



# Knowledge of Pre-hospital Emergency Medical Technician about Endotracheal Intubation: A Manikin Study

**Pourazizi Parviz<sup>1</sup>, Aghaei Iraj<sup>2</sup>, Kazemnezhad Leyli Ehsan<sup>3</sup>  
and Pourshaikhian Majid<sup>4\*</sup>**

<sup>1</sup>Student Research Committee, Guilan University of Medical Sciences, Rasht, Iran.

<sup>2</sup>Department of Neuroscience, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.

<sup>3</sup>Department of Biostatistics, Road Trauma Research Center, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.

<sup>4</sup>Department of Medical Surgical Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran.

## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors PM and PP designed the study, observed accuracy and validity of the study. Author AI participated in the data collection. Authors AI and KLE supervised the project. Author PM wrote the paper. Author KLE participated in the analysis of the data. All authors edited and revised the final manuscript and accepted its publication.*

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## **ABSTRACT**

**Background:** Pre-hospital emergency is an important part of the health-care system helping for critically ill patients in the life-threatening conditions by endotracheal intubation, preventing complications and mortality. The present study was conducted to determine the knowledge of pre-hospital emergency staff about the endotracheal intubation.

**Methods and Materials:** This was an analytical cross-sectional study performed on 70 pre-hospital staff in Rasht. Samples were obtained through census. Data collection tools included a researcher-made questionnaire with three parts: Demographic and job characteristics with 14 questions and

\*Corresponding author: E-mail: [pourshaikhian\\_m@yahoo.com](mailto:pourshaikhian_m@yahoo.com);

knowledge questionnaire, with 15 questions. The reliability coefficient of the knowledge questionnaire was 0.87 and the interclass correlation coefficient was 0.86. Kolmogorov-Smirnov, mean and standard deviation (in the Mann-Whitney and Kruskal-Wallis tests) were used. The collected data were entered into SPSS 24 software and analyzed.

**Results:** The majority of study participants were in the age groups of 26-30 and 36-40 years. Regarding education, the majority had associate and bachelor's degree. The findings of the pre-hospital emergency department staff's knowledge and status of the endotracheal tube insertion based on individual and occupational variables showed that the knowledge score based on work experience in the health system ( $p=0.05$ ) and having unsuccessful intubation at six months ( $p=0.009$ ) was statistically different, so that employees with higher work experience were less aware of endotracheal intubation and employees who have had a history of unsuccessful intubation for the past six months have had a higher level of knowledge.

**Conclusion:** According to the results of the present study, the knowledge of pre-hospital emergency personnel was in moderate level and needs educational programs to reach the optimum level.

*Keywords: Knowledge; pre-hospital; endotracheal tube.*

## 1. INTRODUCTION

Pre-hospital emergency is an important part of the health care system and the most important health sector worldwide [1], and its main purpose is to provide satisfaction in the shortest possible time and in accordance with world standards, in such a way that the time between first call and site of the accident and the bedside of the patient are eight minutes in urban areas and 15 minutes in suburban areas [2-4].

Pre-hospital care is an essential principle in the treatment of emergency patients and the first help with victims in accidents is done by emergency medical system (EMS) staff [5], so that can affect the mortality of the victims [6], because they must take measures to deal with these patients in accordance with international standard protocols such as spine fixation, IV access, control of bleeding, vital signs, level of consciousness, seizures, injections of airways, and ventilation, which are important in protecting the patient's life in four topics: general care, central nervous system care, hemodynamic care, and respiratory system care [7].

Deciding on the selection and initiation of initial actions is an important task of the EMS staff, so they must have sufficient knowledge, skills and knowledge of how to apply their skills and make immediate and correct decisions and provide primary care to all age groups [8].

In most developed countries, pre-hospital care is provided outside the hospital by a trained

emergency services team [9]. In a study conducted by Soysal et al. in Turkey on 81 patients brought by two pre-hospital emergencies to two hospitals, they concluded that pre-hospital emergency care was inadequate and needed to be increased. To increase the quality of pre-hospital emergency care in-service training was suggested [10]. Airway intubation and management in critically ill patients requires sufficient knowledge, skills, and experience of staff as well as adequate equipment to open the airway. In the absence of sufficient equipment or skill and a shorter transfer time, non-invasive masking and amputation techniques may be preferable [11].

