



**Abstracts selected through the 999 EMS Research Forum peer review process and presented orally and by poster at The Joint Royal Colleges Ambulance Liaison Committee Annual Conference 2007**  
**Oral and poster presentations**  
**Poster presentations**

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## Abstracts selected through the 999 EMS Research Forum peer review process and presented orally and by poster at The Joint Royal Colleges Ambulance Liaison Committee Annual Conference 2007



### Oral and poster presentations

#### 001 EFFECTIVENESS OF EMERGENCY CARE PRACTITIONERS WITHIN EXISTING MODELS OF CARE IN ENGLAND

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**Background:** Emergency Care Practitioners (ECPs) have developed in response to a "key" UK government health policy to provide flexible health care focused around patients' needs. Drawn mainly from paramedic and nursing backgrounds, ECPs receive formal training to enable them to work across traditional boundaries in urgent care. In England, ECPs are working in different healthcare settings.

**Objectives :** (1) To evaluate the appropriateness, patient satisfaction and cost of ECPs compared with the usual service; (2) to increase understanding of the opportunities and challenges of ECP working in different settings; and (3) to consider whether ECP working yields cost savings.

**Methods:** Data were collected between March and May 2005. In three different health settings where ECPs are operational and three matched control sites without ECP working, with consent, each patient eligible to be seen by an ECP received a questionnaire at 3 and 28 days post-presentation. We also conducted telephone interviews with a purposive sample of NHS staff in each setting where ECPs were operational and used clinical data to estimate costs.

**Results :** 524 service users (245 ECP-attended and 279 control providers) completed a questionnaire at 3 days. After adjusting for age, sex, presenting complaint and service model, some differences were observed between ECPs working in different settings and also between the ECPs and the usual providers. Overall, ECPs carried out fewer investigations (OR 0.31), provided more treatments (OR 2.74) and were more likely to discharge patients home (OR 7.69) than the usual providers. ECP-attended patients in all settings reported being "very satisfied" with the care received (OR 2.37). The qualitative interviews confirmed commitment to developing and supporting the ECP role. In different ways, ECPs are seen to have a positive impact on service delivery. In one setting, ECP working was associated with costs savings.

**Conclusion:** We found no evidence that the care provided by an ECP was less appropriate than the care by the usual providers for the same type of health problem. The challenges for ECP working vary between different healthcare settings. Locally-driven initiatives indicate that the availability of ECPs is influencing how urgent care services are delivered. The potential for cost efficiencies will need to be tested further.

#### 002 AIRTRAQ VERSUS STANDARD LARYNGOSCOPY BY EXPERIENCED PREHOSPITAL LARYNGOSCOPISTS IN A MODEL OF DIFFICULT INTUBATION: A RANDOMISED CROSSOVER TRIAL

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**Background:** This trial evaluated the impact of a new laryngoscope design (the Airtraq) on the management of a model of difficult intubation by experienced prehospital laryngoscopists.

**Methods:** This randomised crossover trial compared between-device differences in first-time intubation success rates in a convenience sample of experienced intubation-trained prehospital providers using the Airtraq and a Macintosh laryngoscope with flexible stylet to manage a manikin model of a Cormack and Lehane grade III/IV view. Participants were attendees at the Australian College of Ambulance Professionals conference in November 2006. Approximately 5 min of training was provided in the use of the Airtraq immediately before data collection.

**Results:** First-time intubation success rates for the Macintosh and Airtraq respectively were 14/56 (25%) vs 47/56 (84%) (59% difference, 95% CI 42% to 72%,  $p < 0.0001$ ); oesophageal intubation rates 9/56 (16%) vs 0/56 (0%) (-16% difference, 95% CI -9% to -28%,  $p = 0.0014$ ); subject-rated difficulty of use scores 86 (IQ range 71-93, range 12-100) vs 20 (IQ range 5-28, range 1-75),  $p < 0.001$ .

**Limitations:** Recruiting volunteers at a clinically-focused conference risks reducing the generalisability of findings as this population is likely to consist of practitioners with a greater commitment to their ongoing education and who may therefore be more skilled in tracheal intubation than non-attenders. Trials involving models cannot be used as a basis for quantitatively predicting benefit in patients.

**Conclusions:** Prehospital providers with training and experience in laryngoscopy achieve significantly higher first-time intubation success rates and have lower rates of oesophageal intubation when managing a manikin model of a grade III/IV difficult intubation with an Airtraq in comparison with standard intubation techniques. Despite receiving only 5 min training in the use of the new laryngoscope, participants rated it as significantly easier to use than a standard Macintosh device.

