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REVIEW

"Airway management complications during anaesthesia, in intensive care units and in emergency departments in the UK"

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SUMMARY

In 2011 the Royal College of Anaesthetists and the Difficult Airway Society published their joint report, the Fourth National Audit Project (NAP4). This project investigated airway management practises and the major complications of airway management during anaesthesia, in the intensive care unit (ICU) and emergency departments (ED) throughout the UK over a one year period. Reports of 184 major complications were received: 133 during anaesthesia, 36 from ICU and 15 in the ED. In total 38 deaths were attributed to airway management: 16 during anaesthesia, 18 from ICU and 4 from the ED. During the year-long investigation 2.9 million general anaesthetics were estimated to have been administered, giving a point estimate of death from an airway event during anaesthesia as one per 180,000 general anaesthetics and a major complication rate of one in 22,000. When compared to anaesthesia the risk of a major airway complication was 36 times higher in the ED and 56 times higher in ICU. Detailed analysis of the individual cases identified a number of themes and learning points leading to the publication of over 160 recommendations and important opportunities to improve patient care.

1. Introduction

The Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society: Major complications of airway Management in the United Kingdom (NAP4) was a prospective national study of major complications of airway management occurring during anaesthesia, in the intensive care unit (ICU) or the emergency department (ED), throughout the four countries of the United Kingdom (UK) during one year, ending September 1st 2009.

1.1. Inclusion criteria

An airway problem leading to death, brain damage, emergency surgical airway or unanticipated ICU admission triggered inclusion in the project. For ICU events the latter criterion was modified to encompass an increased duration of stay. A surgical airway included all forms of direct tracheal access by tracheostomy or cricothyroidotomy with a cannula/needle technique or as a surgical procedure. It was classified as an *emergency* if this was not the primary airway management plan, but was needed as rescue after failure of other techniques.

1.2. Data submission

A network of local reporters (LRs) was established with at least one in each National Health Service (NHS) hospital undertaking surgery. Approximately half of these had additional LRs for the ICU and the ED. Local reporters disseminated information about the project, assisted with the identification of cases and provided a link with the project organisers. Case reports were submitted on-line via a secure, anonymised, password protected website. A 'firewall' between the person receiving the notification and the review panel ensured no reviewer knew where any case was reported from.

1.3. Case reviews

A multidisciplinary panel was constituted. This consisted mainly of anaesthetists with sub-specialty interests, but also included; a lay-person, nurses, operating department practitioners, an

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emergency physician and surgeons all nominated by specialist societies who supported the project. The review process confirmed the appropriate inclusion, recorded the final outcome and identified the likely causal and contributory factors using a classification developed to investigate critical incidents.[1] The review process was systematic and as objective as possible with all reviewers reminded of the risk of outcome and hindsight bias before each meeting.[2,3] It was designed to minimise potential prejudice, though these could not be eliminated.[4]

1.4. Census of airway management

Case reports submitted to NAP4 provided numerators to determine the incidence of complications. To provide a denominator a separate national census of airway management during anaesthesia was completed.[5] This determined the number of general anaesthetics performed annually in the UK and the primary airway management technique used. The census was conducted during the same year as the main project.[6–8] Other sources were used to provide estimated denominators for ICU and ED events.[9,10] In total 2.9 million general anaesthetics were estimated to have occurred in the UK in the year 2008-9. Of these 56% used a supraglottic airway device (SAD), 38% some form of a tracheal tube and 5% used a facemask.[5]

2. Analysis of events

This section highlights the important features of reported cases, the major findings and consequent recommendations. Of the 184 reports submitted, 133 were complications during anaesthesia, 36 in the ICU and 15 occurring during airway management in the ED. Patterns of presentation differed between each of these three areas. The commonest inclusion criterion for events during anaesthesia was ICU admission, however for events in the ICU death or brain damage formed the largest group, contrasting with the ED where an emergency surgical airway was the most common reason for inclusion. Outcomes of the events also differed between areas and these are presented in Table 1.

