Section 7: Resuscitation

Edited by Dr J Nolan

7.1 Resuscitation training for anaesthetists

Dr J Soar, Dr J Nolan

Why do this audit?

All anaesthetists should be able to:

- recognise and treat the patient at risk of cardiac arrest
- recognise and call for help if cardiac arrest occurs
- start cardiopulmonary resuscitation (CPR) based on current guidelines and attempt defibrillation if indicated.

Anaesthetists who are involved regularly in resuscitation require greater knowledge of resuscitation and peri-arrest care. Consultant anaesthetists rarely attend cardiac arrests unless they have a critical care role because cardiac arrest during anaesthesia is relatively uncommon.[1] Anaesthetic trainees are often on resuscitation teams although many hospitals do not routinely have an anaesthetic trainee on the resuscitation team. Frequent retraining (theory and practice) is required to maintain CPR skills and knowledge; although the optimal interval for retraining has not been established.[2,3] Regular updates may be more important for those who are rarely involved in resuscitation. Resuscitation training standards need to be achieved as part of hospital assessments for clinical negligence (e.g. CNST – Clinical Negligence Scheme for Trusts).

Best practice: research evidence or authoritative opinion

Training should be relevant to an anaesthetist's clinical responsibilities and expected role, e.g. for different patient groups such as newborn, paediatric, adult, and pregnant patients. Anaesthetists should be able to use the latest guidance to treat conditions that require peri-operative resuscitation such as anaphylaxis, hypoxia, hypovolaemia, and local anaesthetic toxicity.

Experts working under the guidance of the International Liaison Committee on Resuscitation (ILCOR) have recently reviewed the science supporting training in resuscitation.[2] Several studies have shown a decay in healthcare provider advanced life support (ALS) skills and knowledge after training and retraining from as little as 6 weeks to 2 years. The optimal duration and type of initial training to acquire resuscitation knowledge and skills, and the optimal frequency and type of refresher training required to maintain resuscitation knowledge and skills is not known. Anaesthetists should have annual updates using a variety of methods to acquire and maintain their resuscitation skills and knowledge (e.g. life support courses, simulation training, in-house training, drills in theatre, 'rolling refreshers', e-learning). Resuscitation guidelines are currently updated every five years.[4] Anaesthetists should ensure they keep up-to-date with guideline changes as part of their continuing professional development.

Suggested indicators

- % of anaesthetists who have attended an in-house resuscitation update in the last year.
- % of anaesthetists who are members of a resuscitation team who hold a valid ALS provider certificate (or equivalent courses).

Proposed standard or target for best practice

- 100% anaesthetists should have attended an in-house resuscitation update in the last year.
- 100% anaesthetists who are members of a resuscitation team should hold a valid ALS provider certificate.

Suggested data to be collected

For all anaesthetists:

- indicate whether member of resuscitation team
- evidence of annual update (in-house training or a national course)
- indicate whether ever held an ALS provider certificate
- indicate whether in possession of valid ALS provider certificate
- reasons for failure to attend annual resuscitation training.

Common reasons for failure to meet standard

- Insufficient training resources.
- Insufficient time.
- Resuscitation training not considered a priority or deemed unnecessary.
- The need for resuscitation uncommon during routine anaesthesia.
- Other training courses considered more useful to everyday practice.

Related audits

7.2 – Prevention of cardiac arrest
7.6 – Paediatric resuscitation practice

See also – National Cardiac Arrest Audit (NCAA). *ICNARC* (https://www.icnarc.org/CMS/DisplayContent.aspx?root=AUDIT)

CPD and Curriculum mapping

CPD matrix codes: **1B01, 1B03, 1B04, 2A06, 2B05, 2B07, 3I00, 3J00**

Training curriculum competences: **RC_BK_01–25, RC_BS_01–11, CI_BK_11, CI_BK_34, RC_IK_01–14, RC_IS_01–07, 1.1–1.3, 5.11**

References

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2 Soar J et al; Education, Implementation, and Teams Chapter Collaborators. Part 12: Education, implementation, and teams: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation* 2010;**81 (Suppl 1)**:e288–330.

3 Soar J et al. European Resuscitation Council Guidelines for Resuscitation 2010. Section 9. Principles of education in resuscitation. *Resuscitation* 2010:**81**:1434–1444.

