

Resuscitation from cardiopulmonary arrest

Training and organisation

A REPORT OF THE ROYAL COLLEGE OF PHYSICIANS

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Introduction

Although the management of cardiopulmonary arrest is relatively simple, the availability and efficiency of resuscitative procedures are lacking in both the community and the hospital, due mainly to inadequate training and organisation.

The aim of the working party was to identify the groups who should be instructed in resuscitation to various levels, and to determine how the skills required should be taught and retained. The Report sets down guidelines for the organisation of and the training in resuscitation procedures, with particular reference to District Health Authorities.

Cardiopulmonary arrest in the community

The majority of cardiac arrests in the community are related to ischaemic heart disease. However, a number of arrests, particularly in the younger age groups, are secondary to other factors, for example, hypothermia, heat exhaustion, immersion, acute asthma, drug overdose, electrocution and other causes of acute respiratory failure. It is important to be aware of these possibilities since, whilst resuscitation can be life-saving, other factors, such as hypothermia, may require simultaneous treatment.

Of deaths relating to ischaemic heart disease, 40 per cent occur within one hour of the onset of symptoms and amongst middle-aged and younger male patients, 63 per cent of the deaths occur within one hour. The majority, therefore, occur outside of hospital and over 90 per cent of these deaths are due to ventricular fibrillation which is potentially reversible.

Early coronary care by mobile coronary care units has shown that not only may ventricular fibrillation be prevented or corrected but that the incidence of shock and pump failure may be reduced, thus further lowering the mortality from acute myocardial infarction. It is estimated that 220 out-of-hospital cardiac arrests would occur amongst half a million people each year and that with paramedic units available 30-40 individuals could leave hospital alive. Another estimate indicated that mobile intensive care units could prevent 35,000 sudden cardiac deaths per year in the USA.

Whilst cardiopulmonary resuscitation can occasionally maintain life for at least one hour if appropriately carried out, it has been shown that optimum survival from cardiac arrest is likely when:

- (i) the event was witnessed;
- (ii) a bystander commenced resuscitation;
- (iii) the rhythm was ventricular fibrillation;
- (iv) defibrillation was carried out at an early stage.

Cardiopulmonary arrest in hospital

When a patient suffers a cardiac arrest in hospital the chances of survival should be optimal. However, it has been shown that junior hospital doctors and nursing staff (the staff who usually respond to cardiac arrest calls) are generally not familiar even with basic life support tech-

niques. Few hospitals have formalised instruction of doctors and nurses in resuscitation and regular revision classes are not held. In many teaching centres student doctors and nurses are never adequately trained. The organisation of training in resuscitation is usually delegated to one or more enthusiastic clinicians who have to combine it with their regular duties.

Respiratory arrest not associated with cardiac arrest must be dealt with, with the same degree of urgency as cardiopulmonary arrest. The airway must be opened and basic or advanced ventilatory support applied. In hospital, the cardiac arrest team is summoned and in the community an ambulance is called.

Resuscitation skills and training

Resuscitation skills may be considered at three levels:

Basic life support

Basic life support may be defined as the combination of expired air respiration (usually mouth-to-mouth respiration) and external chest compression. No equipment, except perhaps a simple airway, is used. All unqualified nurses, physiotherapists, radiographers, pre-clinical medical students, other staff who are in contact with patients and the public should be taught to this basic level. Health care professionals and the general public should have regular refresher courses to maintain their skills in basic life support procedures.

The Resuscitation Council (UK) has recommended a standard procedure for basic life support. Adequate instruction in this should take at least two hours. Ideally there should be one instructor to six trainees. A manikin must be available on which to demonstrate and practise expired air respiration and external chest compression. At least 1½ hours should be spent in practice on the manikin.

Choking may cause respiratory obstruction and arrest if not relieved. If back slapping techniques fail, a series of thrusts can be applied to the upper abdomen in an attempt to force air out of the choking patient's lungs, dislodging any impacted object. The exact methods to be used in conscious and unconscious adults, children and infants are well described in the most recent American Heart Association standards and guidelines for cardiopulmonary resuscitation.

