Survey of airway management strategies and experience of non-consultant doctors in intensive care units in the UK

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Editor’s key points

- National Audit Project 4 (NAP4) has highlighted the issue of airway problems in intensive care setting.
- This survey of intensive care units (ICUs) in the UK was undertaken before NAP4 started.
- The findings show a significant scope for improvement in the readiness of the ICUs in dealing with airway problems.
- It remains to be seen whether NAP4 recommendations have had any impact on the findings of this survey.

Background. Airway problems continue to occur in intensive care setting. Management strategies, staffing, and availability of equipment can all have an influence.

Methods. We undertook a standardized telephone survey of airway management strategies, staffing, and airway equipment availability in general intensive care units (ICUs) in the UK, before the reporting of the Fourth National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society.

Results. All 257 UK general ICUs were contacted and 77% replied. At the time of the survey, 6.3% of all ICU patients were judged by respondents to have an increased risk of airway complications. While 38% of respondents reported using individualized airway management plans for patients with higher risk airways, only 19% of the patients identified as ‘at risk’ had such a plan in place. Action plans for the management of unanticipated tracheal tube and tracheostomy displacement were available in 7% and 10% of ICUs, respectively, although 27% of respondents reported no training in recognition and management of these events. Few respondents could describe the equipment available for emergency transtracheal access on their ICU and 13% had no training in its use. More than half of the respondents (56%) routinely used continuous waveform capnography for patients with artificial airways. A fibrescope was available to all ICUs: immediately in 63% and after >5 min in 14%. In 33% of ICUs, the most junior doctor providing out-of-hours cover had not always obtained the Royal College of Anaesthetists initial assessment of competency in anaesthesia. One-third of ICU residents also had commitments outside the ICU. An additional anaesthetist for managing airway emergencies was available in all ICUs with 80% being on-site.

Conclusions. There remains room for improvement in airway management strategies and resources in ICUs in the UK.

Keywords: airway; complications; equipment; intensive care, tracheostomy

Accepted for publication: 21 May 2012
Division (NHS National Services Scotland). Units were included if they considered their workload consistent with that of a general adult ICU. ICUs reporting a high speciality component to their workload and pure high-dependency units (HDUs) were excluded. Between January 15 and April 30, 2011, we undertook a telephone survey examining equipment and pre-defined strategies used in managing potentially difficult airways on the ICU and the availability and competencies of staff providing out-of-hours ICU cover (Tables 1 and 2). The survey also attempted to create a snapshot of the prevalence of patients with potential airway problems on the ICU (Table 1). Questions were posed to ICU doctors present at the time of the phone call: those questions relating to out-of-hours cover on the ICU could only be answered by a non-consultant doctor who provided such cover. The remaining questions could be answered by any grade of ICU doctor.

A spreadsheet of results was analysed using simple statistical tools (Microsoft Excel 2010, Microsoft Corporation, Redmond, WA, USA).

### Table 1 Survey questions relating to equipment and pre-defined strategies for managing potentially difficult airways on ICU

<table>
<thead>
<tr>
<th>Question</th>
<th>Present</th>
<th>Absent</th>
<th>Unknown</th>
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<tbody>
<tr>
<td>How many patients are on your ICU at the present time?</td>
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<tr>
<td>How many patients were admitted because of an airway issue?</td>
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<td>How many patients are known to have an airway issue?</td>
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<tr>
<td>How many patients have tracheal tubes or tracheostomies?</td>
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<td>Does your unit routinely identify and make explicit airway management plans for patients with difficult airways? If so how?</td>
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<td>How many of the patients on your ICU have a specific plan at present?</td>
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<tr>
<td>Do you use unanticipated extubation plans?</td>
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<td></td>
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<tr>
<td>Do you use unanticipated tracheostomy displacement plans?</td>
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<tr>
<td>Do intubated/tracheostomy patients routinely have continuous waveform capnography?</td>
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<tr>
<td>What kit is available for emergency access to the front of the neck?</td>
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<td>Have you received training with this equipment?</td>
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<tr>
<td>Is there a fibrescope available for your ICU? How long does it take to get it?</td>
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</table>

