



Paediatric airway management and concerns: a survey of advanced paramedics in Ireland

Neil Coleman¹ · Tomas Barry¹ · Helen Tobin¹ · Niall Conroy¹ · Gerard Bury¹

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Abstract

Background Paediatric airway management is of fundamental importance in the critically unwell child. Pre-hospital paediatric airway management especially endotracheal intubation is however controversial.

Aim To explore Irish Advanced Paramedics (APs) training, experience and clinical practice in paediatric airway management as well as to examine clinician attitudes toward this topic.

Methods An anonymous online survey of all graduates of the University College Dublin AP training program ($N = 453$).

Results With duplicates and failed email deliveries excluded a valid sample of 382 individuals was obtained from whom a response rate of 185/382 (48.4%) was achieved. Three quarters of responding APs worked in urban or mixed practice with the remaining minority operating primarily in rural areas. One quarter of responding APs reported formal training in paediatric intubation. Almost 70% of APs had encountered a child requiring significant airway management in the preceding year. However, this was a rare exposure in terms of overall workload. Basic airway adjuncts were used frequently in such circumstances, with endotracheal intubation having been attempted by only a small minority of APs. Lack of practice was identified by many responding APs as a key issue causing concern in terms of paediatric intubation.

Conclusion Paediatric airway management has key relevance for pre-hospital care in Ireland. The overall frequency of exposure to children who may benefit from definitive airway management is however likely to represent a significant barrier to the acquisition and maintenance of competency. The ongoing practice of pre-hospital paediatric intubation by APs may not justify its risks.

Keywords Airway management · Education · Emergency medical services · Paediatric emergency care · Pre-hospital care

Introduction

Ireland's population of 4.75 million is served by 29 geographically dispersed emergency departments [1, 2]. All paediatric specialist care is concentrated in Dublin; therefore, many emergency departments (EDs) outside the capital receive both adults and children. In Ireland, statutory pre-hospital emergency care is provided to adults and children by the Health Services Executive, National Ambulance Service (NAS) and in addition in the capital

by Dublin Fire Brigade (DFB) [3]. NAS have in the region of 1200 operational staff trained at Advanced Paramedic (AP) or paramedic level while DFB have 800 dual firefighter paramedics, 46 of whom have been further trained to AP level [4, 5]. All emergency ambulances in Ireland are staffed by paramedic or AP grade responders.

The scope of practice of emergency medical service (EMS) practitioners in Ireland is determined by an independent statutory agency, the Pre-Hospital Emergency Care Council (PHECC) who have published clinical practice guidelines (CPGs) for pre-hospital care and maintain a register of pre-hospital practitioners. In April 2017, there were 2137 individuals registered at paramedic level and 483 individuals registered at AP level in Ireland [6]. CPGs permit airway management by paramedics up to and including supraglottic airway device insertion when necessary in children [7]. Since 2014, the guidelines have

✉ Tomas Barry
tomas.barry@ucd.ie

¹ UCD Centre for Emergency Medical Science, School of Medicine, Health Sciences Centre, University College Dublin, Belfield, Dublin 4, Ireland

supported endotracheal intubation in paediatric patients by AP practitioners [7]. CPG criteria stipulate that use of any advanced airway in a child requires that the child must be above 2 years of age and has a GCS of three with ineffective ventilation. NAS APs have been authorised by their organisation to intubate children, whereas DFB APs have not.

Since 2005 in Ireland, the advanced paramedic training programme has been delivered by the UCD Centre for Emergency Medical Science in conjunction with the ambulance services [8]. The programme does not include training in paediatric intubation, due to the existing evidence base and very limited access to paediatric intubation opportunities in anaesthesia placements [9]. A module on paediatric intubation has recently been introduced by the NAS, as part of a CPD programme.

Ireland experiences approximately 320,000 emergency ambulance calls annually [4]. Limited data exist to indicate what proportion of this call volume involves paediatric patients, with a single regional study suggesting in the region of 1% [10]. Elsewhere, the paediatric cohort is known to represent a small fraction of overall ambulance service workload [11]. Cases involving paediatric critical airway issues are likely to account for an even smaller percentage of this workload.

At peak activity, there are in the region of 137 emergency ambulances and eight rapid response vehicles operational throughout Ireland from geographically dispersed base locations [4]. Forty percent of Ireland's population live in rural areas with settlements of 1500 or less people [12]. This presents key challenges for the ambulance service in reaching critically unwell patients in a timely fashion, caring for such patients over a prolonged transfer time and also in maintaining skill sets when working in a community setting with potentially lower levels of clinical exposure.

