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Improvement Measures for Effective Operation of Field Emergency Medical Units

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Abstract

Background/Objectives: This study analyzed disaster response capacity for events with multiple casualties and fire station workers' and public health center workers' perceptions of on-site emergency medical centers, who are the first responders.

Methods/Statistical analysis: The study were fire station workers and public health center workers who are the first responders. A total of 282 participants including 172 paramedics and 114 public health center workers were surveyed.

Findings: It was observed that fire station workers had greater disaster response capability compared to public health center workers. Appointing fire station first-aid team leaders as chief of on-site medical emergency centers would elevate work efficiency for events with multiple casualties.

Improvements/Applications: It is very important to provide the firefighters and public health workers with the disaster preparedness through training.

Keywords: Mass-casualty incident, Field emergency medical center, 119 Emergency medical service, Public health center

1. Introduction

In the event of a disaster, responders in a field emergency medical unit (FEMU) must carry out initial patient evaluation and triage, provide first aid, make expert decisions, carry out treatment, and perform in-transit assessment, all at the same time. Thus, management prior to hospital arrival is vital for patient survival. Personnel dispatched into the field include the local public health center director, physicians, nurses and administrative staff, with the fire department operating the emergency rescue control team. The public health center director takes command of the emergency facility, working to ensure the availability of hospital beds, secure sufficient personnel and determine equipment inventory to assign manpower as needed to carry out triage, treatment and transport[1,2].

Major disasters have repeatedly identified a number of problems in triage, hospital selection for transport and general delay in running a FEMU, attributed to the lack of a temporary emergency medical facility and poor coordination with related agencies. Rapid and efficient triage is especially important when trying to control a mass casualty situation[3,4].

Recent studies have focused on examining disaster situations as a whole, and while there have been previous studies on public health centers and hospital disaster medical assistance teams (DMATs), there are few detailed studies on fire departments and health centers[5,6]. This study aims to analyze the status of disaster response and FEMU operation in mass-casualty situations by highlighting the fire station and local health centers, in order to identify effective methods of operating FEMUs.

The purpose of this study for improving emergency service is as follows:

1) Determine the disaster response capability for mass-casualty situations according to the subject's general characteristics
2) Determine the level of the subject's disaster response capability
3) Determine the effect of the subject's duty station on FEMU operation
4) Determine the effect of the subject's duty station on his or her awareness of the importance of triage, treatment and transport teams

2. Materials and Methods

2.1. *Study design*

This study was designed as a descriptive-survey study examining the triage, treatment and transport capabilities and awareness of fire station first responders and public health center staff taking part in mass casualty training, aimed at providing a review of the current status of FEMUs in mass casualty situations.

2.2. *Study duration and subjects*

The survey for this study was distributed via social media from September 11 to 17, 2020 to EMT-paramedics ("class 1"), EMTs ("class 2") and nurses serving as first responders assigned to the Chungnam Fire Service; surveys were distributed in person by visiting five public health centers in Chungnam to staff members taking part in mass casualty training. Surveys were collected from 114 health center staff and 172 fire department staff for total 286 responders who acknowledged that they understood the purpose of the study and agreed to participate. Four surveys with incomplete answers were discarded, for a final total of 282 subjects.

2.3. *Research instrument*

The structured survey included seven questions on general characteristics, nine questions on FEMU operation, 25 questions on disaster response capabilities, and four questions on awareness of the importance of FEMU triage, treatment and transport teams for a total of 45 survey items. The instrument for triage effectiveness measurement was used. The survey questions on FEMU operation and triage, treatment and transport awareness were modified and augmented with input from the research task force team as well as two professors of emergency media service studies and five EMT-paramedics working as first responders. Cronbach's α = .967 for overall mass casualty disaster response capability.

2.4. *Data analysis*

The collected data was analyzed as follows using IBM SPSS Statistics 24.0 for Windows.

1) Subject general characteristics were analyzed as frequency and percentage.
2) Disaster response capability based on subject general characteristics analyzed with t-test and ANOVA, with Scheffé post-hoc test.
3) Level of subject disaster response capability was analyzed by average and standard deviation.
4) Subject responses for FEMU operation by duty type was analyzed with MANOVA.
5) Subject awareness of the importance of triage, treatment and transport teams by duty station was analyzed via t-test.