No evidence exists that the HIV virus has been transmitted by saliva. In an emergency, direct mouth-to-mouth respiration should not be withheld. It is important to remember that up to 70 per cent of cardiac arrests occur in the home and a close relative may be attempting resuscitation. However, a theoretical risk of virus transmission exists and airway adjuncts should be available for use by trained personnel. Health care professionals who may frequently have to perform basic life support in the hospital or community should be skilled in the use of these simple devices. Training manikins used for instruction in mouth-to-mouth respiration must be thoroughly disinfected according to the manufacturers' recommendations to avoid any risk of infection by this virus or other organisms.

Basic life support with adjuncts

Basic life support with airway adjuncts. Basic life support techniques plus the use of airways, face masks, suction equipment and oxygen should be taught to qualified nursing staff, basic trained ambulance personnel and clinical medical students. All general practitioners should be instructed to this level.

Basic life support with airway adjuncts plus defibrillation techniques. These should be taught to all hospital medical staff, including house staff and all locum hospital doctors. It is of particular importance that house staff on their first day on duty be given basic resuscitation training by their employing hospital. The same training should be given to specially trained nursing staff working in hospital areas such as cardiac care, intensive care and accident and emergency, and ambulance personnel and offered to general practitioners.

Advanced life support

We recommend that every hospital resuscitation team should be competent in eight areas of life support:

1. *Ability to perform basic life support.*
2. *Knowledge of specialist equipment.* This includes defibrillators, oropharyngeal and naso-pharyngeal airways, face mask, oxygen supply apparatus, suction apparatus, ancillary equipment for manual ventilation and laryngoscope. Staff must be familiar with the particular type of equipment used in their hospital. For example, one hospital may use several different types of defibrillator. The operation of all such models should be understood.
3. *Recognition of the mechanisms of cardiac arrest.* There are four forms of cardiac rhythm which may be associated with cardiac arrest:
 - (i) Rapid arrhythmias, including ventricular fibrillation, typical and atypical ventricular tachycardia.
 - (ii) Slow or absent rhythms, including complete heart block and sinus arrest and ventricular asystole.
 - (iii) Normal or near normal cardiac rhythms with little or no cardiac output, usually secondary to mechanical causes such as hypovolaemia, tension pneumothorax, pulmonary embolism or to cardiac rupture, but occasionally due to primary electro-mechanical dissociation (EMD). Cardiac arrhythmias are not the only causes of reversible circulatory arrest. The mechanical causes of reduced or absent cardiac output or blood pressure with a normal ECG are particularly important. Competency in advanced life support demands knowledge of these possibilities.
 - (iv) Bizarre, broad, slow and usually irregular PQRST complexes known as 'agonal rhythms'.
4. *Ability to treat life threatening cardiac arrhythmias and some other forms of cardiopulmonary arrest.* The emergency treatment of the different forms of cardiac arrest is set down in the publications of the Resuscitation Council (UK). These standard forms of management should be under-

stood by those seeking to provide advanced life support.

5. *Ability to insert an intravenous line.* It is essential that one member of a resuscitation team should be able to introduce a central venous line.

6. *Techniques of mechanical ventilation:*

- (i) Mask/bag and/or oropharyngeal airway
- (ii) Endotracheal intubation

Although endotracheal intubation is not necessary in every cardiac arrest there are numerous situations in which successful resuscitation will not be accomplished without this. The most skilful member of the team should perform the intubation at an arrest. Every member of the team should be regularly trained in endotracheal intubation using an intubation model. The use of ancillary equipment such as suction, oxygen supply and equipment for manual ventilation should be understood.

7. *Drugs and their dosage.* The drugs and their dosage used during a cardiac arrest procedure are outlined in the publications and posters of the Resuscitation Council (UK), with which members of the team should be familiar. Some of these drugs can be administered via an endotracheal tube.

8. *Recognition of endpoints of resuscitation.* No resuscitation procedure can be properly conducted unless a team member understands the endpoints of the resuscitation attempt. The team leader should decide when resuscitation attempts should be abandoned, having consulted other colleagues as appropriate.