### Table 2 Survey questions relating to the availability and competencies of staff providing out-of-hours ICU cover

<table>
<thead>
<tr>
<th>Question</th>
<th>Present</th>
<th>Absent</th>
<th>Unknown</th>
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<tbody>
<tr>
<td>What is your grade and speciality?</td>
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<tr>
<td>How much anaesthetics and ICU experience do you have? And what is your competency in airway management?</td>
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<tr>
<td>Who is the most junior person covering your ICU on-call rota? (Senior tier if &gt; 1 doctor covers ICU)</td>
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<td>Do you have commitments other than ICU?</td>
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<td>Who is your first point of contact for an airway emergency?</td>
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<tr>
<td>Who is your second point of contact for an airway emergency?</td>
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<tr>
<td>Have you had teaching on tracheal tube/tracheostomy displacement?</td>
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### Table 3 Use of unanticipated tracheal tube or tracheostomy displacement plans

<table>
<thead>
<tr>
<th>Plan</th>
<th>Present</th>
<th>Absent</th>
<th>Unknown</th>
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</thead>
<tbody>
<tr>
<td>Unanticipated tracheal tube displacement plan</td>
<td>14 (7.1%)</td>
<td>176 (89.3%)</td>
<td>7 (3.6%)</td>
</tr>
<tr>
<td>Unanticipated tracheostomy displacement plan</td>
<td>19 (9.6%)</td>
<td>170 (86.3%)</td>
<td>8 (4.1%)</td>
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</tbody>
</table>

### Results

All 257 general ICUs in the UK were contacted. Responses were received from 198 units: a 77.4% response rate. Completed questionnaires from 197 ICUs reported equipment and pre-defined strategies used in managing potentially difficult airways. One respondent declined to complete this part of the survey. Completed questionnaires from 194 ICUs reported availability and competences of non-consultant doctors providing out-of-hours airway cover: two ICUs had no resident out-of-hours doctor and two units declined to complete this part of the survey. A total of 1776 patients (1091 level 3 and 685 level 2) were included within the survey, representing 68% of all the available ICU and HDU beds in the UK.

### Airway strategies and rescue plans

Seventy-three patients (4.1% of patients) in 46 ICUs (23.4% of ICUs) had been admitted to the ICU for the management of a primary airway problem. There were 116 patients (6.3% of patients) in 77 ICUs (39.1% of ICUs) judged by the respondents to have an increased risk of airway complications (i.e. anticipated difficult intubation or difficult ventilation for a non-consultant doctor).

Seventy-four (37.6%) ICUs reported that they made explicit, individualized airway management plans for patients with known or potentially difficult airways: 64 (86%) were written in the medical notes, handover sheet, or as computerized text box. Only four of these written plans took the form of a specific airway proforma. Of the 116 patients who were judged by the respondents to have an increased risk of airway complications, 23 (19.8%) had a specific airway management plan in place.

Of 197 ICUs responding, unanticipated extubation or tracheostomy displacement plans had been formulated in 14 (7.1%) and 19 (9.6%) ICUs, respectively (Table 3). Respondents commonly reported the unadapted Difficult Airway Society (DAS) algorithms16 as their unit’s default plan for anticipated and unanticipated airway difficulty.

### The use of waveform capnography and availability of emergency airway equipment

Continuous waveform capnography was routinely used by 111 (56.3%) of responding units for all patients with a tracheal tube or tracheostomy. All ICUs reported having access to a fibrescope. This was immediately available to
123 units (62.8%), within 5 min to 42 (21.4%), in 5–10 min in 12 (6.1%), and after a delay of >10 min in 16 (8.1%).