3. Results

3.1. *Subject general characteristics*

The subjects' general characteristics are shown in Table 1. There were 110 males (39.0%) and 172 females (61.0%), with 168 on fire station duty (59.6%) and 114 on public health center duty (40.4%). The bulk of the subjects were in their thirties with 130 (46.1%), and 177 with college education or higher (62.8%). There were 95 senior fire fighters (33.7%), the largest group. Eighty subjects had two to five years of experience (28.4%), with 73 with over ten (25.9%).

Table 1. General characteristics of the study subjects (N=282)

Category	Classification	N (%)
Gender	Male	110(39.0)
	Female	172(61.0)
Age	20s	71(25.2)
	30s	130(46.1)
	40s	41(14.5)
	> 50s	40(14.2)
Education level	≤College	105(37.2)
	≥University	177(62.8)
Rank	Fire fighter	83(29.4)
	Senior fire fighter	95(33.7)
	Fire sergeant	62(22.0)
	≥ Fire lieutenant	42(14.9)
Duration of work	< 1 year	31(11.0)
	1-2 years	55(19.5)
	2-5 years	80(28.4)
	5-10 years	43(15.2)
	≥10 years	73(25.9)
Certificate or license	Medical doctor or regular nurse	110(39.0)
	Paramedic	146(51.8)
	Training (no certificate)	26(9.2)
Working in	Fire station	168(59.6)
	Community health center	114(40.4)

3.2. *Disaster response capability based on subject general characteristics*

The subject's disaster response capability based on general characteristics is shown in Table 2. Statistically significant differences in disaster response capability by age were noted (F=10.18, $p \leq .001$); the Scheffé test indicated that subjects in their 30's (3.50±0.71) showed higher capabilities compared to subjects 50 and over (3.07±0.71), with those in their 20s (3.79±0.60) exhibiting a significantly higher capability. There were significant differences by job position (F=5.71, p =.001) and experience (F=4.01, p=.004). Statistically significant differences were also noted by license and qualifications (F=69.57, $p \leq .001$). Fire department personnel (3.81±0.55) indicated higher disaster response capability than public health center staff (3.01±0.66), (t=11.02, $p \leq .001$).

Table 2. Disaster response competency according to general characteristics (N=282)

Category	Classification	M±SD	t/F	*p*	Scheffé
Gender	Male	3.57±0.70	1.54	.123	
	Female	3.43±0.72			
Age	20s[a]	3.79±0.60	10.18	<.001	a>b>d
	30s[b]	3.50±0.71			
	40s[c]	3.34±0.69			
	> 50s[d]	3.07±0.71			
Education level	≤College	3.57±0.69	1.55	.122	
	≥ University	3.43±0.72			
Rank	Fire fighter[a]	3.69±0.64	5.71	.001	a>d
	Senior fire fighter[b]	3.51±0.67			
	Fire sergeant[c]	3.38±0.76			
	≥Fire lieutenant[d]	3.17±0.76			
Duration of working	< 1 year[a]	3.72±0.55	4.01	.004	a>e
	1-2 years[b]	3.62±0.76			
	2-5 years[c]	3.55±0.61			
	5-10 years[d]	3.48±0.79			
	≥10 years[e]	3.22±0.73			
Certificate or license	*M. D. or RN[a]	3.26±0.64	69.57	<.001	b>a>c>
	Paramedic[b]	3.83±0.56			
	Training[c]	2.50±0.43			
Working in	Fire station	3.81±0.55	11.02	<.001	
	Community health	3.01±0.66			

* M. D. : Medical doctor, RN : Regular nurse

3.3. *Level of subject disaster response capability*

The level of subject disaster response capability is as shown in Table 3. Total average response ca pability score was 3.48±0.71. For each category, first aid treatment capability score was 3.53±0.84, triage 3.51±0.68 and transport 3.38±0.80. The treatment with the highest score was “I can perform CPR during a disaster situation”, with 3.75±0.92. The highest-scoring response in triage was “I can conduct effective tri age according to patient classification standards”, at 3.69±0.79. In the transport category of questions, “I can determine transport priority by patient status” had the highest score of 3.51±0.89.