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7.2 Prevention of cardiac arrest

Professor G B Smith

Why do this audit?

Many in-hospital cardiac arrests appear preventable.[1,2,3,4,5] Frequently, arrest follows failure to recognise or respond to patient deterioration. Improving the recognition of critical illness and preventing cardiac arrest require a step-wise solution involving staff education, patient monitoring, recognition of patient deterioration, a system to call for help and an effective clinical response.[6] Failures have been reported in each of these components, resulting in adverse outcomes for patients.[1,2,3,4,5]

Best practice: research evidence or authoritative opinion

The five-ringed 'Chain of Prevention' can provide a structure for hospitals to design care processes to prevent and detect patient deterioration and cardiac arrest, and can provide a basis for audit and research.[7,8,9] Improvements to the implementation of the components of the chain,[5,10,11,12] are logical and may lead to improved patient outcomes.

Suggested indicators

- **A** Does the hospital have a specific education programme for the recognition and management of the acutely ill patient in the hospital for ward staff, based on competencies defined by the DoH?[10]
- **B** % of ward staff successfully completing such a training programme per three-year cycle.
- **C** Does the hospital have a specific education programme for the recognition and management of the acutely ill patient in the hospital for staff responding to calls for help, based on competencies defined by the DoH.[10]
- **D** % of responding staff successfully completing such a training programme per three-year cycle.
- **E** % of staff possessing the agreed levels of competencies relating to the deteriorating patient, as defined by the DoH.[10]
- **F** Does the hospital have a written, immediately available policy that dictates (a) the observations to be recorded at each routine vital sounds observation round, (b) the frequency of observations for a given degree of illness and (c) the response to a given level of patient sickness (including response times), as defined by NICE.[12]
- **G** % of patients who have a written vital signs plan in their clinical record that identifies the variables to be measured and dictates the frequency of measurement.
- **H** % of patients whose vital signs measurements occur with the agreed frequency.
- **I** % of vital signs datasets that include an agreed core dataset of vital signs parameters, as defined by NICE.[12]
- **J** Does the hospital use either (a) 'calling criteria'[13] or (b) an early warning score[14] to assist ward staff in the early recognition of patient deterioration for all adult patients outside critical care areas? [Ideally this should be the same throughout the organisation.]
- **K** Does the hospital use an unambiguous protocol for summoning a response to a deteriorating patient, such as RSVP[15] or SBAR.[16]
- **L** Does the hospital have a specific team (rapid response team) that responds to medical crises other than, but possibly also including, cardiac arrest?
- **M** % of calls for help where there is documented evidence of a response by the rapid response team.
- **N** % of calls for help where there is documented evidence of a response by the rapid response team within the time, dictated by the local policy.

Proposed standard or target for best practice

- In order to confirm that the hospital has the necessary structures in place for the prevention of cardiac arrest, hospitals should aim for compliance with audit criteria A, C, F, J, K and L.
- There should be 100% compliance for audit criteria B and D, such that all staff should have completed training/refresher training within a three-year cycle.
- 70% of ward staff, and 100% of responding staff, should possess the agreed levels of competencies relating to the deteriorating patient, as defined by the DoH[10]
- 100% of patients should have a written vital signs plan that identifies the variables to be measured and dictates the frequency of measurement number of patients.
- 90% of patients' vital signs measurements should occur with the agreed frequency.
- 90% of vital signs datasets should include an agreed core dataset of vital signs parameters, as defined by NICE.[12]

- 100% of calls for help should be followed by documented evidence of a response by the rapid response team.
- 90% of calls for help should be followed by documented evidence of a response by the rapid response team within the time, dictated by the local policy.

Suggested data to be collected

- Evidence of educational programmes for staff.
- Evidence of vital signs monitoring and escalation policies.
- Evidence of vital signs monitoring processes;.
- Evidence of use of 'calling criteria' or an early warning score.
- Evidence of use of an unambiguous protocol for summoning a response to a deteriorating patient.
- Evidence of a structured response to patient deterioration.

Common reasons for failure to meet standard

- Failure to educate staff.
- Inadequate or incomplete patient monitoring.
- Absence of a system to assist with the recognition of patient deterioration.
- Absence, or failure to use correctly, a common system for communicating patient deterioration and for calling for help.
- Absence of a structured clinical response system.
- Delayed or inappropriate clinical response.

