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**Teaching life support and resuscitation competencies in
health care – Current practice and strategies for future
research**

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I. Glossary

Acute Life threatening Events Recognition and Treatment (ALERT™) A course designed to teach health practitioners about the recognition and management of the collapsed or deteriorating adult patient and the initiation of simple preventative therapies.

Adrenaline (syn: epinephrine) Naturally occurring catecholamine used to stimulate the heart and increase the blood pressure in critical illness and during resuscitation.

Advanced Cardiac Life Support (ACLS) A course run by the American Heart Association® teaching the knowledge and skills needed to evaluate and manage cardiac arrest, plus teaching about team leadership, drugs and peri-arrest situations.

Advanced Life Support (ALS) A course run by the Resuscitation Council UK teaching the knowledge and skills needed to evaluate and manage cardiac arrest, plus teaching about team leadership, drugs and peri-arrest situations.

Advanced Life Support Group (ALSG®) This is a UK based registered medical education charity which exists to "preserve life by providing training and education to the general public and in particular but not exclusively to doctors, nurses and other members of the medical profession, in life saving techniques".

Advanced Life Support In Obstetrics (ALSO®) This is an educational program designed to assist healthcare professionals in developing and maintaining the knowledge and procedural skills needed to manage emergencies that can arise in obstetrical care.

Advanced Paediatric Life Support (APLS) A course run by the ALSG (see above) designed for medical or nursing staff, teaching the recognition and treatment of the collapsed or deteriorating child.

Advanced Trauma Life Support (ATLS®) A course for medical staff that is franchised and supervised by the Royal College of Surgeons of England. The course teaches an organized approach to the evaluation and management of seriously injured patients.

American Heart Association®Inc (AHA)

AHA, Inc. and AHA National Centre, refer to the American Heart Association, Inc., a not-for-profit corporation that establishes guidelines for emergency cardiovascular care and training. The AHA owns the American Heart Association name, heart-and-torch logo, and slogan ("Fighting Heart Disease and Stroke").

Andragogy Term used for the adult version of pedagogy (defined as any conscious activity by one person designed to enhance learning in another).

Asystole Cessation of electrical activity of the heart.

Automated External Defibrillator (AED) A device that has been shown in the medical literature to dramatically increase the potential for reduction of disability and death from cardiovascular emergencies. While talking the responder through some very simple steps, an AED rapidly analyses the electrical activity of the victim's heart

to determine if defibrillation is necessary and goes on to deliver the appropriate level of shock automatically.

Baccalaureate In this context: French Nursing Diploma.

Basic Life Support (BLS) A course covering non-invasive assessment and interventions used to treat victims suffering a respiratory and/or cardiovascular emergency. This term has become synonymous with cardiopulmonary resuscitation (CPR).

Cadaver In this context: tissues, body parts or other components of a deceased human being who has donated their body to medical science.

Cardiopulmonary Resuscitation (CPR) Generally refers to non-invasive assessment and interventions used to treat victims suffering a cardiovascular and/or respiratory emergency. This term is synonymous with BLS (see above).

C B Nursing Updates Independent providers of course for health professional including life support and medical emergency courses.

Do not attempt resuscitation (DNAR) An advanced directive agreed by medical staff ideally following consultations with the patient (and recorded in the medical notes) that in the instance that the patient is in cardiac arrest, no attempt should be made to resuscitate them.

Fibrillation Arrhythmia; rapid, uncoordinated electrical activity of the heart.

International Liaison Committee on Resuscitation (ILCOR) International organisation with representatives from resuscitation services in Europe, Australasia and the United States who work together to review scientific evidence in order to develop management, treatment and education guidelines.

Immediate Life Support (ILS) course consists of training in life support and includes training in the causes and prevention of cardiac arrest, basic airway management and in the use of manual or automated external defibrillation.

M & K Update Independent provider of courses for health professionals including life support and medical emergency courses.

MedicALS A course run by the ALSG (see above) for all UK medical staff who deal with acute medical emergencies. The course teaches a practical approach to the assessment and treatment of the collapsed or deteriorating patient.

Moulage A simulated emergency medical or trauma situation during which a realistic scene is created using props and made-up actors.

Newborn Life Support (NLS) developed by the Resuscitation Council (UK) provides theory and practical instruction in airway support and resuscitation of the newborn. It is designed to be undertaken by any healthcare professional who may need to resuscitate a newborn baby.

Paediatric Advanced Life Support (PALS) RCUK course (recently replaced by the European Paediatric Life Support Course) designed to teach advanced medical assessment and interventions used to treat paediatric (child) victims of respiratory

and/or cardiovascular emergencies, including invasive techniques such as intubation and drug administration.

Pedagogy Any conscious activity by one person designed to enhance learning in another.

Resuscitation Council of the United Kingdom (RCUK) This organisation was set up in 1981 to facilitate education of both lay and healthcare professional members of the population in the most effective methods of resuscitation appropriate to their needs. The aims of the RCUK are: 1) to encourage research into methods of resuscitation; 2) to study resuscitation teaching techniques; 3) to establish appropriate guidelines for resuscitation procedures; 4) to promote the teaching of resuscitation as established in the guidelines; 5) to establish and maintain standards for resuscitation; and 6) to foster good working relations between all organisations involved in resuscitation and to produce and publish training aids and other literature concerned with the organisation of resuscitation and its teaching.

II. Executive Summary

1. Life Support – training courses designed to master competencies of life support are constantly evolving. Success rates have improved little over the last two decades. This may reflect attempted resuscitation of patients with less prospect of success or less than optimal techniques as well as lack of appreciation of the enabling factors such as the roles of team care. At the one extreme, immediate cardioversion for post-myocardial ventricular fibrillation in hospital is one of the most cost-effective treatments available. The salvage rate is over 40% assuming (reasonably) that the great majority (over 90%) of patients would otherwise have died. On the other hand, salvage rates for discharge from hospital drop to under 7% for patients developing asystole on the ward, and the figures become worse still if the downtime before commencing resuscitation is over 5 minutes. The chances of survival decline and the chances of brain damage among survivors rise as the duration of attempted resuscitation increases. Still lower are the success resuscitation rates for cardiac arrests outside of hospitals. More research to better titrate the relationship between the duration of resuscitation and other clinical variables on the one hand, and the chance of intact survival on the other, would be helpful to inform the public debate on when and how long resuscitation should continue.

2. A large activity has emerged around the provision of life support courses. Individual hospitals provide many original in-house courses and also purchase training via external providers who prescribe and quality assure a smaller number of validated courses e.g., RCUK ALS course. Most courses are associated with high opportunity costs such as requiring staff to attend during work hours. As with many training interventions, evaluations and competency assessment are limited and few in number.

3. Pedagogical Theory – much material of relevance to life support training was found ranging from Vygotsky’s Theory of Social Cognition to the Neurophysiology of Learning, Bloom’s taxonomy and curricula were carefully scrutinised to see how well they conformed to state of the art theories on pedagogical theory. Much good practice was noted. For example, team based training enhances the role of social interaction in facilitating learning. Frequent reinforcement and feedback within training conforms with our knowledge about the neurophysiology of memory and with behaviourist theories of knowledge generation and sustainment. Nevertheless, much theory also provides a basis for questioning current practice – for example deep immersion or massed courses may be less effective than repeated short or spaced courses complimented by synthetic simulation, which are designed to reinforce knowledge over a longer period of time and hence encourage long-term memory and behaviour change. Such courses have been designed and are now available in the UK.

4. Evaluation of Courses to Teach Life Support versus No Course

- a) The effect on patient mortality has not accurately measured but acquired skills have been demonstrated to deteriorate quite quickly if they are not reinforced.
- b) Before and after studies demonstrate that knowledge improves and participants enjoy the courses.
- c) Traditionally courses have been based on Basic, Intermediate and Advanced skills. Epidemiology shows that defibrillation is the most effective life support skill so this needs to be introduced at the most basic level, along with the increasing availability of external defibrillators such as automated external defibrillators (AEDs).

5. A large number of studies have compared one pedagogical method with another in the acquisition of practical skills in health care, aviation and the military. The outcomes have usually been the

acquisition of practical skills in synthetic environments such as screen based and manikin based simulation. Some clear conclusions have emerged e.g., the need for debriefing and video feedback as effective learning tools. Studies on life support training methods are more limited. Nevertheless, at least one very provocative finding has emerged: “massed training” seems no more effective than interval training, and evaluation of costs and logistics are mostly absent. Taking people out of their workplace for a period of prolonged immersion periods in training may be less cost-effective than a planned series of short training episodes delivered at the place of work. In addition there may be other methods to reduce the time spent away from work in training. For example there is some evidence that requiring team members to complete a programme of computer-assisted learning might reduce the amount of formal instruction required without loss of effectiveness.

6. It is evident that across the domain of drill and simulation (including team training) evaluations are almost exclusively based on proxy outcomes that stop short of assessment of patient outcomes. This does not apply only to life support training but applies to drill and simulation in particular. This is because it is very difficult to arrange for trainees to be assessed objectively in real resuscitation scenarios. However the advent of computerised defibrillators that can store large amounts of information for subsequent retrieval provides an exciting opportunity to study the effect of training of different types and patient outcomes.

7. Turning to provision in the UK:

- a) There are a small number of market leaders for the main externally franchised courses.
- b) These are implemented with great fidelity when compared with the written curriculum description.
- c) Attendance at courses has increased.

- d) Nationally, simulation centres have been established to provide training and research opportunities.
- e) There has been a large (and we think welcome) increase in uptake of 'pre-arrest' courses.
- f) There is a growing interest in the role of team training in enhancing patient outcomes.

8. Overall, training courses are consistent with theory but there are still many unanswered questions, for example: What is the optimum intensity and duration of courses? How well do skills in the lab translate into actual clinical practice? What is the role of experiential learning tools? What is the impact of the various training programs? What is the cost-benefit of these courses?

9. We believe the most fundamental question can be stated as follows: What is the optimum pattern of training when the outcome is performance of the average members of clinical teams on an average day? What configuration of training results in the best use of the training budget in terms of maximising the skills that the average patient will receive? Although the evidence is not conclusive we have reason to question the cost-effectiveness of deep immersion courses as opposed to using the same or less resources for shorter courses updated more often. However many hospitals provide alternative courses. On average these are considerably shorter than the franchised courses. It is likely that hospitals feel any marginal improvements in skills that larger courses may provide is not commensurate with the contingent costs to the organisation. This adds to the arguments for evaluation of shorter courses. However it is possible that existing courses could be shortened by, for example requiring pre-course preparation, on-line e-learning and screen based simulation.

10. We recommend that the National Patient Safety Agency consider organising a stakeholder conference to debate and evaluate our conclusions:

- a) A cost benefit analysis should be carried out to determine the extent to which automated external defibrillators (AEDs) should be made available in hospital wards along with courses in the use of these defibrillators. We acknowledge that many institutions are already considering or implementing a policy of making AEDs more widely available.
- b) Shorter more frequent courses should be introduced or further research should be prioritised to confirm (or exclude) the putative benefits of such a practice.
- c) A considerable research and financial effort should be invested to better understand how to improve the training and implementation of resuscitation courses.

1.0 INTRODUCTION

Cardiopulmonary resuscitation has become an integral part of modern health care. Results of a recent American Heart Association study (1) (based on National Registry of Cardiopulmonary Resuscitation data) show that 17% of all adult cardiac arrest patients leave hospital alive. Other recent studies focussing on post cardiac arrest report similar outcomes(2;3) and suggest that survival rates are not increasing, although this may be because resuscitation is now attempted in ever more impropitious circumstances. There has been tremendous effort focussed on the achievement of consistent treatment guidelines for cardiac arrest at an international and national level (4-6). Organisations such as ILCOR (the International Liaison Committee on Resuscitation), the European Resuscitation Council, and the Resuscitation Council (UK) work to develop treatment and education guidelines (7) for the delivery of Basic Life Support, Paediatric Life Support, Immediate Life Support and Advanced Life Support.

It has been argued that mortality and morbidity in the cardiac arrest victim are directly affected by the ability of health professionals to apply CPR knowledge and appropriate skills (8). However, outcomes following CPR can be affected by many other factors, such as case-mix; variations in use of treatments like defibrillation and hypothermia; appropriate DNAR and the quality of data collection/reporting. Thus the effect of skill levels might not be as great as some claim. Nevertheless, it is in the interests of the purchasers of training for healthcare professionals and of patients and carers that the method of training is efficacious and cost effective.

Around the world, training in life support and resuscitation, consumes considerable resources. However, the UK remains a world leader in resuscitation training and its programmes have been adopted by most European countries e.g. the UK leads the way in educating nurses in the use of Automated External Defibrillators (AED's).

In practice, the implications of providing such quality training are that front line healthcare professionals including senior nurses and doctors have to be absent from short-staffed services, often for 2-3 days so that they can attend deep immersion courses in the subject (although the instructors often take part in their own time). It is important therefore that the most effective courses are produced. Also skills need to be reinforced in circumstances where they are infrequently encountered in practice. Developing a method to ensure that opportunities to update skills are provided is critically important.

Every resuscitation education program must be evaluated before endorsement or marketing. The evaluation should answer questions such as: "Does the course teach what it is supposed to teach? Do the students learn? Do the students retain knowledge and aptitude? Is the course targeted to the right population?" Such evaluation is consistent with recommendations made by the American Heart Association (AHA) in 1992 that "studies must be performed to determine how different educational interventions affect the retention of knowledge and skills" (9). But, do the skills successful students demonstrate under controlled conditions endure; would they translate into improved performance in the real situation and if so, to what extent would that really improve outcomes in this dire situation? Lastly, and perhaps most crucially, given the need for so many hard-pressed clinical staff to be trained, could similar results be obtained in a shorter time frame?

We therefore present a review of pedagogical theory relevant to training course design and an evaluation of the content, quality and effectiveness of training used in specific contemporary life support and resuscitation courses.

2.0 AIMS

To evaluate the quality of life support and resuscitation course training in two dimensions:

1. Comparing and contrasting teaching methods used against contemporary educational theories of best practice, and against the results of any existing comparative studies of different methods to teach life support and resuscitation.

2. Surveying current life support and resuscitation courses to determine what, if any, variations in content and teaching methods exist.

After writing the original protocol we identified a further aim, which we then pursued.

3. A survey of requirements set by professional bodies for life support training.

Lastly, our scoping process unearthed literature showing that:

- a) Not surprisingly, cardiopulmonary resuscitation has a relatively poor success rate;
and
- b) Perhaps more surprisingly, about half of all patients requiring cardiopulmonary resuscitation in hospital have undiagnosed remediable signs of deterioration prior to arrest.

We therefore identified one final aim:

4. To undertake a survey of courses aimed at identifying the critically ill patient and preventing cardiac arrest.

It was intended that, in pursuing the above aims, a strategy for a future research programme on resuscitation training and training in general could be constructed.

3.0 BACKGROUND

The history of resuscitation can be traced back to biblical times, with champions for the cause appearing intermittently. We therefore present a brief overview of the development of resuscitation through time.

3.1 An overview of the history of resuscitation and training in life support

The history of resuscitation is well documented. According to medical historians the earliest recorded incidence of resuscitation can be found in the Bible (2 Kings, Chapter 4)(10) –

“Verse 32. And when Elisha was come into the house, behold, the child was dead, and laid upon his bed. Verse 33. He went in therefore, and shut the door upon them twain, and prayed unto the LORD. Verse 34. And he went up, and lay upon the child, and put his mouth upon his mouth, and his eyes upon his eyes, and his hands upon his hands: and he stretched himself upon the child; and the flesh of the child waxed warm” (11;12).

During the 1700’s some rather peculiar resuscitation methods were employed. Stimulation using rectal fumigation with tobacco smoke, restoration of breathing using a bellows, and physically shaking and slapping in order to ‘wake up’ the victim were recommended by the Dutch ‘Society for Recovery of Drowned Persons’. Other methods employed at the time involved warming the victim by immersion in a warm bath or warm sand (12).

The first successful resuscitation using electricity took place in 1788. Charles Kite was awarded the silver medal by the Humane Society for his 'Essay on the Recovery of the Apparently Dead' which describes resuscitation of a victim of drowning (13). Apparently after an hour of administering warmth, tobacco and 'volatiles thrown into the stomach, frictions and various lesser stimuli', Kite applied electric shocks to the victim's body 'sent through in every direction', which resulted in successful resuscitation.

Throughout the nineteenth century attempts at resuscitation involved ventilation and warming the victim's body, but there is also some evidence that practitioners were developing an awareness of the need to keep the victim's airway clear(11). Around this time, in 1892, French authors Laborde and Billot recommended 'tongue-stretching' in a paper published in the Bulletin de l'Academie de Medicine (11). This involved opening the victim's mouth while pulling the tongue rhythmically and forcefully.

Modern cardiopulmonary resuscitation techniques as we know them really began to develop during the 1940's. Beck and colleagues performed the first successful application of internal defibrillation in 1947 during cardiac surgery. This was followed in 1956 by Zoll and colleagues who performed the first successful human external defibrillation (14;15).

In the late 1950's anaesthetist Peter Safar worked to improve the effectiveness of mouth-to-mouth resuscitation techniques (16;17) and in the 1960's Kouwenhoven, Jude and Knickerbocker developed closed chest massage techniques (18).

During the Vietnam War a move to train the public in cardiopulmonary resuscitation techniques became established, as the need for swift action in the event of a cardiac arrest became more widely acknowledged. Organisations such as St John Ambulance, the

British Red Cross, the American Heart Association, the American Red Cross and the British Heart Foundation have worked to educate the public about the recognition of cardiac arrest and have developed programmes to teach cardiopulmonary resuscitation in both pre- and in-hospital settings.

Since the 1960's there have also been many developments and improvements in equipment that can be used for resuscitation. The arrival of Automated External Debrillators (AEDs) in the early 1970's had an enormous impact on initial or pre-hospital resuscitation training (14). Automated External Defibrillators are used to monitor and correctly identify a shockable cardiac rhythm before administering defibrillation at pre-programmed levels. These are now available in many public areas including shopping precincts, airports and railway stations.

The active compression-decompression resuscitation (ACDR) method developed during the 1990's (which uses chest suction for 'reanimation') was recently the subject of a Cochrane Review, which revealed that there is no clear benefit associated with its use in cardiac arrest (19).

Teaching resources such as manikins and simulators, used to teach practical resuscitation skills, have increased in sophistication over the past 20 years. Simple models such as Laerdal's Resusci® Anne are used to teach basic life support skills, while more complex pre-programmed simulators with features such as physiologically correct pulses, changeable cardiac rhythms and realistic body sounds, can be used to teach practical skills like intubation, chest drain insertion, cardiopulmonary resuscitation and intravenous therapy. Now 'intelligent' simulators have been produced which record the success of practical procedures and provide direct feedback.

Efforts have been made at national and international levels to monitor and improve resuscitation techniques and training. The Resuscitation Council of the United Kingdom formed in 1981 works to facilitate the education and training of healthcare professional and the public, and to disseminate up-to-date research findings (20).

In 1992 the International Liaison Committee on Resuscitation (ILCOR) was set up to provide a forum for representatives of resuscitation organisations around the world. ILCOR works to disseminate research findings, and encourages the review and sharing of information on training and education in resuscitation.

3.2 Epidemiology of resuscitation

The link between coronary heart disease (CHD) and cardiopulmonary arrest is clearly established in the literature, with evidence indicating that it is one of the most likely causes of cardiac arrest and of premature death in many countries. Despite declining incidence, CHD remains the single most likely cause of premature death in the United Kingdom.

3.2.1 Outcome from resuscitation

Two national studies in the last decade and 17 papers published before 1991, suggest that the odds ratio for improved survival of victims of collapse offered bystander resuscitation is approximately 2:5, and the outcome may be no worse if chest compression-only resuscitation is provided, omitting expired air ventilation ('mouth-to-mouth').

A recent systematic review by Fredriksson and colleagues, of studies of outcome after pre-hospital cardiac arrest (21) revealed considerable variability in survival to discharge data between (n=14) sites. The measure, of patients alive at discharge varied from 2% to 49% between sites. Variation existed even though data had been collected by each site in a uniform way, using the Utstein template (22).

A review by Ebell and colleagues of forty-one eligible studies (2) of hospital CPR covering 9,838 patients showed:

1. Immediate survival rate of 43.1%.
2. Survival to discharge of 14.6%.
3. Immediate survival and survival to discharge appear to have changed little over a 15 year time period (since 1980).

The evaluation concluded that, physicians could describe the overall likelihood of surviving to discharge as 1 in 8 for patients who undergo cardiopulmonary resuscitation and 1 in 3 for patients who survive the cardiopulmonary resuscitation. Regarding settings to which patients were discharged, 5 studies reported that: “73/93(78.5%) of patients went home, 18/93 (19.4%) went into a nursing home, and 2/93 (2.1%) went to other settings”.

Ebell and colleagues’ meta-analysis of survival after in-hospital CPR also examined predictors of survival based on 10 studies fulfilling strict criteria, (n=2434 participants). They found that the following variables were associated with failure to survive to discharge: sepsis on day prior to resuscitation (1 study) (OR=31.30, metastatic cancer (5 studies) (OR=3.91), dementia (2 studies) (OR=3.1), African-American race (1 study) (OR=2.8), serum creatinine level over 1.5mg/dL (2 studies) (OR=2.2), cancer (8 studies) (OR=1.9), coronary artery disease (6 studies) (OR=0.65) and location of resuscitation in the intensive care unit (4 studies) (OR=0.51). So, the chances of survival are much

enhanced if the arrest takes place in the ICU/ITU or if based on CAD rather than if, for example, septicaemia causes the arrest. Universal reporting that creates equivalence in presented data still remains difficult, and whilst this provides an excellent baseline by which 'success' is measured, new defibrillation technology supported by innovative in-hospital training programmes are reporting favourable outcomes (23;24).

A national audit to collect data on the process and outcome of cardiopulmonary resuscitation following in-hospital cardiac arrest at 49 hospitals was undertaken by Gwinnutt (25) between May and November 1997. The total number of cardiac arrest calls logged by hospital switchboards during the study period was 3942, but not all of these related to patients requiring cardiopulmonary resuscitation. Analysis of cases in those hospitals, which were able to identify the true reason for the call, showed that only 2477 out of 3366 (73.6%) were to patients requiring cardiopulmonary resuscitation. Of 2074 audit forms submitted, 439 were rejected because they were inappropriate, incomplete or inconsistent. A further 267 forms indicated that up to date guidelines had not been followed, which left a total of 1368 cardiac arrests for analysis; 805 patients were male and 563 female.

The authors reported that 42% of patients with shockable rhythms were discharged alive whereas the figure was only 6.2% when the initial rhythm was not ventricular fibrillation or ventricular tachycardia. Results revealed that 18% of patients were discharged alive, while at 6 months 82% of these patients were still alive. If the circulation returned in less than 3 minutes or if the patient was younger, then there was a significantly increased probability of successful resuscitation.

However, this is highly confounded with the indications prompting such use. The need for adrenaline implies failure to defibrillate after three shocks, or a non-shockable rhythm and

this simple association is likely to explain the poor outcome after adrenaline. The results of this study suggest an improvement in survival (compared with the 1992 survey) of in-hospital patients in the UK who have a VF/VT cardiac arrest.

The BRESUS study published in 1990 and the more recent in-hospital cardiac arrest study were audits of adult resuscitation events. This was a process whereby hospitals were invited to participate and any data submitted was provided on a voluntary basis. Until recently there was no published national audit of resuscitation events in children. The National Audit of Paediatric Resuscitation is a study funded by the Resuscitation Council (UK). The data for this study are collected for all children under the age of 16 who have a respiratory or cardiac arrest in participating hospitals. It is hoped that this study will establish a central registry for all resuscitation events in children. Similarly whilst an adult resuscitation registry exists in America, there is currently nothing similar in the United Kingdom.

3.2.2 Special circumstances affecting resuscitation technique

Patients who have a permanent laryngectomy or tracheostomy are a special group who may need a different approach. It has been argued by patient groups, that the technique for the resuscitation of “neck breathers” should form part of the skills taught on advanced life support courses. However the Resuscitation council states that “where possible, the basic life support (BLS) guidelines have been simplified to aid learning and a balance has been struck between ensuring that course participants remember the essential elements of the management of cardiac arrest and teaching additional procedures for less common situations”. For these reasons the both the ALS and BLS Subcommittees of the Resuscitation Council (UK) have not included specific guidelines on resuscitation of neck

breathers. Other special circumstances, arising more frequently, include resuscitation with asthmatics and with trauma patients (26).

3.2.3 Neurological outcomes

Where there is a lack of blood flow for more than five minutes following cardiac arrest, recovery without residual neurological damage is rare. The lack of oxygenated blood causes a chemical cascade to occur which results in cerebral injury (27). An important study was carried out by the 'Hypothermia after Cardiac Arrest Study Group' and reported in the New England Journal of Medicine in 2002 (28). This study was concerned with neurological damage after cardiac arrest and was a multi-centre randomised trial with blinded assessment of outcome. All patients had suffered cardiac arrest due to ventricular fibrillation. Several studies, referenced in this paper, had shown that moderate systemic hypothermia (of 30°C) or mild hypothermia (of 34°C) markedly mitigates brain damage. In the randomised trial hypothermia was associated with improved neurological function, despite an improvement in overall survival. An editorial, accompanying this issue of the New England Journal of Medicine, reported in more detail on some of the other studies. Two studies, one in Australia (28) and one in Europe (29), looked at survivors of out of hospital cardiac arrest and again, hypothermia was helpful.

On the basis of the published evidence to date, the Advanced Life Support (ALS) Task Force of the International Liaison Committee on Resuscitation (ILCOR) made the following recommendations in October 2002. "Unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest should be cooled to 32-34 °C for 12-24 h when the initial rhythm was ventricular fibrillation (VF). Such cooling may also be beneficial for other rhythms or in-hospital cardiac arrest"(28).

3.2.4 Psychological sequelae: near-death experiences

People who have suffered a life-threatening crisis often describe extraordinary experiences. These near death experiences have been reported after serious traffic accidents, shipwreck and other disasters, but are also reported with increasing frequency after cardiopulmonary resuscitation. A very large study of near death experience was recently reported in the Lancet, from the Netherlands (30). Sixty-two of 344 consecutive cardiac patients who were successfully resuscitated after cardiac arrest, reported a near death experience - that is to say 18%. This experience was not associated with the duration of cardiac arrest. Near death experience was associated with a higher risk of death within 30 days.

Thirty-seven patients were interviewed for a second time after 2 years. Data from interviews were compared with a control group matched for age, sex and time. People who had gone through a near death experience had a significantly increased belief in an after life and a decreased fear of death, compared with people who had not had this experience.

In an 8-year follow up of 23 patients who had encountered a near death experience, patients could still recall a high level of detail about their experience. There is no systematic measurement of the health-related quality of life of patients in the study, but it is a detailed account and it would appear that having had a near death experience was not traumatic in itself.

3.2.5 Spontaneous and unexpected return of circulation

The expression 'Lazarus phenomenon', first used by Bray (31) and referring to the biblical character Lazarus who was resurrected from death by Christ, is used to describe the

unexpected return of spontaneous circulation (ROSC) after cessation of apparently unsuccessful resuscitative attempts.

The Lazarus phenomenon is a real occurrence and the time delay between cessation of resuscitation efforts and ROSC is often very long. People in Victorian times were often buried with a string from their coffin to a bell on the surface, due to fear of this phenomenon occurring. In most reported cases confirmation of circulatory arrest at the time of termination of CPR was only on clinical grounds and by ECG. However, there are also cases where invasive arterial blood pressure was zero and cases where two independent ECG devices proved asystole (31).

Bray suggests that the Lazarus phenomenon is probably grossly underreported due to medico-legal concerns. Although the true incidence of the phenomenon is unknown, it may be fairly high. Lapinsky and Leung, reviewing 89 cases of in-hospital cardiac arrests with pulseless electrical activity, found three cases of unexpected return of cardiac output (32).

Since the first description by Linko et al. in 1982 (33), reports of more than 20 patients with ROSC after cessation of CPR have been published, at least eight of these were discharged able to care for themselves.

3.3 Evidence base and recommended methods of resuscitation

In recognising the need to provide practitioners with skills to deal effectively with life support, the Royal College of Physicians 1987 report on Resuscitation from Cardiopulmonary Arrest provided the directive for the healthcare profession to have an established ALS national training programme (34). Consistent with this was the release of

United Kingdom Resuscitation Guidelines for Cardiac Arrest in 1992, providing a benchmark for clinical practice. These were agreed as the European Resuscitation Guidelines for the management of Cardiac Arrest (1992) (35).

This led to the development of a protocol-based approach to professional practice, and created the opportunity for greater uniformity in the approach to treatment of cardiac arrest. Standardising clinical practice has the potential to ensure that healthcare professionals are working to best evidence, and whilst the consensus on science International Liaison Committee on Resuscitation (ILCOR) provides the basis for practice, initial guidelines were broadly based on anecdotal evidence and best practice, agreed by experts in the field. This remained so until the late 1990's when through ILCOR, key players from within Europe, Australasia and the United States joined together in widespread review of evidence thereby sourcing updated evidence based guidelines for the new millennium (35).

Although the Royal College of Physicians Report (1987) supported this need for standardised formal training in 1987 (see above), it took until 1993 for the first nationally approved ALS course to be offered in the United Kingdom (36). The American Heart Association's Advanced Cardiac Life Support Course had been the only option prior to this. The ALS drew on the strengths of the American Heart Association course, but was adapted to the United Kingdom and was supported with its own educational material.

Thus courses have evolved a high degree of formality over the last half a century, predominately influenced through traditional medical educational models. The attainment of feedback from students is routine on most modern courses including all of those provided by the Resuscitation Council UK and provides a strong evaluation base that shapes contemporary practice.

This project set out to compare the various courses and determine the degree to which they vary and then discuss which practices had the most support in the scientific literature.

The current practice of techniques used in resuscitation and advanced life support are based on: -

- De Latorre F, Nolan J, Robertson C, Chamberlain D, Baskett P. European Resuscitation Council Guidelines 2000: adult advanced life support. A statement from the Advanced Life Support Working Group and approved by the Executive Committee of the European Resuscitation Council. *Resuscitation* 2001; 48: 211-221.
- The American Heart Association in Collaboration with the International Liaison Committee on Resuscitation (ILCOR). Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care - An International Consensus on Science. *Resuscitation* 2000; 46: 1-448.
- The 2000 European Resuscitation Council Guidelines for Adult Advanced Life Support. In: Bossaert L (ed.). *European Resuscitation Council Guidelines for Resuscitation*. Amsterdam: Elsevier, 2000.
- The 2000 European Resuscitation Council Guidelines for the management of the airway and ventilation during resuscitation. In: Bossaert L (ed.). *European Resuscitation Council Guidelines for Resuscitation*. Amsterdam; Elsevier, 2000.

Table 3.1 Example of RCUK adult basic life support (BLS) resuscitation algorithm

Student looks for risks to him/herself, the victim and any bystanders
Victim is assessed to be unresponsive
Victim's head is positioned to ensure a clear airway
Visible obstructions in the airway are sought and removed
Absence of normal breathing is established
Additional help is summoned
Two rescue breaths are given
Absence of a circulation is established
Chest compressions are commenced with hands in the correct position on the sternum

Typical resuscitation training follows a four-stage technique:

1. A real speed demonstration of the skill by the instructor
2. Repeat demonstration with explanation. This allows the instructor to modify the pace and content of the delivery according to the knowledge and aptitude of the student. It also provides the opportunity for the learner and teacher to establish rapport.
3. Repeat demonstration guided by one of the learners. The learner explains the procedure as the skill is practised. This provides an opportunity to learn while doing and for the student to organise information in the mind.
4. Repeat demonstration and practice by all learners during which expertise and confidence is gained with plenty of supportive feedback.

4.0 METHODS

We describe the methods for the two main studies, literature review and survey of courses in the UK.

4.1 Literature Review

We reviewed the educational literature to identify contemporary educational theories and those relevant to training in practical skills. We then undertook a systematic review of studies of skill attrition and the effect of training on both student and patient outcome. Next we systematically reviewed direct evidence comparing different pedagogical methods used in general skills training and specific studies of these methods in life support training.

Further to this we undertook a survey of pre-arrest prevention, ILS and ALS training courses, with two aims:

1. To determine the extent to which current teaching methods and media are supported by educational theory.
2. To compare the various courses with respect to content and teaching methods.

Lastly we undertook a survey of requirements set by professional bodies for life support training.

The methods for each of the aforementioned sections are presented separately next.