Endotracheal intubation is the gold standard and best practice for airway management and control in critically ill patients, gastric traumatic patients unable to protect the airway from aspiration of gastric and blood contents, patients with significant lung abnormalities (low lung capacity, high airway resistance and oxygenation disorder, patients who have failed other airway opening procedures, and patients with cardiopulmonary arrest [12], permitting positive-pressure ventilation and play a key role in mechanical ventilation [13]. Therefore, the present study was conducted to evaluate the knowledge of EMS personnel about endotracheal intubation.

## 2. MATERIALS AND METHODS

The study population was all EMS staff in Rasht city and its suburbs. The sample of this study was 70 pre-hospital emergency staff who met the inclusion criteria which were obtained through

census. Sampling method was census and all staff were recruited. Inclusion criteria were all nurses, and emergency, anesthesia technicians and diplomas that had passed medical emergency courses and were employed in EMS.

Data collection tools included a questionnaire with 14 questions, related to individual-occupational information of the samples including age, level of education, work experiences in the health and treatment system, work experience in hospital type of in-service training, endotracheal intubation training and history of intubation in corpse or alive human. The second part consisted of 15 researcher-made questionnaires to assess participants' knowledge of endotracheal intubation including lower airway function, indications of endotracheal intubation, airway anatomy, head position at the time of intubation, the size of the endotracheal tube, the pressure on the cricoid, the laryngoscope, the type of endotracheal cuff, the cuff function, the standard value of cuff pressure, the accuracy of endotracheal insertion and the value of airway entrance.

After assessing the developed tool by 12 faculty members of Guilan University of Medical Sciences, the suggestions and comments of supervisor, advisor professors and biostatistician, its validity and reliability was checked and final tool was set so that one question was totally revised, and two questions were partially revised. The reliability coefficient of the equivalence questionnaires was used to validate the knowledge questionnaire and the intra class correlation coefficient (ICC) was used to compare the scores of the two questionnaires. To do this, a questionnaire of knowledge was distributed to 10 operational staff. After one week, the same questionnaire with similar and sometimes duplicate questionnaires was distributed among the same 10 people. The reliability coefficient of the knowledge questionnaire was 0.87 and the ICC was 0.86 ( $p=0.004$ ).

The knowledge on intubation and pressure monitoring were assessed using Kolmogorov-Smirnov test. The data collected after coding were entered into SPSS version 24 software. The knowledge score on endotracheal intubation was poor for 1-3 score; 4-6 was moderate and 7-

9 was good. Significance level was set at  $p < 0.05$ .

### 3. RESULTS

The majority of study participants were in the age groups of 26-30 and 36-40 years. Regarding employment status, the majority had contract status ( $n=32$ ). Most of the staff had a 1-5 year work experience in the health system (32.9%), 40% had a work experience for 11-15 years in the pre-hospital emergency; 51.4% had passed both the preliminary and advanced intubation courses and 82.9% had in-service airway management training. The majority of EMS staff had a history of intubation on the manikin (92.9%). Regarding the number of intubation, the majority of staff had at least one to five times (44.3%) and the majority of staff (78.6%) had at least one to 10 times. Also, 38.6% of the study staff had a history of unsuccessful intubation in the past six months, and 88.6% of EMS staff reported that they only adjusted the endotracheal pressure manually (Table 1).

The knowledge of pre-hospital emergency personnel about endotracheal intubation and cuff pressure control was investigated. The mean and standard deviation of knowledge score on endotracheal intubation was  $4.44 \pm 1.16$ . The majority (75.7%) had moderate knowledge (score: 4-6). Only 2.9% had good knowledge (score: 7-9). Regarding cuff pressure adjustment, the mean and standard deviation of knowledge score was  $3.61 \pm 1.04$ . The lowest score was one and the highest score was five and the majority had moderate knowledge. In relation to the total score of knowledge, the mean and standard deviation was  $8.06 \pm 1.79$ . The lowest score of knowledge was 3 and the highest score was 11. The majority was in moderate condition and none of the staff had good knowledge. Also, 34.3% of staff had poor knowledge about endotracheal intubation and cuff pressure adjustment (Table 2).

