

## Role Allocation and Team Dynamics during Pre-Hospital Rapid Sequence Induction of Anaesthesia by a Physician-Critical Care Paramedic Team in the United Kingdom: A 12 Months Review of Practice

Nick Crombie, Arun George and Carl McQueen\*

Hawthorne House, Dudley Road, Stourbridg, Midlands Air Ambulance/West Midlands, UK

\*Corresponding author: Carl McQueen, Midlands Air Ambulance, Hawthorne House, Dudley Road, Stourbridg, UK, Tel: +44-0-7946304307; E-mail: [carl\\_mcqueen@hotmail.com](mailto:carl_mcqueen@hotmail.com)

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### Abstract

**Background:** Critical care paramedics working alongside physicians in the West Midlands MERIT scheme Medical Emergency Response Incident Team (MERIT) have been shown to demonstrate high levels of proficiency in laryngoscopy during Rapid Sequence Induction of anaesthesia (RSI). The MERIT SOP does not stipulate the team member who should be allocated the role of laryngoscopy during RSI. The aim of this study is to analyse and identify factors that influence role allocation in pre-hospital RSI performed by MERIT scheme personnel in the West Midlands.

**Methods:** We conducted a retrospective review from 12 months of our mission database for patients who had undergone pre-hospital RSI performed by MERIT. Data collected included the indication for RSI, the number of intubation attempts (including documented failures to intubate), documentation of predicted difficulty in intubation and the degree of airway soiling prior to RSI. The clinical role of the operator performing laryngoscopy was recorded for each attempt.

**Results:** 113 cases of pre-hospital RSI were identified. Critical care paramedics successfully intubated 49/58 (84.48%) cases in which they were allocated the first attempt at laryngoscopy. Success at first attempt lower for physicians (76.92%) but greater proportions of such cases involved patients at the extremes of age and heavy airway soiling with a wider range of indications.

**Conclusions:** As part of a multidisciplinary team working alongside physicians, Critical Care Paramedics successfully intubate the majority of patients at the first attempt in carefully selected groups. Further research to investigate other factors at scene that influence role allocation and team dynamics in pre-hospital RSI is required.

**Keywords:** Pre-hospital care; Rapid sequence induction of anaesthesia; Enhanced care teams; Helicopter emergency medical service; Team resource management

### Background

The delivery of Pre-hospital Rapid Sequence Induction of Anaesthesia (RSI) is a challenging task requiring high levels of proficiency in both technical and non-technical skills [1]. In addition to the demands of ensuring safe and efficient endotracheal intubation, teams delivering pre-hospital RSI have to contend with a myriad of other potential challenges at incident scenes. Clear and effective team dynamics, underpinned by robust governance and training structures, are essential components of the skill armamentarium of personnel involved in the delivery of such skills in the Pre-hospital environment [2-4].

Recorded indication	Total (%)
Reduced consciousness	83 (73.45)
Airway obstruction (actual/impending)	13 (11.50)

Anticipated clinical course/transport considerations	8 (7.08)
Oxygenation ± ventilatory failure	5 (4.42)
Major burns	3 (2.65)
Severe haemorrhagic shock	1 (0.88)

**Table 1:** Recorded indications for Rapid Sequence Induction (RSI).

Standard Operating Procedures (SOPs) for pre-hospital RSI in the United Kingdom (UK) lack uniformity [5]. In some services the role of laryngoscopy and endotracheal intubation is under taken solely by physicians. In recent years some services in the UK have developed the role of Critical Care Paramedics [6]. Such personnel are experienced paramedics that have received additional training to work alongside physicians as part of multidisciplinary teams to deliver critical care interventions, such as RSI, in the pre-hospital environment. Critical Care Paramedics, when employed in teams with physicians, have been shown to demonstrate levels of proficiency in laryngoscopy during RSI consistent with physicians [7,8]. Delegation of the role of laryngoscopy in RSI by physicians to other team members with appropriate levels of competence has potential benefits in avoiding the pitfalls associated

with cognitive overload and task fixation that may precipitate error [9-11]. Factors influencing the decisions that influence role allocation in pre-hospital RSI have yet to be examined.

