REVIEW

Advanced airway management in the emergency department: what are the training and skills maintenance needs for UK emergency physicians?

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This article reviews the evidence for the training of emergency physicians in advanced airway management.

The subject of advanced airway management currently generates much controversy and debate in UK emergency medicine specialist practice.[1 2] Effective airway management is the central part of emergency resuscitation and many see it as an undisputable core skill for emergency physicians.[3] Much of the current discussions centre around the specific technique of rapid sequence intubation (RSI), which is generally accepted to be the technique of choice for most situations in the emergency department.[4–9] Several recent studies have demonstrated the emergence of emergency physician performed RSI in the UK with acceptable safety and complication rates.[1 6 7]

Most published work from the USA and the UK concerning advanced airway management has tended to concentrate on the clinical performance of RSI and its associated complications.[1 4 5 7 8] There has been comparatively little work looking at the training requirements for emergency physicians who wish to undertake this work in the UK.[1 2 10]

For the past 25 years, higher specialist trainees in accident and emergency medicine in the UK have been required to undertake a minimum three month secondment in anaesthesia and intensive care. In the early days of specific specialist training in accident and emergency medicine, this was to orientate trainees who were predominantly from medical and surgical backgrounds to the concepts of anaesthesia and specifically to train them in basic and advanced airway management skills, namely endotracheal intubation.

At that time it was not generally expected that emergency medicine trainees would become competent in the use of anaesthetic or paralysing drugs within those three months and it was not envisaged that they would perform airway manoeuvres requiring anaesthetic or paralysing drugs without involving an anaesthetist.[2]

During the 1980s the situation began to change. Several emergency medicine centres throughout the UK, notably Edinburgh,[11] began to promote RSI in the emergency department and indeed in the prehospital environment. Minimum training requirements remained at three months of full time anaesthesia and intensive care, although many trainees were undertaking longer periods of training in anaesthesia. This was supplemented by regular "real life" use of the techniques in the emergency department, usually under senior supervision.

In the UK, a joint working party has been established between the Faculty of Accident and Emergency Medicine and the Royal College of Anaesthetists to produce a plan for the future training of emergency medicine specialists. Debate continues as to the precise training requirements and ongoing skills maintenance needs for emergency physicians who wish to provide a comprehensive advanced emergency airway service.[12] Debate also continues over the training requirements for anaesthetists in the UK with respect to airway management.[13]

AIM

This review aims to review the evidence for initial training for advanced airway management, and specifically, RSI, for emergency physicians as relevant to UK practice. It will also consider the evidence and requirements for skills maintenance in this field for the established emergency medicine specialist.

METHOD

Medline (1966–2002) and Embase (1980–2002) were searched using the following strategy: [{exp laryngoscopy OR laryngoscopy.mp OR exp intubation, intratracheal OR intubation.mp OR intubat$.mp OR induction.mp OR "rapid sequence induction".mp OR "rapid sequence intubation".mp OR "difficult airway".mp OR "difficult intubation".mp} AND {exp education OR education.mp OR training.mp OR exp internship OR residen$.mp}] LIMIT to human AND English.

Manual searches of the bibliographies of relevant papers identified as a result of these searches were done and any further relevant papers were retrieved. The abstract books from the 2001 and 2002 annual scientific meetings of the Faculty of Accident and Emergency Medicine were also scrutinised.

The Web of Science database (previously the Science Citation Index) was searched using papers produced by Walls[3 14 15] to identify further papers.

The web sites of the Faculty of Accident and Emergency Medicine (http://www.faem.org.uk), the British Association of Accident and Emergency Medicine (http://www.baem.org.uk), the Royal College of Anaesthetists (http://

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www.rcoa.ac.uk), the Society for Academic Emergency Medicine (http://www.saem.org), the American College of Emergency Physicians (http://www.acep.org), and the Australasian College of Emergency Medicine (http://www.acem.org.au) were searched to identify any references to training requirements for airway management and the evidence for these. A manual search of *Emergency Medicine*, the journal of the Australasian College of Emergency Medicine, was done for 2000 to 2002 inclusive.

Data on the frequency of RSI in UK emergency departments were obtained from the Scottish Trauma Audit Group RSI Study Group and from the Trauma Audit and Research Network (TARN) for England and Wales. Data on previous work on developing a consensus curriculum for anaesthesia for trainees in emergency medicine was also obtained (personal communication, Dr Mark Nicol).

