Section 7: Resuscitation

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7.1 Resuscitation training for anaesthetists
7.2 Equipment checks
7.3 Process of in-hospital cardiac arrest – response times
7.4 Outcome after in-hospital cardiac arrest
7.5 Appropriateness of cardiac arrest calls
7.6 Paediatric resuscitation procedures
7.7 Quality of in-hospital cardiopulmonary resuscitation
7.8 Implementation of therapeutic hypothermia after cardiac arrest
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 arrest unless they have a critical care role. Anaesthetic trainees are often on resuscitation teams.

Frequent retraining (theory and practice) is required to maintain cardiopulmonary resuscitation (CPR) skills and knowledge; although the optimal interval for retraining has not been established. 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

Experts working under the guidance of the International Liaison Committee on Resuscitation (ILCOR) have recently reviewed the science supporting training in resuscitation. Several studies have documented decay in healthcare provider advanced life support (ALS) skills and knowledge after ALS training and retraining from as little as 6 weeks to 2 years. Refresher courses based only on knowledge did not prevent the decay in psychomotor skills. Significant decay of ALS skills among anaesthetists can be demonstrated 6 months after completion of a European Resuscitation Council (ERC) ALS course.

Standards for clinical practice and training in CPR were published in 2004 by the Royal College of Anaesthetists, the Royal College of Physicians of London, the Intensive Care Society, and the Resuscitation Council (UK). This document indicates that clinical staff should undergo regular resuscitation training to a level appropriate for their expected clinical responsibilities and their skills should be updated annually.

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.

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 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 reach standards

- Insufficient training resources.
- Insufficient time.
- Resuscitation training not considered a priority or deemed unnecessary.
- Other training courses considered more useful to everyday practice.

References

Equipment checks
Ms N Poplett, Professor G B Smith

Why do this audit?
For advanced life support to be effective, the cardiac arrest equipment needs to be readily available and in good working order. Equipment failure has been identified as the responsible factor for delays in instituting cardiopulmonary resuscitation in 18% of arrest calls. The National Patient Safety Agency (NPSA) reported 86 incidents involving missing or broken equipment on cardiac arrest trolleys and a separate survey of such trolleys in 2002/2003 found that the equipment available varied considerably from recommended standards. Defibrillators do also occasionally fail, but many errors are caused by poor defibrillator care and maintenance. 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.

Best practice: research evidence or authoritative opinion
The Resuscitation Council (UK) has a recommended cardiac arrest equipment list for cardiopulmonary resuscitation of both adults and children and makes recommendations for other equipment-related issues in its 2004 standards document. Institutions should adopt common cardiac arrest equipment recommendations based on these standards and should ensure that regular equipment checks are performed. 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
% of clinical areas with a list of ‘essential’ equipment including spares.
% of clinical areas with a written record of performed checks.
% of clinical areas with evidence of a mechanism for reporting deficiencies.
For each clinical area, the % of days that a check is documented which includes availability, function and cleanliness. Disposable equipment must be in date. The resuscitation trolley should be easily mobile.
% of known resuscitation episodes for which a post-use check is documented.
% of reported equipment malfunctions that are corrected or substituted immediately on reporting.

Proposed standard or target for best practice
The first three indicators should be true for 100% of clinical areas. High risk areas may elect to undertake such checks at each nursing shift handover.
There should be a documented check on 100% days and after 100% resuscitation episodes.
100% malfunctions or deficiencies should be corrected or substituted immediately on reporting.
Resuscitation

Suggested data to be collected

Name of clinical area. Presence of 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 reach standards

Absence of list of ‘essential’ equipment. There may be a need for a standardised check-list, which should appear on every resuscitation trolley.
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.

References

Process of in-hospital cardiac arrest – response times

Dr T Craft

Why do this audit?
Outcome following cardiac arrest and cardiopulmonary resuscitation (CPR) is dependent on the timely administration of critical interventions such as early defibrillation and effective chest compressions. The true effectiveness of in-hospital resuscitation is not known and its assessment is hindered by the use of non-uniform nomenclature, different patient inclusion criteria, and different data intervals. These differences prevent valid interhospital and intrahospital comparisons. Examination of the resuscitation process against internationally agreed data sets is essential for research into specific interventions and outcomes. Survival rates will be improved by minimising the delay in starting resuscitation and attempting to defibrillate ventricular fibrillation (VF) and ventricular tachycardia (VT) promptly.