### Poster presentations

#### 003 RISK-ADJUSTMENT MODELLING IN EMERGENCY MEDICAL CARE: THE DAVROS PROJECT

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**Background:** There are many thousands of ambulance-transported emergency medical cases each year. Not all of these cases have the same chance of survival. This is partly the result of emergency system performance and partly the result of factors intrinsic to the individual patient. An important question therefore in emergency care is to know what factors predict a patient's survival or otherwise in 999 emergency cases. If that is known, we can evaluate emergency system performance in a way that properly takes case mix variation into account.

**Methods** The DAVROS Project (Development and Validation of Risk-adjusted Outcomes for Systems of emergency medical care) aims to do that. Between now and 2009 researchers at the University of Sheffield, assisted by Yorkshire Ambulance Service, will gather data on 999 patients who are admitted to hospital. Specifically, the researchers will be looking at routinely collected clinical data and responses on an additional range of "predictive" variables (eg, is the patient able to talk in sentences?) that are not routinely collected. We can then measure the association between the predicting variables and the primary outcome of 30-day survival rates. Starting from a base in the South Yorkshire area, DAVROS will move to a national

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level in 2008, culminating in the involvement of data-gathering centres in Australia and Canada by the end of the project.

**Results:** The results from DAVROS will clearly identify what factors (other than purely biochemical or physiological factors) act to preserve or reduce survival chances in ambulance emergency patients. We intend that the identified predictor variables become part of the standard data set every ambulance crew routinely collects, and that the data are used for ongoing audit of emergency department performance, eventually leading to improved standards of care across the sector.

#### 004 TO CANNULATE OR NOT TO CANNULATE? VARIATION, APPROPRIATENESS AND POTENTIAL FOR REDUCTION IN CANNULATION RATES BY AMBULANCE STAFF

A N Siriwardena, M Iqbal, D Shaw, A Spaight, J Stephenson. *East Midlands Ambulance Service, UK*

**Background:** Peripheral intravenous (IV) cannulation is a key intervention in the prehospital setting, but inappropriate use may cause unnecessary pain, distress or risk of infection. The aim of this study was to examine the rate and appropriateness of prehospital cannulation and the relative importance of factors associated with increased likelihood of cannulation.

**Design and setting:** Cross-sectional survey of patients transported in Lincolnshire, East Midlands Ambulance Service.

**Methods:** Retrospective non-identifiable data for September 2006 were extracted. Clinical conditions were classified according to whether they warranted, did not warrant or were uncertain as to the need for cannulation. Other potential indications for cannulation including IV drug administration, reduced consciousness, systolic hypotension, respiratory depression and haemorrhage were combined to determine whether cannulation was indicated. Other variables were investigated as predictors of cannulation. The method of analysis was agreed at the outset.

**Results:** Paramedics cannulated 14.6% (1295/8866) of patients. IV drug administration, clinical indication, reduced conscious level, respiratory depression and hypotension were associated with greater likelihood of cannulation ( $p < 0.001$ ). Cannulation was more likely in older patients but was not associated with gender, haemorrhage or hypoglycaemia. Multivariate logistic regression showed IV drug administration as the strongest predictor of cannulation. Cannulation rates varied threefold by ambulance station (mean 13.4%, 5.8% to 19.0%). It was estimated that 202 (15.6%) of the cannulations performed could potentially have been avoided.

**Conclusion:** Rates of cannulation were higher than previous studies with wide variations between ambulance stations. 15.6% of cannulations performed could have been avoided, thus reducing pain, distress and other potential complications such as thrombophlebitis, extravasation and infection. The generalisability of this study was limited by use of a single site, short duration and dependence on accurate retrospective data. The data demonstrating wide variations suggest that there may be scope for consideration of interventions to reduce cannulation rates.

#### 005 DOES THE INTRODUCTION OF A COMPETENCY-BASED ASSESSMENT FRAMEWORK AFFECT LEVELS OF CLINICAL CONFIDENCE AMONG EMERGENCY CARE PRACTITIONERS?

T Edwards. *London Ambulance Service and University of Hertfordshire, UK*

**Background:** Competency Based Education and Training (CBET) has become an integral part of training for healthcare professionals. In 2003 a metropolitan Ambulance Service NHS Trust piloted the introduction of Emergency Care Practitioners (ECPs). To assist in practice development, a competency-based assessment framework was designed for use by ECPs during clinical placements.