Finally, the curriculum for higher specialist training in accident and emergency medicine[16] and the accompanying document on secondments[17] were reviewed to identify current official UK requirements for training for emergency medicine specialists.

RESULTS

A total of 1487 papers were identified by the initial Medline and Embase searches, of which 405 were relevant to this review. The Web of Science search yielded a further 35 papers.

Review of the web sites listed previously revealed a policy statement on RSI produced by the American College of Emergency Physicians.[18] The Royal College of Anaesthetists' web site provided information on basic anaesthetic training requirements in the UK.[19] A further paper was identified in *Emergency Medicine*.[20]

Table 1 summarises the relevant papers. Internationally agreed evidence levels (as defined by the Scottish Intercollegiate Guidelines Network[21]) were assigned to each paper.

Data from TARN[22] indicates the relative rarity of RSI in the emergency department in England and Wales. This retrospective study looked at a subset of the TARN database for the past 10 years with good data capture for intubation data. It suggests that in an average department size of 68 000 patients per annum, two emergency RSIs for trauma would be required per month. Data from STAG suggest a 2:1 ratio of non-trauma RSIs to trauma RSIs,[23] so this would suggest a total of approximately six RSIs per month in the emergency department for a ''standard'' hospital.

Data from the STAG RSI Project Group[23] also suggest the lack of ''real life'' experience with RSI for all practitioners in the emergency department. A total of 735 RSIs were performed over two calendar years in seven Scottish emergency departments staffed by a total of 24 consultants in emergency medicine. This equates to a mean of 31 RSIs per consultant per year or 2.5 RSIs per month. These figures are broadly comparable to the TARN data as described above.

DISCUSSION

The Faculty of Accident and Emergency Medicine documents on higher specialist training include the following references to training in emergency airway management, anaesthesia, and intensive care (see box 1). It can be inferred that there are no prescriptive guidelines on the type or number of specific procedures required for airway training in the UK for higher specialist trainees in accident and emergency medicine at present. An Australasian study suggests this is also the case in Australia and New Zealand.[20]

Training requirements in airway management can be broken down into airway assessment, technical aspects of endotracheal intubation and alternative airway techniques, and rapid sequence intubation in itself.

Assessment of the airway constitutes one of the most important aspects of airway management.[24] It is unclear from this review of the literature as to what constitutes an acceptable minimum training in airway assessment. Reports of management of the difficult airway consistently refer to the difficulties of its prediction despite using multiple accepted methods of assessment.[25–31] It is obviously important to recognise signs of a potentially difficult intubation early in resuscitation, but the emergency physician must remain aware that unexpected difficult intubation will occur occasionally.

However, there is no specific requirement in the curriculum for emergency medicine in the UK for trainees to develop skills in any of these techniques. If a difficult airway is anticipated in advance, senior anaesthetic and intensive care assistance can be sought without further delay while preparations are made to gather appropriate equipment and personnel to deal with that difficult airway safely.[32] It would

Table 1 Summary of evidence

Author	Reference	Topic	Principal results	Numbers	Level of evidence
Faculty	16	FAEM requirements for airway training	Consensus opinion	–	4
Amarasinghe	20	Australia and New Zealand survey of anaesthesiology training requirements	Anaesthesiology training should focus on airway skills and last six months	315 emergency physicians	3
Koppel	29	Anaesthesiology training for difficult airway skills in US	Survey—only 27% of training programmes required a ''difficult airway rotation''	143 programmes	3
Konrad	33	Learning curve for new anaesthesiologists	90% success rate after 57 attempts; 18% still need help after 80 intubations	11 residents	3
Charuluxananan	34	Minimum number of oral intubations for competency	Mean 27 cases for competency	9 residents, 100 intubations	3
Hayden	35	Number of intubations during three year emergency medicine residency in US	Mean 75 intubations over three years (95% confidence intervals 62 to 87)	65 programmes	3
Forrest	41	Simulators to test novice anaesthetists	Simulation can observe and quantify technical skills of anaesthesia	26 consultants, 6 novices	3
Chopra	51	Simulator training for anaesthetists	Training on simulator improves anaesthetists emergency management	28 anaesthetists and trainees	1–

Box 1 Curriculum for higher specialist training in emergency medicine

Knowledge base

- III Anaesthesia
  - (A) Principles of airway management
  - (B) Rapid sequence induction
  - (C) Pain relief
  - (D) General, regional, local anaesthesia
  - (E) Interface with intensive care

Clinical skills

- III Major trauma management
- IV Airway (cervical spine control)
  - (A) Basic airway management
  - (B) Advanced airway management (tracheal intubation/alternatives)
  - (C) Surgical airway
- V Breathing
  - (B) Ventilation techniques

be possible to define an expert consensus on what assessment skills should be expected of emergency medicine specialists.