4.1.1 Methods for the literature review of educational theory and training theory

The original methods for this section were formulated in a protocol in December 2002 (see appendix 1). However, upon initiation of the intended methodology, preliminary findings necessitated certain changes in approach. Our initial aim had been, to undertake a comprehensive review of literature on general educational or “pedagogical” theories. Yet, initial searches revealed this to be an unrealistic aim, given that for example, a scoping search on the Educational Information Resources centre, (ERIC) using the term “educational theories” returned 4065 hits. In other words, to provide an exhaustive bibliography of all existing literature related to general pedagogy was unrealistic, since this would represent a huge volume of material. After discussion, the review team resolved to amend the stated aim, such that the new intended output of this section, would be the creation of a narrative overview/summary of pedagogical theory. This would then provide a general framework around which the subsequent sections of the project could be structured. It was felt that this action was justifiable, given that *this* section is not pivotal to the findings and recommendations of this project, whereas the systematic reviews that follow *are*.

The narrative overview of pedagogical theory was accomplished by searching each database (see below), specifically starting with the most recent literature and going back in time, until that database was not yielding any newer concepts. In other words we searched until we reached apparent theoretical saturation. We made a collection of classical theoretical topics and identified a number of web-based sources, reviews and papers, for example Vygotsky’s Theory of Social Cognitive Development (37).

Focussing on pedagogical theory tends to separate pedagogy (the actions to promote learning) from curriculum objectives (what kind of learning) and from those individuals

being taught (who is learning). In order to integrate theories on teaching in general to context specific training e.g. practical skills training in life support (the focus of this project) we conducted further electronic searches for reviews on the theory of training and the design of training courses. Lastly hand-searches of life support course documentation and the “Generic Instructors Course” manual was performed to identify references on the uptake of taught practical skills, medical training curriculum design and qualities or methods for instructors of life support. Due to the lengthy time frame of the review, updating searches were run at regular intervals to capture any emergent literature.

Due to the change in stated aims, the review team felt it would be beneficial for the narrative review to be quality assured, by an expert in educational theory. Thus we invited Professor Harry Daniels (HD) to do four things. Firstly, HD was asked to check the results of our searching, to advise where we may have missed any seminal or indeed obscure theories. Secondly, he was asked to identify any interpretation of the results, which an expert would believe to be illogical or incorrect. Thirdly, he was tasked with ensuring that interpretations of bodies of literature were assimilated correctly. Lastly, HD was asked to identify situations, where interpretations of the literature, conflicted with other theories and findings and to provide advice and clarification in such and event.

Search strategy

Guidance on general topic areas to search (as well as references) were obtained by following discussion with education experts and then accessing the De Montfort University Learning website (<http://www.dmu.ac.uk/~jamesa/learning/contents.htm>). The following databases or search engines were then used to search for literature based on the identified pedagogical theories:

- Bibliographic databases: The Bath Information and Data Services (BIDS 2003), which incorporates The British Education Index (BEI 1986-2002) and The Educational Information Resources Centre (ERIC 1965-2003); The National Foundation for Education Research library (Cuadra STAR) database; The Campbell Library 2003; and The Cochrane Library Issue 1 2003.
- Citation lists of relevant papers (including reviews identified at the scoping stage).
- Internet searches using Alta Vista, Dogpile, OMNI. Website searching on UK, European and USA education groups.
- Hand searches of the most recent issues of the following journals:
Education. British Educational Research Journal, Medical Teacher. [from January to July 2003].
- Contact with the Campbell Collaboration Methodology Group based in America.
- Contact with the Best Evidence for Medical Education (BEME) Collaboration based in Dundee Scotland.
- The Current Educational Research in the UK (CERUK) Database for ongoing research.

No date or language restrictions were placed on the search, but where foreign language citations were uncovered, only English translation versions were included. The search was made broad to compensate as much as possible, for our search method of truncating the research historically, at the point when no new knowledge or ideas were emerging. The assumption here, is that the most pivotal ideas and useful findings will be propagated forward in time, albeit, in particular “traditions” which can be captured by a very broad search.

Inclusion criteria

One reviewer (RW) retrieved reviews and papers or used reference sources.

All retrieved references were exported to *Reference Manager v 9.5*.

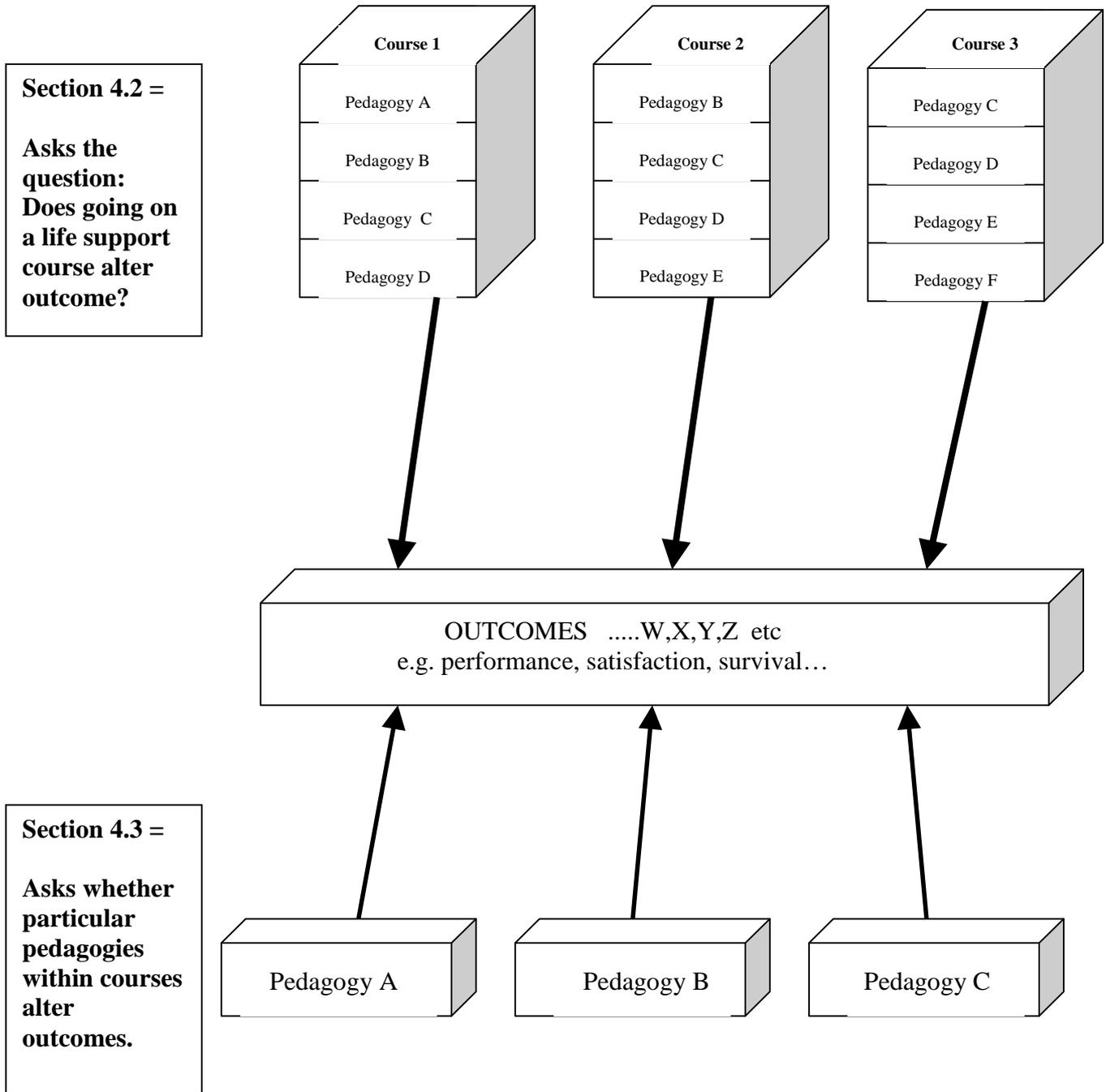
Information Extraction and Synthesis

Information was extracted, analysed and assimilated by one reviewer (RW). A narrative summary of the information was produced.

4.2 Systematic review of research measuring the effect of life support skills training courses on performance; student satisfaction; skill attrition; and patient survival.

Having completed the broad review of general theories of education (and theory relating to practical skills, life support course design and delivery), we next turned our attention to the efficacy of life support training. Figure 4.1 shows diagrammatically the rationale for reviewing separately the effect of whole courses on outcomes and then individual pedagogies on outcomes. This section (4.2) was specifically concerned with studies and reviews of the effect of life support courses (as a whole entity). Section 4.3 goes on to review the effects of the individual pedagogies, which contribute to courses. Scoping searches were first performed to refine the question, and a protocol was then produced in line with guidance from the Cochrane Collaboration handbook and “Undertaking Systematic Reviews of Research on Effectiveness” The NHSCRD's Guidance for Carrying Out or Commissioning Reviews. The review was then carried out with reference to these guidelines between January and July 2003. Our aim was to collect reviews and studies of or quantitative design, which examined the efficacy of life support training. In other words, we set out to collect studies, which measure the degree of effect of life support on various outcomes.

Figure 4.1 Figure to show the difference between sections 4.2 and 4.3



Search strategy

Firstly, since there are significant methodological problems in measuring the effectiveness of training programmes and educational method interventions in their many different types, the first part of this search aimed to retrieve papers highlighting, examining and proffering solutions to these issues. (See section 5.2.1)

Secondly, a search for reviews and comparative studies from the last ten years was undertaken using a variety of sources with advice from an Information Scientist:

- Bibliographic databases: Campbell Library, Cochrane Library Issue 1 2003, MEDLINE (Ovid) 1993 – January 2003.
- Citation lists of relevant papers (including reviews identified at the scoping stage), which may have included references older than ten years.
- Internet searches using Alta Vista, Dogpile, OMNI. Website searching on UK, European and USA education groups.
- Hand searches of the most recent issues of the following journals:
Resuscitation, Medical Teacher, Journal of Emergency Medicine. [From Jan to July 2003]
- Citations in presentations made at relevant conferences.
- Contact was made with clinical experts and with authors of papers where there were any queries.
- The National Research Register Issue 1 2003 and Current Clinical Trials register (includes number of individual trials registers, such as the UK National Research Register and MRC Clinical Trials Register), were searched for information on registered trials that are currently under way.

The search process involved determining the final individual search syntax for each source, executing the searches, and collating the results e.g. removing duplicates. No geographical or language restrictions were applied to the searches. All references were exported to Reference Manager v 9.5.

Search terms used include: -

review; randomised controlled trial; controlled clinical trial; intervention studies; experiment; random allocation; impact; intervention; evaluation studies; effect*;
comparative studies; qualitative; methodolog*; educat*; train*; practical; skills; resuscitation; life support; human; outcome*; performance; survival; satisfaction; attrition;

Inclusion and exclusion criteria

RW scanned all the titles and abstracts and identified the potentially relevant articles to be retrieved. If there was any doubt as to the relevance, items were not eliminated to ensure comprehensiveness. The full-text article for all potentially relevant citations was retrieved. If it was unclear whether a citation was relevant (e.g., if no abstract was provided, or if relevance was unclear from the abstract), the full-text article was retrieved.

Population type

Reviews of life support training of adults from any field both in and outside of healthcare were included. Studies based on “immediate” or “advanced life support” courses were included, rather than basic life support except where the form training activity (pedagogy/andragogy) was relevant to both e.g. the use or non-use of course manuals. We concentrated on ALS and ILS because they include specific components such as defibrillation and the use of pharmaceutical agents which are a) the most clinically

effective forms of life support (38) and b) most relevant to front line professionals.

However we encountered three important documents:

- 1) A survey of provision of basic life support training for health care professionals by Jordan & Bradley in 2000 (39);
- 2) An unpublished literature review of first aid training by Dr Mark Woods which forms part of a Health & Safety Executive discussion document (contained in Appendix 2) (40);
- 3) Eisenburger and Safar's 1999 review of basic life support (41).

Outcomes

Outcomes measured included student satisfaction, performance in non-clinical settings, performance in clinical settings and patient survival. We limited the patient outcome to "survival to discharge" since we realised from the scoping searches that we were likely to encounter few studies of training reporting long-term outcome data for survival or more specific outcomes such as neurological functioning. One of the problems in reviewing available literature is that access to all sources of information is not immediate, and access to large data sets relating to course evaluation was made available by RCUK. This demonstrated trends such as high student satisfaction that was not an immediate observation from the scientific literature, most likely as it was a not a defined research outcome.

Interventions in studies

Comparisons of course A versus course B effect on outcome were included whereby both course A and B may constitute different advanced life support training courses. Further to this comparative studies or reviews whereby course A is an Advanced Life Support and course B is Basic or Immediate Life Support were included. Quantitative studies measuring student satisfaction were also included.

Data extraction and quality

RW independently extracted the data from all included papers and conducted an assessment of the quality of papers.

Data synthesis and analysis

A detailed narrative summary of the characteristics and quality of all included papers was undertaken. This often took the form of qualitative data, but where RCT's reported assessed improvement in learning on a numerical scale, this data was tabulated. A discussion of any heterogeneity of information was undertaken. (Results reported in section 5.2.2)

4.3 Systematic reviews of different methods (pedagogies) to teach life support skills

Having reviewed the effect of life support training on certain measurable outcomes, the remaining task to be undertaken via systematic review methodology was to examine what evidence exists to support the use of particular methods of pedagogy or andragogy in current courses. We set out to collect reviews and studies, in which, the effectiveness of individual training methods were compared. A protocol to collect and analyse comparative studies of alternative methods of training in general and for life support in particular, was produced in line with guidance from the Campbell Collaboration and the Best Evidence Medical Education (BEME) Collaboration (42). The review was then carried out with reference to these guidelines between January and July 2003. Our first task was to collect papers describing particular pedagogical methods used in training and or justifying particular approaches identified in the previous section. This was for three

reasons. Firstly, this information links the previous section (5.1) on educational theory, to the study of effective methods reviewed here. Secondly it provides descriptive information on what was being tested and why. Lastly, it was used to develop the questionnaires used in later stages of the project such as the course survey. In this way, we collected reviews and/or studies making a comparison of two or more types of pedagogical methods in a general training context or a specific context of life support from in depth studies.

Search strategy for comparative studies of different methods of training in life support.

A search for reviews and primary studies from the last ten years was undertaken using a variety of sources with advice from an Information Scientist:

- Bibliographic databases: Campbell Library, Cochrane Library Issue 1 2003, MEDLINE (Ovid) 1993 – January 2003.
- Citation lists of relevant papers (including reviews identified at the scoping stage).
- Internet searches using Alta Vista, Dogpile, OMNI. Website searching on UK, European and USA education groups.
- Hand searches of the most recent issues of the following journals: Resuscitation, Medical Teacher, Journal of Emergency Medicine. [From January to July 2003].
- Contact with the Campbell Collaboration Methodology Group based in America.
- Contact with the Best Evidence for Medical Education (BEME) Collaboration based in Dundee Scotland.
- Citations in presentations made at relevant conferences.

- Contact was made with educational and clinical experts and with authors of papers where there were any queries.
- The National Research Register Issue 1 2003 and Current Clinical Trials register (includes number of individual trials registers, such as the UK National Research Register and MRC Clinical Trials Register), were searched for information on registered trials that are currently under way.

The search process involved determining the final individual search syntax for each source, executing the searches, and collating the results e.g. removing duplicates. No geographical or language restrictions were applied to the searches. All references were exported to Reference Manager v 9.5.

The review design followed the approach used by The Cochrane Collaboration in which randomised experimental designs are considered the “gold standard” for effectiveness studies (43).

Therefore search terms used include: -

review; randomised controlled trial; controlled clinical trial; intervention studies; experiment; random allocation; impact; intervention; evaluation studies; effect*; descript*; comparative studies; educat*; train*; pedagog*; method*; resuscitation; life support; human.

Inclusion and exclusion criteria

Citation lists of relevant reviews were scanned to assimilate a list of other reviews or randomised controlled trials. Further titles and abstracts to be retrieved were identified from the electronic searches. If there was any doubt as to the relevance, items were not

eliminated to ensure comprehensiveness. The full-text article for all potentially relevant citations was retrieved. If it was unclear whether a citation was relevant (e.g., if no abstract was provided, or if relevance was unclear from the abstract), the full-text article was retrieved in order to be fully assessed.

Population type

Reviews of pedagogical methods to train adults from any field both in, or outside, of healthcare were included. Studies based on “immediate” or “advanced life support” courses were included, rather than basic life support, except where the form of pedagogy was relevant to both e.g. the use or non use of course manuals. We concentrated on ALS and ILS because they include specific components such as defibrillation and the use of pharmaceutical agents which are a) the most clinically effective forms of life support (38) and b) most relevant to front line professionals. Thus, reviews or comparative studies of basic life support course methods were excluded, unless they constituted the only available evidence to support a particular pedagogical method.

Outcomes

Outcomes measured had to include either student satisfaction, performance in non-clinical settings or performance in clinical settings (see section 5.2.1 on methodological issues).

Interventions in RCTs

Different modalities of educational methods (pedagogy/andragogy) used in general fields or specifically in life support training.

Data extraction and quality

Data were independently extracted from all included papers and an assessment of the quality of papers conducted.

Data synthesis and analysis

A detailed narrative summary of the characteristics and quality of all included papers was undertaken. This was sometimes in the form of qualitative data, but where RCT's reported assessed improvement in learning on a numerical scale, this data was tabulated. A discussion of any heterogeneity of information was undertaken. (Results reported in section 5.3.1).

Having assimilated all of the results from sections 5.1 to 5.3.1, there follows a summary and recommendations for future research in these areas in section 5.3.2)

4.4 Methods for the survey of UK Life Support Courses

The survey began by compiling a list of courses teaching resuscitation as a whole, covering adult life support and life support for particular groups of patients (e.g. paediatric, neonatal and obstetric courses, courses for hazardous sports and occupations such as diving) and courses for the general public. This was achieved by carrying out internet searches (using Google, MSN, AOL and Ixquick) and by making telephone inquiries. During the telephone survey of the pedagogy of life support courses (see below), course coordinators were asked if they were aware of any other exceptional

course or courses teaching life support in the UK and details of these courses were added to the list.

4.5 Survey of adult life support courses and ‘pre-arrest management’ courses

4.5.1 Hospital adult life support and ‘pre-arrest management courses’

This study was undertaken to examine the number and type of courses teaching life support in English NHS hospital trusts. Because of the considerable number and type of life support courses available, including for example, specialist courses in maternal care, paediatrics, neonatal care, major incident medical management and support of patients, we focussed the survey on courses concerned with the recognition and management of the collapsed or deteriorating adult patient, provided by English NHS acute hospital trusts.

We were particularly interested in the possibility that there may be differences in course length, candidate numbers, instructor to candidate ratio and the teaching of manual defibrillation training, between nationally formally approved (franchised) courses purveyed by resuscitation organisations such as the Resuscitation Council (UK), and local in-house designed, operated and quality assessed hospital courses.

A questionnaire, designed in collaboration with the research team (see Appendix 3a and 3b) elicited the following information:

1. The proportion of sites running hospital life support courses with automated external defibrillation versus the proportion of hospital life support courses with manual defibrillation;
2. The proportion of advanced life support courses that are ‘formally approved by national bodies’ (we call these ‘franchised’) versus advanced life support courses,

that are ‘hospital designed, operated and quality assessed’ (we call these ‘in-house’).

3. The difference in the length of ‘franchised’ life support courses versus ‘in-house’ life support courses.
4. The proportion of candidates attending ‘in-house’ versus ‘franchised’ hospital life support courses of similar type.
5. The proportion of instructors to candidates in ‘franchised’ courses versus ‘in-house’ courses.

A semi-structured telephone interview with resuscitation officers and resuscitation managers at randomly selected sites was used to obtain data. An independent statistician was employed to make a random selection from a list of 161 acute NHS hospital trusts obtained from an NHS website (44). Sites were allocated a sample number (1 to 161). A random selection sample interval of 5.367 gave a sample of 30 sites from 161 sites (first number 4.717). Where a Resuscitation Officer could not be contacted, or did not reply after 5 attempts by telephone interviewers, the next site on the list of acute hospitals would be contacted.

Where hospitals did not have resuscitation officers, coronary care units or hospital managers were contacted to ask about life support training courses. The questionnaire was piloted with 5 of the 30 sites and the format revised prior to completion of the remaining 25 interviews. The team research nurse and resuscitation manager were asked to complete the telephone interviews.

4.5.2 Survey of life support training requirements for specialist health practitioners, by professional accreditation or standard setting bodies

This survey identified life support training required to be undertaken by post-graduate medical practitioners, professionals allied to medicine, midwives and nurses, in order to qualify for membership of specialist medical or health colleges in the UK. The survey also identified the continuing professional development training requirements of specialist medical practitioners, nurses, midwives and professionals allied to medicine of each UK professional accreditation or standard setting body.

The information about training requirements was established by:

1. Obtaining the on-line training guidelines and course curriculum of each UK specialist medical, professionals allied to medicine, and nursing and midwifery colleges by searching the respective internet sites;
2. Telephoning education departments of colleges, if online documents were not available, to request a copy of training guidelines and course curricula;
3. Examining the documents of each professional body to identify whether life support training is required in order to qualify for registration and to maintain registration; and to establish what type of training is required.

Data collected included:

1. Courses that trainees are required to attend in order to achieve membership;
2. Continuing Professional Development training requirements in order to maintain membership;
3. Courses that trainees are recommended to attend with no membership consequences.

4.5.3 Survey of UK medical school training

This survey identified the life support training offered to medical undergraduates by a sample of UK medical schools in the UK. The list of 24 UK medical schools was obtained online at www.helpdoctor.co.uk (on 18 November 2002) (45). This site was selected using the Google internet search engine. (Total number of medical schools identified: n = 24; the number of medical schools attempted to contact n = 24; the number of medical schools on which data collected n = 21)

The information about training requirements was established by:

1. Obtaining the online undergraduate curriculum where available (n = 4);
2. Emails sent to the undergraduate dean or sub-deans of each medical school (n = 14);
3. Telephone call to undergraduate deans (n = 2);
4. From telephone call to resuscitation officer (n = 1)

Data collected included:

1. The year of study during which life support training takes place;
2. The type of training that takes place e.g. RCUK BLS, ILS, or ALS (see Appendix 2 'Abbreviations')
3. Whether students receive ALERT course type training.

4.6 Methods for survey of course pedagogy

4.6.1 Life support courses

The team studied the pedagogy of the most frequently prescribed nationally formally approved (franchised) life support courses, and focussed on courses dealing with following circumstances: the initial resuscitation of an adult, who has had an acute collapse in the hospital, but not in the intensive care department or operating room (see Aims and Assumptions in Appendix 1). This is because the teams dealing with resuscitation in intensive care or the operating room have a different skill-mix and level of experience when compared to the typical cardiac arrest teams serving the rest of the hospital.

The study focussed on courses purveyed by the Resuscitation Council (UK), the Advanced Life Support Group (ALSG) and the Royal College of Surgeons. These groups either franchise courses to various centres around the UK, or run an outreach training service directly. Senior people (typically course co-ordinators or resuscitation officers) were also interviewed in order to confirm our understanding of course materials, fill in gaps and explore the thinking on which the educational methods were predicated. In order to gain a greater understanding of the type of instruction employed in courses, we also obtained course materials and instructor's manuals. The number of trainees in 2002 attending each type of life support course developed by course purveyors was established by telephoning senior people from these groups (see Appendix 6).

4.6.2 Courses for the recognition and management of adult acute life-threatening illnesses ('pre-arrest management courses')

This survey included courses designed to teach health practitioners about the early identification of at risk patients and the initiation of simple preventative therapies.

Courses that met the survey criteria were identified:

1. By discussion and during the telephone interviews with course coordinators of the ALS, ILS, ATLS and other life support courses, during the first section of the study, as previously described;
2. During telephone interviews with staff, or while surveying internet sites of professional accreditation or standard setting bodies, to ascertain specialist training information and continuing professional development requirements;
3. Through internet searches using search engines.

Data about these courses were collected by:

1. Discussion and during telephone interviews with course organisers, developers or coordinators;
2. Information gathered from course internet sites;
3. Examination of course manuals, timetables and guidelines.

Detailed questions used to elicit information can be found in Appendix 3(c).

4.7 Detailed analysis of the fidelity with which courses are implemented

Of the franchised courses offered by these groups, we further selected three types of courses – Immediate Life Support (ILS), Advanced Life Support (ALS) and Advanced Trauma Life Support (ATLS). A survey of Basic Life Support (BLS) courses has previously been published (40).

For each type of course, we obtained a list of teaching centres from the course website or by consulting the purveyor of each course. Each course centre on the list was allocated a number sequentially. An independent colleague randomly selected five course centres of each course type. The team agreed that where a course organiser could not be contacted after 5 attempts, the next site on the list would be included in the survey.

The coordinator of each randomly selected course was contacted and a semi-structured telephone interview was conducted (see Appendix 3(c)) to determine, firstly, the fidelity with which the course followed the prescribed pattern and, secondly, the reasoning behind any deviations. Only one course organiser objected to being asked to take part. Two other course organisers did not reply to emails or keep telephone interview appointment times. In these three cases, we interviewed the next course provider on the list.

The semi-structured telephone questionnaire, designed to ascertain pedagogical details and compare this with the template of pedagogy prescribed by the purveyor, was piloted with course organisers at one Advanced Life Support course centre and one Immediate Life Support course centre. Prior to conducting telephone interviews to complete this questionnaire, course organisers were contacted to ask if they would take part in the study. If they agreed to participate, then they were sent information about the project by email and asked to provide us with their course timetable and course manual.

At a time convenient to each course organiser, the team research nurse completed the semi-structured telephone questionnaire, to examine the pedagogy of each course. During the ten to fifteen minute telephone interview course organisers were also asked if they were aware of any exceptional (in their opinion) courses or methods teaching life support. This information was used to add new courses to the index of life support courses.

Information given by telephone interview was triangulated by examining course timetables. This enabled us to establish the total number of teaching hours; the ratio of theoretical teaching time to practical skills teaching time; and the ratio of assessment time to total teaching time.

5.0 RESULTS

5.1 Results of the literature review of education theory and training theory

5.1.1 Literature review of general pedagogical theory

Pedagogy is generally defined by the literature as "any conscious activity by one person designed to enhance learning in another" (40) and "the cluster of decisions and actions that aim to promote learning in individuals". The terms such as pedagogy (traditionally viewed as child orientated) and andragogy (traditionally viewed as adult orientated) are used interchangeably or at least pedagogy is used as a catchall phrase for teaching methods, whether for adults or children. The importance of the principles of pedagogy is undisputed and, even though they affect how millions of people are taught every day, pedagogical theories have been neglected in the design of successful education in some contexts (46). In past centuries, rather than producing and utilising "systematic collections of evidence to formulate educational courses, teachers and trainers have had to rely heavily on ideological positions, folk wisdom and the mantras of enthusiasts for particular approaches"(47). During the last century however, the social sciences in general and education research in particular, started to carry out direct comparative studies of various methods. This was followed by systematic reviews and meta-analysis – a term Glass coined in 1976. According to Egger "meta-analysis was rediscovered by medical researchers to be used mainly in randomised clinical trial research, particularly in the fields of cardiovascular disease, oncology, and perinatal care" (48). There follows a summary of the results of searches for general pedagogical theory.

The literature review search process initially unearthed 4065 hits on the topic of “educational theories”. With further iterations a search on “pedagogical theory” found 304 hits. These titles were scanned and a total of 30 sources were selected for use under the headings of general theories of pedagogy, the design of learning and, because of its relevance to our stated aims, training theory. The initial search strategies did not focus on, nor limit to “andragogy” – a specialised pedagogy or adult learning theory. However, general searches on pedagogy found work by such academic researchers as Knowles (49-51) who developed these theories of adult learning. It became apparent that andragogy forms an important basis for the design of current courses in the UK. Hence material on andragogy is presented alongside other forms of individual pedagogical theory. Figure 5.1 summarises the search process.

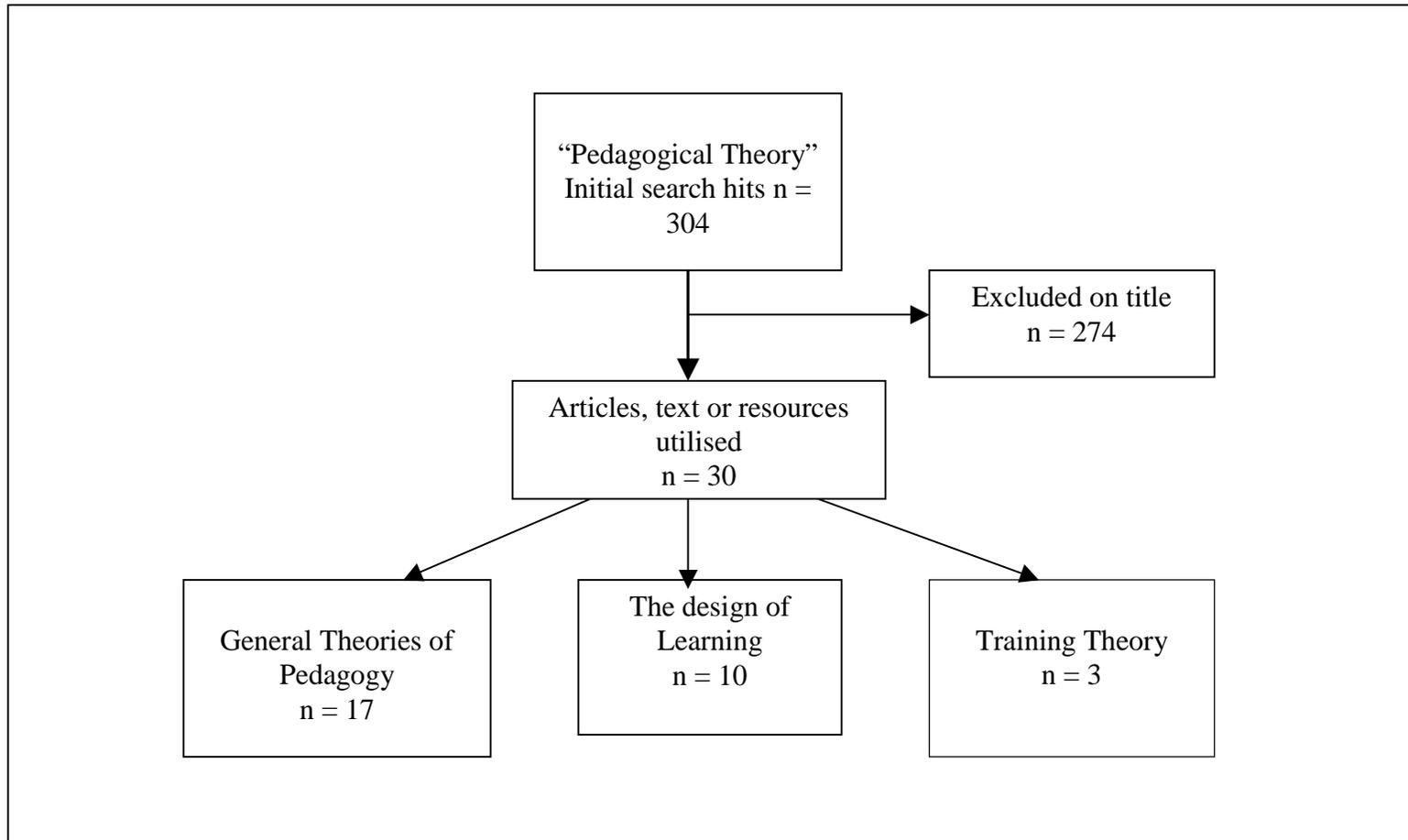


Figure 5.1 Literature review search and inclusion process.

The review found a voluminous and rich body of literature on general pedagogical theory using the search term “pedagogy”. In total 17 information sources were utilised. This section gives examples of the included papers, texts and resources. From this literature it is possible to distinguish five reasonably distinct conceptual domains: (1) Biological, (2) Behavioural, (3) Cognitive, (4) Social Cognition and (5) Humanist. A brief narrative description of the basis for these five dimensions is provided herein.