2.1. Demographic data

The most frequent patient and event characteristics of the anaesthesia group were; male, ASA grade 1–2, age less than 60, anaesthetised by consultants between the hours of 0800 and 1800. These data are compared for the 3 areas in Table 2. ICU events occurred in patients with the poorest ASA grade status whilst events occurred most frequently out of routine working hours in the ED. All complications during anaesthesia were managed by anaesthetists, mainly consultants but some in the ICU and ED were managed by doctors who might be expected to lack the appropriate expertise either due to their primary specialty or lack of seniority. This is demonstrated by an analysis of the practitioner managing ED events shown in Table 3.

Table 1
Final outcome of all reports.

	All reports	Anaesthesia	ICU	ED
Death	38	16	18	4
Brain damage	8	3	4	1
Other permanent harm	10	6	3	1
Full recovery	124	106	9	9
Unrelated death	4	2	2	0

Table 2
Patient and event characteristics.

	Anaesthesia	ICU	ED
Male	62%	58%	67%
ASA 1-2	56%	22%	40%
Age <60	61%	61%	80%
Event 18:00 - 08:00	24%	46%	53%
Consultant present	63%	58%	53%

3. Emergency department reports

Of the 15 (8%) events reported from the ED the primary problem arose from difficult or failed intubation in 14 cases. An emergency surgical airway was performed in 10 ED events and was eventually successful in all cases though several initial attempts at cannula cricothyroidotomy failed, requiring rescue with a surgical approach. Of the five patients not requiring a surgical airway two died as a result of unrecognised oesophageal intubation, and three required ICU admission, two following aspiration of gastric contents and one as a result of tracheal perforation with an intubating bougie.

The identified issues can be summarized in the concepts of 'right person, right place, right equipment, right preparation'.

3.1. Right person

In four cases managed by junior trainees the doctor involved is likely to have lacked the experience to deal with the airway problem they encountered: for example in two reports inexperienced trainees attempted to undertake rapid sequence induction and tracheal intubation in patients with mid-face fractures and blood in the airway without seeking appropriate help or support. Analysis of these cases suggested poor communication both with other doctors in the ED and with senior colleagues in anaesthesia. In two other cases the attending airway practitioner was a critical care trainee who lacked the required airway skills: in both these cases unrecognized oesophageal intubation led to an apparently avoidable patient death. Where critical care physicians respond to airway emergencies it is essential to ensure that they have the relevant competencies and access to support, regardless of their apparent seniority. Team leaders in the emergency department should establish the skills and role of all team members, and a formal checklist is likely to prove valuable in ensuring staff introduce themselves and their role, and in preparing for all advanced airway interventions.[11]

3.2. Right equipment

In more than half of the ED events capnography was either not available, or not used during attempted intubation. Failure to use capnography led to two unrecognised oesophageal intubations,

Table 3
Specialty and grade of the practitioner managing the airway at the time of the reported emergency department event.

Grade and specialty	Number
Consultant or Associate Specialist in anaesthesia	7
Specialist Trainee Year 7 (ST7) in anaesthesia	1
Specialist Trainee Year 6 (ST6) in critical care (non-anaesthetist)	2
Specialist Registrar (Year unrecorded) in emergency medicine	1
Specialist Trainee Year 3 (ST3) in anaesthesia	3
Acute Care Common Stem Trainee in anaesthesia (5 months experience)	1

both of which led to death. In one case of oesophageal intubation the lack of a capnograph trace was erroneously attributed to cardiac arrest, when in fact a somewhat attenuated, but typical, trace can be seen in cardiac arrest whilst cardiopulmonary resuscitation (CPR) is ongoing Fig. 1.

3.3. Right place

In two cases a consultant anaesthetist elected to move a patient to theatre in order to perform a surgical airway following failed intubation in the ED, and in one patient this led to a prolonged period of hypoxia and cardiac arrest. There is an understandable desire by anaesthetists to move a patient with airway compromise to a more familiar environment, however this is not without risk. Ideally, patients presenting to the ED with acute airway compromise should not be moved to another location until their airway has been secured.