The technical aspects of endotracheal intubation also need to be taught and learned, although it is difficult to define what competent means in terms of learning objectives. Konrad found that there was a rapid improvement in the success rates for endotracheal intubation during the first 20 attempts in novice intubators (anaesthesiology residents).[33] A 90% success rate was reached on the learning curve after a mean of 57 attempts at endotracheal intubation. However, after 80 intubations, 18% of residents still required assistance. Although it is difficult to be clear on exact numbers and accepting that there will always be variations between people, it would seem that novice anaesthesiology residents require 80 or more intubations to achieve reasonably consistent skills in endotracheal intubation.

In another small study on anaesthetic trainees in Thailand,[34] the minimum requirements for competency in oral tracheal intubation was determined to be 27 cases. The small numbers in this study again cast doubt on whether this is accurate. It remains to be seen whether emergency medicine will be required to develop competency based objectives for airway management. In the US, several studies have reported on the requirements and experience of their residents in emergency medicine.[35–37] Hayden and Panacek[35] reported that the mean number of intubations per trainee was 75 (95% confidence intervals 62 to 87); this is over a three year residency in emergency medicine in a US setting. This remains concerning as it is below the 80 intubations required in Konrad's study[33] to achieve an acceptable level of procedural competency for endotracheal intubation. Indeed, 80 may be too low a number as it included all intubations, not just the intubations performed in the difficult emergency department environment. The use of novel teaching tools such as laryngoscopic video imaging[38–40] may improve teaching in this difficult skill. Human simulators have been shown to be effective in training novice anaesthetists technical skills[41 42] and it is probable that this would be a useful tool for emergency medicine trainees as well.

There is no consensus among UK anaesthetists as to how many intubations are required for anaesthetic trainees. Important concerns about training in airway management for anaesthetists have been raised recently.[43–45] Some anaesthetists have suggested at least 20 intubations a week per SHO, which would suggest a total of 1040 intubations per annum.[46] In the era of the laryngeal mask, it is highly unlikely that any anaesthetic trainee will gain this level of experience.[47]

Others have suggested that the laryngeal mask airway should only be used in 25% of cases, using basic airway management and endotracheal intubation for others in the interests of training.[48] Similarly this is unlikely to gain popularity given the significant clinical advantages of the laryngeal mask airway in elective anaesthesia. It is therefore very difficult to extrapolate these opinions to the field of emergency medicine.

It is widely accepted that endotracheal intubation in the emergency room is significantly more hazardous and associated with an increased rate of difficult intubation and failed intubation than that in the operating room.[15] Koppel and Reed surveyed anaesthesiology residency programme directors as to what formal instruction is provided to their residents in difficult airway management.[29] Only 27% of the responding programmes required residents to participate in a rotation dedicated to the management of the difficult airway. UK training of this nature seems to be rare and difficult to obtain, even for anaesthetists.[45]

The only two techniques that were commonly taught on patients were the flexible fibreoptic laryngoscope and the laryngeal mask airway. Bearing in mind that this is an American study, at that time the use of the laryngeal mask airway was somewhat less that in the UK. However, it is probable that in the UK the laryngeal mask airway would be the immediate rescue airway for most anaesthetic and emergency medicine personnel in the event of a failed intubation given its popularity and familiarity with use.[49]

Anaesthetic simulators have also been used to improve the training of junior and senior anaesthetists in the UK and other parts of the world.[2 41 42 50–58] These expensive, dedicated machines are limited in number in the UK but can provide extremely valuable experience especially for rare emergencies tht typify anaesthesia (for example, malignant hyperthermia, anaphylaxis, etc). These rare crises can be modified for the teaching of emergency medicine specialists. Such crises may include management of the burned upper airway, management of the patient with profound hypovolaemia, and management of the unexpectedly difficult intubation. The principal value of the simulator is teaching the decision making process (''non-technical skills'') leading to the critical intervention,[59] rather than perfectly replicating the technical skills required for that particular scenario.