Paediatric airway management is of fundamental importance when managing the critically unwell child. European Resuscitation Council guidelines state that tracheal intubation is the most secure and effective way to establish and maintain the paediatric airway but caution that only skilled and experienced practitioners should perform this skill [13].

Of note even in skilled hands, paediatric intubation has a documented morbidity and mortality [14, 15]. Pre-hospital paediatric emergency care has a limited literature regarding patient safety [16]. Despite this observation, the capacity to provide pre-hospital paediatric intubation has been suggested as an essential paramedic skill and is considered a standard for EMS practice in some jurisdictions [17]. However, the absence of high-quality scientific evidence supporting this stance has been previously highlighted in the literature [18]. In some areas such as the UK, there has been a move away from paramedic intubation, taking the perspective that pre-hospital intubation without the use of drugs might actually worsen patient outcome [19]. Endotracheal intubation of children by paramedics is ultimately a controversial issue given the infrequency of the procedure and the critical importance of success [20].

Aims

Little is known about pre-hospital paediatric airway management and intubation in Ireland. This study aimed to explore AP training, experience and clinical practice in this area as well as to examine clinician attitudes toward this topic.

Methods

Study participants

This study took place in April 2016 among all graduates of the Advanced Paramedic training programme. All graduates ($N = 453$) were contacted at the personal email they provided when registering to the programme; a small number of APs who are graduates of overseas programmes are registered in Ireland and were not included in this study. Of the 453 individual emails sent, 64 failed to deliver as the email addresses were no longer current. In addition, seven duplicate email addresses were identified and thus the survey was distributed to 382 individuals.

Table 1 Demographics. Not all respondents answered all questions

Gender ($n = 183$)	Male 157 (85.8%)	Female 26 (14.2%)		
Age in years ($n = 175$)	Mean = 40.2	SD = 7.3	Median = 40	Range = 20–61
AP service in years ($n = 180$)	< 2	2 to 4	5 to 8	> 8
	43 (23.9%)	56 (31.1%)	52 (28.9%)	29 (16.1%)
Currently practicing in Ireland ($n = 183$)	Yes	No		
	179 (97.8%)	4 (2.2%)		
Currently practicing as AP ($n = 183$)	Yes	No		
	177 (96.7%)	6 (3.3%)		
Predominant work environment ($n = 182$)	Urban	Rural	Mixed	
	36 (19.8%)	46 (25.3%)	100 (54.9%)	

Table 2 Paediatric (< 8 years old) intubation training history. Not all respondents answered all questions

Training received (<i>n</i> = 183)	Yes 42 (23.0%)	No 139 (76.0%)	Do not know 2 (1.0%)	
Training setting (<i>n</i> = 41)	AP training (mannequin) 4 (9.8%)	AP training (real patient) 26 (63.4%)	Post AP training (CPC) 7 (17.1%)	Other 4 (9.8%)

Eligibility criteria

Any graduate of the programme was eligible to participate, including those who were no longer currently practicing as APs and those practicing outside Ireland.

Data collection

The study instrument was informed by our understanding of EMS care as delivered in Ireland and the existing literature concerning pre-hospital paediatric airway management. The first author NC (an academic AP) led the questionnaire design which was further refined in conjunction with the other study authors HT and GB. The questionnaire included sections on demographics, work setting, paediatric airway training, experience of paediatric airway management and finally practitioner attitudes toward this topic. The study instrument was designed so as it could be completed within 5 min. The instrument was first piloted on a convenience sample of 5 APs and minor amendments were made prior to widespread dissemination. The pilot responses did not form part of the final study or results reported here.

An initial email was sent to all eligible APs in April 2016. A reminder email was sent at 2 and 4 weeks after the initial mailing. Our email invitation included a link to the online survey which was designed and administered through Google Forms. A study information leaflet was included at the start of the survey instrument.

Data analysis

Data was analysed using Microsoft Excel (2013) and IBM SPSS (Version 20). Not all questions were completed by all participants and thus denominator data are reported where relevant. A chi-square test for independence was used to examine the relationship between geographical work context and exposure to paediatric airway emergencies, while a Mann-Whitney *U* test was used to test for difference in self-rated confidence between rural and urban/mixed APs.

Results

This survey achieved a response rate of 185/382 (48.4%). Respondents' demographic profile is outlined in Table 1, of which the majority (85.8%) were male and practicing in Ireland (97.8%) at AP clinical level. Age ranged from 20 to 61 years old, with a mean age of 40 (SD 7.3). Of the respondents, 55% had 4 years or less experience practicing at AP level. Just over half of respondents (54.9%) worked in mixed geography settings. The remaining respondents (45.1%) indicated their work to be predominantly rural (25.3%) or urban (19.8%).