Explanation of the biological dimension of pedagogical theories

There is large literature on the actual physiology of learning. Readers will be aware that short-term memory is coded chemically and that long-term memory involves physical growth of the brain in the form of increased synaptic connections. Chemical coding is related to growth of new synaptic connections to long-term memory – no wonder long-term memory is hard to acquire, and that it is easier to learn than to unlearn. There is evidence that involving simultaneously more than one aspect of perception enhances learning – pictures and sound in multi-media instruction for example. Emotion also interacts with learning – a finding with technological connotations – who does not remember where they were when they heard of President Kennedy’s assassination? Repeated use of the brain increases the connections and makes learning much more permanent. The corollary of this knowledge is that learning is hard, and this is particularly so for long-term learning. Repeated practice over a long period of time is necessary. Skills taught only over a short period of time, are likely to be ephemeral. Other skills, become imprinted in new neural circuits and become like riding a bicycle -

much more permanent. This would suggest that deep and sudden immersion courses are not the most effective way to teach people skills, which they need to retain throughout their professional careers. On the contrary, repeated training is necessary, especially if the skill is not likely to be repeated at regular intervals during clinical exposure.

Explanation of the behavioural dimension of pedagogical theories

Behavioural psychology is originally derived from Pavlov's classic conditioning of Russian dogs. Crucial to behaviour theory and practice is the concept of reinforcement, which is introduced in order to increase the likelihood of a desired behaviour.

Developments of the theory take into account the fact that human beings are not mere machines, but that the behaviour may be modified by their beliefs and values. However, at a slightly deeper level, it is clear that even beliefs and values can be influenced - societal pressures can create a kind of herd behaviour, even in human beings. After all, this is what we try to achieve when we talk of cultural change. What are the practical implications of behaviourist theory for teaching of resuscitation? We think that they are the same as the above - the need for continuing learning and upgrading and also, we would argue, for teaching in realistic scenarios, so that certain patterns of behaviour and action become routine.

Explanation of the cognitive dimension of pedagogical theories

Cognitive skills are influenced by psychotherapists such as Gestalt and developmental psychologists, most notably Piaget. Gestalt was interested in the way the brain imposes a

pattern on the perceived world and Piaget on how age and experiences affects understanding. Piaget discovered that children have innate theories about why things happen, and the same idea is now applied to teaching adults - if you want to explain something to someone, start with what they already believe they know or understand. This is more likely to be successful than education that treats the recipient as an empty vessel. These ideas are the basis of the educational approach called constructivism, which emphasizes the role of the learner in constructing his or her own model of the world.

What are the implications of the cognitive skill for education in resuscitation? We would argue that teachers should start by listing from students what they really believe they know, especially as many will already have views on resuscitation and how it should be conducted.

Explanation of the humanist dimension of pedagogical theories

The humanist dimension emphasizes the natural desire that all people have to learn, and the importance of empowering the learner so that she or he has control over the learning process. The instructor should relinquish control and become more of a facilitator. The school is associated with Carl Rogers and Abraham Maslow. The implications for resuscitation would seem to be the importance of taking a development and mentoring route to learning, in which, for example students are asked to comment on their own performance, rather than being hectored or criticized by others. It would suggest the importance of creating a supportive social environment or backdrop to the educational experience.

Explanation of the social cognition dimension of pedagogical theories

More complex and provocative still are theories of social cognition harking back to Vygotsky. The idea here is that social interaction has a powerful effect on learning perhaps by bringing the emotions into play, by providing a chance to shape meaning and by stimulating more than one part of the brain's system of perception. People can sometimes recall information only in the relevant social context. Implications for training in groups and for positive social interaction are obvious.

Theory and practice in life support training

The practice of life support seems to conform well to the above hypotheses. The ideas that the brain codes short term memory chemically and the behaviourist theories of gradual adaptation to the external environment both support the ideas of repeated practice (drill) and over training. Cognitive theories concerning internal cognitive structuring support the integration of theoretical and practical training along with providing opportunities for reflection. The social cognitivist theories are well represented in the team nature of most training and the iteration between teacher and learner and the sense of engagement that is part and parcel of most training programmes. Humanist and androgical theories are reflected in the insistence that training should be supportive and build on the motivation of the learner. Similarly the notion that people approach new learning through the prism of their existing understanding of the subject is respected by the opportunities for mutual engagement between teacher and learner. Of course recognising that course conforms broadly with educational theory is a long way from being able to determine the more precise form that training should take. For example determining the optimum frequency and duration of training sessions requires direct empirical work and cannot be inferred from theory alone.

5.1.2 Literature review of training theory

Below we summarise the twenty-eight articles retrieved by our search. However we also identified a review by Salas and Cannon-Bowers (52) with no less than 140 references. There was no overlap in these references, perhaps because this is a diffuse topic, which overlaps many disciplines including psychology, general educational theory, organisational theory, culture and so on. Much of the literature seems rather anodyne but we try to summarise the main points.

In 1958 Dewey wrote that the purpose of teaching, was to arrange the environment so that students could effectively interact with it, in order to optimise their learning (53) and the life support training we describe in section 5.5 does provide this intellectually, practically and socially.

Moser and Coleman and Colley and Beech (54) both stress the importance of reaching a stage where skills become deeply ingrained:

“Researchers and lay people alike would agree that activities are said to be skilled when the performance of them has reached a level where it appears to be effortless, where it is almost always accurate and where additional practice makes little apparent improvement.”

Facilitating professional development and the idea of encouraging professionals to examine their own strengths and weaknesses and take charge of improving their skills –

reflective practice - have become important influences in the design of teaching curricula (55).

Eisenburger and Safar review training approaches for the public in their paper “review and recommendations” (41). As a result of the paucity of both volume and quality of experimental research in this area, opinion from experts and authors constitutes best evidence to date. In this review, qualitative aspects of the educational experience related to methodologies such as action research and phenomenology do not sit comfortably within the evidence based practice perspective.

The need for life support skills is an issue that faces all healthcare professionals, not just those who form the emergency team. Life support courses are therefore attended by staff of varying professions and varying grade. A variety of pedagogies combined in a course curriculum could, hypothetically, cover a range of learning styles to optimise learning for all types of staff. The idea of training needs assessment emerges very strongly in the Salas review (52). However implementation is not straightforward, since designing training in a way that is responsive to the disparate needs of different learners is obviously a logistical challenge. (See section 6 - who should be taught what.)

In the context of the curriculum design Field and Drysdale (56) cite the importance of:

- Recognising and supporting the need for ‘on the job’ learning (but simulation could be a substitute for this)
- Providing training in ‘under the surface’ skills (training theories used to promote deeper learning)
- Grounding training in the organisational culture (simulation, role-play and moulage)

- Recognising the active nature of learning (including opportunity for feedback, including via video)
- Ensuring equal access to training (everyone gets a turn)
- Introducing integrated training solutions (e.g. simulations).

Salas and Cannon-Bowers (52) in their 2001 paper on the Science of Training also cover the area of cognitive ability – the commonsense observation that some people are more ‘teachable’ because they are cleverer, more self sufficient, or more motivated. Over-learning is effective and is one of the few observations with an empirical basis. Behaviour role models are discussed in a favourable light and the report stresses the importance of team training in which shared mental models are developed and positive reinforcement given.

The Salas and Cannon-Bowers review (52) has a large section on transfer of knowledge within organisations. One idea is that organisations should do a task analysis to identify who should be taught what in an organisation – a task that organisations have taken on for themselves with respect to professional training.

Rogers suggests that there are four areas that should influence teachers in preparing for teaching in order for learning to be of significance for each adult (57). These are:

- Personality factors
- Physical changes
- Situational causes
- Bad relations

Research literature postulates that feedback is crucial to encourage learning (58;59) It is evident that an instructor's personal style, commitment and enthusiasm are all major motivating factors in helping students to continue learning. Mentor support is reported to be a crucial aspect of skills teaching (60). Students respond to instructors who show genuine interest and concern in individual achievements, who support and encourage them as adult learners, and who interact with them on equal terms throughout the course (61).

Current opinion suggests that the approach to teaching skills in life support courses is congruent with best practice, and reflects much of Turner's suggested format (62):

- Teach from the simple to the complex;
- Teach skills in the order they will be used;
- Teach one technique at a time;
- Employ continual reinforcement;
- Practice overlearning;
- Integrate cognitive and psychomotor learning; and
- Encourage confident employment of the skills.

Wynne's work on teaching resuscitation skills has also helped shape current educational practice (63). It is influenced largely by behavioural theory, utilising the work of psychologists such as Skinner (64). Skinner's view is that behavioural theory should inform and lead the teaching of psychomotor skills. However, the current teaching methodology, recommended by the Resuscitation Council UK is influenced by models of teaching that relate to how information is processed. This is reflected in the curriculum

for the Generic Instructors Course (GIC), which they co-developed with the Advanced Life Support Group (ALSG). (For further detail see section on staged teaching).

The principles of good teamwork have also been examined by the authors and include division of labour by expertise, clear concise communication, displaying situational awareness, back up and filling in, shared sense of priorities, conscious integration of joining members, and planning and debriefing.

5.1.3 Medical Team Training Programmes in Health Care

Throughout the health care community small groups of individuals work together in intensive care units (ICU), operating rooms (ORs), labor and delivery (L&D) wards, and family-medicine practices, physicians, nurses, pharmacists, technicians, and other health professionals must coordinate their activities to make safe and efficient patient care a priority. However, even though a myriad of the conditions addressed by health professionals require interdisciplinary teams, members of these teams are rarely trained together; furthermore, they often come from separate disciplines and diverse educational programs.

Much of health care is performed by interdisciplinary teams – individuals with diverse specialized skills focused on a common task in a defined period of time and space, who must respond flexibly together to contingencies and share responsibility for outcomes. Traditional silo based clinical education and training are remiss because they assume that individuals acquire adequate competencies in teamwork passively without any formal training.

Performance incentives in health care are targeted at individuals, as are job and other selection and assessment processes, and not at teams (65). With a few exceptions, risk management and liability data, morbidity and mortality conferences, and even quality improvement projects do not systematically address systems factors or teamwork issues. Substantial evidence suggests that teams routinely outperform individuals and are needed in today's complex work arenas where information and resources are widely distributed, technology is becoming more complicated, and workload is increasing (66). Nevertheless, our understanding of how medical teams coordinate in real-life situations, especially during time constrained and crises situations, remains incomplete. Given the interdisciplinary nature of the work and the necessity of cooperation among the workers who perform it, team training is critical to ensuring patient safety and avoiding errors. Teams make fewer mistakes than do individuals, especially when each team member knows his or her responsibilities, as well as those of other team members (67). However, simply installing a team structure does not automatically ensure it will operate effectively. Teamwork is not an automatic consequence of placing people together in the same room. Teamwork depends on a willingness to cooperate towards a shared goal, maintaining a patient's health status and avoiding errors.

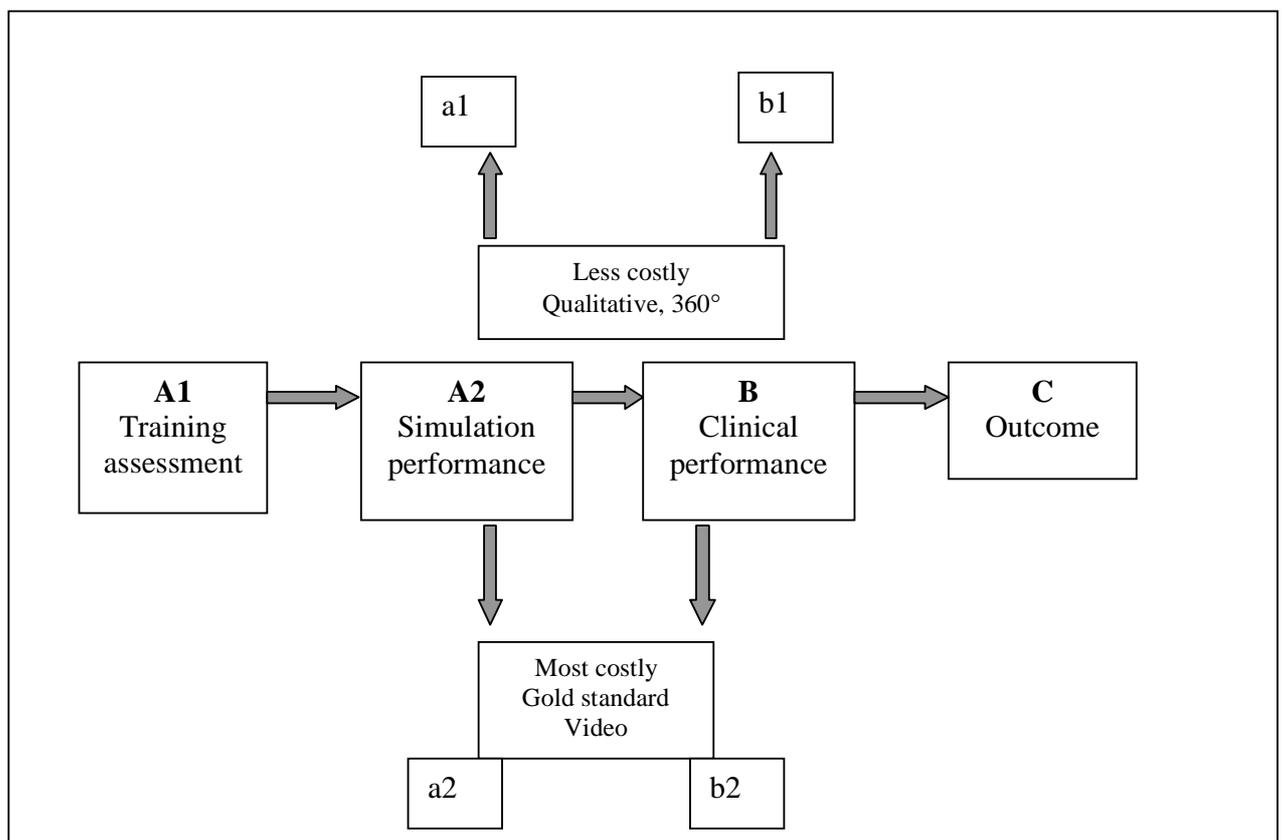
Numerous medical team training programs have been developed and implemented in response to the patient safety crisis. The role of effective teamwork in accomplishing complex tasks is well accepted in many domains. Similarly, there is good evidence that the outcome in health care depends on effective team performance. AHRQ Evidence Report 43 entitled, *Making Health Care Safer: A Critical Analysis of Patient Safety Practices*, reviewed existing data for the efficacy team training, with a special focus on Crew Resource Management (CRM) – a sub-domain of team training (68). We have examined the purpose and strategy of each and reviewed the reported empirical evidence (69). In addition, we report the results from a series of course observations, curriculum reviews, instructor interviews, and an independent assessment of participant reactions. Finally, on the basis of the evidence reviewed, we present a set of recommendations for how the health care community can evolve medical team training in the future (70). Although there is growing evidence of the effectiveness and impact of team training, we caution that additional research is required to establish an evidence-base for wide spread team training strategy in health care.

5.2 Results of the systematic review of observational research on the effect of different life support courses on skill performance; skill attrition; and patient survival.

5.2.1 Methodological issues in educational or training intervention studies

On conducting the review work it became apparent that there are significant methodological problems in measuring the effectiveness of training programmes and educational method interventions in their many different types. To this end, a brief discussion of the two of the main areas of difficulty is provided here to precede the results for this section such that they may be read and assessed with this prior explanation. This also reflects the largely evaluative data that the central bodies have collected, of which the authors had access to from the Resuscitation Council UK, that demonstrates outcomes from learning relevant to the student experience.

Figure 5.2 Causal Chain



Perhaps the most important methodological consideration in evaluative studies of educational interventions is the outcome to be used. Training improves outcome if it reduces error, improves clinical processes, as depicted in the following causal chain shown in Figure 5.2.

While outcome for patients (C) is the ideal outcome, measurement of performance in a clinical setting (B), is adequate if the link between the relevant processes and outcome has already been convincingly established: if B leads to C, and A leads to B, then A must also lead to C. Extending this logic, if A2 leads to B and B to C, then showing an improvement in A2 should be sufficient evidence of effectiveness of A – it is a valid (and relatively cheaply measurable) surrogate. Here lies the problem. Whilst a number of interventions have been evaluated in non-clinical settings (A1 to A2 but no further) and while many processes obviously are or have been shown to be effective (B to C), the missing link is in showing the extent to which, improved training outcomes translate into improved clinical processes (i.e. reduced errors) (A2 to B). There are exceptions, e.g. training in intubation (A) enables a reduction in time and number of attempts for novices to perform this manoeuvre successfully the first time it is used on a live patient (B). However, this review and the AHRQ review shows that much more work is needed. Where the effects on clinical practice can be measured relatively cheaply this should be done, in a routine. Where not, some experimental studies are needed to confirm transferability of skills from simulation centre to bedside. Perhaps, more realistically, we need to calibrate the extent to which performance in the former setting translates to the latter and examine how this varies by the type of training involved.

While individual performance can be tracked into the clinical environment, albeit at some cost, team training is (yet) more problematic, given that teams are not stable but come together as required. So proving that clinical practice or outcome of resuscitation can be improved by such team training, a cluster study would be required; e.g. randomisation of between 30 hospitals to have different interventions. Assuming an intra-class correlation of 0.01 this would provide 80% power to show an improvement in error rate from 25% to 15%. Much larger numbers would be needed to show plausible change in mortality. An example of this is the MERIT study, which is assessing the impact of medical emergency teams on the incidence of unexpected cardiac arrest.

Another important issue for measurement is decay in skills. Until the PhD work of Bullock, educational research in resuscitation training demonstrated that within 6 months of intense training there can be as much as a 50% decay in functional ability. This can be measured, for example, by repeat testing using a team independent of those responsible for training. Whether this is due to knowledge attrition underpinning the skill, or failure to replicate learnt skills because of lack of repeated use is not fully explained. Research in this area is characterised typically by small-scale underpowered cohort studies and quasi-experimental studies that fail to provide a definitive source of evidence upon which to shape opinion. The need for such delayed testing of skills across intervention groups brings us to another important consideration – that of “contamination”. Cluster randomisation is a method sometimes used to limit the possibility of ‘contamination’ – where at least some of the information provided in one arm of an educational trial is transmitted via informal pathways to participants in the other arm, particularly if one intervention is deemed to be superior. The occurrence of contamination could have serious effects on outcomes (which will often be behavioural), reducing the apparent effect of the interventions. By physically separating participants in different trial arms, cluster-randomised educational trials reduce

the risk of contamination. However, the use of cluster-randomised designs is not without problems, as trials of this type are very costly. There is a school of thought which postulates that contamination is an over-rated problem, therefore research is needed first into how contamination may be measured, and second, to develop methods which predict contamination levels, given intervention and study characteristics. Recently, it has been reported in an RCT that skill decay is not as great as first reported in the literature characterising practice in the 1990's, particularly relevant as skill retention was measured in the vital life saving intervention of defibrillation (71). (See section 5.3.2 for recommended future research)

5.2.2 Reviews and comparative studies of the effect of life support training on outcomes.

5.2.2.1 Effect of basic life support training on performance

There is some evidence that outcome following cardiac arrest is directly linked to the ability of those performing basic life support skills (72) – see Section 5.2.2.2. However the vast majority of studies measure the outcome of basic life support skills training in terms of the initial acquisition of practical skills and the retention of those skills.

In their review of (n=156) studies of the science behind life support and the methods used to teach members of the public basic life support, Eisenburger and Safar (41) concluded that for successful skill acquisition to take place teaching sessions must incorporate simplicity, repetition and practical skills-based instruction.

Three studies reviewing the effect of basic life support teaching on performance were uncovered during our search. The most recent, the 2003 ILCOR advisory statement on Resuscitation in Education (73) provides an extensive overview of (n=110) studies of life support teaching. The review reveals that most students, both the public and health professionals, undertaking a basic life support course will not be able to perform the skills even immediately after completing a course. The authors attribute this poor skill acquisition and retention to inadequate instructor training and a lack of appropriate teaching skills and methods. Recommendations include the development of evidence-based, educationally sound basic life support courses that target people who would be most likely to attend a cardiac arrest. As we stated in section 4.2 we found a review by Dr Mark Woods that we include with permission as Appendix 2. This includes 72 source papers. Twenty-three of these compared one method of training (pedagogy) with another and so are also relevant to section 5.3. As far as the overall effect of BLS is concerned the findings taken as a whole confirm that:

1. BLS training results in a sharp improvement in performance.
2. Skills decay over time, though the rate of decay varies considerably between studies.
3. Retraining produces a rapid restoration of performance levels.

Moser and Coleman (72) reviewed studies that focussed on the retention of life support knowledge and skills, and reported a rapid deterioration of life support skills after course completion in all (n=9) studies. Of (n=14) studies testing interventions aimed at improving skills retention, only retesting of practical skills (using a manikin) at regular intervals was marginally more effective than other methods.

As a result of studies indicating the difficulty both health professionals and members of the public have in locating the carotid pulse, many students training in basic life support are no longer taught to perform the task (72;74;75). One study revealed that only forty percent of students from healthcare professions were able to locate the carotid pulse within 10 seconds after attending training sessions.

5.2.2.2 Effect of basic life support training on survival

The acid test for effectiveness of life support training after cardiac arrest is survival to discharge. Survival is more likely following pre-hospital cardiac arrest if a particular sequence of actions - a 'chain of survival' - is implemented (23;76). Cummins and colleagues stressed the need for this sequence to begin with 'the recognition by bystanders of early warning signs' in pre-hospital resuscitation training, as many bystanders in their study failed to contact emergency services because they had not recognised that the person was having a cardiac arrest (77-79).

The epidemiology (section 3.2) suggests that survival to hospital discharge for all out-of-hospital arrests is 17%. The average survival increases to 29% for patients with ventricular fibrillation (80). There has been a lack of improvement in survival rate since the 1970's however. Eisenberg attributes this continued lack of improvement to a delay in pre-hospital defibrillation. He argues that the majority of cardiac arrests occur at home and that lay first-responders lack basic life support skills and knowledge, and the motivation to learn these skills (81).

Eisenberger and Safar's review (41) of basic life support revealed that although initiation of bystander CPR increases survival, involvement of bystanders in CPR is low in both European and American studies. Despite increasing numbers of people attending courses (for example American Heart Association provides first aid courses to approximately 5.5 million people per year and American Red Cross to around 12 million people per year) only 30% of pre-hospital cardiac arrests have CPR initiated by bystanders.

Eisenberger and Safar also reviewed several papers examining the relationship between the quality of bystander CPR and patient survival following pre-hospital cardiac arrest found that quality of basic life support has a direct effect on patient survival.

5.2.2.3 Effect of advanced life support training on performance

The United Kingdom advanced life support course was developed in response to studies indicating that the level of health practitioner knowledge and skill was generally poor (82-85). The UK Resuscitation Council has worked to rectify this skills deficit by developing courses based on current evidence and by working with resuscitation instructors to develop their role and monitor their performance and training.

There was concern in the past about the appropriateness of training all health practitioners in advanced life support given the fact that they might never be called upon to be a member of a cardiac arrest team. However Hulme's 2003 UK study indicates that members of cardiac arrest teams who will use the skills taught in advanced life support courses in clinical practice, are now more likely than other practitioners to attend courses (86).

While many intervention studies evaluating student performance after advanced life support training have been in the classroom others have attempted to measure the extent to which classroom performance translates into practical skill in real-life scenarios.

The impacts of certain pedagogies on the outcome of student performance and the comparison of pedagogies in terms of performance have also been studied. For example it is now widely known that practical skills based training is far more effective than simply reading a manual to gain knowledge and skills (87), while the use of high fidelity simulation for instruction and evaluation allowing real physiological measurements and interaction with the 'victim', have proved successful (88).

Studies measuring post-training retention have revealed that life support knowledge is more likely to be maintained than practical skills. In an attempt to improve retention Stross and colleagues sent students reprints of life support literature quarterly, for 12 months after completion of training. A follow-up test revealed good knowledge but poor skills retention (89).

Computer simulation has also been used to assess retention of life support skills. Schwid and O'Donnell tested anaesthesiologists in advanced life support skills in the operating room using a computer simulation program. Successful management was achieved by 71 percent of those who had trained 6 months earlier, while that number was reduced to 30 percent in those who had trained 6 months to 2 years earlier. Not one subject who had trained prior to 2 years successfully completed the tasks (90). Hammond and colleagues' cohort study produced similar results (91) when they retested critical care nurses and medical officers 18 months after training.

We understand that the Resuscitation Council UK has addressed the issue of poor retention of life support skills by recommending re-training in life support and automated external defibrillation at least annually.

5.2.2.4 Effect of advanced life support training on survival

The presence of staff trained in advanced life support has a positive impact on the survival of patients after cardiac arrest. Dane et al (92) used a cohort case-comparison to compare survival in patients who are attended by advanced life support trained nurses, with those attended by nurses not similarly trained. Patients attended by nurses trained in advanced life support had a better chance of survival. In 1986, Lowenstein and colleagues also found a higher survival rate for patients who were attended by a cardiac arrest team who were trained in advanced life support (93).

A Cochrane Review examining the impact of advanced trauma life support training on survival did not find any evidence to suggest that trauma management systems made a difference to the outcome of patients who had suffered a traumatic injury (94). Their report did find though that educational programmes increased staff knowledge of trauma care and recommended further investigation into the effect of such programmes on patient outcomes.

Three different retrospective case note reviews report that advanced life support after cardiac arrest has a positive impact on survival to discharge (95-97). Cooper and Cade's study used a prospective analysis of all (n=808) life support attempts over a 3-year period and concluded that advanced life support training reduced the number of serious

difficulties experienced by those attending arrests, and improved survival to discharge rates. Similarly, a review by Jabbour designed to examine the effectiveness of life support training (98) revealed three further studies highlighting the positive outcome on the morbidity and mortality of advanced life support training.

The rapid administration of defibrillation prior to any other intervention is associated with increased survival-to-discharge following in-hospital ventricular fibrillation or ventricular tachycardia, according to results of a 2-year prospective resuscitation audit by Spearpoint and colleagues (23). The authors argue that services providing care to patients with a diagnosis of cardiac arrest should be organised in such a way that immediate access to defibrillation is available if required.

5.2.2.5 Student satisfaction

Student satisfaction is the most widely used test of the success of training programmes. Certainly training increases confidence (99).

A prospective single centre observational study was carried out on final year medical students in Glasgow between 1993 and 1997 (100). Over the years the proportion of medical students who felt that they had had sufficient training has gradually increased.

It would appear that increasing training increases overall confidence in the cardiac arrest situation but does not result in complete confidence presumably because such training is inevitably artificial (101). Large data sets (Speed Quest and Multi Quest Data Bases, Resuscitation Council (UK)) are available at the Resuscitation Council (UK) demonstrating high student satisfaction typified by right of centre scoring on the standard

five point scale where 1 is low satisfaction and 5 is high satisfaction. This data is regularly fed into the ALS sub committee and reviewed, informing and shaping curriculum review such as the new Advanced Life Support course launched in January 2005 (Minutes of Subcommittee Meetings, Resuscitation Council UK: 06/02/02; 15/05/02; 04/09/02; 18/12/02; 31/03/03; 01/05/03; 28/07/03; 23/09/03).

In the new ALS course, learning is typified by small group activity in workshops, simulation and skill acquisition. Candidate experience is utilised and the sharing of experience encouraged, ensuring integration of knowledge and skill. But how well improved confidence translates into enduring objective performance is unknown. As a general rule there is little positive correlation between peoples' confidence and their ability.

5.3 Systematic reviews of different methods to teach life support skills

Here in section 5.3 we report the results of the search described in section 4.3.

5.3.1 Systematic review of general and context specific evidence for use of pedagogical methods included in life support courses

The search of electronic databases returned 486 titles. After the exclusion criteria had been applied, a total of seventy-eight papers were retrieved for inclusion in this part of the review. Forty-seven papers were concerned with studies, which either compared whole courses or compared specific pedagogical components of courses. Of these twenty-eight were quantitative comparative studies whilst nineteen were qualitative studies or commentaries. Ten reviews were found of which two were primarily assessments of BLS courses but still contained relevant pedagogical considerations. The remaining eight were reviews of all methods of training or reviews of studies on specific pedagogical components, which are applicable to advanced life support training. The reviews of primary studies contained a total of ninety-five studies. The twenty-one further papers retrieved were utilised for general background information.

5.3.1.1 Duration of training

The relationship between duration of training and skill level achieved is very important since training is expensive not only in terms of the cost of the training per se, but also the cost to the service from which people must be seconded in order to undergo tuition. The Resuscitation Council UK recommends between 4 and 8 hours for training in the use of BLS and AEDs around 17 hours in ALS.

The duration of the life support courses looked at in the studies, varied from a minimum of one to a maximum of twenty-one hours. Moreover, the survey of UK sites providing these courses showed that there was further variation of how long individual courses lasted i.e. some courses lasted longer at particular site than prescribed by the course provider.

One small, randomised study of (n=18) house doctors investigated the effect of short versus longer advanced courses on skill retention. The doctors underwent one or 2 day ACLS courses and were then tested using a standard scenario one month later. The two groups performed equally at baseline but at one month the students attending the two day course achieved statistically significantly lower scores than those attending the one day course (102;103). In contrast three studies of BLS in Wood's review (40) show a positive correlation between course duration and performance, but the courses tended to be very short. Unsurprisingly courses with practical training are superior to didactic training alone – but we do not include here video self-instruction.

5.3.1.2 Massed versus Spaced Practice

The issue of massed versus spaced training is a practically important topic addressed by some studies in this review. Quinn's definition of massed and spaced practice is:

“Massed practice involves continuous practice until the skill is learned, whereas spaced practice spreads the practice over a period of time, with a rest in between” (104). The Spaced Practice approach equates to a modular course whereby the same volume of learning contained in a massed course is divided into sessions and spaced over a time period. Here, students are afforded more time to practice and build knowledge and skills.

Quinn's description of massed and spaced practice learning is helpful when considering new and creative ways of delivering the life support curriculum content, and starts to address this important area of looking not just simply at the curriculum content but also the process of learning. The main theory being that skills may best be acquired and then retained if they are consistently reinforced over weeks or months, rather than in a single continual course (105).

The massed Practice (Traditional course learning) approach to skill acquisition where there is repeated exposure until the skill is learnt is consistent with the traditional two and a half-day ALS course, which tends to be very intensive, and is based around long days (see course matrix for details). It has been running in the UK for 8 years. Many of the papers and studies related to skills learning are based around intensive massed methods to deliver ALS content. Furthermore many of the discussion papers on the subject of massed practice are based around Basic Life Support (BLS) skills, which is only one component of the more advanced courses.

One published study described a comparison of two methods of teaching CPR, where CPR skills and knowledge were compared immediately after the course and then again three months later (106). Forty-nine subjects were randomly assigned to either a control group (didactic (massed) instruction) or an experimental group (modular (spaced) instruction). Knowledge retention was evaluated by means of a written examination. The Mandel observation instrument evaluated practical skill. The knowledge and skills performance of both groups, immediately following the class and at 3 months follow up, were not significantly different.

Further to this Ian Bullock undertook a larger study (published as conference proceedings) of 120 students undertaking either massed or spaced ALS course. Knowledge, skill and decision making outcomes were measured and the results showed that whilst initial learning outcome was not affected by the method of teaching, the modular course resulted in better skill retention (71). Based on these results, modular instruction appears to be an effective alternative to the conventional, time-consuming and expensive massed method commonly used for CPR instruction.

5.3.1.3 Lectures, small group teaching & individual instruction

Educational research supports the idea that traditional lectures are less effective than informal group teaching. The use of visual representations of information and a learning environment where the student has greater control over the sequence and pace of learning have been shown to be more effective. One study (107) compared a lecture-demonstration-repeat demonstration method and a self-directed method. The sample consisted of 63 baccalaureate-nursing students who were assigned to one of the two teaching methods. American Heart Association instructional materials and cognitive and performance tests were used with both groups. Initial mastery and retention were tested during week two and eight respectively. Both groups retained cognitive knowledge at a mastery level at eight weeks. In addition, there was no difference in retention of performance skills based on teaching methods. However, neither group was able to demonstrate retention of performance skills at a mastery level. Additional data indicate the self-paced subjects spent less time in learning activities. While the self-paced instructional package was more costly on a one-off basis, repeated applications would

decrease the cost per student.

5.3.1.4 Written or illustrated course materials

Braslow wrote that “Excessive, additional material detracts from the core goal of CPR skill acquisition.” (108). The Cochrane review of the use of printed educational materials (in general, not for life support training specifically) supports this view (109).