Best practice: research evidence or authoritative opinion
The European Resuscitation Council Guidelines for Resuscitation1 and the 2005 International Liaison Committee on Resuscitation (ILCOR) consensus guidelines2 are the accepted best practice for the resuscitation of adult patients. The Utstein template for the collection of resuscitation data has been updated recently.3 A prospective Swedish study reported an overall survival of 33% when CPR was started in < 1 min compared to 14% when started > 1 min after collapse (OR 3.06, CI 1.59–6.31).4 In patients whose rhythm was VF, 66% were discharged alive if defibrillated ≤ 3 min compared with 20% when defibrillated ≥ 12 min.5

For all cardiac arrest patients:

- % in whom the time of collapse to CPR < 1 min
- % whose initial arrest rhythm was VF/VT
- % defibrillated < 3 min after collapse.

Proposed standard or target for best practice

For all cardiac arrest patients:

- 100% should be given CPR < 1 min
- 100% in VF/VT, defibrillation should be attempted < 3 min
- 100% should have data collected in the Utstein format.

Suggested data to be collected
Total number of cardiac arrests where resuscitation is attempted.
Time of witnessed/monitored cardiac arrest.
Time of first CPR attempt.
Time of first defibrillation attempt (if initial rhythm VF/VT).
7.3 Resuscitation

**Common reasons for failure to reach standards**
- Delays in initiating CPR.
- Ward staff not trained and/or permitted to use a defibrillator.
- Equipment not readily available.
- Inadequate processes for recording data and populating local cardiac arrest registry.

**Related audits**
- 7.4 – Outcome after in-hospital cardiac arrest
- 7.7 – Quality of in-hospital cardiopulmonary resuscitation

**References**


Outcome after in-hospital cardiac arrest

Dr C Gwinnutt

Why do this audit?

The principles of resuscitation after cardiac arrest are widely accepted. Despite improvements in the science of resuscitation overall success rates after in-hospital cardiac arrest remain poor, with only 15–20% of patients surviving to discharge. However, much better survival rates can be achieved when there is minimal delay starting resuscitation, the initial arrest rhythm is ventricular fibrillation or ventricular tachycardia (VF/VT) and defibrillation occurs rapidly (see audit 7.3). The outcome of all cardiac arrest patients should be audited to enable meaningful targets for improvement, quality assurance, and comparisons between institutions. This will be achieved only if standardised criteria for reporting the process and outcome of resuscitation are used.

Best practice: research evidence or authoritative opinion

In UK hospitals, Gwinnutt reported 61.7% immediate survival and 42.2% survival to discharge after VF or VT, but only 17.6% overall survival to discharge after cardiac arrest. Uniformity in definitions and reporting of results is essential to enable evaluation of structure, process and outcome of care. Data should be collected in the Utstein format.

Suggested indicators

For all cardiac arrest patients:

- % patients whose initial arrest rhythm was VF/VT
- % patients who have any return of spontaneous circulation (ROSC: defined as a palpable pulse)
- % patients who survive the event
- % patients who survive to discharge from hospital
- neurological status of those surviving to discharge.

Proposed standard or target for best practice

For all cardiac arrest patients:

- > 50% of patients whose initial rhythm was VF/VT should survive to discharge
- > 25% patients overall should survive to discharge from hospital
- > 90% of survivors should be capable of independent living (i.e. Cerebral Performance Category (CPC) 1 or 2)
- 100% cardiac arrests should have data collected in the Utstein format.

Suggested data to be collected

Data defined by Utstein template.

Absence of signs of circulation and/or considered for resuscitation

Resuscitation not attempted

- Do Not Attempt Resuscitation (DNAR) order in place
- Considered futile

Location of arrest

- Ward
# Resuscitation

## 7.4 – Process of in-hospital cardiac arrest – response times

### Common reasons for failure to reach standards
- Delays in initiating basic and advanced life support (see audit 7.3).
- Lack of resuscitation officers, training facilities, regular training and updates for staff.
- Lack of beds in appropriate areas (HDU, ICU or Coronary Care Unit).
- Data not collected in Utstein format.