**Aim:** To investigate if the introduction of a competency-based assessment framework affects clinical confidence among ECPs.

**Methods:** 28/63 ECPs agreed to participate in the study. Participants were subjected to a repeated measures research design involving administration of two questionnaires. The first section of the initial questionnaire collected demographic details. The second section assessed self-reported levels of confidence using Likert scale responses to a range of statements relating to clinical examination and management of cardiovascular, respiratory and abdominal complaints. Participants were then randomised to either the experimental or control group. The experimental group were given a competency framework to trial during clinical placements while the control group continued with existing practice. After 1 month the self-reported confidence section was readministered to all participants in the form of a second questionnaire.

**Results:** Results from the first stage indicated that lack of confidence was most pronounced in cardiovascular examination and management of abdominal complaints. Higher levels of confidence were observed in relation to respiratory examination and management. Following implementation of the competency framework, respondents from the experimental group indicated higher levels of confidence in cardiovascular and abdominal assessment and management of abdominal complaints compared with the control group.

**Conclusion:** The results suggest that introduction of a competency framework among ECPs may improve levels of clinical confidence in specific areas. These results must be interpreted in the context of a small sample of experienced practitioners. Further research is needed to explore which other variables affect clinical confidence.

#### 006 IMPACT OF SPECIALISED TASKING ON A RURAL HELICOPTER EMERGENCY MEDICAL SERVICE

V Kypta, R Furse, C Mitchell. *Kent Air Ambulance Trust, UK*

**Background:** In November 2005 Kent, Surrey and Sussex became the first rural Helicopter Emergency Medical Service (HEMS) in the UK to employ full-time doctors. The Kent-based helicopter was initially tasked directly by ambulance control. This study examines whether the introduction of a dedicated, flight paramedic-run HEMS desk improved the effectiveness of helicopter tasking.

**Methods:** A retrospective analysis of HEMS dispatches was carried out for 6-month periods before and after the introduction of the HEMS desk in December 2006. During both periods the helicopter operated with a physician/paramedic crew. The desk was staffed by current HEMS crew paramedics. Dispatch outcomes were categorised as either "stood down", "treated but not transported" or "treated and transported".

**Results:** Overall activations decreased by 33% following inception of the HEMS desk. However, there was a 22% reduction in the "stood down" rate and a 19% increase in the patient contact rate. Within this group it is important to note that the "treated but not transported" rate also decreased (28%) with a 21% increase in those "treated and transported".

**Conclusion:** HEMS are a limited and costly resource. It is vital that the service identifies that small proportion of patients who are most likely to benefit from on-scene treatment by a qualified prehospital physician or from direct triage to a tertiary trauma or specialist centre. This study shows that the introduction of an appropriately staffed HEMS desk can improve the ability of the helicopter to respond to such patients through increased understanding of HEMS operations, fewer competing interests and interrogation of lower acuity tasks. In addition, reducing the number of "stand downs" minimises unnecessary risks and costs to the service. Other HEMS providers, especially those looking towards employing full-time doctors, should consider the benefits of an internally-run dedicated HEMS desk.

### 007 CAN LOW PRIORITY EMERGENCY AMBULANCE CALLS BE MANAGED BY TELEPHONE ADVICE?

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**Background:** Ambulance services are seeking to find alternative methods of management for low priority 999 calls. We have evaluated the alternative strategy of transferring some ambulance calls to the UK NHS Direct telephone advice service where nurse advisers conduct further assessment and provide advice or alternative referral.

**Objective:** To evaluate the processes, costs and effects of the transfer of non-urgent 999 calls for telephone advice.

**Methods:** We used a mixed methods approach. The first stage, reported here, was a randomised controlled trial in three sites to assess clinical effectiveness, caller and patient satisfaction and acceptability. A pre-consent randomisation design was used. Eligible calls were randomised to ambulance dispatch or nurse advice and the caller was then asked by emergency medical dispatchers if they would like to take part. Callers agreeing to talk to the nurse had their call immediately transferred. Consenting callers/patients were sent a postal questionnaire 1 week later.