Of the 183 respondents, only 42 (23.0%) reported having received training or supervised experience in intubation for patients under 8 years of age (Table 2). Most respondents with this experience received it during the AP training programme. This was most frequently as real patient interactions during clinical placements rather than simulation training.

Table 3 Paediatric (< 8 years old) emergency airway exposure (previous 12 months). Not all respondents answered all questions

Most serious problem	0 cases	1 case	2 cases	3 cases	> 3 cases	Range	Median	
Compromised airway (<i>n</i> = 170)	77 (45.3%)	46 (27.1%)	24 (14.1%)	12 (7.1%)	11 (6.4%)	0 to 8	1	
Apnoea (<i>n</i> = 153)	68 (44.4%)	54 (35.3%)	19 (12.4%)	6 (3.9%)	6 (3.9%)	0 to 7	1	
Cardiac arrest (<i>n</i> = 151)	75 (49.7%)	47 (31.1%)	17 (11.3%)	11 (7.3%)	1 (0.6%)	0 to 5	1	
Any of the above (<i>n</i> = 173)*	53 (30.6%)	20 (11.6%)	29 (16.8%)	24 (13.9%)	47 (27.2%)	0 to 16	2	
Airway device used once or more in managing any of the above problems (<i>n</i> = 121)*	BVM 111 (91.7%)	OPA 96 (79.3%)	Suction 86 (71.1%)	SGA (i-gel) 19 (15.7%)	SGA (LMA) 11 (9.1%)	Magill 9 (7.4%)	ET tube** 8 (6.6%)	Needle Cric 1(0.8%)

**ET tube use: range 1–5, median 1

*One hundred twenty individuals indicated managing one or more case(s) whose most serious problem was compromised airway, apnoea or cardiac arrest. One hundred twenty-one individuals indicating using at least one of the airway devices listed

Table 4 Self-rated confidence and competence in paediatric (< 8 years old) intubation. Not all respondents answered all questions

	5 (none)	4	3 (some)	2	1 (complete)	Mean
Confidence (<i>n</i> = 178)	38 (21.3%)	30 (16.9%)	87 (48.9%)	18 (10.1%)	5 (2.8%)	3.4
Competence (<i>n</i> = 171)	39 (22.8%)	23 (13.5%)	84 (49.1%)	19 (11.1%)	6 (3.5%)	3.4

In the next section, we reviewed the preceding 12 months of clinical practice, examining specifically paediatric cases requiring significant airway management, in particular, cardiac arrest, apnoea or compromised airway. The results show in the preceding 12 months, 69.4% of respondents (120/173) encountered at least one of the listed scenarios on at least one occasion (range 0–16, median 2). Geographically, rural work setting was associated with lower levels of exposure to the critical emergency situations examined, with 52.3% (23/44) of predominantly rural APs having managed at least one critical emergency situation versus 75% (96/128) of APs working in urban or mixed settings ($p = 0.005$ chi-square test, geographical setting missing in 1/173).

Further details of the proportion of respondents having used various airway devices in managing the above situations are reported in Table 3. The majority used only basic airway adjuncts such as a bag valve mask (111/121, 91.7%), oropharyngeal airway (96/121, 79.3%) or suction (86/121, 71.1%), while a small number (8/121, 6.6%) reported endotracheal tube use.

APs self-rated confidence and competence in intubation of patients less than 8 years of age is outlined in Table 4. Although the majority reported at least some confidence and competence in this skill, approximately one in five reported none. No significant difference in self-rated confidence was found between rural and urban/mixed practice APs ($p = 0.082$, Mann-Whitney U test: $U = 2529$, $z = -1.740$, rural APs $Md = 3$, $n = 46$. urban/mixed setting APs $Md = 3$, $n = 131$).

Respondents were asked to identify and rank their most important concerns in relation to intubating patients under the age of eight (Table 5). Respondents were free to identify multiple issues and could rank different issues equally. Lack of practice was highlighted as a primary concern by 63.4% of respondents. When asked how best to maintain competence in clinical skills not commonly used, most respondents (155/183, 84.7%) identified ongoing exposure to in-hospital practice as a preferred mechanism (Table 6).