3.4. Right preparation

Emergency airway management outside the operating theatre is associated with more frequent problems than routine anaesthesia, and with a higher incidence of difficult or failed intubation.[12,13] Although the timing of the most challenging events cannot be predicted, patients with upper airway obstruction will present to every ED in the UK. To ensure these patient groups are managed by experienced individuals with specific training it is sensible to agree in advance who will respond and in what time-frame to common ED airway emergencies. There must be a clear system of clinical governance to ensure that commonly accepted standards are maintained.[14]

4. Intensive care unit reports

Thirty-six ICU cases were reported accounting for less than 20% of the total number of cases reported to NAP4. 18 patients died and 4 suffered permanent neurological injury as a result of the airway complication. This 61% rate of death or brain damage is much higher than for complications during anaesthesia (14%) or in the emergency department (31%). Airway complications in ICU fell into the following major categories: failed or oesophageal intubation; accidental extubation, including tracheostomy; and problems during transfer.

Fig. 1. Capnograph trace during cardiac arrest with CPR in progress (courtesy of S. Chapman).

4.1. Failed/oesophageal intubation

In ten cases, patients either could not be intubated, or could not be re-intubated following accidental extubation. In several patients with a recognised potentially difficult airway, intubation was delayed until the patient was *in extremis*, sometimes out-of-hours, exacerbating an already difficult situation. There was evident failure on occasions firstly, to recognise potential difficulty and secondly, to have a back-up plan for patients at risk of difficult intubation. For some, plans were established but equipment or skilled staff to execute the plan was not available when needed. Five of these patients deteriorated to the 'can't intubate, can't ventilate' scenario. Failure of cricothyroidotomy was noted in this group where five were attempted but in three cases insertion failed. Failed intubation was managed with surgical tracheostomy in six cases.

Four patients suffered unrecognised oesophageal intubation leading directly to two deaths and contributing to a third. Two were performed by junior trainees and later, re-intubation proved to be straightforward; one of these patients died. In two further events, patients were intubated in cardiac arrest and found after death to have had oesophageal intubations. Capnography was not used in any of these events.

4.2. Accidental extubation

Eighteen cases involved accidental airway displacement, of which 14 involved tracheostomy tubes. Obese patients and those with known difficulty airways were over-represented in this group. Displacement most often occurred during patient movement. Inadvertent dislodgement of a tracheostomy tube led to half of all cases of death or brain damage in ICU. Capnography was rarely used and in several cases it was clear that recognition of tube displacement was delayed, even to the point of cardiac arrest.

Tube displacement occurred at all hours of the day and night, and staff attending did not always have the knowledge or skills to manage the problem in a structured way. There was evidence of a lack of advanced airway skills, especially out of hours. There is scope to improve tracheostomy tube design to cater for patient deformity and the increasing prevalence of obesity.

4.3. Patient transfer

Three patients suffered adverse events directly related to transfer to or from ICU; all died or suffered brain damage. It is evident that patient transfer is fraught with hazard and that moving patients even as part of routine care can lead to misadventure. All staff caring for patients with artificial airways should receive training in safe movement and transfer of patients and must be alert to the possibility of airway displacement.

4.4. Airway equipment

Capnography is the standard of care for patients with artificial airways in the operating theatre and the NAP4 panel recommended it must be used for all intubations and should be used continuously in all patients with artificial airways who are ventilated. To maximise benefits staff must be trained in interpretation of capnography traces. Advanced airway management equipment such as the intubating laryngeal mask airway and fibreoptic laryngoscope was frequently unavailable. Difficult airway trolleys must be available on all units and their contents should be familiar to staff and the same as those used in the operating theatre and in the ED. A flexible fibrescope should be immediately available on ICU.