Total number of attempts required for intubation by any operator/first laryngoscopist	MERIT CCP (%)	MERIT Doctor (%)	BASICS Doctor (%)	Land Paramedic (%)
1	49 (84.48)	30 (76.92)	11 (91.67)	3 (100)
2	7 (12.07)	6 (15.38)	1 (8.33)	0
3	2 (3.45)	3 (7.69)	0	0

**Table 2:** Breakdown of number of attempts required, by any operator, for successful intubation according to the role of team members allocated first attempt at laryngoscopy.

Midlands Air Ambulance (MAA) employs a fleet of three helicopters, during daylight hours, to provide advanced pre-hospital emergency care in the West Midlands region of the United Kingdom. Resources are dispatched via the regional Ambulance Service according to an agreed protocol. Two platforms are staffed by teams consisting of Critical Care Paramedics (CCPs) with the remaining aircraft comprising a physician-CCP team called the Medical Emergency Response Incident Team (MERIT). A MERIT service is provided by Fast Response Vehicle during hours of darkness or in inclement weather. Doctors employed on MERIT platforms are senior registrars or consultants in either Emergency Medicine or Anaesthesia. Rapid Sequence Induction of Anaesthesia is only performed by MERIT teams in this system. The proficiency in laryngoscopy and endotracheal intubation of CCPs employed within the West Midlands has previously been reported [7]. The SOP used by MERIT does not stipulate the team member who should be allocated the role of laryngoscopy. Roles are assigned on a case by case basis on scene. The aim of this study is to analyse and identify factors that influence role allocation in pre-hospital RSI performed by MERIT scheme personnel in the West Midlands.

## Methods

Following each mission completed by MERIT teams the duty crew enters detailed and contemporaneous information into a specifically designed database. The database (constructed using the 'Access' programme from Microsoft) can be searched using any one or more of the data entry variables. Within each record a check-box field is used to identify patients requiring RSI, and there is also a check-box field for 'ETT' (Endotracheal Tube). Data collection adheres to the international consensus of reporting of pre-hospital airway management.

A retrospective review was performed of all missions that occurred between 1st August 2013 and 1st August 2014. The mission database was searched using the terms 'RSI' and 'ETT'. A data collection form was designed and all data entered by hand. Inclusion criteria were any

RSI or intubation carried out during the selected time period, regardless of indication or patient age. Cases in which patients were intubated prior to the arrival of MERIT, or by non-MERIT teams, were excluded from further analysis. Data collected included the indication for RSI; the number of intubation attempts (including documented failures to intubate); documentation of predicted difficulty in intubation and the degree of airway soiling prior to RSI. The clinical role of the operator performing laryngoscopy was recorded for each attempt.

First laryngoscopist/age range	<11 (%)	12 to 69 (%)	>70 (%)
MERIT CCP	0	51 (87.93)	7 (12.07)
MERIT Doctor	4 (10.00)	29 (72.50)	7 (17.50)
BASICS Doctor	0	10 (83.33)	2 (16.67)
Land Paramedic	0	2 (66.67)	1 (33.33)

**Table 3:** Breakdown of role of first laryngoscopist and age range of patients.

## Results

MERIT teams attended a total of 843 incidents during the period evaluated. The initial search of the database revealed 179 cases involving intubation during this period. On review of the records 59 cases were excluded from further analysis because patients were in cardiac arrest and were intubated without drugs. Two cases of hyperacute transfer from a Trauma Unit to a Major Trauma Centre were miscoded as an RSI; the procedure having been performed by the hospital based team and not MERIT. One case was recorded incorrectly as an RSI when in fact the patient had not been intubated and in a further case although drugs had been administered to facilitate intubation of the trachea an existing tracheostomy site was used.