The results of this review found that of 9 included studies, none showed a statistically significant effect when compared with controls and only one of 6 trials that included printed materials in a multifaceted approach demonstrated benefit. In other words the beneficial effect of passive dissemination of information compared to no active intervention appeared small. Of note, all of the evaluated trials were plagued by methodological shortcomings and since the search for this review was performed the Cochrane review has been withdrawn for updating. George Marsh, in a review of pedagogy on general concludes that ‘students who get verbal and graphical/visual information achieve more than students who receive only a verbal presentation’ (<http://www.healthnet.org.np/training/software/WW188.htm>).

Moving on from course materials in general, to their use in life support training, one study of achievement in adult CPR classes in public participants was found. The study of sixty-eight classes found that distributing workbooks before the class had a significant positive effect on student achievement (110). The addition of written material by the instructor decreased achievement. The manuals used in current life support courses vary considerably in their extent and the ideal amount of written material remains an open question. Examples from the course matrix show manuals to have a range of pages between 68 and 504 pages. (See appendix 9 for full details)

5.3.1.5 Instructional Multimedia CD's, Videos & Virtual Reality

This topic has been the topic of one extensive review that includes three reviews of the use of multimedia (111). Bosco and colleagues reviewed (n=29) studies of interactive video mainly in educational and military settings (112). Sixteen studies provided a direct comparison of interactive video with conventional training and in thirteen of these studies the experiential method was more effective.

Smith also provided a brief review of a number of studies and concluded: "specific evidence for the effectiveness and efficiency of interactive multimedia is growing" (113).

Turning now from interactive video to the similar topic of computer-assisted instruction (CAI) Jelovsek and Adebonojo reviewed 49 randomised trials (114) examining practical and cognitive performance and found that in 60% of studies CAI was beneficial.

Moving to life support in particular, we found two studies one randomised and one not, of training with and without computer 'videodiscs'. Schwid and colleagues (115) undertook a randomised trial to determine whether an advanced cardiac life support computer programme improved retention of advanced life support guidelines more effectively than a textbook review. Forty-five anaesthesia residents were randomised 10 to 11 months after training commencement. They were randomised to either receive the textbook or computerised instruction. Simulated resuscitations were attempted by both groups; "mock codes" were videotaped and scored using a standardised code by assessors who were blinded to the allocation. The results showed that participants who used the computer programme scored significantly higher (mean 34.9 +/- .0 [sd] of 47 possible points) than

participants revising with a textbook (29.2+/- 4.9); $p<0.001$. Pass rates were also higher in the group that used the computer programme. The authors concluded that the computer programme significantly improves retention of advanced life support guidelines over the use of a textbook.

A non-randomised study by Christenson and colleagues compared multi-media with standard ACLS training (116). A total of 113 final-year medical students was divided into two groups based on convenience scheduling and given advanced life support instruction either in a standard format ($n=38$) or with a multimedia course ($n=75$). Students were evaluated with the same 50-item multiple-choice written examination, a structured evaluation immediately after the management of a mock cardiac arrest, and a second structured evaluation of the same mock arrest (videotaped) by an instructor blinded to the education method. Students were assigned a mark from 1 to 5 in each of 4 domains: assessment, immediate priorities, continual assessment, and leadership. The authors concluded that in medical students with no previous ACLS training, structured access to the multimedia ACLS did not improve educational outcome.

These two studies came to opposite conclusions however, in several UK universities and in America, work is underway to create Virtual Reality training for life support. Preliminary experimental work shows that this could provide a promising alternative or additional modality to role-play or moulage scenarios whilst utilising the flexibility of modern technology (117).

5.3.1.6 Manikins/Simulators/Cadavers/Animal parts

A review sponsored by Agency for Healthcare Research and Quality (AHRQ) containing a chapter on Simulator-Based Training and Patient Safety by Jha and colleagues states that, although simulators have been used for many years in a variety of settings, data on their efficacy are still emerging (118). The review also states that, “whilst there is currently no evidence that simulation-based training leads to improved patient outcome, it may prove difficult to conduct such studies”. They point out that only very large studies could establish cause and effect. It occurs to us that cluster design would also be needed to hypothecate outcomes on training methods with a team based activity like CPR.

Given the difficulty with use of survival rate/ adverse events the only feasible strategy might be use of surrogate outcomes. Gaba maintains that "...no industry in which human lives depend on skilled performance has waited for unequivocal proof of the benefits of simulation before embracing it" (119). Simulators certainly have high face validity, in promoting transition to real patients (120). Whilst simulators offer an excellent adult learning tool, their learning potential is directly linked to the facilitation skills of the instructor, for example in teaching a simple psychomotor skill such as opening the airway in order to insert an airway adjunct. In order to achieve this, expertise is gradually passed from the instructor to the student until mastery of the skill is acquired. More demanding activities, of which team leadership is a good example, use the same structured approach but are more complex. Providing feedback is an important tenet of simulation based training (57).

All life support courses advocate the use of simulators, manikins and cadaveric or animal material for practical skills training. Animals provide realistic materials on which to

practice technical, surgical interventions such as thoracotomy, saphenous cutdown and cricothyroidotomy, which are seldom performed on a human, but which can be life-saving when needed. During a study by Custalow and colleagues, residents randomised to advanced trauma life support sessions on live anaesthetised pigs showed that they performed better after 6 months, than controls. The intervention group performed better when assessed blind and were also quicker (121).

The costs of simulators for use in life support vary widely. "Home-made" or simple trainers are far less expensive than complex simulators or full-scale simulation centres. The average cost of high-fidelity patient simulators is on the order of £ 125,000. Medium fidelity simulators may be as little as £16,000 (122). Establishing a dedicated simulation centre can cost a million pounds or more (including the simulator) depending on the amount of space, the type of clinical equipment to be used, the extent of renovations needed, and the sophistication of the audio-visual equipment. For most simulation training the dominant cost is that of instructor time. Another indirect cost is that of removing clinical personnel from revenue producing work to undergo training. The healthcare industry currently does not fully embed time or costs of training into the system, but instead often leaves these costs for the individual clinicians to bear (see Appendix 9 for details of course participant costs).

There are potential risks to simulation-based training. Where the simulator cannot properly replicate the tasks or task environment of caring for patients, there is a risk that a clinician might acquire inappropriate behaviour (negative training) or develop a false sense of security in their skills that could theoretically lead to harm. Although there are

no data to suggest that this currently happens, these theoretical risks are part of the rationale for evaluation of the effects on actual clinical practice, at least in some cases.

In summary the literature shows that, although there is currently little evidence that simulation training improves patient care, the experience with simulation in other industries and the high face validity of their applications in healthcare has led many institutions to adopt the technology. It is likely that simulators will continue to be used and their role in training of medical personnel will grow. Definitive experiments to improve our understanding of their effects on training will allow them to be used more intelligently to improve provider performance, reduce errors and ultimately, promote patient safety. Although such experiments will be difficult and costly, they may be justified to determine how this technology can best be applied. (See methodology section.)

5.3.1.7 Role play/ clinical scenarios/moulage

For practical purposes all life support training involves an element of role-play. One of the ideas behind role-play is that it encourages students to develop internal motivation through social interaction and personal involvement. Students may improvise or follow a script (playing either their intended role or the role of another team member).

Students might be asked to perform set tasks alone such as demonstrating intubations or laryngeal mask insertion. Alternatively highly interactive scenarios require interaction of multiple team members. This is apparent in studies of the cardiac arrest simulation,

where students' organisational and communicative skills come into play and it allows for leadership and follower behaviours to emerge (123).

The putative benefit of using scenarios in resuscitation education is in creating a reality for the learner so that both the knowledge and psychomotor skills training are more likely to be transferred into actual practice. Therefore structured learning by using this teaching approach helps students to order their emotions, perceptions and personal insight relating to the cardiac arrest event. Instructors need to assess the knowledge and experiences of students in order to build competence in a sequential and deliberate way, and to allow for individual differences in acquisition of skills. It is important that the student should not perceive the environment to be competitive or hostile and positive feedback is therefore important.

A particular kind of role-play occurs during peer led education. A comparative study (124) compared peer led with conventional training in two industrial settings and concluded that the peer led method was cost effective. Similarly peer led education has been evaluated in Birmingham (125) and this study shows no drop in the proportion of students who pass their assessment at first attempt, since the introduction of this method. It would be interesting to see direct comparative studies, such as randomised trials, but the preliminary results suggest that this may be a highly cost effective method of teaching.

5.3.1.8 Teamwork training

Marilyn Hammick states that Interprofessional Education (IPE) is a specialised pedagogy (126). "The development of a theoretical base for interprofessional pedagogy is

necessary. The lack of knowledge about interprofessional pedagogy and the effectiveness of IPE needs to be seen in context”.

One challenge is to achieve consensus on what can be designated as out of date in professional curricula. This will give space for the introduction of interprofessional aspects of health and social care practice, for example, leadership training for interprofessional teams (127).

A paper entitled "Consultants only, ALS courses - is there a need?" reported the results of a survey showing that Consultants did not want to attend ALS course unless it was consultants only (128). This is one feature of the organisational cultural barriers to multi-professional learning. Furthermore, life support training is largely not tiered according to pre-requisite skills. For example nurses may find themselves on part of the course pertaining to for example acid-base buffers, which may be irrelevant for them.

Advantages to multidisciplinary ALS courses may also exist. The main one being that the doctors, nurses, and other health-care professionals train and practice together so that they get used to working in multidisciplinary teams. This contributes to the realism of simulation and encourages constructive interaction between team members (129). The problem comes in deciding exactly what should be included in the course. For some students, the course may be too basic, while others may be overwhelmed with information and skills that are irrelevant to their practice; this may distract them from learning the core skills adequately. The ideal would be to target the curriculum to the needs of the students.

5.3.1.9 Video-task analysis, Video self instruction

Video Self Instruction (VSI) systems allow the user to self pace their learning experience and in the environment that they prefer. Alternatively students could be filmed during a simulation/role-play/moulage scenario and then receive video task analysis as a means of facilitating structured feedback on their performance. The EVALS study supported by British Heart Foundation and conducted by Bullock and Fleming (1999), involved high quality video simulation of real resuscitations and participants found that it supported learning (130). Five of the 23 comparative studies in Wood's review (40) of BLS training compared video self-instruction with traditional methods and all five showed results in favour of video self-instruction (not to be confused with simply incorporating videotapes into traditional training where the results tend to be null).

Mackenzie and colleagues have conducted studies on the use of Video Task Analysis in anaesthesiology as a means of assessing skill competence and again participants reported that it was useful tool (131).

Just after the introduction of public training in CPR, self-training methods were shown to be superior to classroom methods among youthful subjects (132). Attempts to maximise the emphasis in CPR classes on psychomotor practice, termed 'overtraining' and 'drilling' by their authors, demonstrated that fostering mastery of (rather than mere exposure to) the CPR skills could increase learning and retention. In their review of public life support training, Eisenburger and Safar concluded individualised practice coached by video has advantages over instructor-led courses (41).

Wik demonstrated that individuals trained at home in informal 30–60 min sessions could perform better CPR as measured both by observer skill assessment and objective assessment with an instrumented manikin than subjects trained in traditional 4-h CPR courses (133). When the American Red Cross first introduced videotape as a means of delivering cognitive course content, it was shown to result in superior performance of subjects on cognitive tests as compared with instructor lectures. These results should also be applicable to training for health professionals (134).

Video self-instruction (VSI) can be carried out by clinicians without the need to attend expensive courses and disrupt clinical attachments. VSI can be carried out using a short training tape and an inexpensive manikin. When VSI was compared to traditional classroom training VSI (135) subjects performed better on compression technique, ventilation method and assessment and sequence skills; for all three dimensions. The benefit of VSI was greater still for trainees over 40 years of age and the advantage of VSI was still measurable on testing after 60 days.

Video task analysis was used to evaluate the performance of individuals in a resuscitation team over a ten month period in a UK hospital (136). All CPR events carried out in an A&E resuscitation room were videotaped. Variables monitored were: time to perform three defibrillatory shocks; time to give intravenous adrenaline (centrally or peripherally); the numbers and grade of medical and nursing staff involved in the resuscitation; the experience and training of these personnel. Of the 101 resuscitations recorded, 69 were carried out by the A&E team alone and 32 by the hospital cardiac arrest team. Resuscitation procedures were carried out significantly more rapidly by the former. Skills and protocols were most effectively used when the resuscitation team was led by an

experienced doctor who had received specific training in cardiopulmonary resuscitation, that is, ALS or ACLS. Such an individual was always present at A&E team resuscitations but in only 6% of cardiac arrest team resuscitations.

5.3.1.10 Conventional tiered teaching compared with a graduated method of increasing complexity

Chamberlain and colleagues (73) compared conventional and tiered teaching with a method based on teaching compressions first and then gradually introducing more artificial breaths. This was done in a randomised trial of 495 volunteers. The first ('bronze') stage was simplified by omitting ventilation and giving compressions in sets of 50 with pauses to open the victim's airway; in the second ('silver') stage ventilation was introduced in a ratio of 50 compressions to five breaths, and in the third ('gold') stage, the volunteers were converted to conventional CPR. No special difficulties were noted in changing the ratio of compressions to ventilation that was necessary to convert the staged training volunteers to conventional CPR. Results suggest that during the first critical 8 min of a resuscitation attempt, novices deliver 58% more compressions by using the 50:5 ratio — an increase that is likely to result in a significant augmentation of blood flow with important clinical implications.

5.3.2 Recommendations for future research

- Training needs analysis in variety of settings and for whole range of staff.
- Research into the optimal way to group students and the benefits or disadvantages of multiprofessional training.

- Design and implementation of modular and tiered courses – whereby staff with differing pre-requisite skills can join at the appropriate module level.
- Modules spaced optimally and incorporating elements of best androgogical methods.
- Multimedia tools (CD Rom's, videos and WWW) to be used for pre-course learning, as well as revision and refresher facilities.
- Training methods in the use of automated external defibrillators for both professionals and laypersons.
- Less detail in manuals – key information only.
- Research into factors associated with the instructor e.g. what is the most cost-effective ratio of instructors to students and how much teaching time is necessary? Who should the instructors be – practising doctors, student peers or specialist lay persons?
- Definition of the optimum balance between didactic lecturing and interactive learning is needed.
- How long should the overall minimum length of training be?
- Testing of different assessment methods.
- Encouragement of feedback loops to help improve course development.
- How frequently should health professionals undertake retraining in life support?
- Continued use and improvement of manikin simulators.
- Innovation for and research of learning tools such as Virtual Reality projects.
- Continued research into relevant pedagogical theories.
- Piloting of new course designs in some areas such as pre-arrest management.
- Evaluation of, how life support training affects outcome from cardiac arrest – in terms of both provider performance and patient survival?

- Methodological research to evaluate means of reducing contamination in educational intervention studies and definition of the extent to which, improved training outcomes translate into improved clinical processes.

5.4 National survey of UK life support courses

The search for courses revealed a large number of purveyors, offering many basic and advanced life support courses. The courses are aimed at people ranging from hospital staff to the general public. The type of courses vary from basic life support to specialised courses, e.g. for divers. It became apparent from this search that a limited number of courses had become market leaders in their field. Detailed results of this search can be found in Appendix 9.

5.5 Narrative summary of the survey of UK life support courses

5.5.1 Comparison of adult life support courses at NHS hospitals

Of the thirty hospitals surveyed all but one site ran life support courses. The site not running courses did not have a resuscitation officer in post and the manager of the coronary care unit (CCU) reported that there were no courses run by the hospital at the time of the survey.

Six hospitals were excluded and replaced with the next site on the list, as described in the methodology section. The reasons for exclusion are shown in Table 5.5.1.

Table 5.5.1 Reasons for site exclusion

SITE NUMBER	REASON FOR EXCLUSION
Site 1	No resuscitation officers available to complete the interview until the end of March 2004.
Site 3	Resuscitation officer could not be contacted, and did not reply to telephone messages, after 5 attempts. The original Site 3 resuscitation officer replied on her return from sick leave, and completed the telephone interview.
Site 4	Could not be contacted, and did not reply to telephone messages, after 5 attempts.
Site 5	Could not be contacted, and did not reply to telephone messages, after 5 attempts.
Site 24	Could not be contacted, and did not reply to telephone messages, after 5 attempts.
Site 29	Resuscitation officer was on long-term sick leave; and the second replacement occurred because the resuscitation officer was unavailable for our first telephone appointment time, and was called away to tend to patients during two subsequent appointment times.

Figure 5.5.1 Survey of Adult Life Support Courses provided by NHS hospitals

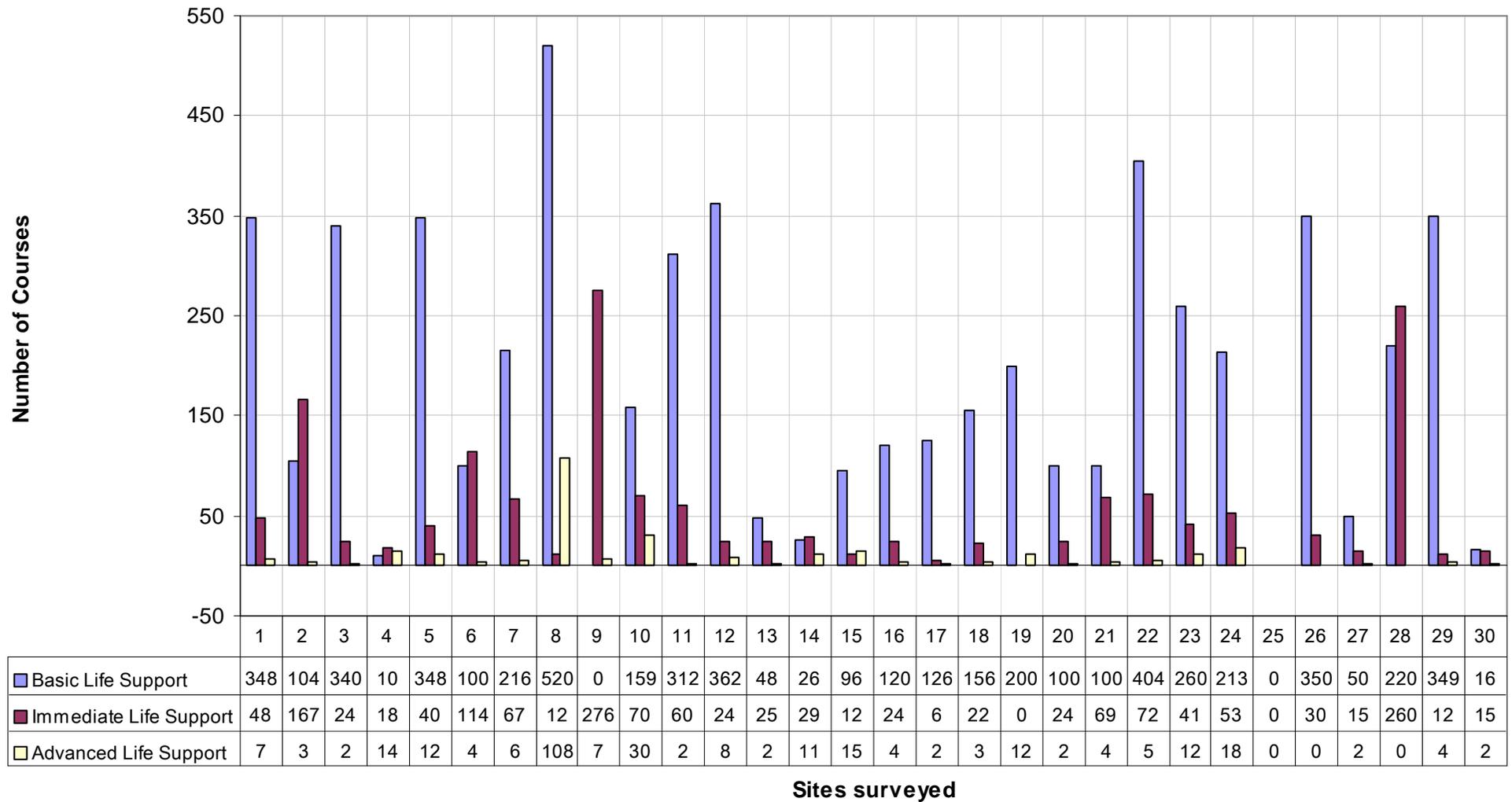


Figure 5.5.1 Illustrates the total number per annum of basic life support (BLS), hospital life support with defibrillation (ILS) and advanced life support (ALS) courses run by each site.

5.5.1.1 Basic Life Support

‘Basic life support’ courses in the survey included in-hospital basic life support with or without training in the use of airway adjuncts, and with or without training in practical skills needed to support a cardiac arrest team. Twenty-one of the thirty sites (70%) described their basic life support courses as a mandatory requirement for all clinical staff.

Twenty-eight out of thirty sites surveyed (93%) ran a basic life support course. Eleven (37%) sites ran an ‘out-of-hospital’ basic life support course teaching life support without equipment. One site ran an in-hospital life support course with automated external defibrillation, instead of a basic life support course. The results of the numbers of courses run by each site are detailed in Figure 5.5.1.

5.5.1.2 Immediate life support

Immediate life support (ILS) courses consist of training in hospital life support and include training in the use of manual or automated external defibrillation. Twenty-eight (93%) out of the thirty sites surveyed ran such courses. The RCUK Immediate Life Support Course (ILS) was run by twenty sites. Ten (33%) of the thirty sites ran both RCUK and ‘in-hospital’ courses. Eighteen of the thirty sites surveyed ran only their own ‘in-hospital’ life support course with automated external defibrillation or manual defibrillation training. Only one site ran a separate ‘safety and competence’ course teaching manual defibrillation for staff other than medical or nursing personnel. This course was run for health care assistants (HCA’s) and occupational therapists.

Of the fifty-three courses being run by the thirty sites surveyed, the total number of hospital life support courses with manual defibrillation was twenty (38%), compared with a total of thirty-three (62%) courses teaching hospital life support with automated external defibrillation training.

Of the fifty-three courses, twenty-three (43%) were franchised to the Resuscitation Council UK, while the remaining thirty courses (57%) were in-house designed, operated and quality-assessed courses.

5.5.1.3 Advanced Life Support

Advanced life support courses consist of immediate life support plus teaching about team leadership, drugs and peri-arrest situations and recognition of contributing causes such as pneumothorax. Twenty (67%) of the thirty sites surveyed ran the Resuscitation Council UK (RCUK) Advanced Life Support (ALS) course. Six of those sites also ran an in-house designed, operated and quality-assessed course. Six sites (20%) surveyed ran only an in-house designed, operated and quality-assessed advanced life support course. Four (13%) of the sites surveyed did not run an advanced life support course.

Some resuscitation officers interviewed for the survey were concerned at not being able to run more Resuscitation Council UK Advanced Life Support courses. Reasons cited include: insufficient funding to provide recommended RCUK life support courses (11 sites); lack of staff cover in order to release medical and nursing staff attending a 3 day course (9 sites); and inability to employ enough qualified instructors to run the course as

per RCUK guidelines (5 sites). However other resuscitation officers (7 sites) said that they were sufficiently skilled and experienced in designing and running courses teaching life support skills and did not require RCUK course guidance.

Our survey found that 'in-house' advanced life support courses are generally shorter than those prescribed by the Resuscitation Council UK. Figure 5.5.1.3 illustrates this trend. Our survey also revealed that the proportion of 'Instructors to Candidates' on courses was higher on RCUK Advanced Life Support Courses than on in-house designed, operated and quality-assessed advanced life support courses. See Figures 5.5.1.4 (a) and (b). In short the in-house courses were more economical to run than the Resuscitation Council UK courses.

Figure 5.5.1.3. Comparison of Length of RCUK: In-house ALS courses

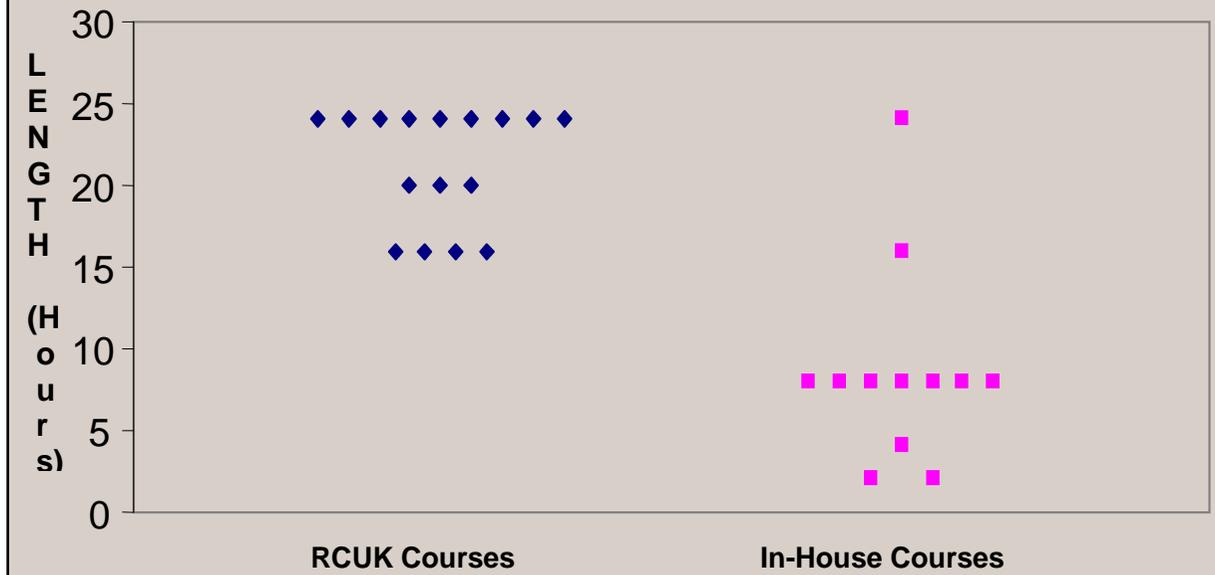


Figure 5.5.1.4(a)

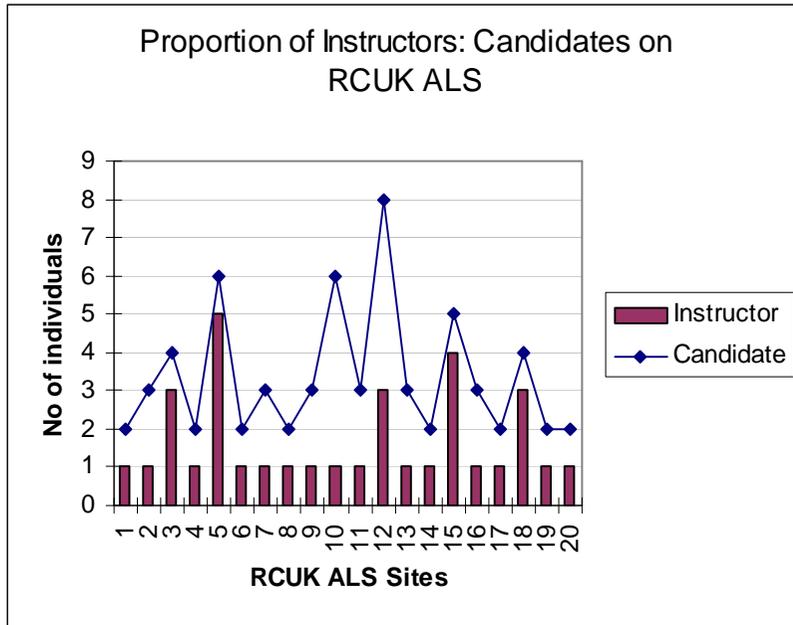
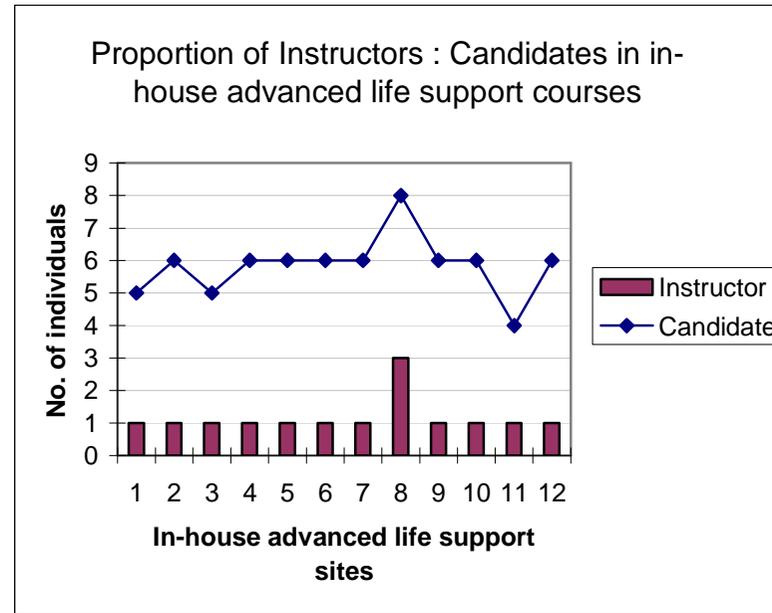


Figure 5.5.1.4(b)



5.5.1.4 Hospital life support courses teaching manual defibrillation

Safe and effective manual defibrillation skills are required by medical staff who will be required to attend cardiac arrest calls, and those working in specialist fields (e.g. anaesthetics, coronary and intensive care), and by nurses working in specialist clinical areas (e.g. coronary care, intensive treatment units and accident and emergency departments). The Resuscitation Council UK (RCUK) suggests that specialist staff would benefit from attending the Advanced Life Support (ALS) course (6).

Where sites were unable, or did not wish, to run the RCUK ALS course for these staff, some reported that they ran the RCUK Immediate Life Support course with manual defibrillation skills training, while other sites reported that they ran their own in-house designed, operated and quality-assessed course to teach manual defibrillation skills.

Results of the survey question posed by the team as to whether in-house designed, operated and quality assessed hospital life support courses with manual defibrillation training may be taught to a greater number of candidates than 'nationally formally approved (franchised)' hospital life support courses with manual defibrillation are addressed in Table 5.5.1.4. Results show that a greater number of candidates are taught an 'in-house manual defibrillation' course than a Resuscitation Council UK manual defibrillation course.

Table 5.5.1.4 Comparison of ‘Franchised’ (RCUK) manual defibrillation candidate numbers with ‘In-house’ candidate numbers

Site Number	Candidate Numbers (02-03)(Franchised)	Site Number	Candidate Numbers (02-03)(In-house)
1	210	1	180
2	72	2	84
3	48	4	330
4	96	6	90
6	120	5	120
7	180	8	1248
8	120	9	175
9	432	10	180
11	48	11	250
12	384	13	36
13	288	14	36
14	240	15	72
15	72	16	96
16	336	17	20
17	32	18	120
18	210	19	144
20	48	22	192
21	180	23	282
22	150	24	36
30	84	27	180
Total	3350 (46.39%)	Total	3871 (53.60%)

5.5.1.5 'Pre-arrest management courses'

Twenty-five (83%) out of thirty sites run a course to train staff in the recognition and management of acutely ill patients. Twenty-three (76%) out of thirty sites run the ALERT™ (Acute Life-Threatening Event Recognition and Treatment) course.

5.5.1.6 Specialist Training Courses

A course teaching the recognition and treatment of anaphylaxis was offered to clinical staff at fourteen (47%) of the thirty sites surveyed. Rhythm Recognition was taught, as a separate course to clinical staff at ten of the sites. A course teaching Altered Airway Resuscitation was only taught at one of the thirty sites in our sample.

5.5.1.7 Other franchised courses run by hospital trusts

None of the thirty sites surveyed purchased courses from private companies. However five (17%) of the thirty sites ran the Royal College of Surgeons of England Advanced Trauma Life Support (ATLS™) Course, and four (13%) sites ran the British Heart Foundation Heartstart™ course.

5.5.2 Narrative summary of survey of professional requirements

The General Medical Council, Nursing and Midwifery Council, nine specialist medical colleges, ten colleges for Professions Allied to Medicine, and four medical / nursing support and representation bodies were included in this survey.

Our detailed findings are represented in Appendix 8. Other than a General Medical Council recommendation on undergraduate medical education, overall we noted an absence of emphasis on life support training. There were however three notable exceptions – the Royal College of Anaesthetists and the Royal College of Paediatrics and Child Health, who required members to be competent in advanced life support skills, and the Royal College of General Practitioners, which requires trainees to provide evidence of successful basic life support training in order to register.

5.5.3 Narrative summary of survey of UK medical schools

Data were successfully collected from associate, vice or sub-deans at twenty-one of the twenty-four UK medical schools (as detailed in Appendix 7). An online undergraduate curriculum with information about life support training was available for five medical schools. Fourteen sites responded to our request for information, by email. Where sites had not replied telephone calls were made to request information, data were successfully obtained from four sites by telephone.