4.5. Training and guidelines

Intensive Care Units are increasingly staffed by doctors whose primary specialty is not anaesthesia and who do not have advanced airway skills. It was clear that there was often no back-up plan in place for patients with challenging airways. Potential problems should be identified in advance and skilled assistance should be available. Intubation checklists must be available, and should incorporate a plan for failure and this should extend to planned extubations. Guidelines for management of airway displacement should also be routinely available on ICUs.

5. Anaesthesia reports

Of the 133 anaesthesia reports the primary airway problem (Fig. 2) was defined as difficult, delayed or failed tracheal intubation (including can't intubate and can't ventilate cases {CICV}) in 39% of cases. Aspiration of gastric contents formed the next largest group (17%), followed by extubation related problems (16%). Relative to their widespread use supraglottic airways were infrequently recorded as the primary problem (8%).[5]

5.1. Assessment and planning

An airway management strategy is needed; this requires recognition of potential difficulties and identification of sequential plans to be used in the event that the first or subsequent approach fails. In 37 (28%) cases airway assessment was either not performed or not recoded. Difficulty was anticipated in 66 reports (49%) and in some of these cases airway management strategy was poor or lacking with no back-up plan available; in others with a plan no consideration that it might fail was apparent, or sometimes the necessary equipment was unavailable. In cases of CICV alternative anaesthetic techniques such as awake intubation or regional anaesthesia were available but not deployed, or multiple attempts at tracheal intubation by direct laryngoscopy were attempted. Nasendoscopy can be valuable in evaluating the airway prior to induction of anaesthesia but was rarely used.[15]

5.2. Aspiration

Aspiration was associated with 50% all anaesthesia-related deaths, making it the commonest cause of airway related death during anaesthesia in this series. Many of those who survived needed an extended period of care in ICU. Although the assessment of aspiration risk is an imperfect science, it appeared to be poor in this group.[16,17] Despite the presence of accepted risk factors for regurgitation standard laryngeal masks were used where second generation devices would have offered greater protection.[18,19] Mechanical decompression with nasogastric drainage was not used prior to anaesthesia in some cases of intestinal obstruction. In others there were accepted indications for rapid sequence induction but this was not applied. Aspiration of blood clots after extubation caused two cardiac arrests in the recovery period, one resulting in death. Both of these cases presented as airway obstruction which was attributed to bronchospasm: circuit, airway device and tracheal occlusion should all be remembered in the differential diagnosis of total or severe airway obstruction.

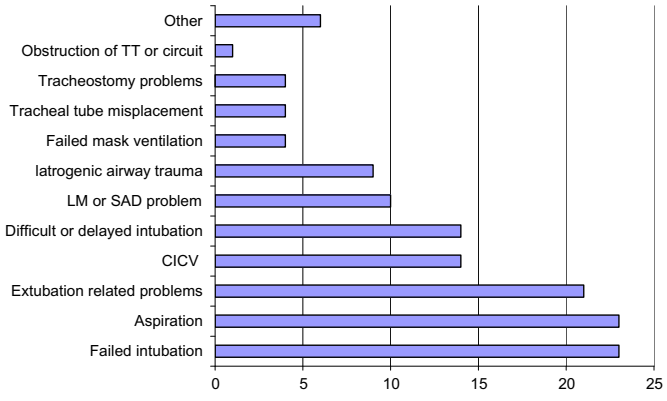

Fig. 2. Primary airway problem of 133 anaesthesia cases.

5.3. Head and neck malignancy

Seventy-two cases reported to the project involved a disease process of the head, neck or trachea and in 40 of these cases there was airway obstruction. Poor preoperative airway assessment and a lack of discussion between the surgeon and anaesthetist were raised as areas of concern. Poor provision and planning for failure of the primary airway management plan was a persistent feature. Tracheostomy under local anaesthesia was given inadequate consideration. Most airway management techniques including direct laryngoscopy, videolaryngoscopy, fibreoptic intubation and cannula cricothyroidotomy were reported to have failed in some cases. Multiple identical failed attempts at airway instrumentation were reported. In many cases airway management should have been conducted in the operating room; this applies both to induction and extubation. After extubation a longer period of evaluation postoperatively might have allowed earlier intervention in some cases. In this group of patients hazards continue post-operatively; the early recovery period entails a high risk for obstructive complications and later bleeding into the airway or neck led to airway oedema with obstruction.