In Scotland, a joint emergency medicine and anaesthesia collaboration has lead to the development of the Scottish Airway and Ventilation Emergency Course (the SAVE course) based at the Scottish Anaesthesia Simulator Centre at Stirling Royal Infirmary. A one day course format consists of familiarisation with the simulator and exposure to one scenario per participant as the team leader, which is video taped and peer reviewed by colleagues and teaching faculty. This course now also occurs in Bristol and London.

General feedback from early participants in this course has been extremely favourable with many participants expressing a desire to have more training of this nature. Its major advantage is that there is no risk to human patients, and all the variables can be independently controlled for a given simulation. Therefore not only anatomical airway difficulties can be introduced, but physiological effects of different drug

doses and regimens can be introduced to ensure a realistic scenario for the participant.

It has been shown that training on anaesthesia simulators has improved the performance of anaesthetists in dealing with emergencies during anaesthesia.[51 60] It is probable that this would also be seen in emergency physicians.[55 61–63]

Specific theoretical learning objectives, such as airway assessment techniques, may be mastered by a combination of didactic lectures and personal study.[64] The American National Emergency Airway Course may also be a useful educational device to introduce emergency physicians to the management of the emergency airway.[65 66] Practical technical education (for example, endotracheal intubation) could be carried out in a clinical skills laboratory setting and subsequently in a human anaesthetic simulator.[61] In addition, it would be appropriate to demand that emergency physicians pass the Royal College of Anaesthetists' initial test of competency as part of their initial anaesthesia training.[19]

It has recently been suggested that future training of UK emergency medicine specialists should include a one year anaesthesia and critical care rotation, involving six months of full time anaesthesia followed by six months of full time critical care.[2] While this in itself would be most useful, it will be important to have specific learning objectives in mind.[12] Emergency physicians have different learning requirements and different competency requirements from trainees in anaesthesia and consequently their training must be tailored to accommodate this.[2] Training requirements and specific competencies will have to be defined to ensure a minimum standard of training and competence in all aspects of emergency airway management across the specialty. It will also be important in the future to carefully study the effects of increased length and quality of training for emergency physicians on the success and failure rates for airway management in the emergency department as performed by these physicians.

It is also important that emergency medicine trainees develop competency in the immediate ongoing (post-intubation) management of the critically ill patient.[12 35] There is little point in successfully securing the airway if there is no capability to provide appropriate ongoing ventilatory and cardiovascular support. These skills should include the safe use of anaesthetic and sedation agents for adults and children; safe use of neuromuscular blocking agents; appropriate ventilatory strategies for specific situations, for example acute severe asthma, severe head injury; rational use of inotropes and fluid management; expertise with invasive monitoring, including the ability to place arterial and central venous catheters. The proposed period of six months critical care training for emergency medicine trainees should be regarded as a minimum.

CHILDREN

There are very few data relating to the management of the paediatric airway in the emergency department. A recent American study suggests that emergency physicians can manage the paediatric airway safely and recommends the use of RSI in this age group.[67] Other observational series support this view, all from the US.[68 69] Recently published data from STAG suggest that the frequency of paediatric intubations in general Scottish emergency departments is a low as three intubations per department per annum, which means that advanced airway skills will be required very rarely, regardless of the grade or specialty of the intubating staff.[69a]

The current UK recommendations for anaesthetists accept that there are many anaesthetists who do not have a regular paediatric practice, but that they may still have to provide an acute resuscitation service for critically ill children.[70] They recommend that consultant anaesthetists should be able to undertake regular supernumerary paediatric lists or secondments to specialist paediatric centres to maintain skills. Consultants and trainees in emergency medicine should also consider obtaining this type of training to maintain skills. It is vitally important to try to maintain airway skills for this age group, but increasingly difficult to do so. In future, paediatric high fidelity simulators may provide a partial solution to this problem.

MAINTENANCE OF SKILLS

Maintenance of skills in emergency airway management is also a subject of considerable debate presently.[12] There is no objective scientific data to support a minimum requirement of numbers of emergency intubations or RSIs to be performed by emergency physicians (or indeed anaesthetists) to maintain competency in this area. It is probable that without regular exposure and experience in any particular technique, skills in that technique will deteriorate over time. What steps therefore should be taken to ensure continuing competence in this complex matrix of assessment and therapeutic skills?