First Indication laryngoscopist/	Reduced Consciousness (%)	Airway obstruction (actual or impending) (%)	Anticipated clinical course/transport considerations (%)	Oxygenation ± ventilatory failure (%)	Major burns (%)	Severe haemorrhagic shock (%)
MERIT CCP	45 (77.59)	4 (6.90)	4 (6.90)	3 (5.12)	1 (1.72)	1 (1.72)
MERIT Doctor	24 (60.00)	8 (20.00)	4 (10.00)	2 (5.00)	2 (5.00)	0

BASICS Doctor	12 (100)	0	0	0	0	0
Land Paramedic	2 (66.67)	1 (33.33)	0	0	0	0

**Table 4:** Breakdown of recorded indication for Rapid Sequence Induction (RSI) according to the role of team member allocated first attempt at laryngoscopy.

A total of 3 RSIs were performed by non-MERIT doctors from regional British Association for Immediate Care (BASICS) [11] that had co-responded to incidents attended by MAA CCP platforms. Doctors from the BASICS scheme provide their time voluntarily to respond to requests from the regional Ambulance Service for additional clinical support for Emergency Medical Services personnel. Competence and proficiency in pre-hospital Anaesthesia varies between BASICS practitioners. These cases were excluded from further analysis as adherence to the MERIT SOP could not be guaranteed. A total of 113 RSIs occurring during the study period were therefore identified as having been carried out by MERIT teams (Figure 1). There were no records with incomplete or missing data. One recorded case of failure to intubate was identified, which was successfully managed by insertion of a supraglottic airway device (0.88% of MERIT RSIs).

### Indications

In just under three quarters of cases in which RSI was performed the recorded indication was ‘reduced consciousness’ (n=83, 73.45%). The next most common indications were ‘actual or impending airway obstruction’ (n=13, 11.50%) and ‘anticipated clinical course/transport considerations’ (n=8, 7.08%). Smaller numbers of patients required RSI for oxygenation ± ventilatory failure’ (n=5, 4.42%) or as a result of ‘major burns’ (n=3, 2.65%). In one case the recorded indication for RSI was ‘severe haemorrhagic shock’ (Table 1).

### Success at first intubation attempt

Of the 112 patients intubated at scene the operator recorded as successfully passing the endotracheal tube was a CCP in 51 cases (45.53%); MERIT doctor in 47 cases (41.96%); a BASICS doctor (under MERIT supervision) in 11 cases (9.82%) and in three cases (2.68%) land paramedics. The overall proportion of cases in which endotracheal intubation was successful at the first attempt was over 80%. Of the 58 cases in which CCPs were allocated the role as first operative in intubation they were successful at the first attempt in 49 (84.48%). One patient was subsequently intubated successfully at the second attempt by a CCP following initial failure to intubate. The remaining 8 cases involved change of operator to the MERIT doctor with two requiring more than one further attempt to successfully intubate the patient. MERIT doctors performed initial laryngoscopy during RSI in 39 cases and were successful in endotracheal intubation at the first attempt on 30 occasions (76.92%). When intubation was not successful at the first attempt by MERIT doctors all but one subsequent attempts were made without a change of operator. One patient was successfully intubated by a CCP following two failed attempts by the MERIT doctor. All but one of the initial attempts at intubation were successful when performed by BASICS doctors and land paramedics (Table 2). The one recorded case of failure to intubate involved three attempts by a MERIT doctor with subsequent insertion of a supraglottic airway device (SGA).

### Patient characteristics and role allocation

The majority of patients in whom RSI was attempted by MERIT teams were aged between 12-69 years. In the four cases involving patients aged ≤ 11 years MERIT doctors were allocated the first attempt at laryngoscopy. Over 80% of cases in which CCPs or BASICS doctors were allocated the first attempt at laryngoscopy were aged between 12-69 years compared to 65% in which MERIT doctors undertook this role (Table 3).

MERIT doctors were allocated the first attempt at laryngoscopy more commonly than other personnel in cases involving ‘actual or impending airway obstruction’; ‘anticipated clinical course/transport considerations’ and ‘major burns’ (Table 4).