5.4. Obesity

Forty-five percent of patients reported to NAP4 were obese compared to 25% of the general UK population. Fourteen (8%) reports came from patients with morbid obesity despite a prevalence of less than 2% nationally. No airway assessment was recorded in 32% of these patients but in those where assessment was performed difficulty was expected in 50%. Some patients with obesity and co-morbidities including obstructive sleep apnoea (OSA) were admitted as a day case where time to discuss alternatives to routine general anaesthesia was not available. Some of these patients went on to experience profound hypoxia, cardiac arrest or death whilst undergoing minor procedures including some that might have been performed under regional anaesthesia. In reports of events in obese patients consultant presence was lower and the proportion of SADs used was higher than in reports from non-obese patients. Intra-operative airway complications occurring during conversion from regional anaesthesia to general anaesthesia were five times more common in obese patients than in the non-obese.

5.5. Emergence and recovery

Although the majority of adverse events occurred at induction of anaesthesia 38(28%) events occurred during emergence or recovery. All 38 reports during this period involved some form of airway obstruction. Almost half ($n = 18$) involving ENT or maxillo-facial operations and 16 following surgery within the airway. Post obstructive pulmonary oedema (POPO) caused one death and 12 ICU admissions; a number might have been easily prevented by the use of a bite block or some other device to prevent occlusion of a tracheal tube or SAD. Poor preparation for predictable problems at the end of surgery and delayed recognition of airway obstruction

was noted. Access to emergency airway trolleys, capnography and suitable trained help was sometimes poor. In some cases better communication to recovery staff of potential complications, the need for additional equipment or the location of suitably trained colleagues might have prevented patient harm.

5.6. CICV and emergency surgical airways

Cricothyroidotomy is advocated widely in guidelines for the management of CICV and this is consistent with the fact that some form of direct access to the airway was attempted in 43% of the complications occurring during anaesthesia.[20] In 20% of cases the peripheral oxygen saturation fell below 70% for at least 5 min and in several cases it was at or below this level for 30 min before ventilation was restored. It is notable that several of these patients went on to make a full recovery, apparently without neurological deficit. In some cases the decision to perform an emergency surgical airway was taken without attempting rescue by SAD insertion or administration of a muscle relaxant, either of which might have permitted pulmonary ventilation. Where there is a high suspicion that an emergency surgical airway will be required consideration should be given to securing the airway under local anaesthesia or the insertion of a cricothyroidotomy cannula before induction of anaesthesia. Emergency surgical airway when performed by an anaesthetist failed to restore oxygenation in 60% of cases. Both needle and wide bore cannula techniques were noted to have failed. Subsequently many of the unsuccessful needle or cannula cricothyroidotomies were rescued by open surgical tracheostomy or cricothyroidotomy, in others by SAD insertion or tracheal intubation. The NAP4 project provides evidence that cricothyroidotomy is used by anaesthetists, but failure rates are high, suggesting additional training and practise in this procedure is needed. Research should be undertaken to establish whether these failures were due to a lack of training and experience, or whether there is a better technique to rescue the airway, e.g. tracheostomy. Meanwhile surgical cricothyroidotomy should be taught alongside needle or cannula techniques.[21]

5.7. Fibreoptic intubation

The most prominent finding in this regard was the failure to use fibreoptic intubation (FOI) when indicated. There were 18 reports with clear indications for awake FOI where general anaesthesia was used instead. For this reason it was a recommendation that this technique should be available to all patients who need it and anaesthetic departments should provide support for colleagues who lack the skill to perform awake intubation.