It is highly unlikely that any individual emergency physician or anaesthetist in the UK will see enough cases that require rapid sequence intubation in the emergency department regularly to maintain skills on that basis alone. The figures from the Trauma Audit Research Network suggest a maximum of about six RSIs per month per department (based on an average of 68 000 patients per year), which, if staffed by four consultants in emergency medicine, will equate to 1–2 RSIs per consultant per month. The STAG data also suggest that the individual consultant in emergency medicine would be likely to be involved in two to three RSIs per month. Accepting that, at current UK staffing levels, consultants cannot be in the emergency department every time an emergency RSI is required, this will mean that individual skills will be difficult to maintain on the basis of experience alone. If this small number of patients is diluted by consultant and trainee anaesthetists as well, then the prospects for individual skills maintenance using this method alone are very limited.

Other methods of maintaining skills in this area have to be sought therefore.

This may include the regular use of a high fidelity human anaesthetic simulator, in the manner described above, as this will ensure regular exposure to difficult scenarios more frequently than will happen in day to day practice. It could also entail regular experience in hospital anaesthetic rooms, although with the changing practice of anaesthesia in the UK (that is, many operations are now performed under general anaesthesia using the laryngeal mask airway rather than performing endotracheal intubation), exposures of this nature may not be as relevant to the practising emergency physician as they were previously. Surgical lists with exposure to large numbers of cases or difficult airways (for example, maxillofacial or otorhinolaryngology lists) may provide useful intubation experience.

However, continuing practice in the management of the airway and the opportunity to use other airway adjuncts such as the laryngeal mask airway should be seen as a benefit, rather than of little use, given the laryngeal mask airway's role as a rescue device in the event of a failed intubation. It also allows physicians to continue to use anaesthetic drugs in vivo under controlled conditions and with experienced support. It is unclear how much of these types of experience and continuing education would constitute a minimum for the emergency physician. It remains to be seen whether emergency physicians will have to prove competency and continuing maintenance of these skills by means of an externally validated assessment of skills[2 64] and if so, how that will be done.

A national audit programme for emergency physicians' airway skills is currently under development. It has also been suggested that individual emergency physicians should keep personal logbooks to show continuing safe activity in this field.[71] Ongoing departmental audit may play a part as well, in ensuring that essential skills are maintained by all members of the team who are willing to provide the service.

CONCLUSION

There are no objectively defined training requirements for emergency airway management for the UK emergency physician at present. The current debate provides an opportunity for the development of specific learning objectives for airway management, with clear training objectives for higher specialist trainees in emergency medicine (box 2). The following suggestions are based on current practice but take into account the comments made in the literature reviewed. They also take account of Nicol's previous work on the consensus curriculum for anaesthesia for emergency medicine trainees (personal communication). No attempt has been made to define minimum numbers of procedures, as the available literature cannot support such a suggestion.

Box 2 Training requirements for higher specialist trainees in emergency medicine

I Theoretical aspects

- Roles and responsibilities of the emergency physician
- Roles and responsibilities of the anaesthetist/intensive care specialist
- Understanding of cooperative nature of emergency airway management
- Rapid assessment of the airway in the emergency environment
- Breathing systems and basic ventilators
- Pharmacology of anaesthetic and neuromuscular blocking drugs
- Knowledge of basic and advanced airway management techniques
- Knowledge of rare anaesthetic emergencies (for example, malignant hyperthermia)
- Surgical airway techniques

II Practical aspects

- Ability to assess the airway rapidly and comprehensively
- Safe conduct of anaesthesia, with emphasis on rapid sequence intubation
- Ability to perform endotracheal intubation competently in adults and children
- Ability to use laryngeal mask airway competently in adults and children
- Exposure to other rescue devices, for example, Combitube, I-LMA
- Exposure to critically ill patients who require emergency anaesthesia
- Gradually increasing supervised experience in the intensive care unit
- Ability to insert arterial and central venous lines via different approaches
- Exposure to airway and anaesthetic emergencies on human simulator

Box 3 Skills maintenance programme for consultants in emergency medicine

1. Personal log of all intubations/airway interventions
2. Regular human simulator sessions
3. Regular sessions in local hospital anaesthetic room
4. Ongoing departmental audit of critical airway interventions
5. Combined anaesthesia/intensive care/emergency medicine reviews of cases

Maintenance of these skills will not be easy for the practising consultant in emergency medicine but one possibility is suggested in box 3. Again, these are distilled from the current published literature but questions about optimum or minimum numbers of procedures or sessions remain and require further research.