CPD and Curriculum mapping

CPD matrix codes: **2C01, 2C03**

Training curriculum: **RC_IK_09–11**

References

1 Safer care for the acutely ill patient: learning from serious incidents. *NPSA*, London 2007 (http://www.nrls.npsa.nhs.uk/resources/?EntryId45=59828).

2 Recognising and responding appropriately to early signs of deterioration in hospitalised patients. *NPSA*, London 2007 (http://www.nrls.npsa.nhs.uk/resources/?entryid45=59834&q=0%C2%ACdeterioration%C2%AC).

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7 Smith GB. In-hospital cardiac arrest: Is it time for an in-hospital 'chain of prevention'? *Resuscitation* 2010;**81**:1209–1211.

8 Immediate Life Support course manual. 3rd edition. *Resuscitation Council (UK)*, London 2011.

9 Advanced Life Support course manual. 6th edition. *Resuscitation Council (UK)*, London 2011.

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11 Patient Safety First 'how to guide' for reducing harm from deterioration (http://www.patientsafetyfirst.nhs.uk/Content.aspx?path=/interventions/Deterioration/).

12 Acutely ill patients in hospital. NICE Clinical Guidelines CG50. NICE, London July 2007 (http://www.nice.org.uk/CG50).

13 Smith GB et al. A review, and performance evaluation, of single-parameter 'track and trigger' systems. *Resuscitation* 2008;**79**:11–21.

14 Smith GB et al. A review, and performance evaluation, of aggregate weighted 'track and trigger' systems. *Resuscitation* 2008;**77**:170–179.

15 Featherstone P, Chalmers T, Smith GB. RSVP: a system for communication of deterioration in hospital patients. *Br J Nurs* 2008;**17**:860–864.

16 Thomas CM, Bertram E, Johnson D. The SBAR communication technique: teaching nursing students professional communication skills. *Nurse Educ* 2009;**34**:176–180.

7.3 Resuscitation equipment checks

Dr N Sayer, Professor G B Smith

Why do this audit?

For Advanced Life Support to be effective, staff need to know where cardiac arrest equipment is located, and that the equipment is readily available and in good working order.[1] Broken or missing equipment, or equipment failure, are often the cause of delays in instituting cardiopulmonary resuscitation.[1,2,3,4,5,6] A survey of cardiac arrest trolleys in 2002/2003 found that the equipment available varied considerably from recommended standards.[7] Defibrillators do also occasionally fail, but many errors are due to poor defibrillator care and maintenance.[8] Inadequate training and a failure of operators to perform daily checks lead to poor familiarity with the equipment and a failure to identify component failure or damaged devices.[8]

Best practice: research evidence or authoritative opinion

The Resuscitation Council (UK) has a recommended cardiac arrest equipment list for cardiopulmonary resuscitation of both adults,[9] children[10] and neonates,[11] and makes recommendations for other equipment-related issues in its 2004 standards document (updated 2008).[12] Institutions should adopt common cardiac arrest equipment based on these standards and should ensure that regular equipment checks are performed.[13] In areas where cardiac arrests are relatively uncommon, this system is likely to maintain standards, detect deficiencies or malfunctions, and also provide excellent teaching and training opportunities.

Suggested indicators

A % of clinical areas with an up-to-date and immediately available list of 'essential' equipment including spares.

B % of clinical areas with a readily available record of equipment checks, which includes the date and time of each individual check, and the person undertaking it.

C % of clinical areas with evidence of a mechanism for reporting deficiencies.

D For each clinical area, document:

- the % of days per month that at least one 'routine' check is documented. The record should document the availability, function and cleanliness of all equipment, and should be dated and timed, and should identify the person undertaking the check.
- All disposable equipment must be in date.
- The resuscitation trolley should be capable of being moved easily by any member of staff.
- % of resuscitation episodes where a post-resuscitation check is documented.
- % of reported equipment malfunctions that are corrected within one working day.