Failed awake FOI was also reported and this was variously attributed to inability to view landmarks, airway obstruction, loss of co-operation, bleeding and impingement preventing passage of a tube through the nose. Some of these failures were attributed to selection of nasal intubation where there were no specific indications to use this route. In other cases where FOI failed, oversedation was considered to be a significant factor as this led to loss of cooperation and airway obstruction with subsequent inability to restore the airway or awaken the patient. Failures during general anaesthesia were also attributed to the same causes. Both successful and failed rescue by FOI through SADs was recorded: success was most widely reported when an Aintree catheter was passed over the endoscope to facilitate tracheal intubation.[22]

5.8. Capnography

Capnography was used in all the reports during anaesthesia but failure to correctly interpret capnography complicated some cases. A flat capnography trace indicates the lungs are not being ventilated even in the presence of cardiac arrest since ongoing cardiopulmonary resuscitation maintains some cardiac output.[23] Failure to recognise this led to delayed diagnosis of oesophageal intubation and tracheal tube obstruction.

Capnography was not used during emergence and recovery events. Its use would likely have identified cases of airway obstruction earlier and may have assisted in diagnosis of several events including some that resulted in a patient death.

5.9. Paediatrics and obstetric events

Thirteen events in children were reported to NAP4 and nine of these were less than 4 years old: three children died. Three reports, including one death, involved patient transfer within or between hospitals. An emergency surgical airway was performed in five children. One paediatric death occurred in each of the anaesthesia, ICU and ED groups. There were four obstetric cases: all complications involved induction of general anaesthesia for or during caesarean section. All patients went on to make a full recovery.

6. Contributory factors

At case review the underlying factors leading to the adverse incidents were identified: the classification used and the pattern of distribution is shown in Table 4. The description below can only touch on a few of the many themes identified.

The most commonly recorded contributory factor was the nature of the airway challenge presented by the patient. Of the remediable factors *judgement* and *education or training* were considered to contribute to more than 60% of events and multiple factors were sometimes implicated. For example, basic assessment of the airway including evaluation of aspiration risk and re-assessment before extubation was sometimes lacking. There was an apparent failure to anticipate problems. This led to the adoption of high risk techniques with failure to establish back-up plans (i.e. a strategy) to manage subsequent difficulty. In practise it is often difficult to distinguish poor judgement from lack of education or training without additional background information. *Equipment* issues included total absence of specific but important items such as a fibreoptic endoscope, second generation SAD or an Aintree intubation catheter. Of particular note was the need to standardise airway equipment on a hospital-wide basis in all locations, including the recovery area, ICU and the ED. *Communication* was sometimes poor between anaesthetists, and with surgeons and recovery staff. *Organisational and strategic factors* observed included a need to identify difficult patients early to ensure they are appropriately evaluated before surgery. This would apply to patients with obstructive sleep apnoea, obesity or a known airway

Table 4
Analysis of factors contributing to adverse events.

Factors	Causal	Contributory	Positive
Communication	4	38	40
Education and Training	12	77	17
Equipment and resources	2	46	21
Medicines	0	31	5
Organisation and strategic	1	42	35
Patient	37	103	1
Task	4	31	7
Team and Social	0	36	22
Work and Environment	1	14	3
Judgement	19	90	23
Other	0	8	0

problem. On an organisational level departments should provide training and rehearsal of airway rescue techniques and ensure anaesthetists who lack the ability to perform an awake fibreoptic intubation have access to colleagues who can. *Task* related factors might be improved by the development of checklists, for example for tracheal intubation in ICU and the ED. *Team working* requires attention in some areas; ICUs are increasingly staffed by doctors whose background is not anaesthesia; it will become increasingly important that advanced airway expertise is available to the ICU in and out of hours with clear lines of communication to escalate airway events to individuals with appropriate skills when a difficult airway is encountered.