**Results:** 1766 calls were allocated to the intervention group and 2158 to the control group. Only 13% of potentially eligible calls were included. The return rate to the ambulance service was high (66.9%), although this varied by site (range 75.5–36.1%). Of calls returned, 25% were for an emergency ambulance response and the remainder for transport or non-clinical reasons. Callers were generally satisfied with the service although this was higher for the control group (94% vs 85%;  $p < 0.001$ ). There remains an expectation that an ambulance should be sent if requested. Ambulance job cycle time was significantly reduced in the intervention group (–9 min 10 s; 95% CI –11 min 11 s to –7 min 44 s;  $p < 0.001$ ). The economic evaluation has shown that a small reduction in ambulance journeys can produce significant cost savings.

**Conclusions:** The number of calls suitable for this service is much smaller than previously estimated, although better referral pathways would reduce return rates. In future this approach may be better viewed as an additional assessment step for appropriate referral rather than an end point.

### 008 THEMATIC RESEARCH NETWORK FOR EMERGENCY AND UNSCHEDULED TREATMENT (TRUST): FIRST YEAR PROGRESS

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**Introduction:** Emergency and unscheduled care is an under-researched yet emerging priority in the arena of healthcare delivery. The evidence base for many developments is lacking, despite recent policy endeavours to shift the onus of care, where appropriate, away from the acute setting. In recognition of the current mismatch between investment in service development and the research evidence to underpin developments, TRUST was funded as part of the Clinical Research Collaboration (CRC) Cymru which, in turn, is part of the UKCRC. TRUST has been running for a year and this is an outline of its progress to date.

**Methods:** TRUST aims to increase the quality and volume of policy relevant research undertaken in the field of emergency and unscheduled care by:

- ▶ enhancing the quality and quantity of research proposals in this area;
- ▶ Encouraging UK and international collaborations;
- ▶ Building capacity through supporting new researchers in the field.

It has an advisory board which is comprised of research experienced professionals from academia, the ambulance service,

emergency care, policy makers, clinicians and other key personnel. Funding from CRC Cymru has supported the employment of two network coordinators and two research development fellows. In its first year the network held a workshop to identify and develop key research areas in emergency and unscheduled care. It has also provided support to projects that come within its remit. Planning for a second workshop and call for further interest groups is underway and due to take place in Spring 2008.

**Results:** So far the network has established a number of topic-focused “research and development groups” which centre on:

- ▶ Out of hours primary care
- ▶ 999 mental healthcare
- ▶ Competencies within the ambulance service
- ▶ Access and interpretation
- ▶ Older people who have fallen
- ▶ Computerised clinical decision support

The network has provided research support to develop bids related to these groups, several have been funded, others have been short-listed and TRUST support is ongoing to develop proposals to the next stage. Projects underway in collaboration with TRUST include the multicentre SAFE (Support and Assessment for Fall Emergencies) randomised controlled trial; the 999 EMS Research Forum research prioritisation exercise; and an assessment of patient experience across unscheduled care providers in Wales. The network endeavours to promote itself locally, nationally and internationally and is developing a broad database of research active/interested professionals. TRUST is also developing processes to involve patients and carers. The TRUST website ([www.trustresearch.org.uk](http://www.trustresearch.org.uk)) was launched in summer 2007.

**Conclusions and comment:** The TRUST network has set out to promote, encourage and support research in emergency and unscheduled care. Opportunities are vast, progress so far is strong and support runs high. To demonstrate added value, however, the network will need to show impact on several levels: success in grant capture; publication and dissemination of outputs; and evidence of engagement and research skill development across the spectrum of emergency care practitioners, managers and policy makers.

### 009 LIFE AT THE END OF THE LINE: ACCURACY OF PREHOSPITAL DIAGNOSIS BY RAF SEARCH & RESCUE HELICOPTER WINCHMEN

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**Background:** Ysbyty Gwynedd is a DGH in North West Wales whose catchment area includes most of Snowdonia. Our Mountain Medicine Database includes all patients (approx 80/year) brought to the Emergency Department (ED) by mountain rescue teams or the RAF Search & Rescue helicopter whose winchmen are mainly HPC-registered paramedics plus a few technician-level individuals. This retrospective study examines the accuracy of prehospital diagnoses by these winchmen.

**Method:** Between January 2004 and August 2007, 283 patients were brought to the ED by mountain prehospital personnel. ED and RAF records were available for 117 casualties whose prehospital care was solely/mainly delivered by RAF winchmen. A paramedic/winchman examined the RAF records and determined the likely significant prehospital diagnoses; a consultant in emergency medicine separately determined the significant hospital diagnoses based on the ED records  $\pm$  hospital notes.