Airway soiling was recorded in 82 out of the 113 cases in which RSI was performed (72.57%). Two thirds of the cases in which MERIT doctors were allocated first attempt at intubation involved heavy airway soiling with blood and/or vomit compared to less than 40% in cases where CCPs were assigned this role (Table 5). A further four cases were recorded as predicted difficult airway in the absence of airway soiling. All patients were successfully intubated at the first attempt (2 CCP; 1 MERIT doctor; 1 BASICS doctor).

First laryngoscopist/airway soiling	None (%)	Slight (%)	Heavy (%)
MERIT CCP	20 (34.48)	15 (25.86)	23 (39.66)
MERIT Doctor	8 (20.00)	5 (12.50)	27 (67.50)
BASICS Doctor	3 (25.00)	3 (25.00)	6 (50.00)
Land Paramedic	0	1 (33.33)	2 (66.67)

**Table 5:** Breakdown of role allocation for first attempt at laryngoscopy according to degree of airway soiling.

### Discussion

Although the proficiency of Critical Care Paramedics in laryngoscopy has been proven in a number of different Enhanced Care Team organisations in the UK [7,8], factors influencing the allocation of roles for pre-hospital RSI have yet to be explored in detail. This study describes the case-mix and RSI profile of a physician-CCP pre-hospital care model in the United Kingdom with specific focus on operational and clinical factors which influence the allocation of roles in such cases. In this retrospective study of 12 months practice of pre-hospital RSI by the West Midlands MERIT service, we found that 113 out of a total of 843 scene attendances by teams resulted in the delivery of pre-hospital anaesthesia (13.40%) with 112 patients successfully intubated prior to leaving scene (99.12%). The majority of patients were successfully intubated at the first attempt. These findings are consistent with those previously reported by the MERIT service over a separate 12 month period [8]. The MERIT service continues to deliver pre-hospital RSI frequently and with a success rate that is consistent

with that described in other well established pre-hospital care systems [12-14].

The proportion of RSIs in which patients were intubated by Critical Care Paramedics has risen from just over a third during the first twelve months of MERIT operations to over half. Success at intubation at first attempt by CCPs was higher than that reported for CCP intubation in another UK system [7]. When allocated the role of initial laryngoscopy both MERIT CCPs and BASICS doctors successfully intubated patients at the first attempt more frequently than MERIT doctors. Notably however the results indicate that patient characteristics likely influenced role allocation in RSI.

MERIT doctors were allocated the first attempt at laryngoscopy more frequently in cases involving indications other than 'reduced consciousness', notably where airway obstruction was the recorded indication. The majority of cases allocated to MERIT doctors involved heavily soiling of the airway. Of the 11 cases in which MERIT doctors required more than one attempt to successfully intubate the patient (9 as initial operator, 2 following change of operator) 9 involved heavy airway soiling. By contrast CCPs and BASICS doctors more frequently undertook the first attempt at laryngoscopy in cases of reduced consciousness that did not involve heavy airway soiling. A greater proportion of cases allocated to MERIT doctors for the first attempt at laryngoscopy involved elderly patients and children.

The results indicate that patient selection is an important component of role allocation in RSI in our system, with MERIT doctors more frequently undertaking the first attempt at laryngoscopy in cases that may be perceived as more challenging. Dynamic risk assessment is a fundamentally important part of the decision making process that underpins success in pre-hospital RSI. In the MERIT system allocation of the role of laryngoscopy in RSI to a CCP/non-MERIT physician appears to be carefully considered in the context of the age of the patient; the clinical indication for anaesthesia and the degree of airway soiling. This likely explains the observed lower rate of successful intubation at the first attempt by MERIT doctors compared to other personnel.