Numerous devices for emergency transtracheal access were identified. The most common equipment available was a wide-bore cricothyroidotomy kit (128 ICUs, 65.0%). Twenty-three respondents were unsure of the transtracheal kit available (11.7%). Four ICUs (2%) had only surgical airway equipment available and six units (3%) reported having no emergency transtracheal airway equipment.

**Out-of-hours staffing, airway competency, and training**

We regarded the most senior ICU doctor resident in the hospital out-of-hours, as the individual available for airway interventions. In 131 (66.8%) units, this doctor had always obtained the Royal College of Anaesthetists (RCoA) initial assessment of competency in anaesthesia. In 73 (36.7%) units, cover was always provided by anaesthetists of specialist registrar level or above. In 33 (16.8%) units, out-of-hours cover was, at times, provided by doctors without the certificate of competency and in a further 30 (15.3%) ICUs, it was not possible to identify whether a certificate of competency had been obtained. Two units had no out-of-hours resident cover.

In the 33 units in which out-of-hours ICU cover was, at times, provided by a doctor without the above RCoA competency certification, there was competent on-site anaesthetic presence in >90% of units (Fig. 1).

All respondents reported availability of a more senior anaesthetist as ‘back-up’ for airway interventions (Table 4) with 157 (80%) units having such assistance ‘on-site’. All ‘back-up’ anaesthetists had other responsibilities other than the ICU. Of those 37 resident doctors without ‘on-site’ back-up, 23 (62%) also had responsibilities other than the ICU.

Of 194 respondents, 135 (73%) resident non-consultant grade doctors providing out-of-hours ICU cover had not been trained in managing tracheal tube or tracheostomy displacement. Similarly, 22 (13.1%) had not received training in establishing emergency transtracheal access.

**The duties of resident doctors outside the ICU**

The majority of respondents had no commitments outside the ICU: 70 (36.5%) ICUs were covered out-of-hours by doctors with other responsibilities, such as anaesthesia for general theatres, and obstetrics.

**Discussion**

This survey examined the institutional preparedness of UK general ICUs for managing airway interventions and complications in critically ill patients, before the reporting of NAP4. We found that approximately one in 25 patients were reported to have been admitted to the ICU because of an airway problem and one in 16 ICU patients were identified as having an increased risk of airway complications (either due to a primary airway problem or because of patient characteristics).

NAP4 reported that poor anticipation of potential airway difficulties and a lack of planning for failure contributed to poor outcomes in the adverse events reported to them. In this survey, despite ICUs recognizing patients with potentially difficult airways, we found a lack of institutional strategic preparedness, which echoes the findings of NAP4. While more than one in three ICUs reported the use of individual specific airway management plans for patients with anticipated at-risk airways, fewer than one in five of such patients actually on ICUs had such a plan in place. Fewer than 10% of ICUs had prepared plans for predictable airway compromise such as tracheal or tracheostomy displacement.

Although we identified the existence of airway plans, we did not investigate the content of these plans in detail. Many respondents reported the use of the DAS algorithms as their plan for managing airway emergencies. The DAS...
algorithms are primarily designed for managing unexpected difficult intubation during anaesthesia and perhaps not to encompass the complexity of anticipated airway difficulty in critically ill patients.

The widespread failure to provide strategic guidance (institutional preparedness) on managing critical airway events is given greater significance by our findings on airway training and competencies (personal preparedness) of ICU staff providing out-of-hours cover. While one-third of ICUs have senior anaesthetic trainees out-of-hours, between one in three and one in six ICUs are, on occasions, staffed out-of-hours by doctors without entry level anaesthetic competencies. This rate is similar to the 14% quoted by Jeanrenaud and colleagues in 2009.\textsuperscript{17} We found that approximately one-quarter of respondents lacked training in the emergency management of airway displacement and 13% had not been trained in the emergency transtracheal access kits available in their ICU. These findings may be partly explained by the increase in recruiting ICU trainees from base specialties other than anaesthesia: a trend set to persist if not increase.