Proposed standard or target for best practice

- Hospitals should aim for 100% compliance for the first indicators A, B and C.
- All clinical areas should check resuscitation equipment at least once per day (highrisk areas may elect to undertake such checks at each nursing shift handover).
- There should be no missing; partially or completely non-functional; dirty or contaminated equipment.
- There should be no out-of-date disposable equipment.
- The resuscitation trolley should be capable of being moved easily by all members of staff.
- There should be a documented check of resuscitation equipment after 100% resuscitation episodes.
- 100% malfunctions or deficiencies should be corrected within one working day.

Suggested data to be collected

- Name of clinical area.
- Presence of a list of 'essential' equipment.
- Record of daily check, which should include a check of function, cleanliness and expiry date where appropriate.
- Record of check after resuscitation event.
- Record of daily check of the mobility of the resuscitation trolley.
- Record of critical incident with evidence of investigation of problem and solution.

Common reasons for failure to meet standard

- Absence of list of 'essential' equipment. There may be a need for a standardised checklist, which should appear on every resuscitation trolley throughout the organisation.
- Failure of clinical area to identify responsible staff to perform checks.
- Absence of a process to record and investigate critical incidents, some of which may be related to equipment malfunction.

CPD and Curriculum mapping

CPD matrix code: **I B04**

References

1 National Reporting and Learning System Quarterly data issue 9. Putting patient safety first (England). *NPSA*, London 2009.

2 Safer care for the acutely ill patient: learning from serious incidents. *NPSA*, London 2007 (http://www.nrls.npsa.nhs.uk/resources/?EntryId45=59828).

3 Patient Safety Bulletin 1. Rapid Learning from reported incidents. *NPSA*, London July 2005.

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12 Cardiopulmonary Resuscitation. Standards for Clinical Practice and Training. *Resuscitation Council (UK)*, London October 2004 (updated June 2008) (http://www.resus.org.uk/pages/standard.htm).

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7.4 Inappropriate cardiac arrest calls

Dr D A Gabbott

Why do this audit?

To assist with the effective implementation of a 'Do Not Attempt Cardiopulmonary Resuscitation' (DNACPR/DNAR) policy that enables patients to be identified for whom resuscitation would be inappropriate.[1,2,3,4,5]

Best practice: research evidence or authoritative opinion

Inappropriate attempts at resuscitation may produce unnecessary prolongation of an unacceptable quality of life.

Resuscitation attempts which contravene the patient's expressed wishes may constitute an assault.

Resuscitation attempts which are clearly futile are ethically unacceptable.

Suggested indicators

- Existence of a DNAR/DNACPR policy for the hospital.
- % of ward-based staff who know where to find it and who have read it.
- % of cardiac arrest calls made for inappropriate patients.
- Inappropriate patients/unsuitability is clarified below.

Proposed standard or target for best practice

- There should be a clear DNAR/DNACPR policy for every hospital admitting acutely ill patients.
- 100% ward-based staff should have read it.
- 100% of DNAR/DNACPR decisions:
  - DNAR form completed
  - Countersigned by a senior doctor (consultant in charge)
  - Discussed with patient and/or the relatives or, if inappropriate, the reason for not discussing with patient and/or relatives is documented.
- 0% cardiac arrest/resuscitation team calls should be made for inappropriate/unsuitable patients e.g:
  - patients with a DNAR/DNACPR order already in existence in the notes
  - patients who are mentally competent and who have specifically expressed a wish not to be resuscitated
  - inappropriate or futile resuscitation in the opinion of the auditor
  - inappropriate or futile resuscitation in the opinion of the medical and/or ward staff, i.e. DNAR/DNACPR order should have been made but was not.

Suggested data to be collected

- Presence/absence of a written DNAR/DNACPR policy.
- Interview of ward-based junior and senior staff to establish if they know how to access it and have read it.
- Review of DNAR/DNACPR decisions made during the audit period on wards that have been chosen for the audit, by looking at the notes and discussing with medical and ward staff.
- Analysis of Cardiac Arrest/Resuscitation Team calls during the audit period to assess unsuitability/inappropriate patient.

Common reasons for failure to meet standard

- Failure to agree a hospital policy or staff to be aware of it.
- Failure of senior doctor to make and record decision.
- Failure of senior doctor to appreciate 'futility' of resuscitation efforts.
- Disagreement between healthcare staff and/or relatives.
- Ambiguity in effective implementation of DNAR/DNACPR order, i.e. 'only give shocks but no drugs' approach.
- Variation in personal values and ethical attitude of the senior doctor.
- Fear of making 'End of Life Decisions'.
- Fear that making a DNAR/DNACPR order means all care is stopped.