Life support training was provided at all twenty-one medical schools that responded.

In summary:

1. Basic Life Support (RCUK) was taught in 1st year at fifteen medical schools. It was taught in 3rd year at two sites and in 4th year at one 1 site.
2. Immediate Life Support (RCUK) was taught in 3rd year at two sites. BLS + Defibrillation (non-RCUK) was taught in 3rd year at three sites. Immediate Life Support (RCUK) was taught in 5th year at seven sites.

3. Advanced Life Support (RCUK) was taught in 4th year at three sites and in 5th year at four sites. Advanced Cardiac Life Support (non RCUK) was taught in 3rd year at one site.

5.6 Narrative summary of survey of the content and pedagogy of life support and ‘pre-arrest management’ courses

5.6.1 Life support courses

The survey results are reported in Appendix 4. The content and pedagogy of courses can be summarised as follows:

Resuscitation Council UK Immediate Life Support (ILS) courses consist of training in hospital life support and include training in the use of manual or automated external defibrillation. Candidates on this 1-day course are provided with an 81 page pre-course manual (137). According to guidelines, the maximum candidate number is 30 and the ratio of instructor to candidates is 1:6. The course pedagogy involves 1 hour of lecture time and approximately 5 hours of practical skills training. Four-stage teaching (138) is employed in practical skills sessions. Clinical role-play, teamwork training and simulation training using a manikin are also prescribed. Candidates are continually assessed and incompetent candidate guidelines apply.

Resuscitation Council UK Advanced Life Support (ALS) courses consist of immediate life support plus teaching about team leadership, drugs, peri-arrest

situations and recognition of contributing causes. Prior to this three-day course candidates are provided with a 142 page course manual (139). The prescribed maximum number of candidates is thirty, and the minimum instructor to candidate ratio is 1:3. Course pedagogy (pre-2005) includes lectures (approximately 6 hours), practical demonstrations, four stage teaching (138), role-play, teamwork teaching, simulation training using a manikin, and peer-led education. Candidates undergo a final multiple choice question examination and are assessed on 4 key practical skills. Incompetent candidate guidelines apply.

Royal College of Surgeons of England Advanced Trauma Life Support (ATLS®) course. Prior to this 3-day course candidates are provided with a 504 page pre-course manual (140). The maximum number of course candidates set by the Royal College of Surgeons of England is 20, and the minimum instructor to candidate ratio is 1:2. Course pedagogy includes approximately 6 hours of lectures and demonstrations, four-stage teaching, clinical role-play, simulation training using a manikin, peer-led education, and teamwork teaching. Candidates undergo a written examination and have a practical skills assessment of 12 key tasks. Incompetent candidate guidelines apply.

To conclude the course survey, the team contacted purveyors in order to establish the number of each course type run annually, and the number of candidates attending courses annually. In summary:

The Resuscitation Council (UK) Immediate Life Support and Advanced Life Support courses; the Royal College of Surgeons Advanced Trauma Life Support course; the

Advanced Life Support Group MedicALS, and ALERT were the most widely taught of franchised courses.

The most widely purveyed course of those surveyed was the Resuscitation Council (UK) Immediate Life Support (ILS), of which 1833 courses were held in 2002. In the UK a total of 16,880 people attended ILS courses in 2002. Detailed results of this survey are available as Appendix 6.

5.6.2 'Pre-arrest management' courses

Five courses were identified during searches (as described in the methodology section). Six course coordinators were contacted to complete the telephone interview. See Appendix 5 for a detailed results table.

Two of the 6 courses surveyed were ALERT™ (Acute Life-Threatening Event Recognition and Treatment) courses (141). There was little variation between the two ALERT courses surveyed in pedagogy or content apart from the amount of time spent on practical skills teaching.

There was however, considerable variation in the pedagogy and content of the remaining 4 courses. Trainees on the ALERT, MedicALS and IMPACT courses spend a large amount of the overall course time in practical skills training, whereas M & K Update and CB Nursing Updates provide only theoretical/didactic teaching. ALERT, MedicALS and IMPACT courses provide a pre-course manual for candidates while M & K Update and CB Nursing Updates do not.

The ratio of trainee to instructor also varies considerably. MedicALS, IMPACT and ALERT have ratios of 2 to 4 trainees to 1 instructor, while M & K Update and CB Nursing Updates both have ratios of 30 trainees to 1 instructor.

Trainees on the MedicALS and the IMPACT courses are assessed whereas the remaining courses had no assessment. The ALERT, M & K Update and CB Nursing Updates courses are aimed at a multidisciplinary group, whereas the MedicALS and IMPACT courses are intended only for medical practitioners. Trainees on all courses surveyed are able to claim Continuing Professional Development points for attendance. It would seem that courses run by independent commercial companies such as CB Nursing Updates and M & K Nursing Updates are becoming increasingly popular. In 2002 alone, CB Nursing Updates ran 15 Acute Medical Nursing Emergencies courses for a total of 600 nursing staff.

5.7 Study of the Fidelity of the Implementation of Courses

5.7.1 Immediate Life Support Courses

ILS courses are purveyed and prescribed by the UK Resuscitation Council. We surveyed a total of six ILS courses from different hospital sites (see Appendix 4a). One site in the survey ran 2 different ILS courses. Both were included in the survey and are referred to in the results table (Appendix 4(a) as Site 3(a) and Site 3(b)). As prescribed, all our sample courses had a pre-course manual, which was sent out to students in advance. Only two of our sample courses altered their course content from

that prescribed by the UK Resuscitation Council. One course was aimed at final year medical students and the other course had two additional lectures covering ‘do not attempt resuscitation’ policies, and clinical audit.

All our sampled courses used the prescribed 4-stage teaching method (138) centred on various clinical scenarios. All but one course undertook a 15-minute “Demonstration” exercise. Two of our courses used “individual teaching” at skills stations, i.e. 1 instructor: 1 trainee, although there was no requirement to do so. There was wide variation in the ratio of manikin to trainee (1:2 to 1:5).

Peer-led education was used in half of our surveyed courses, although this method of teaching was not prescribed. A formal assessment process is not prescribed, although three of our sample courses did incorporate a formal assessment of skills such as defibrillation. Only one course, which was aimed at medical students, included a written assessment.

5.7.2 Advanced Life Support Courses

We surveyed five ALS courses franchised by the Resuscitation Council UK (RCUK) at 5 different hospital sites (see Appendix 4b). As prescribed, all our sample courses provided a pre-course manual, which was sent out to students in advance. No variation in course content was seen between prescribed and sampled courses.

Some variation in pedagogy was found. One course simplified the course content and modified the prescribed RCUK teaching algorithms. Whilst there is no requirement for 1:1 teaching, two courses adopted 1:1 teaching at skills stations, arguing that this

was essential to ensure proper transfer of skills. Three of our sampled courses took twice as long (30 minutes) with “Demonstrations”, compared to the prescribed 15 minutes.

All our sampled courses used the prescribed 4-stage teaching methods centred on various clinical scenarios. As prescribed, peer-led education was used in all our surveyed courses. As prescribed, all our surveyed courses assessed four basic skills using a written assessment based on one or more clinical scenarios.

5.7.3 Advanced Trauma Life Support Courses

ATLS courses are purveyed and prescribed by the Royal College of Surgeons of England (RCSEng). We surveyed five ATLS courses from different hospital sites (see Appendix 4c). As prescribed, all our sample courses had a pre-course manual, which was sent out to students in advance. None of our sample courses altered their course content from that prescribed by the RCSEng.

Some variation in pedagogy was found. All but one (citing time constraints) of our sampled courses used the prescribed 4-stage teaching method centred on various clinical scenarios. Whilst the franchised course does not prescribe 1:1 teaching, three sites adopted a 1 instructor to 1 candidate ratio, if the instructors thought a candidate would benefit from additional practical skills training in a skills station. The prescribed “Demonstration” time was 85 minutes; our sample showed wider variation ranging from 0 minutes (i.e. not done) to 30 minutes.

One of the courses surveyed used actors to simulate patients, whereas the remainder used a manikin. Four of our courses used animal cadavers, but one did not. Education staff at the RCSEng, who were interviewed state that animal cadavers need not be used, although the ATLS manual produced in the USA indicates the use of them.

There was no variation in the mode of assessment and the number of skills assessed in our sample courses and that prescribed.

6.0 Discussion: Implications for practice and research

6.1 Introduction

We have conducted:

- a) a narrative review of the topic of resuscitation;
- b) reviewed methods for teaching resuscitation;
- c) surveyed current UK practice.

We have done so to help answer three fundamental questions:

- a) Who is currently taught what?
- b) What should be taught to whom?
- c) How should it be taught?

We now discuss these topics.

6.2 How, and to whom, is resuscitation taught?

Our study shows that resuscitation training has become a widespread activity across society with courses available across a diverse range of situations, from basic life support for carers of people with heart disease to deep-sea diving courses. Within hospitals it is now 'institutionalised' in the sense that permanent posts exist at most centres and large numbers of staff attend courses. Indeed the coverage within hospitals is far more comprehensive than in medical schools or professional colleges, suggesting that the NHS,

far from responding to the educational and standard setting bodies, has led the way and we have no doubt that the Resuscitation Council UK has been very influential in mentoring this process.

One of our most striking findings is the extent to which ‘pre-arrest’ courses concentrating on recognising and managing the deteriorating patient have caught on; the finding that nearly half of all unexpected cardiac arrests are preceded by clear evidence of deteriorating physiology to which no response is made, has been taken to heart. Again educational institutions have been found to be following the lead set by others; they have been slower to respond. It is therefore encouraging that a group has now been set up by the Resuscitation Council UK (142) to develop an undergraduate medical module teaching the recognition and management of critically ill patients (142;143). The survey of hospital courses also revealed that greater emphasis is being placed on the provision of training in the recognition and management of critically ill patients not only for doctors but also for nursing staff.

During the survey of courses teaching the recognition and management of acute medical emergencies, the team interviewed staff from independent commercial companies about the number of nursing staff taking up places on their courses. As stated in the results section, one of these sites ran fifteen courses for a total of 600 nursing staff. One possible reason for the high uptake of these two courses could be the relatively low cost for course attendance, in comparison to other courses. The courses surveyed provide practitioners with Continuing Professional Development points for attendance. Our pedagogical survey revealed that only didactic teaching was used to teach these courses (see Appendix

5). Given the emphasis that other course developers and educationalists place on the use of practical skills training (6) the research team feel that questions remain about the suitability or effectiveness, of courses offering only large-group lecture-based teaching (144). We recommend that the NPSA should stimulate a randomised study to measure the effects of BLS and ALS courses of different costs on performance.

While the above courses might be insufficiently intensive many other courses may err in the opposite direction. This applies particularly to the franchised Resuscitation Council UK courses. Our reason for saying this is that the evidence we have presented shows that many hospitals simply find them too expensive either in direct costs or in staff time; the perfect may have become the enemy of the good. The Resuscitation Council UK Advanced Life Support course for example involves 3 days of intensive training. In section 5.1, 5.2 and 5.3 we provided indirect research evidence (from educational theory) and direct evidence (from randomised trials) which casts doubt on the benefits of such 'deep immersion' courses over shorter, modular (spaced) courses. We understand that the Resuscitation Council UK is actively considering producing such flexible courses.

Although there is a very wide range of pre-existing knowledge and skill of multidisciplinary staff undertaking some life support courses, it was interesting to note that of all courses surveyed, only two sites tested the pre-course (baseline) knowledge and skill of candidates. The recent ILCOR Advisory Statement on Education in Resuscitation (144) emphasizes the importance of adapting course contents and teaching methods to the needs of the candidate group being taught. Where there is no prior

knowledge of a candidate's skill level a short baseline measure, or pre-test, provides instructors with necessary knowledge about a candidate's training needs and would also provide an indication of the appropriateness of a candidate's inclusion on a course. Applying the same pre- and post-course test would also provide useful feedback to instructors and researchers on the effectiveness of the course contents and pedagogy, indicated by measurable behavioural change i.e. practical life support skills acquisition.

Although it was not a primary aim of the study, the research team were interested in efforts by course purveyors to update the life support treatment and management evidence base of the course contents (see Appendix 6). The International Liaison Committee on Resuscitation (ILCOR), the European Resuscitation Council (ERC) and the Resuscitation Council (UK), provide a good example of groups working to provide a contemporary evidence base for clinicians. This evidence is disseminated at a clinical level through the work of NHS trust resuscitation officers and others involved in the teaching Resuscitation Council UK courses. In a meeting with management staff of the Advanced Life Support Group (ALSG) the team were interested to learn that the contents of courses is continually updated as new evidence emerges. On completing an ALSG course, candidates are advised to log on regularly to the BestBETS website (145) to update their knowledge.

6.3 What should be taught to whom?

It is hard to imagine that all clinicians could be taught all of the skills of advanced life support. Given that most clinicians will seldom be called upon to do life support and that skills decay, a basic set of skills must be taught to a wide community while a smaller number receive training in a more extensive advanced skill set.

The number of Resuscitation Officers (ROs or RTOs) has increased over the past 10 years and most hospitals now have a Resuscitation Service. The level and type of life support courses used to train various grades of hospital staff is decided by trust Resuscitation Committees, who are strongly influenced by the European Council Guidelines on Basic and Advanced Life Support. Basic Life Support forms the major part of the standard level of resuscitation training in most hospitals (146).

What we found is this:

1. When a hospital sets out to deliver a package of training they do so in a very homogeneous way, both with respect to content and pedagogy. There are some differences to which we return, but the basic message is conformity with requirements of the course.
2. However there is considerable disagreement over who should receive which package. While some hospitals (such as hospital 8 in our study) provide over 500 training slots per year in BLS but only a handful of slots at a more advanced level,

others, such as hospital 9, offer many opportunities in immediate life support.

Indeed, hospital 9 stopped using BLS and provides only ILS or ALS.

This invites the obvious question – should automated external defibrillation be incorporated into all BLS training courses thereby effectively converting them to immediate life support (ILS) courses? The idea is supported by the epidemiology - resuscitation is at least four times more successful when carried out in the context of a shockable rhythm than in other circumstances. Moreover, modern equipment contains the ‘intelligence’ to discern such rhythms. It seems almost perverse to install defibrillators in airports, stations, and shopping malls yet not make such equipment available in acute hospital settings. Even if the proportion of cardiac arrests that have a shockable rhythm is higher in pre-hospital cases, than in hospital, the absolute numbers in hospital are likely to be higher. Moreover the outcomes of cardiac arrest on the wards have improved substantially since the installation of AEDs, and training in their use was instituted, at the Hammersmith Hospital (147). Hence we perceive an argument for training all staff in ILS pending much more widespread introduction of AED in hospitals. The controversy over whether attempted defibrillation should be preceded or followed by chest compressions does not need to be resolved in order to reach the conclusion that AED should be part of the most basic life support training repertoire.

Historical precedent should no longer be allowed to automatically dictate the provision of facilities for defibrillation in hospitals. While defibrillation programmes have traditionally been limited to critical care areas where nurses and physicians work together

in recognising and treating ventricular defibrillation, we think that defibrillators should now be more widely available – quite how much more widely could be informed by cost-effectiveness modelling – see below. The traditional idea was that staff outside the critical care area would be trained only to maintain the circulation until the arrival of the resuscitation team. That is to say, they would receive BLS training only. However, given the success of defibrillation depends more on the duration of ‘downtime’ than on the expertise of the practitioner (especially with modern devices) it would seem sensible to make defibrillators more widely available. We have elicited much support for this idea from members of the Resuscitation Council UK. Such a policy could be introduced around the country in a step-wise cluster randomised design to evaluate its efficacy and we seek collaboration in such a study.

A big question is whether staff could be trained to provide such widespread defibrillation cost effectively. Kaye and colleagues (148) have demonstrated that staff located outside the critical care wards can easily be trained to use AEDs. Indeed staff who had already been trained in BLS whether qualified or not can be trained to use AEDs in a 2 hour class. In short little more is required than political will to modify existing courses which staff are expected to take.

Would it be cost effective to follow the policy explicated here? We have argued that including defibrillation training in the repertoire of BLS would be inexpensive and the price of AEDs has fallen rapidly in recent years. This question requires a formal study. Such modelling would require an estimate of the frequency with which defibrillation is

required on the general wards along with estimates of the marginal gains in survival through the availability of local AEDs. A single study in Italy (149) reports that 24 patients required resuscitation in the first 9 months following implementation of a first responder AED programme. Nine of these patients were in ventricular defibrillation and three survived to discharge.

We recommend that the NPSA convene a series of stakeholder meetings to develop a national policy on this point. We recommend that a formal cost-effectiveness model be commissioned to inform this point. This could then be followed by the step wedge cluster trial we suggest above.

6.4 How should resuscitation be taught?

Evidence is the key to guide scientists in the development of their discipline. There are two kinds of evidence – direct and indirect. Indirect evidence arises from in depth observational work (in the laboratory or in real situations) and typically includes a large qualitative component. Direct research can use surrogate or definitive outcomes, but either way involves direct comparison of the effect of one way of doing things with another. Although there are many good experimental studies in education dating back many years, training (in healthcare as elsewhere) has been dominated by indirect evidence. Where direct comparative studies have been done these are dominated by surrogate outcomes – in-vitro training evaluated by in-vitro assessment. Within health and social care settings ‘evidence-based practice’ is accepted as a vital part of providing

optimum patient care. However, direct evidence on the effectiveness of life support training overall and by specific methods is extremely scarce.

Our survey of CPR training in the UK showed minimal evidence of variation in content. So here we have a rather unusual combination of circumstances – little direct evidence showing benefit at the clinical level, yet much agreement about the current practice. This is because there is broad consensus both about the educational objectives of training for life support and about how to reach those objectives. While few would be so sceptical as to doubt the effectiveness of providing some life support training to front line staff, the form and intensity of such training seems open to much more doubt. This invites the question – has consensus solidified too early in the case of the methods for resuscitation training? Few of the current widely accepted methods have been subjected to direct comparative studies, such as randomised controlled trials (RCTs) and even fewer RCTs address outcomes at a clinical level. Uniformity is not complete however. For example there is variation of practice in respect to baseline assessment. Only two courses (all RCUK courses) in our sample of sixteen undertook this.

On the whole however, differences between the main prescribed and sampled courses were small. Furthermore such differences as there are do not appear to be fundamental research questions that would be likely to provide a paradigm shift in our thinking about ways to improve life support training in the UK. It strikes us that the interesting questions lie outside the current range of practice.

The following are interesting and important topics for future evaluation:

1. The duration of training needs to be evaluated. The variation in the average duration of ALS with provision of shorter hospital than franchised courses suggest that many providers find these franchised courses a 'Rolls Royce' they can ill afford, especially in terms of time taken out of hard pressed services. Certainly shorter courses have been used in Britain and the USA and such evaluations as there have been show similar effects (150;151) including retest at 5 to 8 months (152).
2. Closely related to the question of duration, is the issue of staging. Is one in-depth course the optimal method or should the training period be broken up into a series of shorter training sessions – i.e.: would spaced training be more effective? Theories of reinforcement would support the latter but the evidence is so far equivocal and the logistics of frequent shorter courses may be more difficult than a single layer course. Modular courses might also allow some components to be shared by all students, while others are completed by senior nurses and doctors only, or by junior nurses and other health professionals only. Modular courses may also provide greater flexibility for instructors and students to be able to allocate time to training. However, some centres have reported problems with getting learners to attend and complete all the modules within a course. As we have seen, Ian Bullock has evaluated modular ALS courses in the UK showing them to have some benefit on the level of skill

retention over the study period. Defibrillation skill, knowledge acquisition and cardiac arrest management all improved when compared against traditional formats of the ALS course, with the assessment of cardiac arrest management in the team leader role being statistically significantly better when candidates were taught using a modular approach.

3. We have intriguing evidence from one comparative study that self-teaching using a videotape and inexpensive manikin is not only much cheaper but also more effective than skills-lab training. As we have described Braslow and co-workers investigated the effectiveness of a video self-instruction (VSI) model in teaching adult one-rescuer CPR. The VSI group participants were judged more competent in overall CPR performance. This provocative finding cannot be allowed to lie – a replication study is urgently needed.
4. “Peer-led” training for undergraduates and junior doctors should be re-evaluated especially in light of experience in Birmingham where a peer-training model enabled CPR training to be delivered to a large number of individuals at low cost (125).
5. Perhaps the most important question of all, given the documented high rate of decay of clinical skills, is how often refresher training should be given to reinforce skills. How frequently should health-care professionals undertake retraining in ALS? Should it be reinforce on weekly basis similar to other high

risk technical domains? At the moment, the ALS provider certificate is valid for 3 years in the UK. The skills of those providers not involved regularly with resuscitation attempts will deteriorate markedly within 3 years. But, more frequent refresher training has significant resource implications. Shorter courses reinforced frequently may be much more effective than a 'deep immersion' course reinforced infrequently (153). Kaye and colleagues showed that a refresher course that recognised and corrected participation weaknesses in resuscitation was effective.

We recommend that the NPSA build on previous sessions on training to convene a stakeholder meeting to set up at least one large scale RCT of alternative policies. This might be a cluster or individual study. The comparisons could be:

1. BLS. Randomise hospitals to practice as at present versus wider availability AED and ILS.
2. ALS. Randomise individuals to current course versus 6 monthly team training plus log books versus a spaced course.

7.0 Conclusion

The spectrum of unanswered issues in training of life support skills for health care professionals ranges from issues of pedagogy, practicality, to assessment of competencies. These issues are linked and inform each other. The pedagogical questions include such issues as differentiated learning styles, massed vs. spaced learning programmes, experts vs. novices etc. The practical questions include how to provide high quality multi-professional training for health care practitioners that is both cost-efficient and effective for the NHS. Furthermore, from the individual health care professional's point of view, we need to address how to streamline the content and number of courses that NHS providers should be required attend to ensure minimal overlap in content and therefore ensure efficiency in terms of learning, time and cost are important.

The prescription for the most urgent future research does not come from comparison of the most widely used existing methods for life support training. On the contrary, one of our main research findings is a high degree of uniformity between courses. As far as the prescribed/intended methods are concerned a very small number of market leaders have emerged that lay down the details, not only of content, but also of teaching methods. Nor is there much local variation in the fidelity with which these courses are delivered.

All this begs the following vital question. Has life support teaching practice solidified in the correct form? Is it making the difference in patient outcomes? This is important

because the form in which it is currently solidified is a large use of resources not only in staff time but also in the opportunity costs for clinicians working on the wards. Since the overall success rates do not appear to have improved, and since removing staff from their place of work has obvious drawbacks, the prevailing dogma that all staff need mass (off-site) training must be evaluated.

As a by-product of this project, we have developed good links with key stakeholders including the UK Resuscitation Council, lead researchers in this area and Resuscitation Officers. There is a clear sense that academic collaboration to develop methods of on-going monitoring of outcomes of CPR and research projects designed to robustly test different teaching methods would be welcomed by the Life Support community in general.

8.0 Appendices

Appendix 1 Life Support Training Project L.I.S.T Protocol

Assumptions And Aims

ASSUMPTIONS

- A. Humans may suddenly collapse without warning.
- B. The cause of their collapse may be a condition that is curable or at least made less severe if trained help is available. In a significant proportion of cases deaths may be significantly postponed (otherwise known as “Lives Saved”)
- C. The usefulness of assistance (professional health care workers and/or laypeople) depends on the existence and quality of training that they may (or may not) have received.
- D. In the light of the above the quality and availability of training and the proportion of health care workers and lay people who have received training is therefore a matter of public and therefore political concern.
- E. The National Patient Safety Agency has a responsibility in this matter.
- F. The NPSA has accepted a proposal by Professor Lilford to provide a “Review, Analysis and Critique of Educational Programmes to teach Advanced Life Support and Resuscitation”

AIM OF STUDY

It is proposed to do this as follows:

Topic A.

1. To document variations in the context, content and mode of teaching used in Advanced Life Support training courses in the U.K. and abroad.
2. To provide a critique, supported by educational references as to the probable value of such variations, and to identify the most effective teaching methods that might be recommended for future use.
3. This assessment will either decide a) that there is sufficient existing evidence as to the comparative value of different methods of teaching or b) should suggest a grant application to identify the most efficient and effective methods of providing such training.

Topic B.

To identify

1. What proportion of the health professional population probably ought to receive such training in structured courses
2. How far this has so far been achieved.
3. The probable annual cost of providing such training to all those considered to be in need of it.
4. How such training might be more cost effectively provided to all those needing it.

Documents to be created.

1. This list of documents to be created as part of the project (RF).
2. Document ASSUMPTIONS which upon which the project is based (RJL, MAM).
3. Define our Agreed Specific AIMS (Main responsibility RF, MAM)
(both for this stage and for proposals of future work)
4. A comprehensive list of ORGANISATIONS or METHODS through which Life Support Training can be obtained or Guidelines obtained (RF)
 - a. Names and Addresses details
 - b. Names of Course(s) they Run
 - c. Manuals that they use or recommend
 - d. Videos they use or recommend
 - e. Manikins they use now and in the past.
 - f. Computer aided learning programs which they use or recommend
5. Obtain lists of advanced life support, immediate life support and advanced trauma life support course for random selection of course centres to be included in telephone survey. (LB, MAM)
6. Create telephone QUESTIONNAIRES/MATRICES in Excel (LB,MAM)
 - a) District/Trust Information e.g. Person most responsible for the Resuscitation Training Program.
 - b) For each different training program used whether from external or internal source.
7. Pilot, refine then complete telephone survey. (LB)
8. Project Team Core Members: Document e-mail, mobile phone, home phones, addresses, etc. (RF)
9. CONTACTS: Document of other relevant contacts (RF)
10. List of MANIKIN Suppliers and Versions of their manikins likely to be in current use. (LB)
11. List of VIDEOS. Suppliers and Versions of their videos likely to be in current use.
12. List of COMPUTER-AIDED LEARNING. Suppliers and Versions of their Programs like to be in current use.

Action Points (as of 15 November 2002)

1. Create a project TEMPLATE. As set out on this page top and bottom (MAM, RW)
 - Heading at the top as above (only on first page)
 - At the bottom as below (on every page)
 - a) Filepath: with place to enter actual file path which for this project will consist of a common folder and a folder owned by each team member which can be read but not altered by other members of the team
 - b) Automatic Date when this copy has been printed
 - c) Simple list of team members and a contact phone number and and e-mail address

13. Assign key documents as proposed in “Documents to be created List” (Main responsibility RF) Person assigned to continue their development

14. Undertake literature review and systematic reviews. (RW)

15. Visit
 - a) Several Resuscitation officers (Main responsibility RF & LB)
 - b) Manikin Vendors (Main responsibility LB & RF)

16. Arrange to attend training programmes e.g. RF & RL to attend ALS in Jan (Main responsibility RF & LB) and to complete “Questions about Training Programmes Protocol) (LB & RF)

17. Arrange to see some more Resuscitation Officers or equivalent. (RF & LB)

18. Complete interviews, investigations and compile matrices. (LB & RF)

19. Assimilate master document for editing (RW)

20. Edit main document (RJM main responsibility)

21. Complete by July 2003.

Appendix 2 Literature review by Dr Mark Woods for HSE Discussion Document:

'A review and evaluation of the effectiveness of the Health and Safety (First-Aid) Regulations 1981'

(Permission to include obtained from author, Dr Mark Woods PhD, Senior Scientific Officer, Corporate Medical Unit, Health and Safety Executive (Mark.Woods@hse.gsi.gov.uk) and Iain Roberts, Copyright Officer DIAS 2 Productions, on 26th January 2005)

Summary of papers on first aid training and retention of skill and knowledge (abbreviations used are listed at the end of the table).

REFERENCE¹	METHODS	RESULTS	CONCLUSIONS²
Vanderschmidt H, et al Evaluation of a cardiopulmonary resuscitation course for secondary schools <i>Med Care 1975;13:763-74</i>	Secondary school students were instructed to perform CPR according to AHA standards, by their usual teachers who had received a special educational programme in preparation. Students were given a practical and written test immediately after instruction and 3 months later.	55% of students were able to perform skills immediately after instruction and 31% after 3 months. Retention of continuous skills (breaths and compressions) was good but discrete motor skills (opening the airway, checking vital signs) was poor.	It is possible to train secondary school students to perform the ABC of CPR if they have the opportunity to practise these skills. Teacher training is an important factor.
Vanderschmidt H, et al Evaluation of a cardiopulmonary resuscitation course for secondary schools retention study <i>Med Care 1976;14:181-4</i>	2 groups of secondary school students were tested for retention of CPR skills 15 months after they had received training - 178 had been given didactic and practical CPR training and 38, only didactic training. Each group was further divided into 'film' and 'no film' groups. Film groups were given a 28 minute refresher film on CPR skills prior to testing.	Retention of continuous skills showed very little loss but discrete skills showed considerable loss over time. The film did little to improve CPR skills. No significant differences in performance were observed between those that had seen a CPR film before the test and those that had not.	Training in CPR leads to good retention of essential skills but retention of ancillary decision making skills was not satisfactory. Methods for teaching these skills need further development.
Webb DD, Lambrew CT Evaluation of physician skills in cardiopulmonary resuscitation <i>JACEP 1978;7:387-9</i>	35 physicians at various levels of postgraduate training in internal medicine were evaluated for performance skills in CPR according to standards of the AHA. They were given instruction in cognitive knowledge related to CPR through lectures and a demonstration of the technique without supervised manikin practice.	22% of physicians were able to adequately compress and ventilate the manikin.	
Korttila K, et al Importance of using proper	46 young conscripts were given 2 hours of CPR instruction - viewing a film on	Before training, no subjects passed the surprise test. After training, 62% of the	CPR training for lay people may not result in an adequate level of skill.

techniques to teach cardiopulmonary resuscitation to laymen <i>Acta Anaesthesiol Scand</i> 1979;23:235-41	theory and practice, discussing the film and instructed individual practice with a recording manikin. 56 conscripts were given a 1 hour illustrated lecture on CPR and group training with a non-recording manikin. Performance in CPR was measured with a recording manikin before and 2 months after training.	group trained more intensively passed the test according to criteria acceptable for lay public and 28% passed when measured against strict criteria for medical personnel. Less intensive training did not improve resuscitation.	Proper training is important but does not guarantee a satisfactory level of CPR performance if skills are not later refreshed.
Weaver FJ, et al Trainees' retention of cardiopulmonary resuscitation. How quickly they forget <i>JAMA</i> 1979;241:901-3	Lay persons trained in CPR were evaluated 6 months after completion of a 4 hour basic life support course to determine the degree to which CPR cognitive and psychomotor performance skills were retained. Evaluation criteria were based on AHA recommended standards.	There was a significant decrease in resuscitators' retention of CPR knowledge and skills.	-
Breivik H, et al Life-supporting first aid self-training <i>Crit Care Med</i> 1980;8:654-8	Acquisition of first aid knowledge and skills was evaluated in 230 lay people - some underwent self training group instruction without qualified first aid instructors using audiotape instructions, flipover charts, an instruction booklet, first aid materials and a manikin. Some underwent self training at home with an instruction booklet and first aid materials.	The 2 teaching systems were equally effective in providing theoretical first aid knowledge but the group instruction was better for teaching practical skills.	-
Deliere HM, Schneider LE* A study of cardiopulmonary resuscitation technical skill among trained EMT-A's <i>The EMT Journal</i> 1980;4:57-60	131 EMT-As were tested for performance in CPR. Time since last CPR training was assessed by questionnaire.	61% of subjects passed an examination in one rescuer CPR 1-6 months after last CPR training, falling to 36% after 7-12 months, 27% after 13-24 months and 0% after 25-80 months. There was no significant association between number of CPRs performed on actual cardiac arrest victims and CPR skill displayed during the examination.	There is a significant association between CPR technical skills retention and decreasing length of time from the last CPR training. To minimise rapid deterioration, retraining in CPR skills should occur quarterly and recertification should take place perhaps every 6 months but not less than once a year.
Tweed WA, et al Retention of cardiopulmonary resuscitation skills after initial	CPR skill retention was assessed in a police force initially trained to instructor level as defined by the AHA. Police	Retention scores were: knowledge, 76%; assessment skills, 83%; call for help, 85%; number of adequate ventilations, 100%;	Overtraining of highly motivated and mature non-medical rescuers produces satisfactory skill retention for at least 1

