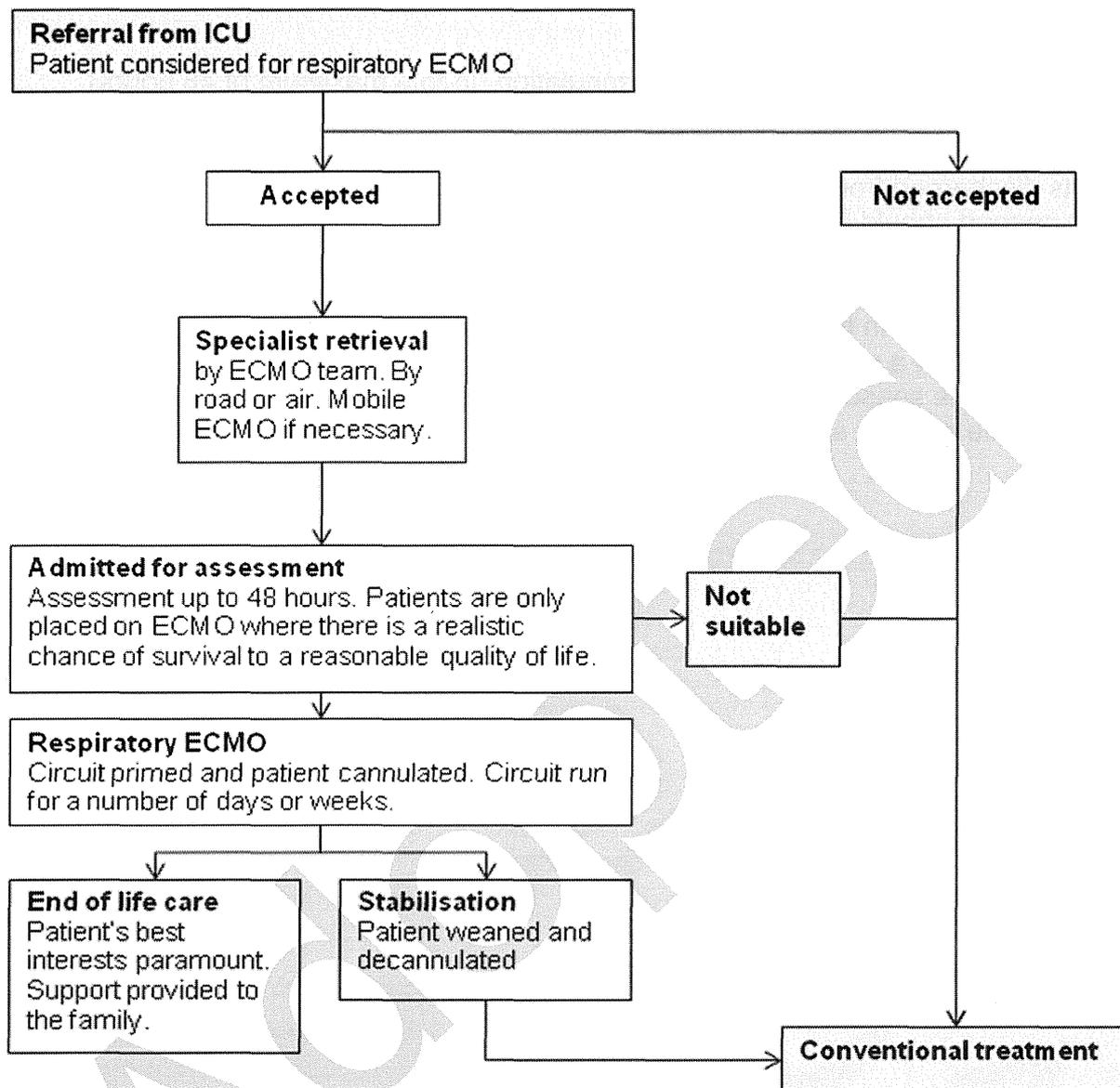
Patients discharged from the specialist ECMO service following the period of post ECMO support should be transferred back to the critical care team.