Related audits

7.2 – Prevention of cardiac arrest
7.8 – Outcome after in-hospital cardiac arrest

See also:

- National care of the dying audit – hospitals 2008/2009. *Marie Curie Palliative Care Institute Liverpool and Royal College of Physicians* (http://www.mcpcil.org.uk/liverpool-care-pathway/national-care-of-dying-audit.htm).
- Cardiac Arrest Procedures. *NCEPOD*, 2012. (http://www.ncepod.org.uk/cap.htm).

CPD and Curriculum mapping

CPD matrix codes: **1F04, 2C06**

Training curriculum competences: **RC_BK_22–23, 8.1**

References

1 Decisions relating to Cardiopulmonary Resuscitation – a joint statement from the British Medical Association, Resuscitation Council (UK) and the Royal College of Nursing. *RCN, RC(UK) and BMA*, London 2007 (http://www.resus.org.uk/pages/dnar.htm).

2 European Resuscitation Council Guidelines for Resuscitation 2010. Section 10. The ethics of resuscitation and end-of-life decisions. *Resuscitation* 2010;**81**:1445–1451.

3 Cardiac Arrest Procedures. *NCEPOD*, London 2012 (http://www.ncepod.org.uk/cap.htm).

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5 Treatment and care towards the end of life: good practice in decision making. *GMC*, London 2010 (http://www.gmc-uk.org/guidance/ethical_guidance/end_of_life_care.asp).

7.5 Quality of in-hospital cardiopulmonary resuscitation

Dr J Soar

Why do this audit?

There is evidence that the quality of cardiopulmonary resuscitation (CPR) undertaken in and out of hospital is suboptimal.[1,2,3,4] This is also the case during training.[5] Specifically, prolonged interruptions in chest compressions, excessive ventilation rates, and inadequate chest compression rate, depth and leaning are common. The quality of CPR is one of several factors that determines outcome after cardiac arrest.[6] Poor quality CPR can be addressed by improving training for healthcare providers and providing feedback during training, and where feasible during actual cardiac arrests.[7] Measurement of CPR quality during training and actual cardiac arrests and feeding back to rescuers during arrests or in subsequent debriefings may improve CPR quality at subsequent cardiac arrests.[8]

Best practice: research evidence or authoritative opinion

The European Resuscitation Council (ERC) has published clinical evidence-based guidelines based on a review of the available evidence.[6] The guidance emphasises importance of high-quality CPR in determining survival after cardiac arrest. Chest compressions should be delivered at a rate of 100–120 min^{-1}, depth of 5–6 cm, with complete recoil between compressions and minimal interruption to compressions for other interventions (e.g. defibrillation, tracheal intubation). Excessive ventilation rates are common during CPR and reduce coronary perfusion pressure.[1,4] The ERC guidelines indicate that, once the airway is secured, the ventilation rate during CPR should be 10 min^{-1}. When resuscitating a patient in ventricular fibrillation or pulseless ventricular tachycardia (VF/VT), the delay between stopping chest compressions and delivery of the shock ('the preshock pause') correlates with short-term outcome. Current guidelines recommend that chest compressions continue during defibrillator charging to minimise the preshock pause to a few seconds.[6]

Suggested indicators

Analysis of indicators of quality of CPR is best undertaken during the 2-min periods of chest compressions in the 2010 advanced life support (ALS) algorithm:

- % of 2-min periods with mean compression rate of 100–120 min^{-1}
- % of compressions 5–6 cm over 2-min period of CPR
- % of 2-min periods with ventilation rate 8–12 breaths min^{-1}
- % of time with no chest compressions during cardiac arrest ('no-flow time')
- % of intervals > 3 s between stopping chest compressions and shock delivery in VF/VT

Proposed standard or target for best practice

For all cardiac arrests audited:

- 95%* of 2-min periods with mean compression rate of 100–120 min^{-1}
- 95%* of compressions 5–6 cm over 2-min period of CPR
- 95%* of 2-min periods with ventilation rate 8–12 breaths min^{-1}
- < 20% time with no chest compressions during cardiac arrest.
- 0% of intervals > 3 s between stopping chest compressions and shock delivery in VF/VT.