Table 3. Disaster response competency of the subjects (N=282)

Subcategory	Question	M±SD
Triage competency	• I am able to perform triage in disaster.	3.69±0.79
	• I am able to do history taking including symptoms and signs.	3.65±0.94
	• I am able to take care of cardiac arrest patients.	3.64±0.83
	• I am able to apply rapid triage to multiple disaster incident.	3.62±0.81
	• I am able to integrate the patient symptoms and mechanism of injury.	3.48±0.81
	• I am able to do the first priority among patient symptoms.	3.48±0.82
	• I am able to perform triage tag in disaster condition.	3.47±0.78
	• I am able to perform immediate treatment on arrival of disaster site.	3.42±0.81
	• I am able to find the serious clues from the statement of patient.	3.40±0.81
	• I am able to do differential diagnosis from patient’s chief complaints.	3.40±0.82
	• I am able to do triage on the basis of standards.	3.37±0.82

	Subtotal	3.51±0.68
First aid competency	• I am able to perform cardiopulmonary resuscitation in disaster.	3.75±0.92
	• I am able to perform wound management in disaster casualties.	3.67±0.93
	• I am able to perform oxygen therapy in disaster casualties.	3.53±1.03
	• I am able to perform basic life support on the basis of triage standards.	3.48±0.89
	• I am able to establish the intravenous line and fluid therapy in disaster.	3.48±1.07
	• I am able to perform shock patient assessment and emergency care in di	3.46±0.95
	• I am able to perform airway management in disaster condition.	3.46±0.96
	• I am able to perform multiple trauma patient assessment and emergency	3.40±1.00
	Subtotal	3.53±0.84
Transport competency	• I am able to determine the first priority of transport on the basis of triag	3.51±0.89
	• I am able to do rapid report and transport using communication to the h	3.44±0.96
	• I am able to perform patient assessment and preparation before hospital	3.43±0.87
	• I am able to perform the appropriate hospital transport on the basis of tr	3.42±0.86
	• I am able to perform patient assessment emergency care during transpo	3.42±0.90
	• I am able to perform patient transport on the basis of contraindication of	3.06±1.03
	Subtotal	3.38±0.80
Total of disaster response competency		3.48±0.71

3.4. *Analysis of subject responses for FEMU operation by duty station*

The results of an analysis of subject responses for FEMU operation by duty station are shown in Table 4. Statically significant differences were noted for level of awareness of FEMU-related laws (X2=6.17, p =.046). Significant differences by duty station were also noted for responses regarding the partnership structure between the public health center and fire station for FEMU operation (X2=53.84, $p \leq .001$) as well as the number of mass casualty training and education sessions completed during the subject's career (X2=21.32, $p \leq .001$).

Table 4. Management of field emergency medical unit (FEMU) according to working area of the subjects (N=282)

Category	Classification	Fire station (N=168)	Community health center (N=114)	X^2	p
		N(%)	N(%)		
Knowledge of FEMU Act	Do not know.	16(5.7%)	22(7.8%)	6.17	.046
	Average	73(25.9%)	49(17.4%)		
	Know.	79(28.0%)	43(15.2%)		
Management system of FEMU	Do not know.	11(3.9%)	10(3.5%)	1.74	.417
	Average	26(9.2%)	23(8.2%)		
	Know.	131(46.5%)	81(28.7%)		
Collaboration management of FEMU	Do not operate.	60(21.3%)	11(3.9%)	53.84	<.001
	Average	82(29.1%)	41(14.5%)		
	Operate well.	26(9.2%)	62(22.0)		
Training of multiple casualties program	1-5 times	123(43.6%)	85(30.1%)	21.32	<.001
	6-10 times	29(10.3%)	7(2.5%)		
	≥ 11 times	6(2.1%)	0(0.0%)		
	Never	10(3.5%)	22(7.8%)		

Preparedness of emergency response team	Do not prepare. Average Prepare well.	22(7.8%) 47(16.7%) 99(35.1)	41(14.5%) 42(14.9%) 31(11.0%)	32.42	<.001
Operation of FEMU	Fire station Public health center Hospital	80(28.4%) 67(23.8%) 21(7.4%)	53(18.8%) 59(20.9%) 2(0.7%)	11.77	.003
Satisfaction with FEMU	Satisfactory Operated by one	19(6.7%) 149(52.8%)	23(8.2%) 91(32.3%)	4.21	.040
Influence of multiple casualties training to FEMU	Not helpful Average Helpful	62(22.0%) 82(29.1%) 24(8.5%)	72(25.5%) 39(13.8%) 3(1.1%)	22.85	<.001