Centres will be expected to:

- anticipate, plan for and manage seasonal variation
- respond on a national basis to unanticipated surges in demand, over and above the seasonal demands. This may impact on the trust's capacity to provide elective services.

Adopted

Pathway for adult respiratory ECMO



Referral processes and sources

2.2.1 Patient referral

Patient referral

Referrals to the service should only be made by adult intensive care units for patients who are critically ill and already receiving lung protective mechanical ventilation

Providers will accept patients referred to the service who:

- have potentially reversible severe respiratory failure
- have failed optimal conventional intensive care management
- meet the agreed objective eligibility criteria for the respiratory ECMO service; these will be based on the CESAR criteria.

To fulfil the CESAR eligibility criteria the patient will have severe but potentially reversible severe respiratory failure, defined as a Murray score ≥ 3.0 , or uncompensated hypercapnoea with a pH < 7.20 despite optimal conventional treatment. Reversibility will be based on expert clinical opinion.

The Murray score uses four variables to assess the acuity of lung injury:

- oxygenation
- radiographic findings Chest X-ray changes
- level of positive end expiratory pressure (PEEP) used in mechanical ventilation
- lung compliance.

It may be appropriate to discuss patients when the Murray score is ≥ 2.5 as if the patient continues to deteriorate the referral process can be expedited.

Exclusion criteria

Patients will not usually be eligible if they have:

- been on high pressure (peak inspiratory pressure > 30 cmH₂O) and/or high FiO₂ (> 0.8) ventilation for more than 7 days (168 hours)
- signs of intracranial bleeding
- other contraindication to limited heparinisation
- any contraindication to continuation of active treatment.

Specialist retrieval

It is the responsibility of ECMO centres to retrieve patients where a direct referral has been made for consideration of ECMO support. This will require that each centre has:

- a dedicated transport team which can transport patients by road or by air
- the ability to undertake mobile ECMO for the group of critically ill patients whose respiratory function is too poor to transfer safely unless established on ECMO at the referring hospital.

Patient pre-ECMO management

Advanced ventilatory support is commissioned up to a maximum of 48 hours, for all eligible critically ill patients accepted by the service for clinical assessment for respiratory ECMO support. Some patients may be managed through maximising their conventional care by the use of advanced ventilatory support techniques and will not require ECMO support. Approximately 20% of patients come into this category.

Conventional intensive care is not commissioned after the initial 48 hour period of

assessment for respiratory ECMO support.

Patient ECMO support

ECMO support is commissioned for patients with potentially reversible severe respiratory failure who are eligible to access the service. It is expected that venous-venous ECMO will be undertaken when supporting patients with severe respiratory failure unless there is a clinical indication for venoarterial ECMO.

A patient is weaned from ECMO support once they demonstrate clinical improvement in respiratory parameters including measures of lung compliance, radiological changes and improvement in blood gas exchange.

If lung function remains poor, or further deteriorates, after a prolonged period of ECMO support (greater than 14 days) it is expected that the centre will discuss the clinical management of the case with one of the other ECMO providers.

Post treatment support

Once a patient has been weaned from ECMO support, decannulated and is clinically stable it is expected that they will be discharged from the ECMO service to the care of the intensive care team.

Post-ECMO support is commissioned up to a maximum of 48 hours following decannulation. Conventional critical care is funded by the patient's Clinical Commissioning Group (CCG).

Transport to repatriate patients back to their referring hospital is not within the scope of this service.

End of life care

There are some patients, who will fail to improve despite ECMO support and on these occasions it may not be clinically appropriate to continue ECMO support. In such cases the multi-disciplinary team should meet to discuss treatment options; family members should be included. The patient's best interests are paramount in these situations.

End of life care is included within the scope of the service and it is expected that providers will follow best practice, for example use of the Liverpool Care Pathway.

Providers should share examples of good practice.

Patient information and family support

Providers will ensure that information is available for relatives at all stages of the care pathway. This will include information on:

- ***Retrieval:*** relatives should be informed about the retrieval process with

particular reference to the associated risks. Assent must be obtained from the family obtained.