* A standard of 95% has been chosen because it is unrealistic to expect 100% for these interventions, but a target of 95% is achievable and emphasises the importance of high-quality CPR.

Suggested data to be collected

Data can be collected by direct observation or taken from defibrillator download data. Modern defibrillators can provide some of this data in real-time.[1,3] Data for collection include chest compression rate and depth, ventilation rate, no-flow time, and preshock pause.

Common reasons for failure to meet standard

- Lack of knowledge, training and understanding of current guidelines either at an individual or team level.
- Chest compressions are often delegated to untrained individuals whilst trained individuals undertake 'advanced tasks' with a prolonged and harmful pause in chest compressions.
- Need for improved teamwork so that all interruptions in chest compression are planned and minimised.

Related audits

National Cardiac Arrest Audit (NCAA). *ICNARC* (http://www.icnarc.org/CMS/DisplayContent.aspx?root=AUDIT)

CPD and Curriculum mapping

CPD matrix codes: **1B03, 1B04**

Training curriculum competences: **RC_BK_01–25, RC_BS_01–11, CI_BK_11, CI_BK_34, 1.1–1.3, 5.11**

References

1 Abella BS et al. Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest. *J Am Med Assoc* 2005;**293**:305–310.

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7 Yeung J et al. The use of CPR feedback/prompt devices during training and CPR performance: A systematic review. *Resuscitation* 2009;**80**:743–751.

8 Soar J, Edelson DP, Perkins GD. Delivering high-quality cardiopulmonary resuscitation in-hospital. *Curr Opin Crit Care* 2011;**17**:225–230.

7.6 Paediatric resuscitation

Dr R Bingham

Why do this audit?

Acute paediatric care is increasingly centralised but sick children will present initially to local units, where staff may not have regular experience of acute paediatrics. All hospitals, into which a sick child may be admitted, should have developed systems and be properly equipped to ensure that a deteriorating child is recognised early. Appropriately trained staff should be available to institute treatment to stabilise prior to transfer to a specialist unit, as well as to manage a cardio-respiratory arrest, should it occur.

Best practice: research evidence or authoritative opinion

Reports into the management of acutely ill children have emphasised the importance of having systems to recognise the deteriorating child and staff trained to manage such children available at all times.[1]

Systems such as early warning scores[2] or paediatric emergency teams[3] may facilitate this process. Recommendations on levels of resuscitation training suggest that all staff encountering sick children should be trained to recognise the critically ill child and initiate appropriate immediate treatment.[1]

Suggested indicators

For clinical areas where children are treated (emergency department, theatres and children's wards)

- Clear policy on recognition and treatment of critically ill children.
- % areas with specialised paediatric resuscitation equipment.
- % days in audit period with a record of paediatric resuscitation equipment check.
- % staff qualified in recognition of critically ill child (e.g. PILS).
- % staff in resuscitation team with paediatric advanced life support (EPLS/APLS) training.

Proposed standard or target for best practice

For clinical areas treating children (emergency department, theatres and children's wards)

- Presence of a policy on recognition and treatment of critically ill children.
- 100% should have specialist paediatric resuscitation equipment.
- 100% days should have an adequate record of equipment check.
- 100% clinical staff should have training in recognition of critically ill child.
- Resuscitation team should have members with paediatric ALS training at all times.

Suggested data to be collected

For each area in which children are treated

- Presence/absence of a policy on recognition and treatment of critically ill children.
- Presence of paediatric emergency equipment.
- Presence of daily record and adequacy of checks performed.
- Record of staff who have received paediatric life support training (PLS/PILS, EPLS/APLS).

Common reasons for failure to meet standard

- Absence of policy on management of acutely ill children.
- Inadequate checking of equipment.
- Inadequate provision of training and study time to attend courses.
- Importance of specific paediatric training not appreciated.