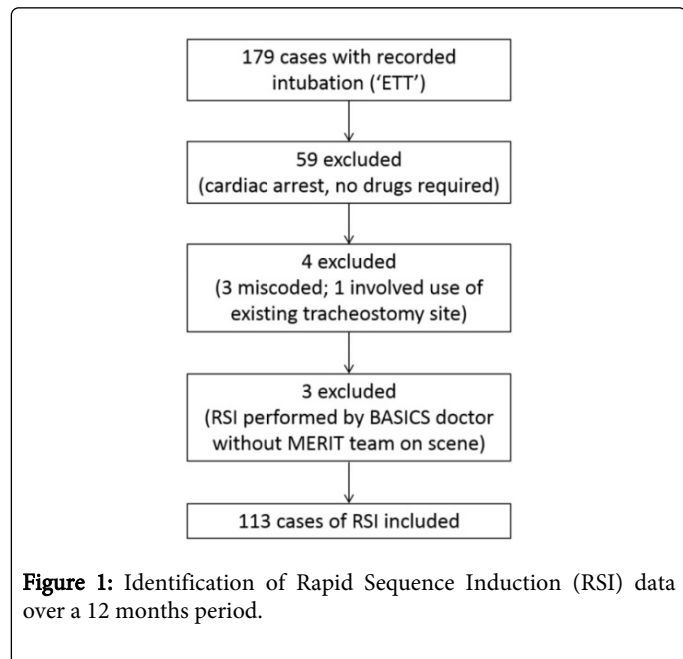
The results of this study also offer an insight into the dynamics experienced within teams during pre-hospital RSI. In cases of failure to intubate at the first attempt there appears to be a low threshold for a change of operator from CCP to physician. Conversely an operator change is very infrequently employed when initial attempt at intubation is not successful by MERIT doctors. This observation may be accounted for by a higher level of perceived difficulty in cases initially assigned to physicians and reluctance within teams to therefore transfer responsibility for subsequent attempts at intubation to the CCP. A notable limitation of this study is that whilst the number of intubation attempts was recorded the reasons for failure to intubate and the components of the failed intubation drill employed to rectify any identified problems were not. Further prospective research is required to improve data collection relating to the processes employed during pre-hospital RSI and the factors that influence decision making in cases involving difficulties in intubation.

Whilst some degree of insight into team dynamics during pre-hospital RSI may be derived from the findings of this study they are limited by its retrospective design. A more detailed understanding is required of the decision making and risk assessment processes that are undertaken in preparation for the procedure and how they may subsequently influence role allocation. It is notable for example that during the period evaluated a land paramedic was allocated the first attempt at laryngoscopy on three occasions. All patients were successfully intubated at the first attempt but the reasons underpinning the decision to utilise a land paramedic in such a role are unclear. Whilst not strictly in contravention of the MERIT SOP the use of land paramedics in this role could be questioned. It is however possible that extraneous factors at scene such as the number and acuity of patients meant that the allocation of a land paramedic in this role provided the safest and most expedient approach to securing a definitive airway. Managing cognitive burden through recognising and mitigating the risk of overload are important skills for pre-hospital personnel [3,4,9,10]. Adaptability and fluidity of roles in the context of pre-hospital RSI have great advantages to manage the demands of delivering the intervention in extremely challenging environments but are also associated with potential pitfalls. This study demonstrates that patient selection contributes to decisions relating to role allocation in pre-hospital RSI but a greater understanding is required of the other factors at scene that influence decision making and team dynamics.

This study demonstrates that patient selection influences the choice of operator in pre-hospital RSI in a system that utilises a physician-CCP model. Critical Care Paramedics successfully intubate the majority of patients at the first attempt in carefully selected groups. As part of a multidisciplinary team working alongside physicians, Critical Care Paramedics experienced in laryngoscopy and intubation provide adaptability and fluidity in role allocation in pre-hospital RSI. This may be utilised in selected cases to ensure that the cognitive and task burdens experienced by pre-hospital teams can be appropriately distributed amongst personnel. Further research to investigate other factors at scene that influence role allocation and team dynamics in pre-hospital RSI is required.

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**Figure 1:** Identification of Rapid Sequence Induction (RSI) data over a 12 months period.

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