3.5. *Subject awareness of the importance of triage, treatment and transport teams by duty station*

The results of analyzing subject awareness of the importance of triage, treatment and transport teams by duty station can be seen in Table 5. Statistically significant differences were shown by duty station on the importance of the triage team at initial fire department arrival (t=3.00, p =.003). A significant difference was found by duty station for treatment (t=-2.43, p =.016), with subjects from public health centers responding that the treatment team was important. Health center staff also emphasized the importance of transport to the FEMU (t=-6.22, $p \leq .001$). A significant difference (t=-2.79, p =.006) was noted for the importance of the public health center's role in FEMU operation.

Table 5. Awareness analysis of triage, treatment and transport according to working area (N=282)

Category	Classification	Fire station (N=168)	Public health center (N=114)	t	*p*
		M±SD	M±SD		
Fire station on scene (FEMU)	Triage	42.26±12.88	37.54±13.05	3.00	.003
	Treatment	35.41±11.20	38.98±13.27	-2.43	.016
	Transport	22.55±10.55	23.63±9.49	-0.87	.384
Public health center on scene (FEMU)	Triage	36.54±15.28	33.94±13.50	1.46	.143
	Treatment	37.91±12.98	42.31±15.88	-2.54	.011
	Transport	25.71±12.97	23.80±10.61	1.35	.178
Role of fire station in FEMU	Triage	36.66±12.07	30.30±11.13	4.55	<.001
	Treatment	38.33±11.66	35.16±12.36	2.18	.030
	Transport	25.29±11.36	34.59±13.56	-6.22	<.001
Role of public health center in FEMU	Triage	35.95±14.73	33.50±13.75	1.40	.162
	Treatment	35.53±14.30	40.56±15.59	-2.79	.006
	Transport	28.63±16.44	25.91±12.37	1.58	.115

4. Discussion

This study surveyed 168 fire station personnel and 114 public health center personnel, aiming to offer a model for systematic FEMU operation.

A large number of training sessions cannot overcome a lack of training motivation.

EMTs (3.83±0.56) exhibited a higher disaster response capability (F=69.57, $p \leq .001$) compared to doctors and nurses (3.26±0.64), and fire department personnel showed a higher capability (F=11.02, $p \leq .001$) over health center staff (3.01±0.66). Health care staff showed a lower disaster response readiness and higher demand for disaster training.

Scores for disaster response capability of firefighters was 3.59±0.74, compared to 3.56±0.74 for nurses and nurse officer. In first aid treatment capability, the response scoring the highest was "I can perform CPR during a disaster situation", with 3.75±0.92.

In the event of a disaster, a delay in the operation of a FEMU composed of a health center director and disaster medical support team leads to difficulties in early response[7,8]. While fire departments have 24-hour duty rosters, health centers have regular daily hours that prevent them from preparing effectively for an emergency. The Emergency Rescue and Control Team Commander oversees joint training between emergency medical organizations and related agencies at least one per year. Asked if mass casualty training helps with FEMU operation, more fire department personnel answered in the affirmative (X2=22.85, $p \leq .001$). Public health center personnel are regularly rotated to take on new positions, making it difficult to take part in actual field emergency medical operations.

After initial arrival on site, fire department personnel responded that the triage team was important, with public health center personnel indicating the treatment team as priority in importance. Fire station staff were also found to perform more accurate triage before health center staff prior to training.

The role of the fire station EMT lead is required for rapid FEMU deployment and operation that can minimize casualties and accelerate patient triage, treatment and transport[9-11]. This study also highlights the importance in disaster response of utilizing the fire department EMT lead for FEMU operation.

4. Conclusion

For mass casualty training, the participation of personnel experienced in FEMU triage, treatment and transport is important. In reference to Chapter 5 of the Regulations of Emergency Rescue Response and Field Operations: the Establishment and Operation of a Field Emergency Medical Unit, a fire department EMT lead should appointed to command the field unit. Health care rapid response teams should be trained in patient triage. Virtual reality training programs should be adopted by fire academies to provide motivation for mass casualty training. Triage should be included in the scope of an EMT's duty in disaster response.

5. References

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