7. Incidence of complications

NAP4 produced both numerators (cases reported) and denominators (census data on the number of general anaesthetics performed annually) enabling calculation of an incidence of major airway complications during general anaesthesia of 1 in 22,000 and of death from such events as 1 in 180,000. The accuracy of the calculated value for the incidence of complications is likely to be undermined by a degree of underreporting: this is discussed in depth in the original report.[6,7]

A comparison of complication rates from anaesthesia, ICU and the ED yields important insights. Denominator data for the ICU and ED were not determined as part of the NAP4 project but a separate census in EDs identified approximately 20,000 rapid sequence inductions annually.[9] Combining the NAP4 data on events in the ED with this denominator suggests major airway complications in the ED are approximately 36 times more common than during anaesthesia. Similarly, based on Department of Health hospital episode statistics[10,24] for England and extrapolating for the whole UK we can estimate 58,000 patients received advanced respiratory support during the period of NAP4. Based on these figures the incidence of major airway complications is 56 times higher in the ICU than during anaesthesia. These calculations are based on data not directly collected by the NAP4 project so should be treated with caution, but the implications are self-evident.

8. Discussion

The events reported here may represent the tip of a larger iceberg since many similar events will not have met the inclusion criteria. Though the overall distribution of reports was compatible with complete reporting it was estimated that as few as one in four events may have been reported, increasing the calculated incidence of complications accordingly. While there are limitations to our estimate of incidences of these events the real value of the project comes from the detailed analysis of the case reports.

The majority of the complications reported to NAP4 could have been prevented through more effective systems, better preparation and good communication. The hazardous nature of airway management outside of the operating room is well known.[12,13,25–27] This project identified a number of areas in which opportunities exist to improve airway management in the ED, the ICU, and during anaesthesia. Over 160 recommendations were made and whilst not all of these can be addressed in this brief article they are conveniently located in one chapter of the final report to facilitate detailed examination.[7] In order to improve patient care and rectify as many deficiencies as possible a structured approach is required with systematic examination of the problems highlighted and the implementation of change.[28]

One strong message to come from this project is the importance of capnography for monitoring the airway in all areas where patients require airway management and tracheal intubation. NAP4 recommends use of capnography for all patients dependent on an artificial airway whether during anaesthesia, in ICU or the ED; along with availability in the recovery room. Several organisations have revised their recommendations on capnography since the publication of NAP4. These include the Association of Anaesthetists of Great Britain and Ireland, the Intensive Care Society and the European Board of Anaesthesiology whose guidelines or recommendations all now reinforce those of NAP4.[29–31] Continuous capnography on intubated patients on ICU was judged by the review panel to be the single recommendation most likely to save lives.

NAP4 is a report of perhaps unique breadth and depth, but despite this many of the findings in NAP4 reinforce what we know already. The high failure rate of cricothyroidotomy in the hands of anaesthetists is an important new finding which requires further consideration but other more familiar problems are well documented; these include poor assessment of the airway, poor back-up planning, high death rate from aspiration, problems in patients with airway obstruction, the important role of capnography, complications associated with obesity, the adoption of high risk behaviour by anaesthetists and failure to use awake intubation when indicated.[32–38] Some recommendations are similar to those that have appeared before in similar reports.[36] Failure to implement the findings of investigations such as NAP 4 is well described and it remains a major challenge for those who provide healthcare to effectively alter behaviour in order to improve patient outcome.[39,40]

9. Conclusion

The project recorded a point estimate of one airway death per 180,000 general anaesthetics, and therefore airway management during anaesthesia could be considered relatively safe. Airway management in the ICU and ED is more hazardous but in all areas important opportunities exist to improve patient safety. Implementing the findings and recommendations of NAP4 is a major challenge to individuals, departments and organisations, but only by rising to this challenge can the opportunities that exist to make airway management safer be realised.

Conflict of interest

Dr Tim Cook has been paid by Intavent Orthofix and the LMA Company for lecturing. His department has received free or at cost equipment for research. He has no other financial arrangements with any such companies.

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