- **Assessment, treatment: and post-ECMO:** regular contact and discussion will be maintained with families, either directly or on the telephone as indicated. The services of a chaplain or a psychologist will be available.
- **End of life care:** bereavement and counselling services should be available and will be offered to all families.

Follow-up

Patients are not routinely followed-up. However, a patient may be seen as required at the request of the general practitioner or referring hospital. All reasonable requests will be accommodated.

2.2.4 Equity of access to services

NHS England is committed to ensuring equality of access and non-discrimination, irrespective of age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex (gender) or sexual orientation.

2.3 Population covered

The service outlined in this specification is for individuals ordinarily resident in England*; or who are the commissioning responsibility of the NHS in England (as defined in *Who Pays?: Establishing the Responsible Commissioner* and other Department of Health guidance relating to individuals entitled to NHS care).

Additionally the UK has a reciprocal arrangement for international referrals with European countries, most notably Sweden.

2.4 Any acceptance and exclusion criteria

Acceptance criteria

Referrals to the service should only be made by adult intensive care units for patients who are critically ill and already receiving lung protective mechanical ventilation

Providers will accept patients referred to the service who:

- have potentially reversible severe respiratory failure
- have failed optimal conventional intensive care management
- meet the agreed objective eligibility criteria for the respiratory ECMO service; these will be based on the CESAR criteria.

To fulfil the CESAR eligibility criteria the patient will have severe but potentially reversible severe respiratory failure, defined as a Murray score ≥ 3.0 , or

uncompensated hypercapnoea with a pH < 7.20 despite optimal conventional treatment. Reversibility will be based on expert clinical opinion.

The Murray score uses four variables to assess the acuity of lung injury:

- oxygenation
- radiographic findings Chest X-ray changes
- level of positive end expiratory pressure (PEEP) used in mechanical ventilation
- lung compliance.

It may be appropriate to discuss patients when the Murray score is ≥ 2.5 as if the patient continues to deteriorate the referral process can be expedited

Exclusion criteria

- conventional care (including critical care) once a patient is discharged from the adult respiratory ECMO care pathway. This is funded by the patient's Clinical Commissioning Group
- repatriation transport back to referring centre.

2.5 Interdependencies with other services

Providers of respiratory ECMO must be an active member of the Extracorporeal Life Support Organization (ELSO), and provide international benchmarked data to commissioners.

A multi-centre forum exists to facilitate best practice development between respiratory ECMO providers, and includes international members from the Karolinska Institute in Sweden.

Interdependent services

Provision of ECMO should be within tertiary intensive care units which has expertise in the specialist management of severe respiratory failure and is part of the local critical care network. There must be co-location of cardiothoracic surgery.

It is expected that providers are always able to maintain an adult respiratory ECMO capability, despite competing pressures from other services.

3. Applicable Service Standards

Each centre must comply with the national standards for Extra Corporeal Membrane Oxygenation (ECMO) for patients over 16 years of age with severe potentially

reversible respiratory failure. These are attached as an Appendix to the specification.

3.1 Applicable national standards e.g. NICE, Royal College

To be agreed in 2013/14

4. Key Service Outcomes

1.1. Measures				
<i>Quality Performance Indicator</i>	<i>Threshold</i>	<i>Method of measurement</i>	<i>Consequence of breach</i>	<i>Report Duration</i>
Mortality	40%	monthly monitoring report	Review and action plan	Monthly
Success of cannulation	ELSO threshold	Critical incident reporting	Review and action plan	6 monthly
Survival rate	ELSO threshold	ELSO reporting	Review and action plan	6 monthly
Survival to discharge	Significant variation from the national average or, in services with one or two national centres, significant variation from the outcomes achieved in the previous three years	Annual report (September of contract year) with data from previous financial year April to March	Performance notice as set out in Clause 32.4 Review and action plan	Annual report (September contract year)

The Extracorporeal Life Support Organisation (ELSO) provides the international summary of outcome data for different patient groups and also produces a centre specific report with outcome data for all centres registered with the organisation. The data provided in the annual report includes outcome data but also information on patient and circuit complications. This enables benchmarking of centres. Providers will need to submit a copy of the ELSO annual report to commissioners.