Table 5 AP concerns in relation to paediatric (< 8 years old) intubation. Not all respondents answered all questions

	#1 (most NB)	#2	#3	#4	#5 (least NB)
Tube size (<i>n</i> = 159)	20	18	30	58	33
Ability to visualise vocal cords (<i>n</i> = 158)	40	35	59	17	7
Lack of practice (<i>n</i> = 178)	113	29	16	3	17
Frequency of requirement to intubate children (<i>n</i> = 171)	67	48	23	16	17
Other (<i>n</i> = 76)	6	0	6	6	58

Discussion

Our study is the first survey of its kind in Ireland, capturing the experience and views of a significant proportion of Irish APs who practice across diverse geographical settings. The results suggest that although a high percentage of APs are likely to manage a child with a critical issue that requires airway intervention in a given year, this will tend to be a rare event in the context of overall workload for individual practitioners. Basic airway devices and manoeuvres including BVM, OPA and suction appear to be frequently used by APs in these situations while advanced airway devices are not. Intubation of a child under 8 years of age was attempted by only eight of 185 respondents, which suggested low experiential exposure to this procedure. A range of barriers to competence were identified but most focused on the skillsets involved and skill retention rather than on the decision making process involved or on controversies generated by the evidence base. There was strong appetite among APs for ongoing hospital rotations to maintain competence in airway skills not often used. APs working in rural areas are worthy of some consideration as this group are likely to care for critically unwell patients over a more extended transport time frame. Although rural APs were less likely to have experienced a critical airway situation than their colleagues working in urban or mixed practice settings, one in two still reported having managed such a patient over the preceding year. Previous research has demonstrated that paramedics from low-call-volume areas reported lower baseline self-efficacy in airway management, derived larger improvements with training, but also experienced the most decline between training events [21]. Our study did not find that rural APs reported lower levels of confidence in paediatric airway management; nonetheless, this group would represent a logical target population for upskilling initiatives in these areas.

Limited high-quality evidence is available to guide EMS system policy on the issue of optimum paediatric airway

Table 6 Perspectives on how to maintain skills not commonly used ($n = 183$). Not all respondents answered all questions

Hospital rotations	CPC	Courses	Self-directed learning	Research	Other
155 (84.7%)	103 (56.3%)	102 (55.7%)	64 (35%)	38 (20.8%)	14 (7.7%)

management; a single clinical controlled trial that assigned over 800 consecutive paediatric patients requiring airway support to either bag mask ventilation or endotracheal intubation found no significance difference in terms of survival or neurological outcome and demonstrated prolonged scene times in the intubation group [9]. Previous studies have cautioned of a high complication rate with paediatric intubation by paramedics [16, 22]. However, overall success rates in excess of 95% have been documented in some systems [20]. One reason intubation may not benefit paediatric patients is the potential advantages of an endotracheal tube securing the airway may be mitigated by procedural complications or by detrimental effects on other aspects of resuscitation [16]. Suitable alternatives to intubation such as supraglottic airway device placement have been suggested as quicker and more convenient strategies in the pre-hospital environment [23].

Despite low procedural exposure to endotracheal intubation of patients less than 8 years of age and a documented lack of training, over half (61.8%) of respondents to our study reported at least some confidence in the procedure. It may be that this confidence is a function of procedural currency in adult intubation and a sense of skill transferability. The UK, College of paramedics consensus statement ‘a framework for safe and effective intubation by paramedics’ states that significant on-going clinical exposure is required to maintain competence in tracheal intubation and recommends that a minimum of two intubations per month should be undertaken for each patient age group for which intubation is permitted in either clinical practice or in a simulation setting [24]. Endotracheal intubation by paramedics is supported where robust systems of training, clinical governance and skills maintenance are in place. It is not clear that such structures currently exist in Ireland.

Limitations

Although our study captured a substantial cross section of Ireland’s total AP population, our findings are limited by a survey response rate of 48% and by exclusion of those who were trained overseas. It is possible that non-respondents may have differed in training, clinical exposure or attitude toward paediatric advanced airway management from their colleagues who responded to this survey; for example, experience of difficult cases may raise concerns that deter practitioners from participating in surveys like this one. Our

bespoke data collection tool has not been formally validated but was designed by a field expert and piloted prior to use. Ireland is distinctive in terms of geography, service organisation and delivery and thus the findings of this study may not be applicable to other jurisdictions. The self-reported paediatric airway management competencies of APs may differ significantly from their ability to safely perform key airway tasks in the real world and this study did not include any form of performance evaluation. Despite these key limitations, our study provides an important insight into AP paediatric airway practice about which little is known despite having critical relevance in terms of patient morbidity and mortality.

Conclusion

Our research findings confirm the relevance of advanced airway management to AP clinical practice. The overall frequency of exposure to children who may benefit from definitive airway management is however likely to represent a significant barrier to the acquisition and maintenance of competency. Given this observation, the ongoing practice of pre-hospital paediatric intubation by advanced paramedics may not justify its implicit risks.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The UCD Human Research Ethics Committee granted exemption from full ethical review prior to the commencement of data collection (Ref: LE-E-16-32-Coleman-Bury).

Informed consent Information concerning the study was provided to participants electronically and consent was obtained immediately prior to participation in the survey.

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