<p>overtraining <i>Crit Care Med 1980;8:651-3</i></p>	<p>officers were given a basic 8 hour course of CPR training followed by written and performance tests on a recording manikin using instructor level criteria as the standard. 12-18 months later 116 randomly selected personnel were retested. Retention was calculated by: (retest score/training score)x100%.</p>	<p>number of adequate compressions, 97%. Assessment time and incidence of practice which could cause injury were the same.</p>	<p>year.</p>
<p>Gombeski WR Jr, et al Impact on retention: comparison of two CPR training programs <i>Am J Public Health 1982;72:849-52</i></p>	<p>CPR trainees completed an 8 hour, 3 session or 4 hour single session course and were studied for skill and cognitive retention 1 year after certification.</p>	<p>Knowledge and performance scores were significantly higher for trainees from the long course but performance skills for both groups were below certification levels when compared with AHA standards.</p>	<p>There is a need to further evaluate course components which could improve retention for all trainees.</p>
<p>Mandel LP, Cobb LA* Initial and long-term competency of citizens trained in CPR <i>Emerg Health Serv Quart 1982;1:49-63</i></p>	<p>Lay people were trained in a 3 hour course to perform CPR at an acceptable level when tested immediately after class. They were later retested to assess retention.</p>	<p>By 1 year, retention of most CPR skills was poor. The 10-15 min required for retention testing improved performance on subsequent retention testing. A 1 hour review class significantly improved competency in almost all procedures, raising it to post training levels.</p>	<p>Although lay people can learn CPR, intervention can help maintain proficiency.</p>
<p>Fossel M, et al Retention of cardiopulmonary resuscitation skills by medical students <i>J Med Educ 1983;58:568-75</i></p>	<p>A group of preclinical medical students received CPR certification 2-3 weeks (group 0), 1 year (group 1) or 2 years (group 2) prior to assessment of CPR performance and knowledge. Practical and written examinations were conducted.</p>	<p>There was a higher rate of failure to perform adequate CPR by groups 1 and 2 compared with 0 (p<0.05). There was no significant difference in failure rates between 1 and 2. The most frequent errors related to chest compression rate and compression to ventilation ratio. Written test scores were higher in group 0 than 1 or 2 (p<0.001).</p>	<p>Written examination scores were not reliable predictors of CPR skill in individual cases.</p>
<p>Gass DA, Curry L Physicians' and nurses' retention of knowledge and skill after training in cardiopulmonary resuscitation <i>Can Med Assoc J 1983;128:550-1</i></p>	<p>Physicians and nurses who successfully completed a 1 day training programme in basic life support CPR were retested 6 and 12 months after training.</p>	<p>Both groups initially had the same level of knowledge of CPR but physicians learned significantly more and retained it longer. After training, nurses were involved much more in CPR incidents, providing basic life support. Physicians' involvement remained at the same level and was limited to advanced life support. By 12 months scores in both groups were similar to pretraining</p>	<p>Practice with feedback is necessary during the 1 year period before retraining and recertification. The 2 groups may require different training programmes.</p>

		scores.	
Martin WJ, et al CPR skills: achievement and retention under stringent and relaxed criteria <i>Am J Public Health 1983;73:1310-2</i>	33 health professional students underwent CPR training. Their ability to deliver effective CPR was assessed immediately and 3 months after training, the latter unsuspected. Performance using AHA standards was compared with that using relaxed criteria.	Statistically significant declines were noted in psychomotor skills.	Current lengths of training sessions, duration of recertification and application of AHA standards may require re-evaluation.
Wilson E, et al CPR skills retention of lay basic rescuers <i>Ann Emerg Med 1983;12:482-4</i>	950 telephone company personnel were trained and tested at the basic rescuer level on recording manikins. A random group of 40 was retested without warning on a recording manikin, at least 9 months after training. Skill retention was measured by comparing tapes from training and retesting.	40% of those retested were able to perform effective ventilations and compressions with 60-70% average retention. 11 individuals retested at 13-14 months did not perform better than those retested later. The group that performed effectively on average were younger and had first aid training in addition to CPR training.	Lay basic rescuers should be retrained in the first year; further studies of the factors influencing retention are advisable, the younger age groups should be the first priority for citizen CPR training; as first aid training appears to improve CPR retention, training in both should be encouraged.
Friesen L, Stotts NA Retention of basic cardiac life support content: the effect of two teaching methods <i>J Nurs Educ 1984;23:184-91</i>	63 nursing students were assigned to one of 2 teaching methods - lecture demonstration-return demonstration or self-paced. AHA instructional materials and cognitive and performance tests were used for both groups, tests being conducted at 2 and 8 weeks.	Cognitive knowledge was retained at a mastery level by both groups at 8 weeks. There was no difference in retention of performance skills between teaching methods. Neither group was able to demonstrate retention of performance skills at mastery level. Self-paced subjects spent less time in BCLS learning activities. The self-paced instructional package was more costly on a one time basis.	Repeated application of the self-paced instructional package would reduce the cost per student.
Nelson M, Brown CG CPR instruction: modular versus lecture course <i>Ann Emerg Med 1984;13:118-21</i>	A randomised prospective study was conducted on students who entered a self taught modular course or took a standard lecture course. Cognitive and motor skills were tested at 1, 2 and 4 year intervals after training. Half the students on both courses took a refresher course after 1 year.	There was no difference in retention based on method of teaching ($p>0.05$). Students who took the refresher course performed better at the 2 year interval ($p<0.01$). After 4 years, results were uniformly poor in both groups. Only 3 of 104 students were able to meet AHA standards for performing CPR.	Refresher courses are vital if CPR is to be performed effectively. They should be available on a continuing basis with self taught courses providing a good alternative to formal didactic courses.
Edwards MJA, Hannah KJ* An examination of the use of interactive videodisc cardiopulmonary resuscitation	A pilot study was carried out on 65 lay people divided into 2 groups taught CPR using either an AHA interactive videodisc system or by traditional	At 3 months scores for tests of cognitive knowledge varied from 71-100%. The passing performance rate for skills was 20% for the traditional group and 37% for	There was no significant difference in retention of knowledge and skills between those trained using a videodisc system and those taught by traditional

instruction for the lay community <i>Computers in Nursing 1985;3:250-2</i>	instruction. Cognitive knowledge and skills were tested immediately after training, then at 3 months and 1 year.	the videodisc group. At 1 year scores for tests of knowledge varied from 48-100% and no one passed the skills test.	instruction.
Mancini ME, Kaye W The effect of time since training on house officers' retention of cardiopulmonary resuscitation skills <i>Am J Emerg Med 1985;3:31-2</i>	33 medical residents who were taught CPR by the same instructor were tested, without warning, up to 1 year or more than 1 year after training, for 1 person CPR on a recording manikin. Performance was evaluated according to AHA Heartsaver criteria. Analysis was carried out on assessment skills (ventilation and compression etc) and sequence (calls for assistance etc).	Knowledge of CPR sequence remains stable and assessment improves while skill performance deteriorates after 1 year.	Assessment may improve because of involvement in actual resuscitations. Deterioration of skills may reflect that senior residents do not actually perform CPR but become team leaders and lose their skills. If 2 year certification is continued, testing of CPR skills at least every 12 months should be considered. If skills have deteriorated, hands on practice should be undertaken at that time.
McKenna SP, Glendon AI* Occupational first aid training: Decay in cardiopulmonary resuscitation (CPR) skills <i>J Occup Psychol 1985;58:109-17</i>	124 occupational first aiders were tested on their ability to carry out CPR at varying times, up to 3 years, after training. The assessment was based on printouts from a recording manikin.	Only 12% of those tested were capable of performing effective CPR. The success rate after 3 years was 2%. There was a rapid and linear decay in CPR skills over time with fewer than 20% of subjects scoring 75% on performance after only 6 months. Age, sex, height, weight and practice on a manikin were not found to influence performance.	Despite drawbacks in the design of the study, it is clear that retraining in CPR skills should be more frequent than the 3 years recommended by current industrial first aid legislation.
Van Kalmthout PM, et al Evaluation of lay skills in cardiopulmonary resuscitation <i>Br Heart J 1985;53:562-6</i>	166 lay people attending a short CPR course were evaluated according to AHA standards. Evaluation was carried out using a recording manikin pre and immediately post course as well as 6 months after training.	No participant could perform CPR before the course. Theoretical knowledge was good at the end of the course and at 6 months. After the initial course, 65% of subjects could adequately ventilate and compress a manikin. 44% could perform adequate resuscitation after 6 months. There was no difference in performance with gender or age. Comparison of data from the recording manikin with AHA standards showed only a few participants could perform CPR correctly. A large discrepancy between self, subjective and objective assessment of CPR knowledge and performance was found.	The importance of a rapid diagnosis, an immediate call for help, an adequate rate of cardiac massage and a reduction in time needed for ventilation should be emphasised on these courses. Refresher courses should be provided at least twice a year.

<p>Kaye W, Mancini ME Retention of cardiopulmonary resuscitation skills by physicians, registered nurses, and the general public <i>Crit Care Med 1986;14:620-2</i></p>	<p>Single rescuer CPR skills of 21 medical residents (MRs), 17 registered nurses (RNs) and 21 lay people were tested using a recording manikin and AHA criteria. All subjects were trained 4-12 months before testing.</p>	<p>None of the MRs or RNs and only 1 lay person performed each step correctly and in the proper order. There were no significant differences between MRs and RNs. MRs and RNs did better than lay people in assessment ($p<0.01$), but some individuals in each group initiated ventilations and compressions without assessing need. All groups were poor at performing ventilations. MRs and RNs were better than lay people at compressions ($p<0.01$) but all had difficulty with the rate and depth of compression. Only one third of lay people demonstrated correct hand placement.</p>	<p>Despite more training and experience, performance of MRs and RNs was comparable to lay people.</p>
<p>Sefrin P, Schafer R Resuscitation by laymen? <i>Anasth Intensivther Notfallmed 1986;21:273-9</i></p>	<p>647 lay people were studied for skill retention after undergoing first aid training. 198 EMTs were also studied following training in CPR.</p>	<p>60% of lay people were able to recognise the signs of respiratory failure and to assess the situation correctly. 35% of those who had been trained 2 years prior to the test were able to properly check respiration. Performance of ventilations was deficient. 1 year after training, 30% had difficulty positioning the head correctly. More than 2 years after training, 39% of lay people could insufflate a sufficient tidal volume. In the study of EMTs, 53% had sufficient theoretical knowledge. 40% could efficiently carry out single person BLS and 55%, the two person method.</p>	<p>Once only instruction of bystanders is not sufficient for providing them with an appropriate level of knowledge for handling emergencies. It is proposed to introduce compulsory and continuing instruction as a progressive teaching schedule, especially to young people, in first aid. Methods of CPR will be incorporated into this programme.</p>
<p>Curry L, Gass D Effects of training in cardiopulmonary resuscitation on competence and patient outcome <i>CMAJ 1987;137:491-6</i></p>	<p>Retention of CPR knowledge and skills was assessed in 31 physicians and 54 nurses. Tests were conducted before and immediately after training as well as at 6 and 12 months.</p>	<p>6 months after training there was no difference in CPR knowledge or skills between groups. In both groups CPR skills had deteriorated to near pretraining levels. By 6 months, physicians' knowledge was not significantly different from pretraining levels. Nurses maintained an improvement in knowledge test scores at 12 months compared with pretraining levels</p>	<p>-</p>

		(p=0.037). Experience with CPR did not contribute to post training knowledge or skills in either group.	
Mandel LP, Cobb LA Reinforcing CPR skills without mannequin practice <i>Ann Emerg Med 1987;16:1117-20</i>	67 subjects trained 1 year earlier were pretested then randomly assigned to 1 of 2 treatments covering 1 rescuer CPR - reading a 3 page review or viewing a 15 min videotape. Testing was carried out using a recording manikin immediately after the refresher.	Pretest scores were low on almost all skills. After treatment, both groups showed improvement (p<0.01), especially on checking the carotid pulse, correct hand position and ventilation volume. Compression rate was performed better after viewing the videotape (p<0.05) but there was virtually equivalent improvement on other skills regardless of treatment.	Both methods showed promise for reversing skills degradation without practising on a manikin.
Ruddick-Bracken H, et al* Recall of first aid knowledge and skills <i>Occup Health 1987;March:91-2</i>	A pilot study was carried out on 50 randomly selected people attending a training centre for refresher courses in first aid, 2-3 years after initial training. They were questioned on aspects of first aid before they started the refresher training.	4% had sufficient knowledge and skills to make examiners feel they could respond adequately in an emergency. 62% remembered part of the essential material. 34% recalled very little essential first aid. 24 subjects had received some in service training but the others did nothing to keep their basic skills fresh. Very few subjects could deal adequately with an unconscious patient, carry out CPR or arrest haemorrhage.	Evidence from study data suggests an initial 4 day first aid at work training course followed by a short refresher course every 3 years is inadequate. When skills are not constantly practised they are easily forgotten. Theoretical and practical skills should be regularly practised by qualified first aiders - at least yearly.
Plank CH, Steinke KR* Effect of two teaching methods on CPR retention <i>J Nurs Staff Develop 1989;May/June:145-7</i>	37 registered nurses were trained in CPR either by traditional instruction with reinforcement or by videotape independent practice. Cognitive knowledge and psychomotor skills were tested immediately after training and 6-8 weeks later.	Knowledge retention was greater in the group that received traditional instruction with reinforcement. 33% of this group and 20% of the videotape group passed a CPR performance test, a difference which was not statistically significant.	Methods of teaching CPR should provide short, frequent exposure to correct CPR.
Van Kerschaver E, et al The effectiveness of repeated cardiopulmonary resuscitation training in a school population <i>Resuscitation 1989;17:211-22</i>	265 students from 4 different school levels were trained in CPR. 6 months later, 134 answered a questionnaire and were retrained while another 129 answering the same questionnaire were tested for CPR skills. 10 months later 75 students who had received 2 training sessions answered the same	Repeated training induces significant improvement of total skill scoring without significant difference between boys and girls, but with improvement of scoring with class level. Scoring was most impressive in certain steps which scored poorly after 1 training session, such as tilting the head. Ventilations and compressions, 10 months	The observation that knowledge of CPR did not increase significantly after 2 training sessions may have been influenced by the time lapse of 10 months after the second session. The methodology excluding interactive instruction, may also explain this discrepancy.

	questionnaire and 65 of these subjects were tested for CPR skills. The 2 training sessions were identical, given by lay teachers instructed in CPR and consisted of a video programme, practical demonstration and individual practice on manikins. Each session lasted 100 min. Skills were evaluated by emergency physicians not involved in the training.	after the second training, averaged 80% correct after 2 sessions compared with 72% correct after 1 session. Knowledge of CPR did not increase significantly after 2 training sessions.	
Yakel ME* Retention of cardiopulmonary resuscitation skills among nursing personnel: What makes the difference? <i>Heart and Lung 1989;18:520-5</i>	106 nurses attended a BLS course and their CPR skills were tested 4 and 8 months later using a manikin.	Mean scores were 38/55 and 42/55 at 4 and 8 months respectively. 69 and 56% of nurses at 4 and 8 months did not follow the correct CPR sequence. More detailed training improved retention. Retention was not influenced by practise of skills or previous CPR training.	There is a need for review or recertification or both, more often than annually, especially for nurses caring for high risk populations.
Moser DK, et al Cardiopulmonary resuscitation skills retention in family members of cardiac patients <i>Am J Emerg Med 1990;8:498-503</i>	31 subjects trained in CPR were given retention packets 3 and 6 months after training. 16 subjects were tested for CPR retention 7 months after initial training and 15 at 12 months.	There were no differences between the 7 and 12 month groups as overall CPR retention was poor. 19% of subjects reported using the retention packet. There were significant differences in retention between those who practised compared with those who did not.	These findings emphasise the importance of promoting practise/ review after initial CPR training for family members of cardiac patients.
Seraj MA, Naguib M Cardiopulmonary resuscitation skills of medical professionals <i>Resuscitation 1990;20:31-9</i>	224 medical personnel and medical students who attended a BCLS course were given 15 MCQs as a pre-test and the same questions in a different sequence were completed post-test. The ability of each candidate to perform single person CPR was assessed using a recording manikin.	Anaesthesiologists and cardiologists showed the best level of theoretical knowledge, followed by GPs and paramedics. Physicians, surgeons, paediatricians and medical students had comparable scores. No candidate performed all CPR steps correctly in the proper sequence. The manikin performance of all groups was poor. Nevertheless, the course improved theoretical knowledge ($p<0.0001$), performance in CPR steps and manikin performance ($p<0.0005$, for both). Experience and prior CPR training influenced the degree of retention of theoretical knowledge only ($p<0.001$),	No assumption based on previous clinical knowledge should be made for the expected CPR performance of all doctors, regardless of specialty. Formal training programmes in medical schools should be considered. Training is the only objective way to improve the performance of all the candidates.

<p>Coleman S, et al Comparing methods of cardiopulmonary resuscitation instruction on learning and retention <i>J Nurs Staff Dev 1991;7:82-7</i></p>	<p>49 subjects were randomly assigned to either didactic instruction or modular instruction in CPR. Knowledge retention was evaluated by means of a written examination. Skill retention was assessed by the 'Mandel observation instrument'.</p>	<p>The knowledge and skills performance of both groups immediately and 3 months after training, were not significantly different.</p>	<p>Modular instruction appears to be an effective alternative to the conventional time consuming and expensive method commonly used for CPR instruction.</p>
<p>Kaye W, et al The problem of poor retention of cardiopulmonary resuscitation skills may lie with the instructor, not the learner or the curriculum <i>Resuscitation 1991;21:67-87</i></p>	<p>An investigation of what actually occurs during a CPR course was carried out.</p>	<p>Despite clearly defined curricula, instructors did not teach in a standardised way. Practice time was limited and errors in performance not corrected. Instructors consistently rated students' overall performance as acceptable but using the same checklist, the researchers consistently rated performance as unacceptable. Despite this, students and instructors were satisfied with the courses and believed the level of performance was high.</p>	<p>Poor retention of CPR skills may lie with the instructor, not the learner or curriculum. As lives are saved with bystander CPR, does documented poor retention matter? Perhaps instructor training should be improved to make certain students receive adequate practice time and accurate skill evaluation. Maybe the criteria for correct performance when testing retention should be modified. These should be based on the minimum CPR skills needed to sustain life before ACLS is available.</p>
<p>Cullen MC* First aid retention of knowledge survey <i>HSE 1992 Research Paper 32 ISBN 0 11 886380 0</i></p>	<p>Newly qualified workplace first aiders (n=268) were given a questionnaire, without warning, to assess their first aid knowledge. The study population contained first aiders who had received their training 6, 12, 18, 24 or 30 months before completion of the questionnaire. Questions covered a broad area of first aid treatment, use of equipment and relevance of signs and symptoms. Responses were scored, the maximum possible score being 22. First aiders were given feedback on their answers so any mistakes were explained and correct information given.</p>	<p>The top score was 18. 11 scored 15 or more; 100, 11-14; 140, 5-10; 17, <5 marks. Ageing did not greatly influence the results. There was some evidence of a progressive decline in first aid knowledge with time since first aid training was completed. 46% of responders within one year of training were able to score more than 10 marks. Many first aiders did not look at their first aid manuals regularly or at all.</p>	<p>The results suggest there is a rapid decline in first aid knowledge after initial training. This occurs well before the current 3 year interval before refresher training is required in first aid at work. Further research is needed to explore reasons for this deterioration. More research is also required on first aid training, particularly the interval between refresher courses.</p>
<p>Goodwin AP Cardiopulmonary resuscitation</p>	<p>The CPR knowledge and skills of 50 junior hospital doctors was assessed by</p>	<p>40% of the group passed both tests. Doctors who had received regular CPR</p>	<p>Junior doctors should undergo CPR training every 6 months in order to</p>

training revisited <i>J R Soc Med 1992;85:452-3</i>	MCQ and use of a manikin.	training performed better on the practical test than those who had not ($p<0.05$). Theoretical knowledge was unrelated to previous training.	maintain their practical skills.
Hussain I, et al Cardiopulmonary resuscitation skills of dental personnel <i>Br Dent J 1992;173:173-4</i>	The CPR knowledge and skills of 25 dental personnel were tested by MCQ and recording manikin. The assessment was based on recommendations of the RC(UK).	13 subjects passed the MCQ examination but all failed the practical assessment.	More emphasis should be placed on CPR instruction in undergraduate dental courses. Regular update courses are advisable to maintain CPR skill.
Moore PJ, et al A study of school students' long term retention of expired air resuscitation knowledge and skills <i>Resuscitation 1992;24:17-25</i>	A group of 102 secondary school students, half of whom had received training in EAR 5 years previously, were studied. Their knowledge of EAR procedures and ability to carry out the procedures were evaluated.	The trained students performed better in practical tasks than untrained students. There was little difference in theoretical knowledge but the trained students did perform better on a number of questions.	-
Wynne G, et al* Instructors - a weak link in resuscitation training <i>J Royal Coll Phys London 1992;26:372-3</i>	A group of 31 trainers attending a 2 day training course was tested for basic life support skills before and after training. They last attended a training course, on average, 12.5 months previously. Skills were assessed using a recording manikin. Data were analysed using guidelines from the RC(UK). The relationship between trainers' confidence and actual skill was also examined.	Practical basic life support skills prior to training were poor and were still inadequate after training.	There is an urgent need for formal instructor training. The training programme should be evaluated, as should the performance of trainers and trainees, to ensure all have acquired the necessary skills. There is a need for regular refresher training to aid retention.
Berden HJJM, et al* How frequently should basic cardiopulmonary resuscitation training be repeated to maintain adequate skills? <i>BMJ 1993;306:1576-7</i>	141 of 180 nurses from non-cardiac wards agreed to being randomly assigned to having reinstruction in CPR at intervals of 3, 6 or 12 months. At the first training session, subjects were asked to perform resuscitation on a recording manikin. They were then given instruction in CPR according to the standards of the DHF. Immediately after they performed another resuscitation attempt. They were then asked to return every 3, 6 or 12 months to perform resuscitation and to attend a refresher	96 nurses completed the 12 month study. After the first instruction session, baseline skills in all groups were similar. All groups scored significantly higher numbers of penalty points just before the second reinstruction when compared with reference scores, indicating a decline in skills. After reinstruction, skills improved and were maintained during subsequent testing of those in the 3 and 6 month groups. The distribution of scores within every group was consistent over time. No correlation was found between	The results suggest resuscitation skills are maintained at a stable level by 3 or 6 monthly refresher courses. An interval of 12 months is probably too long as for most of that time a person's skills would be insufficient. Any influence of instructors on skill retention was eliminated by rotating instructors and giving them regular retraining.

	course. The quality of resuscitation was scored by applying penalty points for aberrations from the normal values of variables which characterise resuscitation skills according to the guidelines of the AHA.	participants' scores or pattern of scores over time and their gender, age, working experience, number of actual resuscitation attempts attended or number of training courses received.	
Lewis FH, et al Revisiting CPR knowledge and skills among registered nurses <i>J Contin Educ Nurs 1993;24:174-9</i>	73 registered nurses from 3 general hospitals were studied to assess what factors were involved in retention of CPR cognitive knowledge and psychomotor skills.	Cognitive knowledge was adequately retained but skills were not. The number of CPR courses taken, certification as a CPR instructor, number of years certified and time since last certification, were significantly related to skill scores.	The findings prompt questions of appropriateness of the usual certification procedures for hospital based registered nurses.
O'Donnell CM, Skinner AC An evaluation of a short course in resuscitation training in a district general hospital <i>Resuscitation 1993;26:193-201</i>	100 nurses underwent a short course in CPR comprising a short lecture and practical training. Subjects were then divided into 3 groups which underwent either monthly refresher sessions, a single refresher at 3 months or no refresher, prior to retesting of all subjects at 6 months.	Initial training improved theoretical knowledge but failed to achieve a uniformly high standard of practical skill. Knowledge and skills declined in all 3 groups. Theoretical knowledge was better preserved in groups having refresher training. Frequent refresher training failed to improve poor initial performance in practical skills.	-
Berden HJ, et al Resuscitation skills of lay public after recent training <i>Ann Emerg Med 1994;23:1003-8</i>	A cross sectional assessment of practical CPR skills was undertaken in a group of 151 lay people who were trained twice in the preceding 20-24 months. The assessment was based on 6 recorded variables that described the quality of CPR techniques in the training situation.	33% of participants were able to perform adequate CPR.	Practical skills in basic CPR after a 12 month training interval are insufficient in the majority of lay people. There needs to be better tailored instruction programmes with emphasis on regular, frequent refresher courses.
Fabius DB, et al Recertification in cardiopulmonary resuscitation. A comparison of two teaching methods <i>J Nurs Staff Dev 1994;10:262-8</i>	70 subjects were randomly assigned to either a traditional or computer method of instruction. Knowledge was evaluated by written examination. Psychomotor skills were assessed by a BCLS certified instructor (control group) or the computer (experimental group) and reevaluated by an instructor at a 6 month interval.	There was no significant difference between the groups in knowledge or performance scores. Significant differences in time spent, learner satisfaction, and pass/fail rate all favoured the traditional method of instruction.	The results conflict with those of other studies on the use of the computer interactive learning system.
Sefrin P, Paulus T	The skills and competence of nursing	7% of subjects were found to have good	CPR skills of hospital nurses are

<p>Resuscitation skills of hospital nursing staff <i>Anaesthetist 1994;43:107-14</i></p>	<p>staff attending 53 CPR refresher courses were examined, according to standards of the GMA. The efficacy of compressions and ventilations was recorded.</p>	<p>skills in artificial ventilation. Attempts at resuscitation made by 59% were completely inadequate. 14% carried out effective cardiac massage but 45% failed to do so. Only 1% were able to perform all standard CPR procedures as recommended by the guidelines. The results were not influenced by nurses' educational or professional status, clinical CPR experience or work area within the hospital.</p>	<p>inadequate mainly because of a lack of manual dexterity. The skills learned in CPR courses are lost after a relatively short time. However, these results do not suggest completely inadequate handling of CPR procedures in the hospital setting. Refresher courses in CPR should be made obligatory for nursing staff every 2 years.</p>
<p>Brennan RT, Braslow A Skill mastery in cardiopulmonary resuscitation training classes <i>Am J Emerg Med 1995;13:505-8</i></p>	<p>Skill levels of 48 trainees who were taught CPR in 'ARC: Adult CPR' classes offered at a work site, were assessed. Competence was evaluated with a validated skill checklist and a manikin.</p>	<p>Only 1 in 10 of the trainees could correctly perform all 12 CPR skills on the checklist. Fewer than 12% of all compressions met published standards and fewer than 25% of ventilations met the standards as evaluated by the manikin. Videotape recordings of the practice sessions showed that instructors overlooked many errors in CPR performance and that trainees provided little corrective feedback to one another.</p>	<p>The role of instructors in assisting CPR skill practice and in evaluating skill mastery is questioned.</p>
<p>Bjorshol CA Cardiopulmonary resuscitation skills. A survey among health and rescue personnel outside hospital <i>Tidsskr Nor Laegeforen 1996;116:508-11</i></p>	<p>Practical skills and theoretical knowledge in lifesaving first aid were assessed among 45 police officers, 46 firemen, 57 nurses and 42 GPs. Without warning, participants were asked to 'revive' a manikin. They were then questioned about specific emergency medical situations, how they assessed their own achievement and when they last had training in CPR.</p>	<p>Only 1% were able to perform CPR according to accepted guidelines. 50% believed they were efficient in first aid. Those who had been trained in first aid during the previous year achieved significantly better results than the rest.</p>	<p>Health and rescue workers outside hospital only follow the ERC guidelines on basic CPR to a small degree. This situation can be improved by more regular training.</p>
<p>Broomfield R A quasi-experimental research to investigate the retention of basic cardiopulmonary resuscitation skills and knowledge by qualified nurses following a course in professional development</p>	<p>19 qualified nurses undertook a refresher course in CPR. Using guidelines issued by the RC(UK), an 8 point skills testing observation tool and a 26 point knowledge testing questionnaire were designed and used to test subjects.</p>	<p>The update in CPR skills showed an initial improvement but then a significant decline in retention of skills was seen 10 weeks later. Similar findings were observed for retention of knowledge.</p>	<p>Retention of skills and knowledge quickly deteriorates if not used or updated regularly. This research supports the importance of regular refresher courses.</p>

<i>J Adv Nurs 1996;23:1016-23</i>			
<p>Morgan CL, et al* Effectiveness of the BBC's 999 training roadshows on cardiopulmonary resuscitation: video performance of cohort of unforwarned participants at home six months afterwards <i>BMJ 1996;313:912-6</i></p>	<p>A cohort study of 280 people aged 11-72 years was undertaken. Subjects were trained in CPR by BBC's 999 training roadshows. 6 months later all participants were visited at home without warning and asked to perform CPR on a manikin while being videoed. The videos were then analysed for effectiveness and safety.</p>	<p>At 6 months, 7% of trainees were able to perform effective and safe CPR. Better performances were recorded by those under 45 years ($p<0.05$), those who had attended a subsequent CPR course ($p<0.0001$) and those confident in their initial ability ($p<0.005$). Females were less likely than males to perform procedures in a harmful way ($p<0.005$).</p>	<p>Television is an effective means of generating large training cohorts. Volunteers will cooperate with the realistic simulation of being tested in their homes without warning. Performance of CPR was disappointing but retraining greatly improves performance.</p>
<p>Pettifer S* Maintaining first aid skills, a question of time? <i>Occup Health 1996;April:126-8</i></p>	<p>A study group of 36 qualified first aiders was formed from several military establishments. 12 qualified at 2 months, 12 at 1 year and 12 at 2 years prior to the study. Subjects underwent a spot check of CPR skills according to RC(UK) standards, using a manikin. They were also asked to complete a questionnaire which in part required information on what first aid procedures had been carried out since qualifying. Feedback was given to first aiders following the test. A separate group of 4 first aiders who had received annual first aid training was given the same test as the main group.</p>	<p>No first aider scored 100% but 2 only missed one action. There was a statistically significant deterioration in performance from 2 months to 2 years but not between 1 and 2 years. In reality, the first aiders rarely carried out resuscitation. The 4 first aiders who underwent annual training were nearly 100% proficient in their CPR skills and some were well into the 12 month period.</p>	<p>First aiders have little cause to regularly put their knowledge into practice. They undertake no regular personal revision from their manuals. Consequently, their skills start to deteriorate rapidly. The results show a serious deterioration in knowledge and skills of first aiders 2 years after training. Refresher training is needed prior to the 2 year point, probably on an annual basis.</p>
<p>Braslow A, et al CPR training without an instructor: development and evaluation of a video self-instructional system for effective performance of cardiopulmonary resuscitation <i>Resuscitation 1997;34:207-20</i></p>	<p>Performance of CPR skills immediately following video self instruction (VSI) was compared with that immediately following traditional classroom instruction (TCI). VSI used a 34 min training tape and an inexpensive manikin. Methods were compared using an instrumented manikin, a valid skill checklist and an overall competency rating.</p>	<p>Compared with TCI, VSI subjects performed more compressions, ventilations and assessment and sequence skills correctly (all $p<0.001$). TCI subjects delivered twice as many compressions that were too shallow and underinflated the lungs twice as often. VSI subjects were rated competent or better 80% of the time compared with 45% for TCI subjects ($p<0.001$). TCI subjects were rated as 'not competent' in performing CPR nearly 10 times more often as those in the VSI group</p>	<p>VSI has the potential to reach individuals unlikely to participate in TCI because of its greater convenience, lower cost and reduced training time (30 min for VSI, 3-4 hours for TCI).</p>

		(p<0.001). Subjects aged 40 years and over performed better after VSI than TCI. Superior skill performance in the VSI group persisted 60 days following training.	
Lester CA, et al* Assessing with CARE: An innovative method of testing the approach and casualty assessment components of basic life support, using video recording <i>Resuscitation 1997;34:43-9</i>	67 members of the public were trained in CPR. 27 were assessed shortly after instruction and 40, 6-18 months later. Tests were conducted without prior warning and video recorded for independent scoring by 2 researchers and a paramedic training officer.	Those recently trained were less likely to omit a component and more likely to perform it as taught than those trained 6-18 months previously. At 6-18 months 7% of subjects shouted for help, 15% cleared the airway and 13% phoned for an ambulance.	Video recording and marking using the CARE schedule and guidelines is a reliable method for assessing the preliminary steps in life support.
Noordergraaf GJ, et al Learning cardiopulmonary resuscitation skills: does the type of mannequin make a difference? <i>Eur J Emerg Med 1997;4:204-9</i>	In a blind, prospective, controlled study, the CPR skills of 165 trainees were assessed. One cohort used their own individual torso manikins and the other shared a sophisticated recording manikin between 4-5 trainees.	No major differences between manikins were found when using the 'Berden scoring system'. Trainees preferred individual manikins.	The use of individual manikins in conjunction with a sophisticated manikin neither results in trainees learning incorrect skills nor in significant improvement. Further analysis of training in lay person CPR courses and evaluation of course didactics to optimise training time, appear indicated.
Wenzel V, et al Poor correlation of mouth-to-mouth ventilation skills after basic life support training and 6 months later <i>Resuscitation 1997;35:129-34</i>	The CPR skills of medical students were assessed after a 2 hour BLS class (n=129) and 6 months later (n=113).	The mean written test score decreased from 6.4 to 6.2 (p=0.03). Ventilation skills were unpredictable. There was only a 5% chance that a given student would achieve the same ventilation performance in both the BLS class and 6 months later. Stomach inflation occurred repeatedly.	Teachers of BLS classes need to consider the respiratory mechanics of the CPR manikin being used to ensure clinically realistic and appropriate ventilation skills.
Brennan RT, Braslow A Skill mastery in public CPR classes <i>Am J Emerg Med 1998;16:653-7</i>	226 subjects were enrolled in CPR classes offered to the public by the ARC and AHA. Effectiveness of CPR performance was evaluated immediately after training by trained, independent observers using validated measures and procedures. An instrumented manikin was used to assess ventilations and compressions, applying standards of the AHA.	50% of subjects performed 2% or fewer compressions correctly and 50% performed 10% or fewer ventilations correctly. 65% failed to achieve a compression rate of 80-100/min. 45% failed to open the airway prior to a breathing check. 50% did not adequately assess breathing and 53% did not perform an adequate pulse check. Nearly half of subjects made at least 4 errors in assessment and sequencing of skills.	According to published criteria, trainee performance of CPR is poor. Failure in critical skills may contribute to poor survival following out of hospital cardiac arrest. CPR training programmes must be developed with attention to learner outcomes.