Organisation of advanced life support in hospital

Five main components will be considered:

1. The resuscitation team

The composition of resuscitation teams should be decided by the local resuscitation committee and must relate to local situations. The team should include a minimum of two doctors and, because of their special skills in this context, we recommend an anaesthetist and a physician. Ideally, a third doctor, qualified nurse or a technician, such as an operating department assistant or physiological measurement technician should also be part of the team. All team members must be appropriately trained. A cardiac arrest involves many other personnel, including the ward nurses, specialist nurses (eg, from intensive therapy units or cardiac care units) and other doctors looking after the patient. However, none of these should be considered as a designated member of the resuscitation team although some may play important roles during the arrest procedure and should be encouraged to attend. This is an important element in training.

2. The responsibilities of the team leader

The team leader will usually be the most senior doctor in the team. He has a specific role. It is his duty to supervise

the conduct of the resuscitation procedure and to ensure that, after the automatic responses made during the first few minutes, the resuscitation attempt continues in a coordinated manner. It is also his responsibility to seek the aid of other colleagues as necessary.

3. *The resuscitation training officer*

A resuscitation training officer should be appointed by each District Health Authority or other equivalent body. A suitable candidate for the post would be a senior nurse from a cardiac care or intensive therapy unit or accident and emergency department, or an ambulanceman instructor trained to paramedic level. An appropriate salary would be that of a senior sister or nursing officer. The role of this officer is partly administrative but mainly involves teaching and training (Appendix 1). Extensive experience of basic and advanced resuscitation is important.

A pilot study of full-time resuscitation training officers in Brighton and the North East Thames Regions has shown improvement in the standards of resuscitation training and resuscitative techniques.

4. *The resuscitation committee*

Each hospital district should have a committee responsible for the following:

- Advising on the composition of the arrest team.
- Supervising the performance of the cardiac arrest team.
- Monitoring the results of resuscitation attempts.
- Providing appropriate training for team members.
- Ensuring the provision and maintenance of appropriate equipment, both for resuscitation and resuscitation training.
- Ensuring that the emergency call system for alerting the cardiac arrest team functions effectively at all times.
- Appointing the resuscitation training officer, reviewing the post and the job description when necessary.

The committee should comprise a minimum of three members and should draw its consultant membership from accident and emergency, anaesthetics, intensive care, cardiology and general medicine. The junior medical staff and nursing staff should always be represented. Other groups, such as occupational medicine staff, pharmacists, technicians, porters and telephonists may be able to make valuable contributions. The committee should have a formal constitution and be a subcommittee of the hospital medical executive committee or District medical committee. It should relate, as appropriate, to the hospital's in-service training organisation and postgraduate educational activities.

The resuscitation officer is an essential member of the resuscitation committee.

5. *Training in life support*

In-house training is essential to ensure that cardiac arrests are properly managed. Regular training using simulated

cardiac arrests should be undertaken. The training should be the responsibility of the resuscitation committee and could be implemented through the resuscitation training officer, the medical school or post-graduate training centres.

Training of personnel

Medical students

All medical students should be taught basic life support during the first pre-clinical term. Competence should be re-assessed and reinforced during the second pre-clinical year. Advanced life support should be taught during the clinical course, preferably with adequate time allocated for revision. Clinical students should use the advanced techniques taught only under the direct supervision of a qualified doctor—as for any other treatment or procedure.

Medical schools should provide training manikins that allow basic life support practice, defibrillation practice and intubation training, and should organise appropriate courses of instruction. Medical students should be encouraged to attend cardiac arrests as part of their training.

Knowledge and skill in resuscitation should be tested in the professional qualifying examinations.

Hospital doctors

Pre-registration house officers should be capable of instituting advanced life support. On the first day in post, adequate time should be spent revising procedures and becoming familiar with the hospital's own equipment and cardiac arrest call system. The hospital should be responsible for ensuring proficiency of house staff in resuscitative procedures. Those responsible for signing-up doctors for full registration should consider competence in resuscitative measures to be a prerequisite.

For registered doctors, it is appropriate to consider the training of various specialist groups separately; this Report concentrates on the training of physicians. Continued training and rehearsal of cardiac arrest procedures should be an essential part of general professional training and specialist training. All physicians in training should be tested repeatedly in advanced life support techniques. Resuscitation skills may be tested in both parts of the Membership examination. When posts are assessed by visitors of the Royal College of Physicians for approval as training posts, the visitors should review training programmes in resuscitation, the resuscitation training equipment available and meet the resuscitation training officer.