**Results:** The 117 casualties had 184 major diagnoses between them (1.6/patient). 140/184 (79.5%) were deemed correct; 128/184 (15%) overdiagnosed; 8/184 (4.5%) missed; and 2/184 (2%) underdiagnosed. Of the 8 missed diagnoses, 3 were not detected because the clinical condition of the casualties prevented progression to secondary survey; 2 were undiagnosable in the field (HOCM causing a fall from height

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and major head trauma; suspected laryngeal injury masked by hard collar covering anterior neck bruising); 1 did not alter prehospital management (# NOF in patient already immobilised in vac-mat with suspected pelvic fracture); and 2 were not clinically suspected (C2 fracture; scaphoid fracture).

**Conclusion:** 6.5% of significant diagnoses missed/under-recognised seems impressive given the difficult conditions under which the winchmen work; for example:

- ▶ working alone (usually);
- ▶ hazardous situations (eg, dangling at the end of a wire with casualty on a small ledge);
- ▶ difficult patient positioning (eg, examining casualty on an icy slope while hanging onto an ice axe);
- ▶ hazards of working with aircraft (eg, noise, rotor wash, adverse weather conditions).

#### 010 HAS NHS DIRECT WALES EASED PRESSURE ON AMBULANCE SERVICES?

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**Background:** NHS Direct (NHSD) was set up to signpost callers to appropriate services and promote self-care in order to ease pressure on other emergency services, including the ambulance service. Research following implementation in England did not find any associated changes in demand for 999 calls and other immediate healthcare services. However, with increasing awareness and volume of calls to NHSD over time, the longer term impact needs to be investigated.

**Objective:** To measure the impact of NHSD Wales (NHSDW) on the volume of 999 calls.

**Methods:** Monthly call data were requested from the Welsh Ambulance Services Trust from June 1999 to December 2003. Standard time series techniques were used to measure changes in trends in volume of contacts following introduction of NHSDW in 2000.

**Results:** Full data were received from two of the three Welsh ambulance service regions. The monthly volume of 999 calls ranged from 14 694 to 21 938 (mean 18 146, standard deviation 1809.91). Aggregate analysis on total 999 calls showed an initial downward trend in the data ( $b_1 = -0.00377$ ,  $p = 0.034$ ), becoming an upward trend following the introduction of NHSDW ( $b_2 = 0.010841$ ,  $p < 0.0001$ ). An average monthly decrease of 0.37% in 999 calls became a monthly increase of 0.7%.

**Limitations:** We relied on management data collected for other purposes for our analysis. This helped to minimise observer bias but raised some data quality issues. The study was based on an observational design. Observed changes in 999 calls could be attributed to other initiatives, not just NHSDW. However, we are not aware of major changes in the way 999 calls were handled during the study period.

**Conclusion:** This study has found no evidence of any substitution of demand between NHSDW and 999 calls. Our results suggest an association over time between NHSDW and increased 999 demand. This new finding may reflect the medium to long-term effects of the service missed in earlier studies.

#### 011 TREAT AND REFER GUIDELINES: DO WE LIKE THEM? DO WE USE THEM?

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**Background:** There have been increasing demands on emergency healthcare in Scotland with pressure on all services to reduce patient admissions. To help address these demands, the SAS introduced four Treat and Refer guidelines for all emergency ambulance crews which transferred responsibility from hospital staff to the ambulance crew. Traditionally, ambulance crews

transported all emergency/999 patients by “default” and did not receive any formal training/education, protocols or guidelines to support decisions for referral or discharge.

**Objectives:** To seek views on the concept and implementation of Treat and Refer and to identify factors which influence the usage.

**Methods:** Retrospective questionnaire study using a stratified random sample of 600 crew staff, producing a return of 20% ( $n = 120$ ).

**Results:** Crews were positive (75/100) about the concept and mildly positive (58/100) about the implementation of Treat and Refer, feeling that more training was needed. 65% of respondents reported inappropriate usage of a patient refusal form. Ratings of 64/100 and 62/100 were given for confidence in the use of the guidelines and comfort with the increased professional responsibility, respectively, and the higher the grade of staff the more positive the effect on confidence and comfort. A higher volume of work was reported for those with inappropriate patient refusal form use.

**Limitations:** The questionnaire relies on participants’ self-reports of practice; there may have been a selection bias in which participants who responded may already have a positive attitude.