<p>Donnelly PD, et al* Evaluating CPR performance in basic life support: the VIDRAP protocol <i>Resuscitation 1998;36:51-7</i></p>	<p>The study was carried out during validation of an evaluation tool designed to assess the potential value to a casualty of a simulated resuscitation. 24 subjects were tested on the day of training and 18 between 6-18 months after training. Subjects were asked to perform BLS on a recording manikin while being videoed. Printouts and video tapes were analysed according to ERC guidelines. Effectiveness of CPR was categorised according to a system developed from the BBC 999 roadshows.</p>	<p>For all components of CPR, the performance of newly trained subjects was significantly superior to those trained 6-18 months previously, except for compression depth. 67% and 22% respectively, were considered to be ERC standard or effective ($p<0.01$). However, these figures were reduced to 33% and 11% respectively, for effective CPR with no injurious elements.</p>	<p>Video and manikin printout obviate the necessity for decision making under pressure which may lead to observer errors.</p>
<p>Handley JA, Handley AJ* Four-step CPR - improving skill retention <i>Resuscitation 1998;36:3-8</i></p>	<p>48 lay volunteers were given instruction in CPR. 24 were taught the standard 8-step sequence and the other 24 were taught a simplified 4-step sequence. Tests of performance were carried out on a manikin before and after training.</p>	<p>Those in the 4-step group were better than those in the 8-step group at remembering the sequence of skills immediately after training ($p=0.04$), 1 week later ($p<0.001$) and at 6 weeks ($p<0.001$). 23/24 in the 4-step group got the sequence correct each time they were tested, in contrast to 2/24 in the 8-step group. There was no difference in the quality of performance of the skills between the 2 groups. The 4-step sequence potentially resulted in a useful reduction in the time taken before a rescuer calls for the emergency services and starts CPR.</p>	<p>Further discussion and research is needed to decide whether such a radical change in teaching should be introduced.</p>
<p>Kaepler G, et al Quality of cardiopulmonary resuscitation by dentists in dental emergency care <i>Mund Kiefer Gesichtschir 1998;2:71-7</i></p>	<p>A group of 96 participants at a dental surgery congress were divided into 4 groups: experienced or inexperienced in clinical emergencies or with dummies. A recording manikin was used and after analysis of individual errors, the success of new instruction was assessed. The study was based on standards of CPR issued by the AHA.</p>	<p>Good previous knowledge was identified. Subjects demonstrated post-instruction improvement in all subgroups except that without practice on dummies.</p>	<p>Although the results were encouraging, participants were found to be in need of further education and training in diagnostics and certain CPR procedures. Regular courses should be targeted at specific aspects of CPR.</p>
<p>Todd KH, et al Randomized, controlled trial of video self-instruction versus traditional</p>	<p>Medical students were randomly assigned to a 34 min video self instruction (VSI) programme (n=42) or</p>	<p>VSI trainees displayed superior overall performance compared with traditional trainees. 43% of traditional trainees were</p>	<p>If validated by further research, VSI may provide a simple, quick and inexpensive alternative to traditional</p>

<p>CPR training <i>Ann Emerg Med 1998;31:364-9</i></p>	<p>an AHA Heartsaver CPR course (n=47). 2-6 months after training, students were tested to determine their ability to perform CPR in a simulated cardiac arrest setting. Blinded observers used explicit criteria to assess CPR performance skill. Written tests of CPR related knowledge and attitudes were also completed.</p>	<p>judged not to be competent in performance of CPR compared with 19% of those in the VSI group.</p>	<p>CPR instruction for health care workers and perhaps the general population.</p>
<p>Liberman M, et al* Cardiopulmonary resuscitation: errors made by pre-hospital emergency medical personnel <i>Resuscitation 1999;42:47-55</i></p>	<p>The CPR skills of EMTs, firemen, emergency first responders and CPR instructors, were evaluated using a recording manikin. The tests were videotaped for later viewing and for correlating the errors with the data. All 66 subjects had completed a recertification course within the last 2 years. All participants were required to fill in a questionnaire.</p>	<p>The most frequent errors were observed in landmarking, overcompression, palpating the carotid pulse and insufficient ventilation. 26% of compressions, 40% of ventilations and 45% of carotid pulse checks were performed correctly.</p>	<p>A high rate of errors occurred in the CPR provided by emergency health care professionals.</p>
<p>Todd KH, et al Simple CPR: A randomized, controlled trial of video self-instructional cardiopulmonary resuscitation training in an African American church congregation <i>Ann Emerg Med 1999;34:730-7</i></p>	<p>A randomised, controlled trial was conducted among congregational volunteers in an African American church. Subjects were randomly assigned to receive either 34 min of video self instruction (VSI) or a 4 hour AHA Heartsaver CPR course. 2 months after training, blinded observers used explicit criteria to assess CPR performance in a simulated cardiac arrest setting. A recording manikin was used to measure ventilation and compression characteristics. Participants also completed a written test of CPR related knowledge and attitudes.</p>	<p>VSI trainees displayed a comparable level of performance to traditional trainees. 40% of VSI trainees were judged competent or better in performing CPR compared with 16% of traditional trainees. Scores were similar between groups on tests of CPR knowledge and attitudes.</p>	<p>VSI can produce CPR comparable in quality to that achieved by traditional training methods. VSI provides a simple, quick, consistent and inexpensive alternative to traditional CPR instruction, and may be used to extend CPR training to historically underserved populations.</p>
<p>Assar D, et al* Randomised controlled trials of staged teaching for basic life support 1. Skill acquisition at bronze stage</p>	<p>In a controlled, randomised trial of 495 trainees, performance in tests immediately after training was compared between those who received a</p>	<p>A careful approach was followed by slightly more trainees in the conventional group while appreciably more in the bronze group remembered to shout for help (44 v</p>	<p>Differences occurred as a direct consequence of ventilation being required in one group and not the other, some variation probably followed from</p>

<p><i>Resuscitation 2000;45:7-15</i></p>	<p>conventional CPR course and those who were given bronze level tuition. The latter was based on opening the airway and chest compression with back blows for choking. The tests were based on video recordings of simulated resuscitation scenarios and readouts from recording manikins.</p>	<p>71%). A clear advantage was seen for bronze level training in terms of opening the airway as taught (35 v 56%), checking breathing (66 v 88%) and mentioning the need to phone for an ambulance (21 v 32%). Little difference was observed in acceptable hand position given that those on the conventional course had more detailed guidance. The bronze level group were able to give more compressions per unit time.</p>	<p>unforeseen minor changes in the way that instruction was given, while others may have followed from the greater simplicity in the new method of training.</p>
<p>Batcheller AM, et al* Cardiopulmonary resuscitation performance of subjects over forty is better following half-hour video self-instruction compared to traditional four-hour classroom training <i>Resuscitation 2000;43:101-10</i></p>	<p>202 subjects aged 40 years or older were exposed to video self instruction (VSI) or traditional CPR classes. VSI involved viewing a 34 min videotape and using an inexpensive manikin intended for use in the home. Immediately following training, subjects were tested using validated methods, including a manikin, according to AHA criteria.</p>	<p>VSI subjects performed 21% of all compressions and 25% of all ventilations correctly, compared with 3% and 2% respectively, among those trained by the traditional method (p<0.0001). On average, of 14 CPR assessment and sequence skills, VSI subjects performed 10 correctly and traditional subjects 5 (p<0.0001). For overall performance, 63% of those in the VSI group were rated competent or better, compared with 6% of those in the other group (p<0.0001). Only 18% of VSI subjects were rated as 'not competent' compared with 69% of traditional subjects.</p>	<p>VSI provides an effective, convenient and inexpensive means of training persons over 40 years of age that achieves skill performance superior to that achieved by traditional training.</p>
<p>Capone PL, et al* Life supporting first aid (LSFA) teaching to Brazilians by television spots <i>Resuscitation 2000;47:259-65</i></p>	<p>2 groups of factory employees were compared - 86 controls without TV exposure to LSFA and 116 exposed to brief LSFA skill demonstrations on TV, repeated over the period of 1 week. Their ability to acquire 8 LSFA skills was evaluated on a nurse or manikin as appropriate. Testing was carried out at 1 week, 1 month and 13 months.</p>	<p>1-31% of the control group and 9-96% of the TV group performed individual skills correctly (p<0.001). There was excellent retention over 13 months. >50% of the TV group performed 5/8 skills correctly, including positioning and haemorrhage control. TV viewing increased correct airway control performance from 5 to 25% of trainees, while it remained at 3% in the control group. Performance of the ABC of CPR was very poor in both groups.</p>	<p>A significant proportion of factory workers can acquire simple LFSA skills through TV viewing alone except for CPR steps B and C which need coached manikin practice.</p>
<p>Clark LJR, et al* CPR '98: A practical multimedia</p>	<p>A multimedia computer based teaching package was built for use with</p>	<p>Students who used the package performed better in MCQs and overall scores than</p>	<p>CPR skill is best taught with hands on experience, given that the programme</p>

<p>computer-based guide to cardiopulmonary resuscitation for medical students <i>Resuscitation 2000;44:109-17</i></p>	<p>undergraduate medical students. It consisted of tutorials and test questions in BLS and ALS, incorporating video, graphics and animation to illustrate the techniques involved. It is based on the ALS Manual produced by the RC(UK). The performance of 62 students who did not view the programme prior to a BLS course was compared with 67 students who had used it prior to the course, based on MCQs and practical examination.</p>	<p>those who did not ($p < 0.0007$). However, use of the programme made no significant difference to practical test scores.</p>	<p>made no significant difference to practical test scores. Theoretical scores did improve, suggesting the programme may be a useful supplement to taught courses.</p>
<p>Collins E* As good as new? <i>Occupational Health 2000;July:21-4</i></p>	<p>A study was conducted on 56 current first aiders all employed by the same body and having received first aid training from the same trainer. No reinforcement of training was offered in a 3 year period. Subjects were divided into 3 groups based on time since training: 1, 0-6 months; 2, 7-18 months; 3, >18 months. Each subject was asked to complete a written questionnaire to test factual knowledge, and to demonstrate some specific CPR skills. These were based on recommendations in the first aid manual used in training.</p>	<p>Both skills and facts decayed over time but at slightly different rates. The decline was slow up to 18 months and was then more rapid (more so for skills). For knowledge, mean scores were 80, 76 and 66% for groups 1, 2 and 3 respectively. 13/56 subjects said they had given regular first aid at work. 7 had treated an unconscious casualty.</p>	<p>A first aider with decaying skills has been shown to be unable to provide effective first aid. Regular consolidation is necessary to maintain competency and meet the legal requirements of the Health and Safety (First-Aid) Regulations 1981. Refresher training should be made available to all first aiders at least yearly. Knowledge should be consolidated within the first 6 months through a training programme. First aid training is needed to reinforce areas of poor performance, for example, effective cardiac compression, knowledge of signs, symptoms and causes, and full CPR.</p>
<p>Davies N, Gould D Updating cardiopulmonary resuscitation skills: a study to examine the efficacy of self-instruction on nurses' competence <i>J Clin Nurs 2000;9:400-10</i></p>	<p>A quasi-experimental study randomly allocated a group of 20 nurses to either a self-instruction group or control group that did not undertake this form of training. CPR ability was evaluated using a manikin and observational checklist.</p>	<p>Those in the self-instruction group produced higher ability scores than controls ($p < 0.05$). Self-instruction was evaluated positively by students.</p>	<p>-</p>
<p>Donnelly P, et al* A comparison of manikin CPR performance by lay persons trained in three variations of basic life support</p>	<p>A randomised, controlled trial on lay people was conducted to assess skill acquisition and retention following training in 3 variations of BLS. Training</p>	<p>51% of those trained in the ILCOR guidelines performed effectively compared with 38% trained in ERC guidelines and 25% in the call first variation ($p < 0.01$).</p>	<p>Given the difficulty with ventilation demonstrated in this study, training in a compression only approach merits investigation.</p>

guidelines <i>Resuscitation 2000;45:195-9</i>	was carried out either according to 1992 ERC guidelines, the 1997 ILCOR advisory statement or AHA 'call first' version of the ILCOR statement. Evaluation of manikin CPR using established methods was carried out.	Retention at 6 months was poor (14% effective) irrespective of method.	
Gasco C, et al* Cardiopulmonary resuscitation training for students of odontology: skills acquisition after two periods of learning <i>Resuscitation 2000;45:189-94</i>	116 odontology students were tested at the end of 2 periods of learning using a recording manikin with a validated scoring system. The initial training in 1 rescuer BLS was over a short practice period of 2 hours. This was followed by a second session consisting of 8 hours practice over a period of 2 months.	After both sessions of training, subjects could perform 52% of compressions and 54% insufflations adequately. The errors noted after the first and second sessions respectively were wrong hand position (27 v 12%, p<0.001); excessive compressions (27 v 16%, p<0.05); weak compressions (23 v 17%, p<0.05). Regression analysis found a positive correlation among excessive compression, height and weight (p<0.001) and a negative correlation between weak compression, height and weight (p<0.001).	Overall the results were poor and have led to questioning the methods of teaching BLS.
Hollis S, Gillespie N* An audit of basic life support skills amongst general practitioner principals: is there a need for regular training? <i>Resuscitation 2000;44:171-5</i>	53 GPs from 18 surgeries were assessed for their BLS skills according to RC(UK) guidelines in checklist form as a process criterion. An assessment of each GP was made before and after teaching of BLS skills.	Initial evaluation showed that 91% of GPs were unable to perform adequate BLS. After a practical teaching session, 98% were competent in BLS skills.	Without regular teaching, BLS skills among GPs are likely to fall below an acceptable standard. Even a short teaching period can produce significant improvement in skills.
Lee C, et al A study to assess the level of knowledge of basic life support in UK medical students <i>Resuscitation 2000;45:532</i>	A verbally administered questionnaire was given to 467 medical students selected by grab sampling at each of 3 universities and from each year of the undergraduate curriculum. It consisted of 8 open questions and a mark scheme based on RC(UK) guidelines. Each medical school used a different method and intensity of BLS instruction in the first year - 1 hour lecture, 1 hour practical session and 8 hour practical course.	First year students provided with the greatest amount of BLS instruction scored better than other first year groups (p<0.05). These differences diminished with time so by the fifth year, all students obtained similar scores. Knowledge deteriorated most markedly at 1 year since last instruction.	Knowledge of BLS differs according to the method and duration of training provided. It degrades with time and requires reinforcement at regular intervals during the undergraduate curriculum.
Nyman J, Sihvonen M	298 nurses and nursing students	53% of subjects had studied resuscitation	The skills of participants cannot be

<p>Cardiopulmonary resuscitation skills in nurses and nursing students <i>Resuscitation 2000;47:179-84</i></p>	<p>participated in the study. Background information was collected using a structured questionnaire devised for the study. BLS skills were tested using a recording manikin.</p>	<p>in the last 6 months, 7% had not done any resuscitation training. Before testing, 55% of subjects estimated their resuscitation skills to be good. 36% first assessed the response, 67% opened the airway and 3% determined pulselessness before resuscitating. 21% compressed correctly for at least half the test and 33% ventilated correctly at least half the time. The best predictor for good response assessment and ventilation skills was training in the last 6 months. The best predictor for opening the airway was self confidence.</p>	<p>considered adequate.</p>
<p>Chamberlain D, et al* Randomised controlled trials of staged teaching for basic life support 2. Comparison of CPR performance and skill retention using either staged instruction or conventional training <i>Resuscitation 2001;50:27-37</i></p>	<p>A randomised trial of 495 volunteers was conducted to compare teaching CPR in stages with conventional teaching. The stages were bronze, which omitted ventilations, giving compressions in sets of 50; silver, where ventilations were introduced in the ratio 50 compressions to 5 breaths; gold which involved conversion to conventional CPR. Staged and conventional teaching were carried out with intervals of 2 months between sessions.</p>	<p>51% of the staged group reattended for the silver stage compared with 25% who were taught conventional CPR and advised to return for a revision session. 38% of the staged group reattended for the gold stage compared with 8% in the conventional group. There was improvement in performance in some components tested at silver and gold stages. Comparisons after the gold stage were limited by small numbers who reattended for a third session of conventional training. No difficulty was experienced in converting volunteers to conventional CPR. Skill performance showed some decay between training sessions in both groups, for certain parameters. However, comparisons were limited by small numbers.</p>	<p>-</p>
<p>Rosafio T, et al* Chain of survival: differences in early access and early CPR between policemen and high school students <i>Resuscitation 2001;49:25-31</i></p>	<p>Groups of law enforcement agents (LEA) and high school students (HSS), from the same geographical area, took a BLS course according to AHA standards. They were then evaluated for their knowledge of activation of the emergency medical services and CPR.</p>	<p>HSS were more responsive and receptive than LEA. After 2 months, 4% of the LEA group and 18% of HSS remembered the correct sequence of CPR steps.</p>	<p>To increase retention of CPR steps, the number of steps should be reduced and refresher courses should be included in training programmes.</p>

¹ References are marked with an asterisk where the full article was available

² Boxes are marked with a hyphen where abstracts did not clearly state conclusions or conclusions were unrelated to the purpose of this document

Abbreviations used:

AHA	American Heart Association
ALS	Advanced life support
ARC	American Red Cross
BCLS	Basic cardiac life support
BLS	Basic life support
CPR	Cardiopulmonary resuscitation
DHF	Dutch Heart Foundation
EAR	Expired air resuscitation
EMTs/ EMT-As	Emergency medical technicians
ERC	European Resuscitation Council
GMA	German Medical Association
ILCOR	International Liaison Committee on Resuscitation
LSFA	Life supporting first aid
MCQ	Multiple choice questions/questionnaire
RC(UK)	Resuscitation Council (UK)

Appendix 3(a) NHS LIFE SUPPORT COURSE SURVEY PROFORMA

Question 1 Does your Trust provide in-hospital basic life support training with airway adjuncts and supporting the cardiac arrest team, e.g. attaching leads and preparing drugs?

YES [] **For each question if Yes answer (a) – (h)**

NO [] If No go to next question

Question 2 Does your trust provide a separate in-hospital basic life support course with training in the use of airway adjuncts?

Question 3 Does your trust provide an in-hospital basic life support course without airway adjuncts (except pocket mask), but including teaching breathing and pulse together?

Question 4. Does your hospital provide a separate out-of hospital basic life support session? (i.e. lay person CPR, no equipment, separate breathing and pulse check)

Question 5. Does your Trust provide a hospital life support course with automated external defibrillation training (e.g. ILS with AED)?

Question 6. Does your Trust provide a hospital life support course with manual defibrillation training (e.g. ILS)?

Question 7. Does your Trust provide any type of advanced life support course (e.g. ILS plus team leadership, drugs and peri-arrest situations, special circumstances)?

Question 8. Does your Trust provide the ALERT course or an ALERT-type course (i.e. training in the recognition and management of acutely ill patients)?

**Appendix 3(b) PROFORMA USED TO OBTAIN COURSE
DETAIL**

Name of course:

.....
.....

(a) Is this course nationally formally approved e.g. RCUK, ALSG

Yes [] Go to question (c)

No [] If no is the course A) In-hospital []
B) Purchased from a private company []

(b) Is the course modelled on a nationally formally approved course ? Which course is it modelled on?

.....
.....
.....

(c) How many of these courses have you run over the past 12 months (Dec 02 – Dec 03)? []

(d) What is the maximum number of places on each course? []

(e) Is the course for (i) clinical staff []
(ii) non-clinical staff []
(iii) clinical and non-clinical staff []

(f) What is the instructor: candidate ratio? []

(g) How long is the course in hours? []

(h) Are candidates assessed during the course? No []
Yes [] (i) continuously? []
(ii) on completion []

APPENDIX 3(c) Proforma for Telephone Survey of Life Support Course Pedagogy

	Organisational questions	Date	Time
a)	Type of Course		
b)	'Franchiser'/Owner		
c)	Provider		
d)	Trainer		
e)	Email		
f)	Telephone		
	Course/Trainer Questions		
1.	Do you vary from the prescribed course contents?		
2.	No. of trainees on courses?		
3.	Do you provide: a) A course manual? b) Baseline test? c) Pre-course MCQ?		
4.	Do you vary from the prescribed course pedagogy? a) Individual teaching? b) Ratio of didactic: non-didactic (lecturing: hands-on) c) Skills stations (Teacher: student ratio) d) Do you use video feedback? e) Do you use peer-led education methods? f) Do you use special teamwork teaching? g) Type of manikin? h) Cadavers/ Animal parts used?		
5.	Do you vary in the form of assessment used? a) No. of skills individually assessed? b) Ratio of teaching time: assessment (%)		
6.	Are you aware of any exceptional courses teaching life support in the UK or worldwide?		
7.	Does the supply of courses meet the current demand as far as you can tell?		

APPENDIX 4(a) IMMEDIATE LIFE SUPPORT RESULTS

	PRESCRIBED	SITE 1	SITE 2	SITE 3a	SITE 3b	SITE 4	SITE 5
Pre-course: Manual	YES	YES	YES	YES	YES	YES	YES
Baseline Assessment	NO	NO	NO	NO	NO	NO	NO
Content variation	NO	NO	NO	YES	NO	YES	YES
No. of Trainees	Max: 30	15	12	23	20	14	12
Pedagogical variation	NO	NO	YES	YES	YES	NO	YES
Ratio didactic: practical skill teaching	.17 : .828 (65mins:315mins)	.189 : .81 (75mins:320mins)	.26 : .79 (80mins:305mins)	.26 : .73 (85mins:230mins)	.32 : .67 (110mins:230mins)	.166 : .83 (65mins:325mins)	.246 : .75 (85mins:260mins)
Skill Stations Trainer: candidate ratio	Min: 1:6	1:4	1:6	1:3	1:3	1:5	1:6
Individual teaching	NO	NO	YES	NO	NO	NO	YES
Demonstration (minutes)	15mins	15mins	15mins	15mins	15mins	15mins	NO
4 stage teaching	YES	YES	YES	YES	YES	YES	YES
Clinical Role Play	YES	YES	YES	YES	YES	YES	YES
Moulage	NO	NO	NO	NO	NO	NO	NO
Video feedback	NO	NO	NO	NO	NO	NO	NO
Peer-led education	NO	NO	NO	YES	YES	YES	YES
Teamwork teaching	YES	YES	YES	YES	YES	YES	YES
Manikin Ratio Type	NO NO	1:3 Laerdal Anne; Skills 200	1:3 Laerdal Skills 200 & 400	1:3 Laerdal Anne; Skills 200	1:3 Laerdal Anne; Skills 200	1:5 Laerdal Skills 200	1:2 Laerdal Anne; Skills 200
Animal parts	NO	NO	NO	NO	NO	NO	NO
Assessment variation	NO	NO	NO	YES	YES	NO	YES
Number of Skills Assessed	Nil	Nil	Nil	4	1	Nil	1
Continuous assessment	YES	YES	YES	NO	YES	YES	YES
Written Assessment	NO	NO	NO	YES	NO	NO	NO
Ratio of total teaching time: assessment time	n/a	n/a	n/a	.29 : 1.0 (130mins:445mins)	.09 : 1.0 (35mins:375mins)	n/a	Assess. Mins not specified
Incompetent Candidate Guidelines	YES	YES	YES	YES	YES	YES	YES
Supply= Demand	YES	YES	NO	YES	YES	NO	NO
Site Selection		Random	Random	Random	Random	Not random	Random

APPENDIX 4(b) ADVANCED LIFE SUPPORT

	PRESCRIBED	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
Pre-course : Manual	YES	YES	YES	YES	YES	YES
Baseline Assessment	NO	NO	NO	NO	NO	NO
Content variation	NO	NO	NO	NO	NO	NO
No. of Trainees	Max: 30	15	15	24	30	15
Pedagogical variation	NO	NO	YES	NO	NO	YES
Ratio didactic: practical skills teaching	.45 : .54 (350mins:420mins)	.51 : .48 (405mins:385mins)	.49 : .509 (405mins:420mins)	.503 : .496 (390mins:385mins)	.43 : .569 (415mins:550mins)	.44 : .559 (370mins:470mins)
Skills Stations						
Trainer: candidate ratio	Min: 1:3	1:2	1:1	1:3	1:2	1:1
Individual teaching	NO	NO	YES	NO	NO	YES
Demonstration	Min: 10mins	15mins	30mins	30mins	30mins	15mins
4 Stage teaching	YES	YES	YES	YES	YES	YES
Clinical Role Play	YES	YES	YES	YES	YES	YES
Moulage	NO	NO	NO	NO	NO	NO
Video feedback	NO	NO	NO	NO	NO	NO
Peer-led education	YES	YES	YES	YES	YES	YES
Teamwork teaching	YES	YES	YES	YES	YES	YES
Manikin Ratio Type	1:3 "1xALS Skills trainer with heartsim"	1:2 Anne/Skills Trainer200	1:2 Anne/Skills Trainer200	1:3 Anne/Skills Trainer200	1:2 Anne/Skills Trainer200	1:3 Anne/Skills Trainer200
Animal parts	NO	NO	NO	NO	NO	NO
Assessment variation	NO	NO	YES	NO	YES	NO
Number of skills assessed	4	4	4	4	4	4
Continuous assessment	NO	NO	NO	NO	NO	NO
Written Assessment	YES	YES	YES	YES	YES	YES
Ratio of Assessment time: total teaching time	.18 : 1.0 (170mins:940mins)	.22 : 1.0 (225mins:1015mins)	.24 : 1.0 (265mins:1090mins)	.18 : 1.0 (180mins:955mins)	.218 : 1.0 (270mins:1235mins)	.25 : 1.0 (280mins:1120mins)
Incompetent candidate guidelines	YES	YES	YES	YES	YES	YES
Supply= Demand	NO	YES	YES	YES	YES	YES
Site Selection		Not random	Not Random	RANDOM	RANDOM	RANDOM

APPENDIX 4(c) ADVANCED TRAUMA LIFE SUPPORT

	PRESCRIBED	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
Pre-Course: Manual	YES	YES	YES	YES	YES	YES
Baseline Assessment	NO	NO	NO	NO	YES	YES
Content variation	NO	NO	NO	NO	YES	NO
No.of Trainees	Max: 20	16	20	16	16	16-20
Pedagogical variation	NO	YES	YES	NO	YES	NO
Ratio didactic: practical skills teaching	.52 : .47 (550mins:465mins)	.46 : .54 (460mins:540mins)	.57 : .42 (480mins:360mins)	.40 : .59 (420mins:605mins)	.46 : .53 (435mins:500mins)	.54 : .45 (540mins:455mins)
Skills Stations Trainer: candidate ratio	Min: 2:4	2:4	1:4	2:4	2:4	2:4
Individual teaching	NO	NO	YES	NO	YES	YES
Demonstration	85mins	35mins	NO	60mins	30mins	60mins
4 Stage Teaching	YES	YES	NO	YES	YES	YES
Clinical Role Play	YES	YES	YES	YES	YES	YES
Moulage	YES	YES	YES	YES	YES	YES
Video feedback?	NO	NO	NO	NO	NO	NO
Peer-led education	YES	YES	YES	YES	YES	YES
Teamwork teaching	YES	YES	YES	YES	YES	YES
Manikin	NO	YES	YES	YES	YES	NO
Ratio		2:4	1:4	2:4	2:4	
Type		Laerdal Skills	Resus. Anne	Laerdal Mr Hurt	Laerdal Skills	
Animal parts	YES/NO	YES	NO	YES	YES	YES
Assessment variation	NO	NO	NO	NO	NO	NO
Number of skills assessed	12	10	12	12	12	10
Continuous assessment	NO	NO	NO	NO	NO	NO
Written Assessment	YES	YES	YES	YES	YES	YES
Ratio of Assessment time: total teaching time	.16 : 1.0 (210mins:1260mins)	.17 : 1.0 (210mins:1210mins)	.22 : 1.0 (240mins:1080mins)	.18 : 1.0 (240mins:1265mins)	.16 : 1.0 (180mins:1115mins)	.16 : 1.0 (195mins:1190mins)
Incompetent Candidate Guidelines	YES	YES	YES	YES	YES	YES
Supply=Demand	NO	NO	NO	NO	YES	NO
Site Selection		Random	Random	Random	Random	Random

APPENDIX 5 ACUTE MEDICAL EMERGENCIES

	MedicALS	ALERT	ALERT SITE 1	M&K Update	CB Nursing Updates	IMPACT
Multidisciplinary	NO	YES	YES	YES	YES	NO
Pre-Course: Manual	YES	YES	YES	NO	NO	YES
Baseline Assessment	NO	NO	NO	NO	NO	NO
Content variation	NO	YES	YES	NO	NO	NO
No. of Trainees	MAX: 24	Max 16	16	30	30	16
Pedagogical variation	NO	NO	NO	NO	NO	YES
Ratio didactic: practical skills teaching	.22 : .774 (210mins:720mins)	.77 : .22 (255mins:75mins)	.66 : .33 (285mins:145mins)	n/a	n/a	.57 : .42 (300mins:220mins)
Skills Stations Trainer: candidate ratio	1:3	1:4	1:4	1:30	1:30	1:2
Individual teaching	NO	NO	NO	NO	NO	NO
Demonstration	YES	15mins	15mins	NO	YES	10mins
4 Stage Teaching	YES	NO	NO	NO	NO	NO
Clinical Role Play	YES	YES	YES	NO	NO	YES
Moulage	YES	NO	NO	NO	NO	YES
Video feedback?	NO	NO	NO	NO	NO	NO
Peer-led education	YES	YES	YES	NO	NO	YES
Teamwork teaching	YES	YES	YES	NO	NO	YES
Manikin Ratio Type	YES 1:2 Laerdal	NO	NO	NO	NO	YES 1:2 Laerdal
Animal parts	YES	NO	NO	NO	NO	YES
Assessment variation	NO	n/a	n/a	n/a	n/a	YES
Number of skills assessed	1	n/a	n/a	n/a	n/a	WHOLE SCENARIO
Continuous assessment	NO	YES	YES	n/a	n/a	NO
Written Assessment	YES	NO	NO	n/a	n/a	NO
Ratio of Assessment time: total teaching time	.162 : 1.0 (180mins:1110mins)	n/a Total time: 330mins	n/a Total time: 430mins	n/a	n/a	.329 : 1.0 (255mins:775mins)
Incompetent Candidate Guidelines	YES	NO	NO	NO	NO	YES
No of candidates in 2002	66	15-20,000 in total	No figure given	Awaiting figure	600	48
No of courses in 2002	3	No figure given	No figure given	Awaiting figure	15	3
Cost	£385	£50	£50	£159	£74	Awaiting figure

APPENDIX 6 COURSE NUMBERS FOR 2002

	Courses for Adult Life Support	Number of courses in 2002	Number of people on courses in 2002	Other venues/ developers providing equivalent courses	Update of Courses by developers
Resuscitation Council (UK)	Immediate Life Support	1833	16,880	According to Karla Wright on 17/03/03, ILS Co-ordinator RCUK: ILS is RCUK owned and as far as they are aware there are no other similar courses in the UK.	International Liaison Committee on Resuscitation (ILCOR) Primary aim: 'To provide a consensus mechanism by which the international science and knowledge relevant to emergency cardiac care can be identified and reviewed.'
	Advanced Life Support	565	13,500	Replaced the Advanced Cardiac Life Support course. No similar courses in the UK.	
Royal College of Surgeons of England (RCSEng)	Advanced Trauma Life Support	208	3328	<i>Early Trauma and Critical Care</i> Royal College of Surgeons Edinburgh. Two day course. <u>Day 1</u> : Trauma Management and Resuscitation. <u>Day 2</u> : Management of day-to-day critical care problems. Uses lectures, skills workshops and simulations.	At the end of each course instructors are asked to complete an ATLS Quality Assurance Questionnaire about the course contents and pedagogy. Changes are implemented if ATLS committee agrees with suggested changes.
Advanced Life Support Group (ALSG)	MedicALS (Acute Medical Emergencies)	3	66	From meeting with Sue Wieteska, ALSG Co-ordinator 13/03/03. Not aware of other similar courses.	New courses are developed according to demand. www.bestbets.org Manuals are updated every 4 years but courses are continually updated as new evidence emerges. Candidates on courses are advised to log on to the above web-site to keep up to date. New developments: ALSG is working with the Manchester Visualization Centre www.sve.man.ac.uk/mvc and Salford University Centre for Virtual Environments www.nicve.salford.ac.uk in order to develop new ways of training. ALSG are also working with a group of clinicians and educators to develop web-based training and CD Rom packages.
	Managing Obstetric Emergencies and Trauma (MOET)	13	192	“	Course organisers regularly meet to update the course.
Advanced Life Support in Obstetrics (ALSO)	ALSO	37	1400	MOET is similar but intended more for experienced registrars in anaesthetics as well as obstetrics. ALSO is mainly for midwives and inexperienced SHOs.	
Acute Life-Threatening Events – Recognition & Treatment	ALERT	No figure given	15-20,000 over 2 years	No, none that ALERT are aware of. (from p/c to Vicky Osgood (co-developer) and from Mandy Smales (course co-ordinator).	According to Vicky Osgood (telephone interview 04/03/03) Course organisers are encouraged to add to the content of course in keeping with new evidence. There is an annual network day for all course organisers to discuss new evidence and implement changes to the course content and pedagogy.