While all units reported the availability of ‘back-up’ staff for managing airway emergencies, it was notable that this was more likely to be ‘off-site’ in those units where the out-of-hours ICU resident had duties outside the ICU. NAP4 recommends clear lines of communication to airway experts when an ICU is staffed by doctors without advanced airway skills and it is difficult to see how this can be maintained when there may be no doctor resident.

NAP4 recommends the routine use of continuous waveform capnography for all patients with artificial airways on the ICU and states that this would reduce airway events, including deaths.\textsuperscript{16} This recommendation has now been endorsed by several UK and European anaesthesia and critical care organizations.\textsuperscript{18–20} We found that more than half of all general ICUs routinely use continuous waveform capnography for ventilated patients, which is a notable increase compared with previous UK surveys which reported its use in 25–35% of ventilated patients.\textsuperscript{3,21} While implementation of this recommendation (bringing ICUs in line with long-standing anaesthesia practice) has cost implications, the fact that more than half of ICUs in the country have already achieved it, should send a message to those that have not. The accurate interpretation of a capnographic trace and its relevance to managing tracheostomy or tracheal tube displacement requires training: a topic we did not address in our survey.

Regarding equipment for emergency transtracheal access, we found a wide variety of devices available and high levels of uncertainty regarding their use. The evident lack of detailed knowledge of such equipment implies inadequate training and personal preparedness. The standardization of difficult airway trolleys, as recommended by NAP4, would assist in reducing the apparent uncertainty around such equipment, would provide continuity for junior doctors rotating between hospitals, and would be in line with other emergency equipment such as cardiac arrest equipment in the UK.

The immediate availability of a fibrescope in an emergency situation has been recommended by NAP4.\textsuperscript{14} While two-thirds of ICUs could access one promptly and availability has increased since Georgiou’s survey, in too many units, there was potential for critical delay.

Husain and colleagues\textsuperscript{22} recently examined the airway practices and preparedness of 171 ICUs in Australasia, also by survey, shortly before the publication of NAP4. They identified failure to use continuous capnography in 36% of units. Fewer than 20% of ICUs formally identified patients with high-risk airways and <10% had protocols for managing complications in these patients. Fewer than one-quarter had algorithms for the management of tracheostomy emergencies. A ‘difficult airway trolley’ was not kept inside the ICU in almost one-third of units. In one-quarter of units, the doctors covering the ICU at night were not always anaesthesia trained and also had duties outside the ICU. Although the survey did not seek to identify the frequency or nature of adverse airway events in these ICUs, the findings, in terms of organization and preparedness, resonate with those of this study.

This UK survey has demonstrated that before NAP4, general ICUs in the UK were often inadequately prepared for managing difficult airways, despite frequently being used as a place of safety for patients with potential or actual difficult airways. The NAP4 report made 168 recommendations with 23 specific to the ICU or patients with a tracheostomy. The report recommends a pro-active approach to identifying patients with ‘at risk’ airways and the development of airway management strategies that acknowledge the fact that rescue techniques in the ICU often fail. It recommends appropriate monitoring, equipment, staffing, and training, so that predictable airway events can be identified early and approached in a logical structured manner by trained staff with appropriate equipment immediately available. The report and recommendations have given ICU doctors many areas upon which to reflect both regarding their personal practice and the culture of their ICU or wider organization. This study is a snapshot of practice in UK ICUs before the findings of NAP4 were made public. It has shown that many of the gaps in preparedness and practice inferred from the index cases reported to NAP4 are replicated in this survey of staffing, training, and preparation for problems.

Our survey acts as a foundation against which the adoption of the NAP4 recommendations in UK ICUs can be measured.

**Acknowledgements**

In addition to respondents to our survey, we also thank Drs Clare Hamers, James Walters, Sara Cook, Robert Jackson, Jerry Nolan, Fiona Kelly, and Matt Thomas for their assistance in performing this study.

**Declaration of interest**

T.M.C. was the co-lead of the Fourth National Audit Project of the Royal College of Anaesthetists.
Funding
None.

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