Serious incident reporting is managed in line with each provider's clinical governance process. Any changes in practice should be highlighted in the annual multi-centre meetings to help disseminate good practice.

A microbiology team is expected to be involved in the day to day prescription and monitoring of infection control in patients. Specific notifiable diseases should be reported to Local Authority Proper Officers under the Health Protection (Notification) Regulations 2010:

The ICU will submit data to the Intensive Care National Audit & Research Centre (ICNARC) Case Mix Programme and meet the programme's quality outcome measures

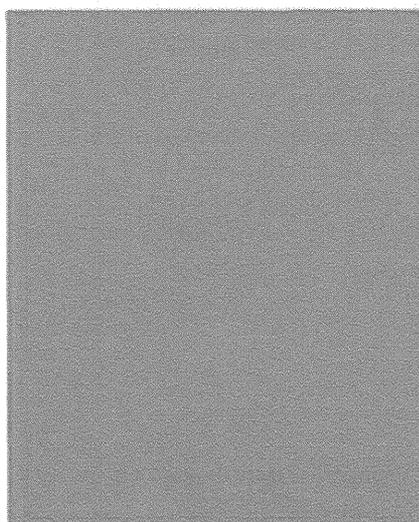
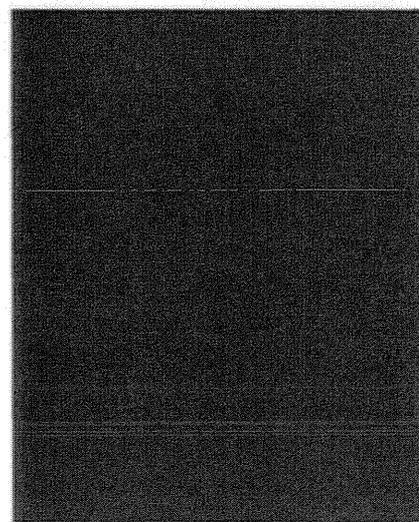
Providers will comply with legislation and statutory guidance to safeguard children and young people (Children Act 1989 and 2004, Working Together to Safeguard Children, 2006

5. Location of Provider Premises

Guy's and St Thomas' NHS Foundation Trust
Papworth Hospital NHS Foundation Trust (Cambridge)
Royal Brompton and Harefield NHS Foundation Trust
University Hospital of South Manchester NHS Foundation Trust
University Hospitals of Leicester NHS Trust

Adopted

Management of surge and escalation in critical care services: standard operating procedure for adult respiratory extra corporeal membrane oxygenation



NHS England INFORMATION READER BOX

Directorate

Medical	Operations	Patients and Information
Nursing	Policy	Commissioning Development
Finance	Human Resources	

Publications Gateway Reference:

00753

Document Purpose	Guidance
Document Name	Management of surge and escalation in critical care services: standard operating procedure for adult respiratory extra corporeal membrane oxygenation
Author	NHS England
Publication Date	14 November 2013
Target Audience	CCG Clinical Leaders, CCG Chief Officers, Foundation Trust CEs, Medical Directors, Directors of Nursing, NHS England Regional Directors, NHS England Area Directors, Communications Leads, Emergency Care Leads, NHS Trust CEs
Additional Circulation List	Chief Executive, Public Health England
Description	A suite of five standard operating procedures (for adult critical care, paediatric intensive care, burn and respiratory extra corporeal membrane oxygenation) that set out (a) consistent approaches by which providers can escalate pressures to NHS England and (b) how NHS England will manage capacity pressures.
Cross Reference	http://www.england.nhs.uk/epr/
Superseded Docs (if applicable)	N/A
Action Required	Recipients are required to review the responsibilities outlined in the documents and ensure that arrangements are in place to implement these in the event of capacity pressures in the five identified services.
Timing / Deadlines (if applicable)	N/A
Contact Details for further information	Fiona Marley Operations Directorate Area 5A, Skipton House 80 London Road, London SE1 6LH (07795) 636 830 TBC

Document Status

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MANAGEMENT OF SURGE AND ESCALATION IN CRITICAL CARE SERVICES: STANDARD OPERATING PROCEDURE FOR ADULT EXTRA CORPOREAL MEMBRANE OXYGENATION

PURPOSE OF THE DOCUMENT

This document sets out the background policy and process for managing surge in demand for Adult respiratory ECMO in England. It describes how the organisations and post holders identified in the standard operating procedure should act.