APPENDIX 7 UK MEDICAL SCHOOL SURVEY RESULTS

GENERAL MEDICAL COUNCIL	From: General Medical Council Tomorrow's Doctors Recommendations on undergraduate medical education July 2002 <u>Curricular content, structure and delivery</u> <u>Content – Clinical and practical skills</u> 19m. [Trainees must] demonstrate competence in cardiopulmonary resuscitation and advanced life support skills.
ROYAL COLLEGE OF PHYSICIANS OF LONDON	From: Royal College of Physicians of London <i>Working Party Report August 5th 2002: 'The interface between Acute General Medicine and Critical Recommendations. Training:</i> 5. The working party recommends that training in the recognition and management of acutely ill patients should begin in medical school. All undergraduates should receive training in advanced life support. [] Postgraduate deans should adopt one of the nationally available training schemes (eg ALERT programme) designed to teach a systematic approach to the assessment and care of the severely ill. The working party recommends that a certificate of course completion and competency should become a mandatory requirement for career progression beyond SHO Year 1.'

NAME OF SCHOOL	TYPE OF LIFE SUPPORT TRAINING	YEAR UNDERTAKEN
University of Aberdeen www.abdn.ac.uk	Email sent to Associate Dean of Undergraduate Medicine, The University of Aberdeen. No reply within study time period.	
Queens University, Belfast www.qub.ac.uk	Email 15/04/03 from Medical Education Unit. Basic Life Support (BLS) Advanced Life Support (ALS)	1st year 4th Year
University of Birmingham www.bham.ac.uk 16/11/2003	From: <i>Buzz Issue 16 Nov 2002 Resuscitation Skills for Medics and Dentists.</i> The course uses a model of peer led resuscitation training where 2 nd year medical students volunteer to train as basic life support instructors. This group of student instructors then delivers an 8 hour BLS/AED training course to their 1 st year colleagues.	1st year
Brighton and Sussex Medical School www.bsms.ac.uk	Email 08/04/2003 from Clinical SkillsTutor Basic Life Support (OSCE tested) Immediate Life Support Advanced Life Support	1st year 3rd year 5th year
University of Bristol	31/03/03 From: <i>University of Bristol MB ChB Year 5 Programme 2002/2003</i> Described as	

www.bris.ac.uk 31/03/2003	being 'based on Advanced Life Support guidelines' in this document and in another medical school curriculum document, as an ILS (Immediate Life Support) course. The course is a compulsory part of Year 5. There is a formative and summative assessment and a certificate is awarded.	5th year
University of Cambridge www.cam.ac.uk	From 28/01/03 <i>telephone interview with Resuscitation Officer Addenbrookes Hospital, Cambridge:</i> Final year medical students undertake an Immediate Life Support course (Resuscitation Council (UK) guidelines. Unlike most centres running the ILC course, Addenbrookes includes an assessment of 4 skills (BLS, airway management, defibrillation and CASTest – Cardiac Arrest Scenario test) and MCQ.	Final year
University of Dundee www.dundee.ac.uk	Email 21/04/03 from Professor of Anaesthesia: Basic Life Support (BLS) Defibrillation	1st & 2nd year 3rd and 4th year
University of East Anglia www.med.uea.ac.uk	Email reply from <i>Dean of the School of Medicine</i> on 01/04/2003: Basic Life Support (BLS) Immediate Life Support (ILS) Advanced Life Support (ALS) ALERT course	1st year 3rd year 5th year 5th year
University of Edinburgh www.mvm.ac.uk	Email 16/04/03 from Undergraduate Resus. Officer: Adult BLS Adult BLS + Airway Management Adult BLS + Manual defib. & AED Cardiac Arrest Management Adult Medical Emergencies (Scottish Clinical Simulator Centre) Basic Life Support for child and infant	1st year 2nd year 3rd year 4th year 5th year 5th year
University of Glasgow www.gla.ac.uk	Email sent to Associate Dean of the Medical School No reply within time period of study.	
University of Leeds www.leeds.ac.uk 01/04/2003	28/01/03 From <i>The Clinical Skills Learning Centre, University of Leeds</i> : 'All third year medical students attend a taught workshop of 75 minutes per week [] including Basic Life Support '. (Also from <i>Year 3 of the MB ChB Curriculum Aims and Objectives for Third Year Medicine and Surgery</i> : 'Objectives: Practical Skills 'By the end of the year you should be able to: demonstrate cardio-pulmonary resuscitation, understanding the principles and applying the ABC approach.')	3rd year
University of Leicester www.le.ac.uk	Email sent to Undergraduate Medicine. No reply within time period of study.	

University of Liverpool www.liv.ac.uk	Email 15/04/03 from Professor and Director of Medical Education Basic Life Support (BLS)	1 st year
University of London: Imperial College School of Medicine www.med.ic.ac.uk	Email reply 03/04/2003 from Head of Undergraduate Medicine, he has forwarded my email to appropriate person. No reply.	
University of London: Guy's, King's, St Thomas' Hospitals School of Medicine and Dentistry www.kcl.ac.uk	Email reply 14/05/03 from Kings College London Vice Dean of the Medical School Basic Life Support (BLS) – St John Ambulance Basic Life Support + Airway management Immediate Life Support (ILS)	1 st year 3 rd & 4 th year 5 th year
Queen Mary University of London www.qmul.ac.uk	From email sent on 17/04/03 by Senior Nurse, Resuscitation Service: Nationally recognised courses are not run. Basic life support In-hospital resuscitation with BLS, airway management and defibrillation. Adult cardiac life support management (curriculum includes ALS guidelines). Recognition and initial management of the critically ill patient.	1 st year 3 rd year 4 th year 5 th year
Royal Free and University College London School of Medicine www.ucl.ac.uk	Email on 08/04/03 reply from Sub-Dean (Curriculum) Basic Life Support (BLS) Immediate Life Support (ILS)	1 st year Final year
St George's Hospital Medical School www.sghms.ac.uk	Email on 08/04/03 from Senior Lecturer in Clinical Skills: Basic Life Support (BLS) Basic Life Support (BLS) revision Also in course: Lectures from ALS, ATLS, First Aid in Trauma, but no formal assessment.	1 st Year 3 rd Year
University of Manchester www.man.ac.uk	Website (19/05/2003): <i>University of Manchester MBChB Years 3-5 Your Essential Guide The Medical School 2002-2003</i> p.57 Appendix 2: Clinical Skills Curriculum Year 3 Basic Skills Course- Basic Life Support (BLS) & Basic Airway Management Resuscitation of a seriously ill patient	3 rd year 5 th year
University of Newcastle upon Tyne www.ncl.ac.uk	Email 09/04/03 from Sub-Dean for Teaching, Learning & Assessment, School, of Medical Education Development: Basic Life Support (BLS) Advanced Life Support (ALS)	1 st & 2 nd year 3 rd and 4 th year
University of Nottingham www.nott.ac.uk	Email from Assistant Registrar & Secretary of the Curriculum Policy Group: Immediate Life Support (ILS)	Final year
University of Oxford www.ox.ac.uk	From University of Oxford Medical Course Core Curriculum for Year 1:	

	BLS in clinical studies ALS and ALERT course	1st year Final year
University of Sheffield www.shef.ac.uk	Email 16/04/03 from Senior Lecturer ,The University of Sheffield Basic Life Support (BLS) ALERT course	1st and 4th year Final year
University of Southampton www.sot.ac.uk	Email from Clinical Sub-Dean and Senior Clinical Lecturer Basic Life Support Basic Life Support adult and paediatric Certificate in Advanced Simulation Training(CAST) Resus training Immediate Life Support ALERT course	1st year 3rd year 5th year 5th year 5th year

APPENDIX 8 PROFESSIONAL BODY LIFE SUPPORT TRAINING REQUIREMENTS

It is now a statutory requirement that to be appointed a Consultant in the NHS, a doctor must have a Certificate of Completion of Specialist Training in order to be entered on the Specialist Register maintained by the GMC (General Medical Council).

COLLEGES	Courses members required to attend	Courses members recommended to attend	Continuing Professional Development
General Medical Council www.gmc-uk.org	<p>From: General Medical Council. <i>Tomorrow's doctors. Recommendations on undergraduate medical education.</i> July 2002</p> <p><u>Curricular content, structure and delivery:</u></p> <p>Content: Clinical and practical skills</p> <p>Undergraduates must: '19 m. Demonstrate competence in cardiopulmonary resuscitation and advanced life-support skills'.</p>		<p>General Medical Council. <i>Good Medical Practice</i> (3rd ed) May 2001. The duties of a doctor registered with the General Medical Council.</p> <p>No specific reference to CPR/life support.</p>
Faculty of Accident and Emergency Medicine www.faem.org.uk	<p>For doctors who have already completed Membership Exams for the Royal College of Surgeons or for the Royal College of Physicians. 5 years A & E training in order to achieve: CCST Certificate of Completion of Specialist Training.</p> <p>No information about life support training or specific courses online. Email sent to Administrator Gerardine Beckett to request information. Awaiting reply.</p>		<p>From : <i>The Faculty of Accident and Emergency Medicine Guidelines on Continuing Professional Development.</i></p> <p>What counts as CPD: '[] Teaching on Life Support Courses. 1 credit per hour of lecture given, skill station taught or skill practised (10 credits maximum per year)'</p>
Royal College of Anaesthetists www.rcoa.ac.uk	<p>CCST Certificate in Completion of Specialist Training.</p> <p>From: <i>The CCST in Anaesthesia, II: Competency Based Senior House Officer Training and Assessment. A manual for trainees and trainers.</i> p.38 (July 2000).</p> <p>SECTION 3 Objectives of workplace training and assessment: 'To satisfactorily complete SHO training the trainee must demonstrate: * the ability to assess, resuscitate and manage a trauma patient [] * the ability to resuscitate a patient following a respiratory or cardiac arrest to the standards set by the Resuscitation</p>		<p>Continuing Education and Professional Development</p> <p>From: <i>Good Practice. A guide for Departments of Anaesthesia, Critical Care and Pain Management.</i> The Royal College of Anaesthetists. Joint Committee on Good Practice. 2nd ed. 2002.</p> <p>Core topics in anaesthesia have been agreed by the Union of European Medical Specialists (UEMS) 1998. These are topics that an individual specialist anaesthetist working in a typical hospital and participating in the</p>

	<p>Council UK []’</p> <p>Section 20: Management of respiratory and cardiac arrest. ‘ Trainees can be regarded as achieving the necessary competencies if they have successfully completed an ALS (Advanced Life Support) course in the last 12 months’.</p> <p>Workplace training objectives: ‘To resuscitate adults (and know the principles of resuscitating children) from cardio-respiratory arrest to the standards set by the Resuscitation Council (UK).</p>		<p>emergency on-call rota should have up-to-date knowledge of and proficiency in.</p> <p>No specific life support course mentioned.</p>
<p>Royal College of General Practitioners www.rcgp.org.uk</p>	<p>Membership of the Royal College of General Practitioners (MRCGP)</p> <p>From: <i>Examination for Membership (MRCGP) Regulations for Examinations in 2003.</i> The Royal College of General Practitioners p34.</p> <p>‘Before completing the Membership examination you must supply a certificate of competence in CPR.’ ‘You must supply evidence that you can perform basic CPR in accordance with currently accepted guidelines such as those published by the Resuscitation Council (UK).’ Regulations go on to say that the certificate can be signed by a consultant in A&E or anaesthetics, by GPs or doctors in HM Forces with a special interest in life support, or by an ambulance training officer. The document provides a list of CPR training and testing centres.</p>		<p>Accredited Professional Development (APD)</p> <p>From: General Practitioners Committee, Royal College of General Practitioners. <i>Good Medical Practice for General Practitioners 2002.</i> p10.</p> <p>No specific reference to maintenance of CPR skills apart from Section 4 Treatment in emergencies – ‘The unacceptable GP: does not maintain his or her resuscitation skills.’</p> <p>No specific life support course mentioned.</p>
<p>Royal College of Surgeons of Edinburgh www.rsced.ac.uk</p>	<p>Membership of the Royal College of Surgeons of Edinburgh Surgery in General (MRCSEd)</p> <p>From: <i>Syllabus for the Examination for Membership in Surgery in General. August 2001 The Royal College of Surgeons Edinburgh.</i></p> <p>Section 6 Trauma and Critical Surgical illness: General Principles of Management (p 3). The course content includes: ‘The applied basic science relevant to the clinical assessment of the critically ill or severely injured patient and to the understanding</p>		

	<p>of disorders of function caused by trauma, haemorrhage, shock and sepsis. [] Resuscitation and haemodynamic support.’</p> <p>No specific life support course found.</p>		
<p>Royal College of Surgeons of England www.rcseng.ac.uk</p>	<p>Membership of the Royal College of Surgeons. From: <i>The Manual of Basic Surgical Training. September 1998</i> The Royal College of Surgeons of England (p6).</p> <p>Section 2.2 The Aim of Basic Surgical Training: ‘The trainee must be able to [] resuscitate a patient and provide emergency care. []’</p> <p>No specific life support course found.</p>	<p>From: <i>The Manual of Basic Surgical Training. September 1998</i> The Royal College of Surgeons p32. ‘The Advanced Trauma Life Support (ATLS) courses are widely available and are strongly recommended to trainees as an important component of basic surgical education’.</p>	
<p>Royal College of Physicians of Edinburgh www.rcpe.ac.uk</p>	<p>For membership a doctor must first pass the MRCP (UK) Part I and Part II examinations (see below).</p>		<p>No specific reference to life support training found.</p>
<p>Royal College of Physicians of London www.mrcpuk.org</p>	<p>For Membership of the Royal College of Physicians, doctors must pass the MRCP(UK) examinations.</p> <p>From: Royal College of Physicians of London <i>Working Party Report August 5th 2002:</i> ‘The interface between Acute General Medicine and Critical Care’ <i>Recommendations. Training:</i> 5. The working party recommends that training in the recognition and management of acutely ill patients should begin in medical school. All undergraduates should receive training in advanced life support. [] Postgraduate deans should adopt one of the nationally available training schemes (eg ALERT programme) designed to teach a systematic approach to the assessment and care of the severely ill. The working party recommends that a certificate of course completion and competency should become a mandatory requirement for career progression beyond SHO Year 1.’</p> <p><i>CCST (specialist registration with the GMC)</i></p>		<p>No specific reference to life support training found.</p>

	<p>According to the Royal College of Physicians of England July 1998 Joint Committee for Higher Medical Training General (Internal) Medicine Curriculum document (http://www.jchmt.org.uk/gim/curr_generalinternal.asp): Trainees undergoing specialist training in General (Internal) Medicine are required to successfully complete a Resuscitation Council (UK) approved Advanced Life Support Course.</p> <p><i>From: Higher Medical Training GENERIC Curriculum 1 January 2003 Joint Committee on Higher Medical Training www.jchmt.org.uk</i></p> <p><u>'12. CROSS-SPECIALTY TOPICS</u></p> <p>C. <u>Resuscitation Objective</u>: To provide the trainee with the knowledge and skills to be able to recognise critically ill patients, take part in advanced life support, feel confident to lead a resuscitation team under supervision and use the local protocol for deciding when to resuscitate patients.'</p>		
<p>Royal College of Obstetricians & Gynaecologists www.rcog.org.uk</p>	<p>Membership of the Royal College of Obstetricians and Gynaecologists 27/02/03 From <i>Royal College of Obstetricians and Gynaecologists website:</i> <i>Membership Examination</i> <i>Basic Module 3: Basic Surgical Skills.</i> 'Target: Recognise and initiate management of post-operative complications: 5.Cardiac Arrest'</p> <p>According to research team member RF (obstetrician): 'It is required that mentors for sub-speciality training in the labour ward should either be an instructor on the ALSO or the MOET course.'</p> <p>No specific life support course indicated.</p>	<p>Regulations for the Certificate of Completion of Specialist Training (CCST) 2. Basic Specialist Training 2.4 '[] Trainees are strongly advised during this period of basic training to consider attendance at a basic surgical skills course and obtain evidence of resuscitation skills'.</p>	<p>No specific reference to life support training found</p>
<p>Royal College of Paediatrics and Child Health www.rcpch.ac.uk</p>	<p>From: <i>Statement of Satisfactory Completion of a Period of SHO Training in an Educationally Approved Post. September 2000</i></p> <p>Basic Life Support (BLS) and Cardiopulmonary Resuscitation during first 6 months of paediatrics. Advanced Paediatric Life Support/Paediatric Advanced Life Support (APLS/PALS) and Neonatal Resuscitation (NLS) during first 2 years of General Professional Training</p>		<p>From Continuing Professional Development to Career Grade Paediatricians. January 2003</p> <p>Self-Directed Activities 4. Instructing in Paediatric Advanced Life Support (PALS) and Advanced Paediatric Life Support (APLS) courses (maximum 10 credits per year)</p>

	<p>From: <i>Specialist Advisory Committee for Neonatal Medicine: Competency Framework for Sub-Speciality Training in Neonatal Medicine. Version 1 June 2001</i></p> <p>Key Competencies: Resuscitation Competency: The trainee will be able to institute and lead neonatal resuscitation both of the term and pre-term baby. [] Level 1 Certification of an advanced life support course which includes the care of the newborn (NLS, PALS, APLS) Level 2 Has advanced resuscitation skills [] Has demonstrated team leadership in resuscitation situations. Level 3 Able to take full decisions in ethically difficult situations. Reached instructor status on and NLS course as above.</p>		
<p>Nursing & Midwifery Council www.nmc-uk.org</p>	<p>From Dr Pam Walter, Professional Officer – Education, Nursing and Midwifery Council on 07/03/03: ‘I can confirm that life support training is a requirement of all nursing and midwifery pre-registration programmes. The NMC does not specify RCUK courses or qualifications for trainers, but all teaching should be undertaken by suitably qualified personnel.’</p>		<p>No specific reference to continuing professional development found.</p>
<p>Professions Allied to Medicine www.hpc-uk.org</p> <p>The Health Professions Council is the accreditation and regulatory body for 12 professions allied to medicine. The education and training committee of the HPC advises the</p>	<p><i>i) Physiotherapists</i> www.csp.org.uk/download/govt/hpc_proficiency_draft.pdf No reference to life support training found. 06/03/03</p> <p><i>ii) Radiographers</i> www.sor.org No reference to life support training found. 06/03/03</p> <p><i>iii) Occupational Therapists</i> www.cot.co.uk Email 23/04/03 from Anne Lawson-Porter, Group Head: Education, College of Occupational Therapists: OTs ‘are not</p>		

<p>council on establishing standards in respect of education and training for both registration and CPD.</p> <p>The Health Profession Council Education and Training Director, Peter Burley: has copied my email requesting clarification about life support training to the training depts of all 12 professional bodies represented by the HPC.</p>	<p>required to undertake first aid training to register, or to register with the HPC.’</p> <p><i>iv) Dietitians</i> www.bda.uk.com No reference to life support training found.</p> <p><i>v) Speech and Language Therapists</i> www.rcslt.org No reference to life support training found.</p> <p>vii) Arts Therapists www.baat.org viii) Chiropodists www.scpod.org Email 16/03/03 from David Ashcroft: New draft of professional standards states that ‘podiatrists must demonstrate competence in the use of basic life support techniques and a knowledge of how to deal safely with clinical emergencies.’ Has not yet had legal clearance.</p> <p>ix) Orthoptists www.orthoptics.org.uk x) Prosthetists & Orthotists www.bapo.com</p>		
<p>Royal College of Nursing www.rcn.org.uk</p>	<p>No recommendations about life support training. Phone call to education office 06/03/03</p>		
<p>The Medical Protection Society</p>	<p>No recommendations about life support (phone call + website) on 05/03/03</p>		
<p>The Medical Defence Union</p>	<p>No recommendations about life support (phone call + website) 05/03/03</p>		
<p>British Medical Association www.bmj.com</p>	<p><i>From website: www.bma.org.uk Policy and politics link:</i></p> <p><i>From: Medical students conference policy guide, December 2002. The Undergraduate curriculum: ‘[] this conference believes that (i) basic life support training should be given before students begin clinical attachments, and advanced life support training should be given prior to graduation. (1999)’</i></p> <p>‘[] this conference believes that the General Medical Council should define the minimum level of resuscitation training to be completed by medical</p>		

	<p>students prior to commencing practice as a doctor as the UK Resuscitation Council course.'</p> <p>From: <i>Medicine in the 21st Century: 4. The Undergraduate Medical Course</i>: (vi) Compulsory Basic Life Support (BLS) training must be provided prior to students embarking upon clinical attachments and Advanced Life Support (ALS) training prior to graduation. Both BLS and ALS should include a formal assessment to enable accreditation to levels approved by the Resuscitation Council UK.</p>		
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2. Other UK Life Support Providers or Courses

I.	A.L.S.O. (Advanced Life Support in Obstetrics) course	www.also.org.uk
J.	Barts and The London Medical Simulation Centre M.O.S.E.S. (Multi-disciplinary Obstetric Simulated Emergency Scenarios)	www.simulation-users.fsnet.co.uk
K.	B.A.T.L.S. (Battlefield Advanced Trauma Life Support)	www.ta.mod.uk/ta/medical
L.	Bristol Medical Simulation Centre	www.bris.ac.uk/Depts/BMSC/
M.	Chelsea and Westminster Healthcare NHS Trust Simulation Centre	www.chelwestsimcentre.co.uk
N.	P.E.T.A.L.S. (Paediatric Emergency & Trauma Advanced Life Support) East Sussex Hospitals	www.resusc.com/mainpages/petals
O.	Scottish Clinical Simulation Centre, Stirling Royal Infirmary <ul style="list-style-type: none"> - S.A.V.E. (Simulated Airway and Ventilation Emergencies) course - Management of Medical Emergencies 	www.scsc.co.uk

3. Courses for the Recognition and Treatment of Acute Conditions

P.	A.L.E.R.T. (Acute Life-Threatening Event Recognition and Treatment Course) - University of Portsmouth	www.port.ac.uk/alert
Q.	Acute Medical Emergencies course - M & K Update	www.mkupdate.co.uk
R.	Acute Medical Nursing Emergencies course - C B Nursing Updates	www.cb-nursing-updates.com
S.	IMPACT (Ill Medical Patients Acute Care and Treatment) course - Royal College of Physicians and Surgeons of Glasgow	www.rcpsglasg.ac.uk
T.	Medical Emergencies Management course - Advanced-life support Group	www.advanced-lifesupport.com
U.	Acute Medical Emergencies - Lister Postgraduate Institute, University of Edinburgh	www.lister-institute.ed.ac.uk
V.	MedicALS (Acute Medical Emergencies Course) – ALSG Manchester	www.alsg.org

4. Job-Related ‘Life Support’ Training

	Airline Cabin Staff Deep Sea Divers Life Boats (Royal National Lifeboat Institution) Military Nursery, Pre-School, First and Primary Teachers Oil Rigs	See BATLS above See county education authorities
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	Scuba Diving Sports Medicine Swimming Pools	www.medicfirstaid.org See Lifesavers below
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5. Lay training “Life Support” Certificates (Including Workplace Training)

	Boy’s Brigade Duke of Edinburgh’s Award Girl Guides Lifesavers Red Cross St John Ambulance Scouts First Aid Badge through St John Ambulance	www.boys-brigade.org.uk www.theaward.org www.girlguiding.org.uk www.lifesavers.org.uk/education www.redcross.org.uk www.sja.org.uk www.scouts.org.uk
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6. International Organisations

	European Resuscitation Council (E.R.C.) International Liaison Committee on Resuscitation (I.L.C.O.R.)	www.erc.edu
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7. Other Relevant U.K. Organisations

	Royal College of Anaesthetists Royal College of Paediatrics and Child Health Council for Professional Resuscitation Officers	www.rcoa.ac.uk www.rcpaed.ac.uk www.cpro.org.uk
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8. Relevant Journals

	Medbioworld: Intensive Care, Critical Care & Emergency Medicine Journals Resuscitation Pre-Hospital Immediate Care Journal	www.medbioworld.com/cgi-bin/displaycontents.cgi?table=med&type=Journals&filecode=(M)%20Critical%20Care www.elsevier.com www.prehospimedicare.com
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COURSE NAME	MANUAL (pages)	DURATION (Days)	CME/CPD (points)	WEBSITE (& COST)
A.L.S.G (Advanced Life Support Group)				www.alsg.org
A.P.L.S. (Advanced Paediatric Life Support)	329	3	23	
P.H.P.L.S. (Pre-Hospital Paediatric Life Support Course)	197	2	17	
P.L.S. (One day Paediatric Life Support Course)	88	1	7	
MedicALS (Acute Medical Emergencies Course)	440	3	18	
S.T.A.R. (Safe Transfer & Retrieval Course)	140	2	15	
M.I.M.M.S. (Major Incident Medical Management and Support)	199	2	21	
T.P.M.I.M.M.S. (Team Provider MIMMS)	211	1	-	
S.I.M.M.S. (Simulated Incident Medical Management and Support)	-	-	-	
M.O.E.T. (Managing Obstetric Emergencies & Trauma)				
G.I.C. (Generic Instructor Course – in association with RCUK)	204	1	-	
Also run under licence:	283	2 ½	-	
N.L.S. (Newborn Life Support RCUK course)	104	2 ½	-	
A.T.L.S. (Advanced Trauma Life Support – R.C. Surgeons of England course)	68	1-2	-	www.moet.org.uk £460
Resuscitation Council (U.K.)				www.resus.org.uk
A.L.S. (Advanced Life Support)	142	2-3		£250-£350
I.L.S. (Immediate Life Support)	81	1		-
P.A.L.S. (Paediatric Advanced Life Support)	112	1		£250-£400
N.L.S. (Newborn Life Support)				£150-£200
E.P.L.S. (European Paediatric Life Support)	-	1	-	-
G.I.C. (Generic Instructors Course - in association with ALSG)				£350-£500
CB Nursing Updates				www.cb-nursing-updates.com
Advanced adult life support programme	None	1	-	£74
Royal College of Surgeons of England				www.rcseng.ac.uk
A.T.L.S. (Advanced Trauma Life Support)	504	-	19	
P.H.T.L.S. (Pre-Hospital Trauma Life Support)	203	-	-	£350
Royal College of Surgeons of Edinburgh				www.rsced.ac.uk
Early Trauma and Critical Care				
British Association for Immediate Care (B.A.S.I.C.S.)				www.basics.org.uk
P.H.E.C. (Pre-Hospital Emergency Care Course)	-	3		£710 - £820
I.C.C. (Immediate Care Course)	-	5		£1165 - £1375
P.H.E.E.P. (Pre-Hospital Emergency Education for Professionals)	-	-		
Emergency Medical Planning Ltd (E.M.P.) - Medic First Aid				www.medicfirstaid.org
B.L.S.Pro (Basic Life Support for Health Care Professionals)		2		
Basic Trauma Life Support Organisation (B.T.L.S)				www.blts.org
B.T.L.S. Advanced (Basic Trauma Life Support - Advanced Course)				

Appendix 10 LIST OF ABBREVIATIONS

Abbreviation	Organisation or Course Name
ALERT	Acute and Life-Threatening Event Recognition and Treatment course
ACUTE	The Acute Undergraduate Teaching Initiative
ALS	Advanced Life Support
ALSG	Advanced Life Support Group
ALSO	Advanced Life Support in Obstetrics
APLS	Advanced Paediatric Life Support
ATLS	Advanced Trauma Life Support
BASICS	British Association for Immediate Care
BATLS	Battlefield Advanced Trauma Life Support
BHF	British Heart Foundation
BLS	Basic Life Support
BLS Pro	Basic Life Support for Health Professionals
BMA	British Medical Association
BTLS	British Trauma Life Support Organisation
CCST	Certificate in Completion of Specialist Training
CCU	Coronary Care Unit
CPD	Continuing Professional Development
CPR	Cardiopulmonary Resuscitation
CPRO	Council for Professional Resuscitation Officers
EMP	Emergency Medical Planning Ltd
EPLS	European Paediatric Life Support
ERC	European Resuscitation Council
FAEM	Faculty of Accident and Emergency Medicine
GIC	Generic Instructors Course
GMC	General Medical Council
HAZIMMS	Hazardous Material Incident Medical Management and Support
HMIMMS	Hospital Major Incident Medical Management and Support
HPC	Health Professionals Council
ICC	Immediate Care Course
ILCOR	International Liaison Committee on Resuscitation
ILS	Immediate Life Support
IMPACT	Ill Medical Patients Acute Care and Treatment
JCHMT	Joint Committee on Higher Medical Training
MedicALS	Acute Medical Emergencies Course
MDU	Medical Defence Union
MIMMS	Major Incident Medical Management
MOSES	Multidisciplinary Obstetric Simulated Emergency Scenarios
MOET	Managing Obstetric Emergencies and Trauma
MPS	Medical Protection Society
NHS	National Health Service
NLS	Newborn Life Support
NMC	Nursing & Midwifery Council
PALS	Paediatric Advanced Life Support course
PAM	Professions Allied to Medicine
PETALS	Paediatric Emergency and Trauma Advanced Life Support Course
PHEC	Pre-Hospital Emergency Care Course
PHEEP	Pre-Hospital Emergency Education for Professionals
PHPLS	Pre-Hospital Paediatric Life Support

PHTLS	Pre-Hospital Trauma Life Support
PLS	Paediatric Life Support (one-day)
RCGP	Royal College of General Practitioners
RCN	Royal College of Nursing
RCOA	Royal College of Anaesthetists
RCOG	Royal College of Obstetricians and Gynaecologists
RCPCH	Royal College of Paediatrics and Child Health
RCPE	Royal College of Physicians of Edinburgh
RCPL	Royal College of Physicians of London
RCSEd	Royal College of Surgeons of Edinburgh
RCSEng	Royal College of Surgeons of England
RCUK	Resuscitation Council (UK)
SAVE	Simulated Airway and Ventilation Emergencies
SIMMS	Simulated Incident Medical Management and Support
STAR	Safe Transfer and Retrieval Course
TPMIMMS	Team Provider Medical Management and Support

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