The score of knowledge based on having unsuccessful intubation over the past six months ( $p=0.009$ ) and also manual control of endotracheal tube cuff pressure was significant, so that employees with higher work experience were less aware of endotracheal intubation. Personnel who had a history of unsuccessful intubation over the past six months had a higher level of knowledge (Table 3).

**Table 1. The frequency distribution of occupational characteristics of EMS staff**

Variable		Frequency	Percent
Work experiences in health system	No experience	21	30
	1-5	23	32.9
	6-10	7	10
	11 and above	19	27.1
Work experiences in EMS	Less than 5	23	32.9
	5-10	14	20
	11-15	28	40
	More than 16	5	7.1
Work experiences in intensive care unit	Yes	33	47.1
	No	37	52.9
Training course for endotracheal intubation	Preliminary	22	31.4
	Advanced	8	11.4
	Preliminary & Advanced	36	51.4
	None	4	5.7
In-service training of airway management	Yes	58	82.9
	No	12	17.1
History of intubation on human	Yes	55	78.6
	No	15	21.4
Number of intubation on human	None	15	21.4
	1-10	21	30
	11-20	10	14.3
	21-30	15	21.4
	More than 30	9	12.9
History of intubation on mannequin	Yes	65	92.9
	No	5	7.1
Number of intubation on mannequin	None	5	7.1
	1-5	31	44.3
	6-10	20	28.6
	11 and above	14	20
Unsuccessful intubation over the past 6 months	Yes	27	38.6
	No	43	61.4
Cuff pressure adjustment after intubation	Yes	62	88.6
	No	8	11.4

**Table 2. Levels of EMS staff's knowledge about endotracheal intubation and cuff pressure**

Knowledge		Frequency	Percent	Lower bound	Upper bound
Intubation status	Poor	15	21.4	13.1	32.1
	Moderate	53	75.7	64.8	84.6
	Good	20	29	6	8.9
Intubation score (0-9)	Mean ± SD	Maximum	Minimum	Lower bound	Upper bound
	4.44 ± 1.16	7	1	4.17	4.72
Cuff control status	Poor	11	15.7	8.6	25.5
	Moderate	43	61.4	49.8	72.2
	Good	16	22.9	14.2	33.7
Cuff control score (0-6)	Mean ± SD	Maximum	Minimum	Lower bound	Upper bound
	3.61 ± 1.04	5	1	3.37	3.86
Total knowledge status	Poor	24	34.3	24	45.9
	Moderate	46	65.7	54.1	76
Total knowledge score (0-15)	Mean ± SD	Maximum	Minimum	Lower bound	Upper bound
	8.06 ± 1.79	11	3	7.63	8.48

**Table 3. EMS staff's knowledge of endotracheal intubation based on occupational characteristics**

Individual-occupational characteristics		Mean	SD	P value
Age	25 and below	4.38	1.19	0.310
	26-30	4.74	0.87	
	31-35	4.58	1.38	
	36-40	4	0.88	
	41 and above	4.58	1.62	
Education	Trained technician in emergency medicine	3.75	1.50	0.224
	A.D in emergency medicine	4.13	1.23	
	BSc in emergency medicine	4.58	0.97	
	BSc in nursing	5	1.24	
	BSc in anesthesia	4.25	0.50	
Employment status	Official	4.73	1.27	0.133
	Temporary	4.88	0.93	
	Contract	4.19	1.23	
	Others	4.20	1.03	
Work experiences in EMS	Less than 5	4.57	1.04	0.18
	5-10	4.79	1.25	
	11-15	4.11	1.17	
	More than 16	4.80	1.30	
Work experiences in ICU	Yes	4.64	1.19	0.297
	No	4.27	1.12	
Training course for endotracheal intubation	Preliminary	4.11	1.21	0.359
	Advanced	4.50	0.53	
	Preliminary & Advanced	4.56	1.25	
	None	4.14	1.21	
In-service training of airway management	Yes	4.41	1.20	0.623
	No	4.58	1	
History of intubation on human	Yes	4.55	1.15	0.142
	No	4.07	1.16	
Number of intubation on human	None	4.07	1.16	0.182
	1-10	4.43	1.29	
	11-20	4.60	1.17	
	21-30	4.27	0.80	
	More than 30	5.22	1.20	
History of intubation on manikin	Yes	4.46	1.17	0.534
	No	4.20	1.10	
Number of intubation on manikin	None	4.20	1.10	0.641
	1-5	4.55	1.12	
	6-10	4.30	1.17	
	11 and above	4.50	1.34	
Unsuccessful intubation over the past 6 months	Yes	4.89	1.01	0.009
	No	4.16	1.17	
Cuff pressure adjustment	Yes	4.56	1.13	0.016
	No	3.50	1.07	