### Related audits
- 7.3 – Process of in-hospital cardiac arrest – response times
- 7.7 – Quality of in-hospital cardiopulmonary resuscitation

### References
## Appropriateness of cardiac arrest calls

**Dr P J F Baskett**

### Why do this audit?
To assist with the introduction of a scheme that enables patients to be identified for whom resuscitation would be inappropriate.

### 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 a waste of resources and depress staff morale.\(^1\-^4\)

### Suggested indicators
- Existence of a written do not attempt resuscitation (DNAR) policy for the hospital.
- % of ward based junior staff who have read it.
- % of decisions made according to the policy or to the guidelines below.
- % of cardiac arrest calls made for unsuitable patients. Unsuitability is clarified below.
- % of those in whom resuscitation is attempted compared to the total of those who die in hospital.

### Proposed standard or target for best practice
There should be a written DNAR policy.

**100%** ward based junior staff should have read it.

**100%** decisions that a patient is not for resuscitation should be made:
- by a senior doctor (consultant in charge)
- after consultation with junior staff
- after consultation with nursing staff
- having considered the opinion of the patient and/or the relatives.

No cardiac arrest calls should be made for unsuitable patients e.g:
- patients with a DNAR order in the notes
- inappropriate or futile resuscitation in the opinion of the auditor
- inappropriate or futile resuscitation in the opinion of the medical and/or ward staff.

### Suggested data to be collected
- Presence/absence of a written DNAR policy.
- Interview of ward based junior and senior staff to establish if they have read it.
- Review of DNAR 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 calls during the audit period to assess unsuitability.
- Total number of deaths in the hospital during the audit period.
## Common reasons for failure to reach standards

- 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.
- Variation in personal values and ethical attitude of the senior doctor.

## References

Resuscitation

Paediatric resuscitation procedures

Dr R Bingham

Why do this audit?

The British Paediatric Association has recommended that acutely ill children are treated in specialist paediatric intensive care units. Sick children, however, 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 be properly equipped and have staff trained to recognise a problem early in order to institute treatment designed to stabilise the child prior to transfer to the specialist unit.

Best practice: research evidence or authoritative opinion

There is evidence that knowledge of even basic resuscitation has been inadequate in those who may be called upon to deal with an acutely ill child. Following the introduction of specific paediatric resuscitation training in the UK however, there has been both an improvement in knowledge and a reduction in mortality for children suffering from trauma. It is essential that healthcare providers should have appropriate training for the treatment of the patients in their care.

Suggested indicators

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

- % areas with specialised paediatric resuscitation trolley
- % days in audit period with a record of paediatric resuscitation equipment check, including availability, function, cleanliness and expiry date where applicable
- % staff qualified in paediatric basic life support (BLS)
- % staff in resuscitation team with paediatric advanced life support (ALS) training.

Proposed standard or target for best practice

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

- 100% should have specialist paediatric resuscitation equipment
- 100% days should have an adequate record of equipment check
- 100% clinical staff should have paediatric BLS training
- 100% resuscitation team members should also have paediatric ALS training.

Suggested data to be collected

For each area treating children:

- presence of trolley, presence and completeness of daily record, adequacy of checks performed
- record of staff who have received paediatric ALS training.
Common reasons for failure to reach standards

- Paediatric trolley not thought necessary.
- Inadequate checking of equipment.
- Inadequate provision of training and study time to attend courses.
- Importance of specific paediatric training not appreciated.

References

Quality of in-hospital cardiopulmonary resuscitation

Dr J Nolan

Why do this audit?
There is evidence that the quality of cardiopulmonary resuscitation (CPR) undertaken in and out of hospital is suboptimal. Specifically, prolonged interruptions in chest compressions, excessive ventilation rates and inadequate chest compression rates are common. The quality of CPR is one of several factors that determines outcome after cardiac arrest. Poor quality CPR can be addressed by improving training for healthcare providers. In turn, the efficacy of training can be determined only by auditing how it is implemented in clinical practice.