Appointment to consultant physician status should not mean the end of resuscitation training. Consultants in clinical medical specialties should be capable of giving basic life support with airway adjuncts and defibrillation; regular revision and retraining should be offered.

Nursing staff

Unqualified nurses should be instructed in basic life

support procedures during their first teaching block before starting clinical duties. Adequate facilities for such training, including training manikins and teaching staff, should be available in the school of nursing. Re-assessment and revision should take place on a regular basis.

Knowledge and skill of basic life support procedures should be tested during the qualifying professional examinations.

Trained nursing staff should maintain their skills by regular compulsory revision. Many trained staff will wish to be trained in basic life support plus the use of airway adjuncts. In high dependency areas, such as cardiac care units, intensive care units and accident and emergency departments, it is essential that specially trained qualified nursing staff should be taught how to recognise and defibrillate patients with life-threatening ventricular arrhythmias.

The senior nursing management should arrange regular training for all nursing staff. In many Districts this may be delegated to the resuscitation training officer.

Paramedical staff

Paramedical staff include staff such as radiographers, physiotherapists, occupational therapists, etc who treat patients. We recommend that they all receive instruction in basic life support during their training and are given revision classes. Also, those working in hospital must know when and how to call the cardiac arrest team.

Lay hospital staff

All lay staff should be offered training in basic life support with refresher courses.

Resuscitation in general practice

Every new principal in general practice in the UK is now required to have undergone vocational training. As a medical student and during the preregistration period, the trainee should have had experience of and training in resuscitation. During house officer appointments the doctor should be attached to a resuscitation team and have regular experience in resuscitation. During the three-year vocational training this experience will be considerably limited in certain specialties and in general practice itself. Trainees who gain further experience in general medicine, geriatrics and accident/emergency will have their resuscitation skills reinforced.

Once the trainee becomes a general practitioner, experience of resuscitation will be restricted and skills will fade unless the general practitioner has relevant clinical assistant sessions such as in accident/emergency or anaesthetics.

The general practitioner should attend a course in basic life support within two years of becoming a principal in general practice and at regular intervals afterwards. Interested general practitioners should be encouraged to attend an advanced life support course.

General practitioners should act as local coordinators for basic life support training and liaise with the local

district resuscitation training officer to provide appropriate advanced training for practice staff. General practitioners should be encouraged to implement public education programmes in emergency aid for the area they serve.

Practice premises should be equipped with appropriate drugs and equipment and adequate resuscitation equipment should be carried by individual general practitioners (and by locums) who undertake 'on call' responsibilities.

District nurses, midwives and health visitors should attend courses in basic resuscitation with regular refresher courses.

Receptionists should attend a course in basic resuscitation with refresher courses.

These measures would go some way to ensure that if patients require resuscitation when on general practice premises, they will receive at least basic resuscitation before other help arrives.

Dental practitioners and dental surgeons

Dental practitioners and surgeons should be trained and competent in basic life support with airway adjuncts.

We also recommend that their staff should be trained in basic life support and attend refresher courses.

Ambulance personnel

Ambulance personnel are likely to be summoned to most out-of-hospital medical emergencies. In many instances they will arrive before the general practitioner (if also summoned). Experience has shown that ambulance personnel who are trained in defibrillation procedures play an important role in the pre-hospital resuscitation of patients from ventricular fibrillation. During extended training, intubation and intravenous infusion techniques are also taught and, although these are most valuable in trauma cases, they can be very useful during resuscitation from cardiac arrest.

'Intelligent' defibrillators are now being developed which can detect ventricular fibrillation and respond to this by automatic or operator-triggered defibrillation. These 'intelligent' defibrillators are easy to use after a short period of training. However, experience with such equipment is still limited and its exact role remains to be determined.

The ambulance service should monitor response times critically. The longer the time that elapses between an ambulance being summoned and the ambulance arriving the lower the chance that the patient will survive.

We recommend that doctors actively involved in the practice of resuscitation should work closely with the ambulance service and offer assistance with training. We also strongly support the extended training of ambulance-men in advanced life support techniques.