Related audits

National Cardiac Arrest Audit (NCAA). *ICNARC* (https://www.icnarc.org/CMS/DisplayContent.aspx?root=AUDIT)

CPD and Curriculum mapping

CPD matrix codes: **1B02, 1B04, 2C01, 2D03, 2D04, 2D07**

Training curriculum competences: **PA_BS_10, RC_IK_01–14, RC_IS_01–07**

References

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3 Tibballs J, Kinny S. Reduction of hospital mortality and of preventable cardiac arrest and death on introduction of a pediatric medical emergency team. *Pediatr Crit Care Med* 2009;**10**:306–312.

7.7 Implementation of therapeutic hypothermia

Dr J Nolan

Why do this audit?

Two randomised clinical trials showed improved outcome in adults remaining comatose after initial resuscitation from out-of-hospital ventricular fibrillation (VF) cardiac arrest, who were cooled within minutes to hours after ROSC.[1,2] The study patients were cooled to 32–34°C for 12–24 hours. An advisory statement from the International Liaison Committee on Resuscitation (ILCOR)[3] recommended the use of mild hypothermia in comatose survivors of out-of-hospital VF cardiac arrest, and this therapy has now been implemented by more than 85% of intensive care units (ICUs) in the United Kingdom.[4]

Best practice: research evidence or authoritative opinion

The 2010 European Resuscitation Council guidelines indicate that unconscious adult patients with spontaneous circulation after out-of-hospital VF cardiac arrest should be cooled to 32–34°C.[5] Cooling should be started as soon as possible and continued for at least 12–24 hours. There is some evidence that cooling is more effective the earlier it is achieved.[6] There are animal data and lower-level human data indicating that mild hypothermia might also benefit unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest from a non-shockable rhythm, or cardiac arrest in hospital.[7] The simplest method to initiate cooling is to infuse rapidly 2 litres of cold (4°C) Hartmann's solution or 0.9% sodium chloride.

The patient should be rewarmed slowly (0.25–0.5°C h^{-1}) and hyperthermia avoided. A period of hyperthermia is common in the first 48 hours after cardiac arrest. The risk of a poor neurological outcome increases for each degree of body temperature > 37°C.[8]

Suggested indicators

Retrospective chart review of all patients admitted to the ICU following out-of-hospital VF cardiac arrest. Record:

- % of comatose patients actively cooled, excluding those with established exclusion criteria (sepsis, pre-existing coagulopathy)
- % with start of cooling within 1 h of return of spontaneous circulation (ROSC)
- % achieving target temperature within 4 h
- % maintained in target range (32–34°C) for at least 12 h
- % with recorded temperature < 31°C
- % rewarmed slowly at 0.25–0.5°C h^{-1}
- % with recorded temperature > 38°C within first 48 h after ROSC.

Proposed standard or target for best practice

For all out-of-hospital VF cardiac arrest patients admitted to ICU without exclusion criteria for therapeutic hypothermia:

- 100% actively cooled
- 100% cooling started within 1 h of ROSC
- 100% achieve target temperature (34°C) within 4 h
- 100% maintained in target range (32–34°C) for at least 12 h
- 100% rewarmed slowly at 0.25–0.5°C h^{-1}
- 0% with recorded temperature < 31°C
- 0% with recorded temperature > 38°C within first 48 h after ROSC.

Suggested data to be collected

- Total number of patients admitted comatose to ICU after out-of-hospital VF cardiac arrest.
- Number actively cooled.
- Time of ROSC.
- Time cooling started.
- Patient temperature for at least the first 48 h.
- Time target temperature achieved.
- Duration of active cooling.
- Rate of rewarming.

Common reasons for failure to meet standard

- Unaware of the evidence for therapeutic hypothermia.
- No protocol in place, emergency physicians and critical care staff not trained in the technique; misperception that this therapy increases ICU length of stay and incurs high costs. Failure to use simple techniques (e.g. IV cold fluid and/or ice pack) while awaiting availability of more complex cooling equipment.

Related audits

10.6 – Audit of the results of therapeutic hypothermia after cardiac arrest

CPD and Curriculum mapping

CPD matrix codes: **1B04, 2C04, 3C00**

Training curriculum competences: **RC_BK_21, 1.3, RC_IK_06, RC_HS_03**

References

1 Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. *N Engl J Med* 2002;**346**:549–56.

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3 Nolan JP et al. Therapeutic hypothermia after cardiac arrest. An advisory statement by the Advancement Life Support Task Force of the International Liaison Committee on Resuscitation. *Resuscitation* 2003;**57**:231–235.