Best practice: research evidence or authoritative opinion
The International Liaison Committee on Resuscitation (ILCOR) has led a recent, extensive review of the science supporting resuscitation practice. The European Resuscitation Council (ERC) has published clinical evidence-based guidelines based on this review of the science. Both of these documents emphasise the importance of quality of CPR in determining outcome after cardiac arrest. The chest compression rate should be 100 min⁻¹, with the aim of delivering 80 compressions in each minute; short-term survival rates reduce with mean compression rates < 90 min⁻¹. Excessive ventilation rates are common during CPR and reduce coronary perfusion pressure. The ERC guidelines indicate that, once the airway is secured, the ventilation rate during CPR should be 10 breaths min⁻¹. When resuscitating a patient in ventricular fibrillation or ventricular tachycardia (VF/VT), the delay between stopping chest compressions and delivery of the shock correlates with short-term outcome — the quality of the VF starts to deteriorate after just 10–20 s. The Resuscitation Council (UK) guidelines indicate that the pause between stopping compressions and shock delivery should be less than 10 s.

Suggested indicators
Analysis of indicators of quality of CPR is best undertaken in 2-min periods corresponding to the 2005 advanced life support (ALS) algorithm:
- % of 2-min periods with mean compression rate of 90–110 min⁻¹
- % of 2-min periods with ventilation rate 8–12 breaths min⁻¹
- % of time with no chest compressions (without a spontaneous circulation)
- % of intervals > 10 s between stopping chest compressions and shock delivery in VF/VT

Proposed standard or target for best practice
For all cardiac arrests audited:
- 100% of 2-min periods with mean compression rate of 90–110 min⁻¹
- 100% of 2-min periods with ventilation rate 8–12 breaths min⁻¹
- 0% time with no chest compressions (excluding periods with spontaneous circulation, and time to check rhythm and pulse and deliver shocks)
- 0% of intervals > 10 s between stopping chest compressions and shock delivery in VF/VT.
## Suggested data to be collected

Some modified defibrillator/monitors will enable most of these data to be recorded automatically, but most hospitals will not have this equipment. Manual data collection will require the auditor to observe all resuscitation attempts to be included in the audit. Data for collection include:

- compression rates for each 2-min period
- ventilation rates once the airway has been secured
- time with zero compressions
- intervals between stopping chest compressions and delivering shocks.

## Common reasons for failure to reach standards

Poor training, lack of understanding about the importance of uninterrupted chest compressions and the harm caused by excessive ventilation, obsessively prolonged ‘safety’ checks before defibrillation.

## Related audits

7.3 – Process of in-hospital cardiac arrest – response times  
7.4 – Outcome after in-hospital cardiac arrest

## References

Implementation of therapeutic hypothermia after cardiac arrest

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 return of spontaneous circulation (ROSC). The study patients were cooled to 32–34°C for 12–24 h. Despite an advisory statement from the International Liaison Committee on Resuscitation (ILCOR) advocating the use of mild hypothermia in comatose survivors of out-of-hospital VF cardiac arrest, implementation of this therapy in the UK has been slow.

Best practice: research evidence or authoritative opinion
The ILCOR Advisory Statement and European Resuscitation Council guidelines state: unconscious adult patients with spontaneous circulation after out-of-hospital VF cardiac arrest should be cooled to 32–34°C. Cooling should be started as soon as possible and continued for at least 12–24 h. Induced 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. Excessive hypothermia increases the risk of complications. 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.

Suggested indicators
Retrospective chart review of all patients admitted to the intensive care unit (ICU) following out-of-hospital VF cardiac arrest. Record:
- % of comatose patients actively cooled excluding those with established exclusion criteria (sepsis, coagulopathy, haemodynamic instability)
- % patients with start of cooling within 1 h of ROSC
- % patients achieving target temperature within 4 h
- % patients maintained in target range (32–34°C) for at least 12 h
- % patients with recorded temperature < 31°C
- % patients rewarmed slowly at 0.25–0.5°C h⁻¹
- % patients 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% patients actively cooled
- 100% patients have cooling started within 1 h of ROSC
- 100% patients achieve target temperature (34°C) within 4 h
- 100% patients are maintained in target range (32–34°C) for at least 12 h
- 100% patients are rewarmed slowly at 0.25–0.5°C h⁻¹
- 0% patients with recorded temperature < 31°C
- 0% patients 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 taken to achieve target temperature.
- Duration of active cooling.
- Rate of rewarming.

Common reasons for failure to reach standards

- 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.

References