The general public

The public should be encouraged to learn basic life support and to revise their skills on a regular basis. The

evidence is that such skills may well save life, especially when there is the support in the community of a paramedic system to take over definitive patient management in the home or street.

The teaching of school children, youth groups, university students and any other interested groups is strongly recommended. It is envisaged that the first-aid organisations and other societies interested in resuscitation will have a major role to play in training. The uniformed members of these organisations are trained in basic life support, and when on first-aid duty at large public gatherings can initiate resuscitation. We strongly support efforts at educating the public such as the 'Save A Life' campaign organised by the Royal Society of Medicine in conjunction with the BBC and other organisations.

Resuscitation for special circumstances

The pregnant woman

Resuscitation in the pregnant woman near term requires specific knowledge about the increased oxygen demands of the fetoplacental unit, the impaired venous return due to inferior vena caval compression by the gravid uterus and hence the difficulties encountered in basic life support. These difficulties, largely encountered by obstetricians and anaesthetists, should nevertheless be mentioned in courses on advanced life support, and should include suggested methods for external cardiac compression and the indications for emergency caesarean section.

Infants and children

Resuscitation at birth

Between 2 and 5 per cent of all babies are intubated at birth. Although some will have suffered irreversible asphyxial brain damage before or during delivery, it is unacceptable that brain damage should occur as a result of inadequate resuscitation after delivery.

Junior medical staff. Paediatric or, where applicable, obstetric senior house officers (SHOs)/house officers (HO) will need to acquire skills in basic and advanced resuscitation, umbilical vein catheterisation for the administration of drugs, endotracheal toilet and suction for those born with meconium aspiration. Until these skills are acquired, the junior doctors will need to be accompanied by someone who is fully trained in all these procedures.

Student midwives. Student midwives require training in basic resuscitation and should be able to identify situations where additional help is immediately required.

Resuscitation in the neonatal period

A significant proportion of babies admitted to neonatal units will require resuscitation.

Senior house officers working in neonatal units. As there may

well be times when the SHOs will be providing neonatal intensive care cover on their own, it is essential that they are familiar with the techniques and equipment available in the unit on the first day of appointment at the latest. They must be able to provide face mask resuscitation and be taught to intubate using the commercially available models. It is essential that they gain the facility for intubating even the smallest of infants in the shortest possible time, and for this they will need to intubate several times under the supervision of a medical colleague who has already acquired these skills.

Neonatal nurses. All nurses working in neonatal units need training in basic resuscitation.

It is also imperative that trained neonatal staff, ie sisters and staff nurses, be taught to intubate babies by using commercially available models.

Paediatric wards

Although children do develop respiratory and cardiac arrest in paediatric wards, this is a rare event and resuscitation is far more likely to be required in the intensive care and accident and emergency departments. All junior medical staff working in paediatric areas must be familiarised with the resuscitation systems available, at the latest on the first day of employment. Senior medical staff must ensure that the junior staff employed can recognise critical situations and provide, as a minimum, face mask resuscitation. It is also essential that they are able to recognise severe upper airways obstruction (foreign body, acute epiglottitis, croup) and are provided with detailed information on action to be taken.

Organisation of resuscitation within the Health Service

1. Each District (local) Health Authority should appoint a resuscitation training officer who should be responsible for organising and coordinating the training and should personally undertake much of the teaching; some teaching may be delegated to other instructors.
2. Each District General Hospital should have a resuscitation committee to advise on the training of staff and the implementation of resuscitative procedures. The committee would advise on personnel, equipment and training aids, and generally supervise the resuscitation programme.
3. Each hospital should provide a resuscitation training room for teaching and practical instruction. Training at all levels in cardiopulmonary resuscitation requires specialist training equipment such as resuscitation manikins and intubation training heads. This equipment should be available in every District General Hospital.
4. All cardiac arrests should be properly documented so that a retrospective audit can be undertaken.

Audit of resuscitation procedures

It is the team leader's duty to ensure proper documentation, on standardised forms, of the resuscitation procedure and outcome. It is essential that proper records are kept for clinical, medico-legal and research purposes. The resuscitation committee should receive and review these forms and act upon the information, as appropriate.