It remains paramount that each centre has a well defined and unambiguous system for dealing with acute airway emergencies, whether it is undertaken by emergency physicians, anaesthetists, or a collaborative approach. Even in hospitals where emergency airway care remains in the hands of anaesthetists, training requirements for emergency physicians must ensure that they still maintain a very high level of decision making skills with respect to critical airway situations.

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REFERENCES

1 **Walker A**, Brenchley J. Survey of the use of rapid sequence induction in the accident and emergency department. *J Accid Emerg Med* 2000;**17**:95–7.
2 **Gwinnutt CL**. The interface between anaesthesia and emergency medicine. *Emerg Med J* 2001;**18**:325–6.
3 **Walls RM**. Rapid-sequence intubation comes of age. *Ann Emerg Med* 1996;**28**:79–81.
4 **Tayal VS**, Riggs RW, Marx JA, *et al*. Rapid-sequence intubation at an emergency medicine residency: success rate and adverse events during a two-year period. *Acad Emerg Med* 1999;**6**:31–7.
5 **Sakles JC**, Laurin EG, Rantapaa AA, *et al*. Airway management in the emergency department: a one-year study of 610 tracheal intubations. *Ann Emerg Med* 1998;**31**:325–32.
6 **Graham CA**, Thakore SB, Mattick AP, *et al*. Rapid sequence intubation: a survey of senior and middle grade staff in Scotland. [Abstract]. *J Accid Emerg Med* 2000;**17**:71.
7 **Butler JM**, Clancy M, Robinson N, *et al*. An observational survey of emergency department rapid sequence intubation. *Emerg Med J* 2001;**18**:343–8.
8 **Dufour DG**, Larose DL, Clement SC. Rapid sequence intubation in the emergency department. *J Emerg Med* 1995;**13**:705–10.
9 **Li J**, Murphy-Lavoie H, Bugas C, *et al*. Complications of emergency intubation with and without paralysis. *Am J Emerg Med* 1999;**17**:141–3.
10 **Gaiser RR**. Teaching airway management skills. How and what to learn and teach. *Crit Care Clin* 2000;**16**:515–25.
11 **McBrien ME**, Pollok AJ, Steedman DJ. Advanced airway control in trauma resuscitation. *Arch Emerg Med* 1992;**9**:177–80.
12 **Nolan J**, Clancy M. Airway management in the emergency department. *Br J Anaesth* 2002;**88**:9–11.