**Conclusions:** Treat and Refer can be considered a total change in practice for ambulance crews who now have the “authority” to make the independent decision to leave patients—within a defined range of conditions and criteria—at home. Not only do crews need to feel positively about the concept, the guidelines need to be implemented well with appropriate training before Treat and Refer guidelines impact positively on patient outcomes.

#### 012 USE OF THE AIRTRAQ LARYNGOSCOPE IN A MODEL OF DIFFICULT INTUBATION BY PREHOSPITAL PROVIDERS NOT PREVIOUSLY TRAINED IN LARYNGOSCOPY: A PROSPECTIVE STUDY

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**Background:** This study evaluated the impact of a new laryngoscope design (the Airtraq) on the management of a model of difficult intubation by prehospital providers without previous training in laryngoscopy.

**Methods:** This prospective study evaluated first-time success rates of a convenience sample of prehospital providers without previous laryngoscopy training when attempting to intubate a manikin model of a Cormack and Lehane grade III/IV view using an Airtraq laryngoscope. We also recorded oesophageal intubation rates, time to intubation, and subject-rated difficulty of use scores. Participants were attendees at the Australian College of Ambulance Professionals Conference, Adelaide, in November 2006. Approximately 5 min of training (including one practice attempt) was provided in the use of the Airtraq immediately before data collection.

**Results:** First-time intubation success rate for the Airtraq was 26/33 (79%) (95% CI 61% to 91%); oesophageal intubation rate was 0/33 (0%) (95% CI 0 to 11%) and the median subject-rated difficulty of use score was 21 (IQ range 7.5–35.5, range 1–65). The median time to intubation was 17 s (IQ range 10–25 s, range 5–30 s, data available for 23/26 successful attempts).

**Limitations:** As we relied on volunteers self-reporting their skill level and previous experience, it is not impossible that some of the participants may have concealed prior laryngoscopy training, although this seems rather unlikely. Trials involving models cannot be used as a basis for quantitatively predicting benefit in patients.

**Conclusions:** Prehospital providers not previously trained in laryngoscopy had a high first-time intubation success rate when

managing a manikin model of a grade III/IV difficult intubation with an Airtraq laryngoscope following only minimal training. Users evaluated the device as being easy to use and were able to achieve placement of an endotracheal tube within an acceptable breath-to-breath interval.

**013 AIRTRAQ VERSUS STANDARD LARYNGOSCOPY BY STUDENT PARAMEDICS IN A MODEL OF DIFFICULT INTUBATION: A PILOT RANDOMISED CROSSOVER TRIAL**

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**Background:** This trial evaluated the impact of the Airtraq laryngoscope on the management of a difficult intubation model by inexperienced laryngoscopists.

**Methods:** This randomised crossover trial compared between-device differences in intubation success rates in a convenience sample of third-year paramedic students using the Airtraq and a Macintosh laryngoscope with flexible stylet in a manikin model of a Cormack and Lehane grade III/IV view. Participants were students attending Charles Sturt University, Australia and had previously undertaken a minimum of 8 h of intubation training using

“standard” techniques. 20 min of training was provided in Airtraq use immediately before data collection.

**Results:** First-time intubation success rates for the Macintosh and Airtraq respectively were 0/23 (0%) vs 10/23 (44%) (44% difference, 95% CI 26% to 63%,  $p = 0.0003$ ); cumulative intubation success rates (after 3 attempts) 7/23 (30%) vs 18/23 (78%) (48% difference, 95% CI 19% to 69%,  $p = 0.0015$ ); first-time oesophageal intubation rates 15/23 (65%) vs 3/23 (13%) (–52% difference, 95% CI –25% to –72%,  $p = 0.0004$ ); student-rated difficulty of use scores 88 (IQ range 78–97, range 37–100) vs 21 (IQ range 15–50, range 0–100),  $p < 0.001$ .

**Limitations:** As we relied on volunteers, our participants may have consisted of enthusiasts likely to undertake additional self-directed intubation practice. If this was so, Macintosh intubation success rates may be lower in a more representative (less motivated) student population. Trials involving models cannot be used as a basis for quantitatively predicting benefit in patients.

**Conclusions:** Student paramedics using an Airtraq following minimal additional training achieve significantly higher first-time intubation success rates, require fewer attempts to successfully place an endotracheal tube and have lower rates of oesophageal intubation and failed intubation in comparison with standard laryngoscopy when managing a manikin model of a grade III/IV difficult intubation.