Ethics of resuscitation

Resuscitation is not indicated for all patients who suffer a cardiac arrest. It is inappropriate to attempt to resuscitate those patients whose lives are drawing naturally to a close because of irreversible diseases.

Summary of recommendations

1. All doctors and qualified nurses must be adequately and regularly trained in cardiopulmonary resuscitation. The degree of skill required will be determined by the role the individual would assume during an actual cardiac arrest.
2. All clinical medical students must be trained to provide basic life support with airway adjuncts and taught to defibrillate safely.
3. All pre-clinical medical students and unqualified nurses must be trained in basic life support.
4. The professional qualifying and diploma examinations in medicine and the registration examination for nurses should test resuscitation skills using training models as appropriate.
5. The Royal College of Physicians of London visitors should assess the organisation of resuscitation procedures and training arrangements when the approval of posts for General Professional Training is being considered.
6. All hospital staff who come into contact with patients, especially the paramedical staff such as physiotherapists, radiographers etc should be regularly trained in basic life support.
7. Each District Health Authority should appoint a full time resuscitation training officer to co-ordinate all resuscitation training in the District. The resuscitation training officer should be responsible to a nominated consultant member of the resuscitation committee.
8. Each hospital should have a resuscitation committee responsible for the management of resuscitation procedures and resuscitation training. The resuscitation training officer should be a member of this committee.
9. Health authorities must provide all necessary equipment for resuscitation procedures and training (Appendix 2). A permanent, dedicated, fully equipped resuscitation training room is recommended.
10. General practitioners should train regularly in basic life support and should be encouraged to become competent in advanced life support techniques.
11. Dental practitioners and dental surgeons should be trained and competent in basic life support with airway adjuncts.
12. The essential role that ambulance personnel with extended training in advanced life support will play in community resuscitation is recognised, and implementation of such training programmes must be given priority. Ambulance response times are critical and should be closely monitored.
13. The public should be strongly encouraged to learn and regularly refresh their basic life support skills.

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APPENDICES

1. Specimen job description for a resuscitation training officer

The resuscitation training officer (RTO) will supervise training in both basic life support and advanced life support to appropriate groups: medical staff, medical students, qualified nurses, unqualified nurses, paramedical personnel such as other hospital employees and members of the general public. The RTO will also be responsible together with the resuscitation committee for the supervision, review and audit of hospital resuscitation procedures.

A high level of skill in the techniques of resuscitation, teaching and administration is essential.

Duties

a. To supervise the training of nurses and medical staff in basic life support.

- b. To supervise the training of nurses and medical staff in advanced life support.
- c. To supervise the training of ancillary staff and health workers in basic life support.
- d. To arrange and help in the training of the general public in basic life support.
- e. To coordinate the care of resuscitation equipment without infringing on the activities of persons or departments already involved.
- f. To keep records of all resuscitation attempts and in particular to explore deficiencies and seek methods of improving systems.
- g. To keep records of the training of nursing and medical staff in basic life support and advanced life support and to arrange instruction and refresher courses as necessary.
- h. To be responsible for the day-to-day running of any research project in resuscitation.
- i. To undertake any other duties agreed by the resuscitation committee.

2. List of resuscitation training equipment

	Size			
	Adult > 15 yrs	Child 1-15 yrs	Paediatric 6 wks-1 yr	Neonate < 6 wks
BASIC				
Resuscitation training models				
Ventilation/intubation training models				
BASIC WITH ADJUNCTS				
Oxygen				
Suction—with suction catheters	10F-16F		6-10F	
Oropharyngeal airways	2-4	1-3	00-1A	00
Bag-valve-mask device	3-6	1A-2	1	0
Defibrillator				
ADVANCED				
Resuscitation training model that can be defibrillated				
Defibrillator with adult paddles				
Defibrillator with paediatric & neonatal paddles				
ECG monitor with rhythm simulator				
Endotracheal tube	7.5-10.0	4.5-7	3.5-4.5	2.5-3.3
Laryngoscope with adult blade				
Laryngoscope with paediatric & Neonatal blades				
Appropriate IV cannulae	18,16,14		24,22,20	
Adjuncts for intubation: forceps, syringes, catheter mount, device for fixation, eg Tunstill, foam, tape, etc.				