13 **Stringer KR**, Bajenov S, Yentis SM. Training in airway management. *Anaesthesia* 2002;**57**:967–83.
14 **Silbergleit R**, Walls RM. The trauma airway: Whose responsibility? *Anesthes Analg* 1998;**86**:1146–7.
15 **Walls RM**, Vissers RJ, Sagarin MJ. Emergency department intubations—final report of the National Emergency Airway Registry Pilot Project. [Abstract]. *J Accid Emerg Med* 1998;**15**:392.
16 **Faculty of Accident and Emergency Medicine**. *Higher specialist training in accident and emergency medicine*. London: Faculty of Accident and Emergency Medicine, 1996. http://www.faem.org.uk/hst1.htm (accessed 18 Feb 2003).
17 **Faculty of Accident and Emergency Medicine**. *Higher training in accident and emergency medicine—secondments*. London: Faculty of Accident and Emergency Medicine, 1999. http://www.faem.org.uk/second.html (accessed 18 Feb 2003).
18 **American College of Emergency Physicians**. Rapid-sequence intubation. *Ann Emerg Med* 1997;**29**:573.
19 **Royal College of Anaesthetists**. *CCST in anaesthesia II: competency based senior house officer training and assessment. A manual for trainees and trainers*. London: Royal College of Anaesthetists, 2000. http://www.rcoa.ac.uk/directorates/directorate_B.asp?ID=34 (accessed 20 Oct 2002).
20 **Amarasinghe V**, Kelly A-M, Rogers I, *et al*. Identifying the core components of an anaesthesiology curriculum for emergency medicine trainees in Australasia. *Emergency Medicine* 2000;**12**:344–8.
21 **Scottish Intercollegiate Guidelines Network**. *Levels of evidence*. Edinburgh: Scottish Intercollegiate Guidelines Network, 2001. http://www.sign.ac.uk/guidelines/fulltext/50/section6.html (accessed 18 Feb 2003).
22 **Butler JM**, Lecky F, Townend WJ, *et al*. Intubations in trauma patients in UK emergency departments. Annual scientific meeting of the Faculty of Accident and Emergency Medicine, London, November 2001:A11.
23 **Graham CA**, Beard D, Oglesby AJ, *et al*. Rapid sequence intubation in Scottish urban emergency departments. *Emerg Med J* 2003;**20**:3–5.
24 **Cosgrove JF**, Gascoigne AD. Inadequate assessment of the airway and ventilation in acute poisoning. A need for improved education? *Resuscitation* 1999;**40**:161–4.
25 **Ezri T**, Szmuk P, Evron S, *et al*. Difficult airway in obstetric anesthesia: a review. *Obstet Gynecol Surv* 2001;**56**:631–41.
26 **Levitan RM**, Kush S, Hollander JE. Devices for difficult airway management in academic emergency departments: Results of a national survey. *Ann Emerg Med* 1999;**33**:694–8.
27 **Crosby ET**, Cooper RM, Douglas MJ, *et al*. The unanticipated difficult airway with recommendations for management. *Can J Anaesth* 1998;**45**:757–76.
28 **Walls RM**. Management of the difficult airway in the trauma patient. *Emerg Med Clin North Am* 1998;**16**:45–61.
29 **Koppel JN**, Reed AP. Formal instruction in difficult airway management. A survey of anesthesiology residency programs. *Anesthesiology* 1995;**83**:1343–6.
30 **Williamson JA**, Webb RK, Szekely S, *et al*. The Australian Incident Monitoring Study. Difficult intubation: an analysis of 2000 incident reports, *Anaesth Intensive Care* 1993;**21**:602–7.
31 **Palmer JJM**, Ball DR. Personal and department preparation for difficult airway management. *Current Anaesthesia and Critical Care* 2001;**12**:201–6.
32 **Shaw RJ**, McNaughton GW. Emergency airway management in a case of lingual haematoma. *Emerg Med J* 2001;**18**:408–9.
33 **Konrad C**, Schupfer G, Wietlisbach M, *et al*. Learning manual skills in anesthesiology: Is there a recommended number of cases for anesthetic procedures? *Anesth Analg* 1998;**86**:635–9.
34 **Charuluxananan S**, Kyokong O, Somboonviboon W, *et al*. Learning manual skills in spinal anesthesia and orotracheal intubation: is there any recommended number of cases for anesthesia residency training program? *J Med Assoc Thai* 2001;**84**(suppl 1):S251–55.
35 **Hayden SR**, Panacek EA. Procedural competency in emergency medicine: the current range of resident experience. *Acad Emerg Med* 1999;**6**:728–35.
36 **Gallagher EJ**, Coffey J, Lombardi G, *et al*. Emergency procedures important to the training of emergency medicine residents: who performs them in the emergency department? *Acad Emerg Med* 1995;**2**:630–3.
37 **Ma OJ**, Bentley B, Debehnke DJ. Airway management practices in emergency medicine residencies. *Am J Emerg Med* 1995;**13**:501–4.
38 **Levitan RM**. A new tool for teaching and supervising direct laryngoscopy. *Acad Emerg Med* 1996;**3**:79–81.
39 **Levitan RM**. A new view on intubation training. *Journal of Emergency Medical Services* 1998;**23**:54–8.
40 **Levitan RM**, Goldman TS, Bryan DA, *et al*. Training with video imaging improves the initial intubation success rates of paramedic trainees in an operating room setting. *Ann Emerg Med* 2001;**37**:46–50.