4 Binks AC et al. Therapeutic hypothermia after cardiac arrest – implementation in UK intensive care units. *Anaesthesia* 2010;**65**:260–265.

5 Deakin CD et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 4. Adult advanced life support. *Resuscitation* 2010;**81**:1305–1352.

6 Wolff B et al. Early achievement of mild therapeutic hypothermia and the neurologic outcome after cardiac arrest. *Int J Cardiol* 2009;**133**:223–228.

7 Walters JH, Morley PT, Nolan JP. The role of hypothermia in post-cardiac arrest patients with return of spontaneous circulation: A systematic review. *Resuscitation* 2011;**82**:508–516.

8 Zeiner A et al. Hyperthermia after cardiac arrest is associated with an unfavorable neurologic outcome. *Arch Intern Med* 2001;**161**:2007–2012.

7.8 Outcome after in-hospital cardiac arrest

Dr J Nolan

Why do this audit?

Reported survival rates after in-hospital cardiac arrest are variable.[1] Survival rates can be improved by effective implementation of a DNAR resuscitation policy and by improving the quality of resuscitation (minimal delay starting resuscitation, minimal interruption in chest compressions, rapid defibrillation if the rhythm is shockable). The outcome of all cardiac arrest patients should be audited to enable meaningful targets for improvement, quality assurance, and comparisons between institutions. Contributing data to the UK National Cardiac Arrest Audit (NCAA) will enable benchmarking against the rest of the UK – this necessitates the collection of data relating to the number of hospital admissions (elective, emergency and day cases), which will standardise the denominator.

Best practice: research evidence or authoritative opinion

A recent North American study of almost 52,000 in-hospital arrests documented an overall survival to hospital discharge of 17.6%.[2] A preliminary report in October 2010 from NCAA documented a survival to hospital discharge of 13.6% but this included specifically only those cases in which a resuscitation team had been called. The presenting cardiac arrest rhythm was VF/VT in 18% of all cases.

Suggested indicators

For all cardiac arrest patients

- % whose initial arrest rhythm was VF/VT.
- % who have sustained return of spontaneous circulation (ROSC: defined as return of a pulse for more than 20 min).
- % who survive the event.
- % who survive to discharge from hospital.
- Neurological status of those surviving to discharge (documenting cerebral performance category [CPC]).

Proposed standard or target for best practice

For all cardiac arrest patients attended by resuscitation team

- Proportion with initial rhythm of VF/VT > 20%.
- Rate of survival to hospital discharge after VF/VT cardiac arrest is > 40%
- Overall survival to hospital discharge is > 15%
- Proportion of survivors capable of independent living (i.e. CPC 1 or 2) is > 90%
- Standardised data should be collected on 100% of cardiac arrests attended by a resuscitation team.

Suggested data to be collected

- Date of birth.
- Sex.
- Reason for admission.
- Location of cardiac arrest.
- Date/time of 2222 call.
- Presenting rhythm (VF/VT; asystole; pulseless electrical activity; bradycardia with a pulse requiring chest compressions).
- Sustained ROSC (> 20 min).
- Date/time of death.
- Date of hospital discharge.
- Cerebral performance category at discharge.

Common reasons for failure to meet standard

- High proportion of inappropriate cardiac arrest calls and futile resuscitation attempts in patients with multiple co-morbidities.
- Lack of resources to collect high-quality data.

Related audits

7.2 – Prevention of cardiac arrest
7.4 – Appropriateness of cardiac arrest calls
7.5 – Quality of in-hospital cardiopulmonary resuscitation

See also: National Cardiac Arrest Audit (NCAA). *ICNARC* (http://www.icnarc.org/CMS/DisplayContent.aspx?root=AUDIT)

CPD and Curriculum mapping

CPD matrix codes: **1B03, 1B04, 1102, 2C03**

Training curriculum competences: **RC_BS_11**

References

1 Sandroni C et al. In-hospital cardiac arrest: incidence, prognosis and possible measures to improve survival. *Intens Care Med* 2007;**33**:237–245.

2 Meaney PA et al. Rhythms and outcomes of adult in-hospital cardiac arrest. *Crit Care Med* 2010;**38**:101–108.