#### 4. DISCUSSION

Pre-hospital care is an essential principle in the treatment of emergency patients and the first contact of victims in accidents is with EMS staff [5], so that can affect the mortality of the victims [6]. Airway management and respiratory support

are issues that need to be addressed promptly and effectively and are among the principles of outpatient resuscitation in critically ill and injured patients [14,15]. The present study was conducted to determine the knowledge of pre-hospital emergency staff about the endotracheal intubation.

The present study showed that the knowledge score based on work experience in the health system and having failed intubation in the last six months had significant relationship with the knowledge, so that employees with higher work experience were less aware of endotracheal intubation and staff who have had a history of unsuccessful intubation in the past six months have been more aware. They had a higher level of knowledge about intubation. Mean and standard deviation of knowledge score in endotracheal intubation was  $4.4 \pm 1.16$ . According to the classification score of knowledge about intubation, the majority of participants (75.7%) had moderate level of knowledge (between 4 and 6). Only 2.9% had a good level of knowledge (between 7 and 9). In relation to ventilation prior to endotracheal intubation, the mean score of knowledge was  $4.49 \pm 2.22$ .

A study by Seidabadi et al. [16] in 2014 was performed for assessment of airway management and endotracheal intubation skills in new students of Iranian medical emergencies". In this study, 62.3% of students had more than 5 years of experience.

Evaluation of students' theoretical and practical skills regarding endotracheal intubation and airway management methods showed that their average skill score was 30, which was significantly lower than the desired score of 40 and was 10-point apart. In addition, students divided their medical emergencies into three groups based on their skill score and the score they received: the first group was low-performing students with a score below 20 (18%), the second group of students having intermediate skills, and their score varied between 20.1-30 (20%) and the third group of students were more proficient and their acquired score was between 30.1 to 40% (about 62%). However, most of the students had acceptable skills, but not all of them were desirable and their familiarity with endotracheal intubation and airway management was not fully accurate and there was a significant difference between their skill and the desired score. The students had very little knowledge and skills. Consequently, evaluating the skill of medical emergency technicians in endotracheal intubation is important for the effectiveness of the students' educational experience. In our study, the average participants' knowledge status was assessed and only 2.9% were in good condition. Of course, the results obtained in each class varied with our study, but were very similar in terms of classification.

Alikhanizadeh et al. in an analytical cross-sectional study in Isfahan in 2017 entitled "Evaluation of Cognitive and Functional Skills of Pre-hospital Emergency Technicians in Airway Management and Related Factors" showed that participants' overall score of knowledge was 20 out of 30 [17]. This study also was similar to our study reported results indicating greater commitment to intubation.

## 5. CONCLUSION

According to the results of the present study, the knowledge of EMS staff is not bad, but has distance with good condition. Also, the history of unsuccessful intubation and work experience can affect the intubation performance and cuff pressure control. Providing practical sites for multiple classes for EMS personnel is helpful. Educational programs for these EMS personnel will increase their knowledge of endotracheal intubation and cuff pressure adjustment.

## 6. STUDY LIMITATIONS

This study was done in a city and cannot be generalized across the country. Also variables such as individual characteristics of participants, accuracy, honesty, mental, and psychological condition of research samples in answering questions may influence the outcome of the research.

## CONSENT AND ETHICAL APPROVAL

Human rights were respected in accordance with the Helsinki Declaration 1975, as revised in 1983. The informed consent was taken from the participants. The study was approved by ethics committee of Guilan University of Medical Sciences (Ethical cod# IR.GUMU. REC.1397.489). This study was conducted as the MSc thesis of Parviz Pourazizi at Guilan University of Medical Sciences.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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