41 **Forrest FC**, Taylor MA, Postlethwaite K, *et al*. Use of a high-fidelity simulator to develop testing of the technical performance of novice anaesthetists. *Br J Anaesth* 2002;**88**:338–44.
42 **Glavin RJ**, Maran NJ. Development and use of scoring systems for assessment of clinical competence. *Br J Anaesth* 2002;**88**:329–30.
43 **Mason RA**. Education and training in airway management. *Br J Anaesth* 1998;**81**:305–7.
44 **Ball DR**, Jefferson P. The airway and the anaesthetist. *Anaesthesia* 2001;**56**:693–4.
45 **Smith HL**. Training in difficult airway management. *Anaesthesia* 2001;**56**:381.
46 **Abdalla S**, Thomson KD. Away with the LMA? *Anaesthesia* 1999;**54**:1116–17.
47 **Weinger MB**, Vredenburgh AG, Schumann CM, *et al*. Quantitative description of the workload associated with airway management procedures. *J Clin Anesth* 2000;**12**:273–82.
48 **Cross J**. Airway management—a current training problem? *Anaesthesia* 2000;**55**:515–16.
49 **Morris J**, Cook TM. Rapid sequence induction: a national survey of practice. *Anaesthesia* 2001;**56**:1090–7.
50 **Chopra V**, Engbers FH, Geerts MJ, *et al*. The Leiden anaesthesia simulator. *Br J Anaesth* 1994;**73**:287–92.
51 **Chopra V**, Gesink BJ, de Jong J, *et al*. Does training on an anaesthesia simulator lead to improvement in performance? *Br J Anaesth* 1994;**73**:293–7.
52 **Plummer JL**, Owen H. Learning endotracheal intubation in a clinical skills learning center: a quantitative study. *Anesthes Analg* 2001;**93**:656–62.
53 **Rogers PL**, Jacob H, Rashwan AS, *et al*. Quantifying learning in medical students during a critical care medicine elective: a comparison of three evaluation instruments. *Crit Care Med* 2001;**29**:1268–73.
54 **Armstrong-Brown A**, Devitt JH, Kurrek M, *et al*. Inadequate preanesthesia equipment checks in a simulator. *Can J Anaesth* 2000;**47**:974–9.
55 **Lloyd G**. High level simulator. *J Accid Emerg Med* 2000;**17**:309.
56 **Devitt JH**, Kurrek MM, Cohen MM, *et al*. Testing internal consistency and construct validity during evaluation of performance in a patient simulator. *Anesth Analg* 1998;**86**:1160–4.
57 **Arne R**, Stale F, Ragna K, *et al*. PatSim—simulator for practising anaesthesia and intensive care. Development and observations. *Int J Clin Monit Comput* 1996;**13**:147–52.
58 **Howells TH**, Emery FM, Twentyman JE. Endotracheal intubation training using a simulator. An evaluation of the Laerdal adult intubation model in the teaching of endotracheal intubation. *Br J Anaesth* 1973;**45**:400–2.
59 **Fletcher GCL**, McGeorge P, Flin RH, *et al*. The role of non-technical skills in anaesthesia: a review of current literature. *Br J Anaesth* 2002;**88**:418–29.
60 **Asbury AJ**. Simulators for general anaesthesia. *Br J Anaesth* 1994;**73**:285–6.
61 **Ellis C**, Hughes G. Use of human patient simulation to teach emergency medicine trainees advanced airway skills. *J Accid Emerg Med* 1999;**16**:395–9.
62 **Gordon JA**, Reznek MA. A simulator-based medical education service. *Acad Emerg Med* 2002;**9**:865.
63 **Reznek M**, Harter P, Krummel T. Virtual reality and simulation: training the future emergency physician. *Acad Emerg Med* 2002;**9**:78–87.
64 **Bishop MJ**, Michalowski P, Hussey JD, *et al*. Recertification of respiratory therapists' intubation skills one year after initial training: an analysis of skill retention and retraining. *Respiratory Care* 2001;**46**:234–7.
65 **Bush S**, Gray A, McGowan A, *et al*. Rapid sequence intubation. *J Accid Emerg Med* 2000;**17**:309.
66 **Walls RM**, Luten RC, Murphy MF, *et al*, eds. *Manual of emergency airway management*. Philadelphia, PA: Lippincott, Williams and Wilkins, 2000.
67 **Sagarin MJ**, Chiang V, Sakles JC, *et al*. Rapid sequence intubation for pediatric emergency airway management. *Pediatr Emerg Care* 2002;**18**:417–23.
68 **Gnauck K**, Lungo JB, Scalzo A, *et al*. Emergency intubation of the pediatric medical patient: use of anesthetic agents in the emergency department. *Ann Emerg Med* 1994;**23**:1242–7.
69 **Marvez-Valls E**, Houry D, Ernst AA, *et al*. Protocol for rapid sequence intubation in pediatric patients—a four-year study. *Medical Science Monitor* 2002;**8**:CR229–34, ,
69a **Oglesby AJ**, Graham CA, Beard D, *et al*. Paediatric intubation in Scottish emergency departments. *Paediatr Anesth* 2003;**13**:589–95.
70 **Royal College of Anaesthetists**. *Guidance on the provision of paediatric anaesthesia services*. London: Royal College of Anaesthetists, 2001. http://www.rcoa.ac.uk/publications/publication_details.asp?ID=152 (accessed 18 Feb 2003).
71 **Nicol MF**. You can't anaesthetise patients—you're not employed as an anaesthetist. *Emerg Med J* 2001;**18**:414.