AUDIENCE

The primary audiences for this document are those involved in planning adult respiratory ECMO services, others involved in the oversight of specialised services in NHS England, providers of adult respiratory ECMO services and communications staff. Given the small number of providers of adult respiratory ECMO services, surge demand is managed on a national (rather than regional or local) basis.

SUMMARY

In the event of a surge in demand identified via the daily capacity monitoring system or via alerts from the adult ECMO centres, the Adult ECMO Lead co-ordinates NHS England's response. All surge issues should be referred to the Adult ECMO lead in-hours.

DEFINITIONS

The definitions used in this document are:

- Pre-surge – heightened risk of surge
- Surge – need for additional capacity to be deployed
- Escalation – all capacity deployed
- Recovery – surge and escalation phases passed and pre-surge arrangements reinstated

BACKGROUND

Respiratory ECMO is indicated for acute severe but potentially reversible respiratory failure. Aetiologies include, but are not limited to, pneumonia, acute respiratory distress syndrome, pulmonary aspiration, air leak syndrome and large airway disease or disruption. Referrals to the service should only be made by adult intensive care units for patients who are critically ill and already receiving lung protective mechanical ventilation or for patients in whom lung protective ventilation is not possible due to the severity of hypoxaemia/hypercapnea. Eligibility criteria are based on those of the CESAR study.

Inclusion criteria are:

- Adult patients > 16 years old
- Potentially reversible respiratory failure
- Lung injury score (LIS) >3 or arterial pH <7.20 due to hypercapnea despite optimal conventional treatment. A LIS>2.5 is acceptable in the context of a rapidly declining patient.

Contraindications for ECMO are:

- High pressure (peak inspiratory pressure > 30 cmH₂O) and/or high FiO₂ (> 0.8) ventilation for more than 7 days (relative contraindication)
- Signs of intracranial bleeding (relative contradiction)
- Other contraindications to limited heparinisation (relative contraindication);
- A contraindication to continuation of active treatment

The LIS or Murray score uses four variables to assess the acuity of lung injury

- Oxygenation
- Findings on a plain chest radiograph
- Level of positive end expiratory pressure (PEEP) required in mechanical ventilation
- Respiratory system compliance

The service commissioned by NHS England includes:

- Patient retrieval by air or road, including mobile ECMO if necessary
- Assessment for respiratory ECMO
- Respiratory ECMO treatment
- Post ECMO trialling off and stabilisation
- End of life care on ECMO if necessary, including family support

NHS England does not commission bridge to transplantation.

ECMO Centres

There are five designated centres in England that provide this service and with whom NHS England has standard contracting arrangements:

- Guy's & St Thomas' NHS Foundation Trust [Three beds]
- Papworth Hospital NHS Foundation Trust [Three beds]
- Royal Brompton & Harefield NHS Foundation Trust [Three beds]
- University Hospital of South Manchester NHS Foundation Trust [Three beds]
- University Hospitals of Leicester NHS Trust [Three beds]

Referral

Once a referral has been made to one of the designated centres, it is the responsibility of that designated centre to source an ECMO bed at one of the five designated centres.

The five designated centres may be able to provide additional capacity at times of 'surge'. There are **no additional designated surge** centres that provide capacity when there is pressure on the five designated centres.

NHS England also works very occasionally with the centre in Stockholm, Sweden.

If there are no beds available within the designated and surge capacity in the UK, a bed may be sourced internationally, for example, from the Karolinska Institute, Sweden (under a reciprocal arrangement).

NHS England holds a dedicated budget for surge capacity. This position is confirmed by the Adult ECMO Lead.