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Investigation of Clinical Skill Levels of Emergency Medicine Residents on Toxic Terrorism Medical Management

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INTRODUCTION: Toxic terrorism is the use of a chemical, biological, radiological, or nuclear (CBRN) agent for threat or attack to cause panic, illness, injury, and death in a civil society. The cases of toxic terrorism in which CBRN agents are used are increasing every day. Diagnostic uncertainty and inexperience in emergency management might delay the initiation of life-saving interventions and increase the morbidity and mortality of patients in cases of toxic terrorism. A limited number of topics on toxic terrorism readiness and medical management is included in the current core curriculum of Emergency Medicine Specialization training, and these are handled at different levels in each department [1]. OSCEs (Objective Structured Clinical Examination) are employed to evaluate clinical skills in emergency medicine residency training programs, and studies showing that OSCEs can predict future performance in both general and specific core competencies are included in the literature [2-4].

The purpose of the present study was to develop clinical scenarios to be applied as a standard to measure toxic terrorism readiness and medical management skills by applying simulation-based clinical exams to the emergency medicine department residents and to identify the missing and insufficient aspects of medical management in toxic terrorism clinical scenarios in the specialty education curriculum.

METHOD: The present study had a descriptive and cross-sectional design. The emergency medicine residents of Karadeniz Technical University (KTU), Faculty of Medicine, Emergency Medicine Department, and Health Sciences University, Trabzon Kanuni Training and Research Hospital, Emergency Medicine Department participated in the study.

A total of five OSCE stations were designed by two medical toxicologists. The scenarios and evaluation forms for the stations were formally evaluated by the study team with medical toxicologists and attending physicians. The design consisted of a total of five stations, one high-reality model, two with standardized patients, and two video scenarios recorded during the study. The performance of the residents in the first three stations was evaluated under three main headings: overall assessment stabilization, diagnostic approach, and specific treatment. The participants were asked to answer the prepared questions in writing after watching the video footage, which was specially shot at the last two stations.

RESULTS: A total of 48 Emergency Medicine residents participated in the study.

Table 1. The descriptive data of the participants

Variables	n = 48	%
Gender		
Female	16	33.3
Male	32	66.7
Age		
20-24	1.0	2.1
25-29	36	75.0
30-35	10	20.8
36-41	1.0	2.1
Institution Type		
Institution with a Medical Toxicology Unit	34	70.8
Institution without a Medical Toxicology Unit	14	29.2
Resident Training Period		
24 months and less	28	58.3
Over 24 months	20	41.7
Previous CBRN Training		
Yes	17	35.4
No	31	64.6
If yes, time elapsed since last CBRN Training		
1 year ago	2	4.2
2 years ago	13	27.1
3 years ago	2	4.2
Not received	31	64.6
CBRN Case Management Experience		
Yes	10	20.8
No	38	79.2
Simulation-Based Training Experience		
Yes	24	50.0
No	24	50.0
Simulation-Based CBRN Training Experience		
Yes	5	10.1
No	43	89.6
Level of Qualification in stations	Sufficient	Insufficient
1. Station 1	2 (4.2)	46 (95.8)
2. Station 2	-	48 (100.0)
3. Station 3	16 (33.3)	32 (66.7)
4. Station 4	13 (21.7)	35 (78.3)
5. Station 5	4 (8.3)	44 (91.7)
Level of Qualification in stations according to number of stations	n	%
Those Who are not Sufficient at Any Station	28	58.3
Sufficient in 1 Station	9	18.8
Sufficient at 2 Stations	7	14.6
Sufficient at 3 Stations	4	8.3

The descriptive data of the participants are presented in Table 1.

Table 2. Success Situations in the Sub-titles of Medical Management of the Stations

Station 1	**Sufficient**	**Can be developed**	**Insufficient**
Cholinergic syndrome	30 (62.5)	-	18 (37.5)
PPE and decontamination application	23 (47.9)	17 (35.4)	8 (16.7)
Supportive treatment	33 (68.8)	12 (25.0)	3 (6.3)
Specific treatment	2 (4.2)	11 (22.9	35 (72.9)
Station 2			
Recognizing acute radiation syndrome	8 (16.7)	-	40 (83.3)
PPE and decontamination application	3 (6.3)	1 (2.1)	44 (91.7)
Supportive treatment	9 (18.8)	1 (2.1)	38 (79.2)
Specific treatment	1 (2.1)	-	47 (97.9)
Station 3			
Recognizing botulism	30 (62.5)	-	18 (37.5)
Supportive treatment	40 (83.3)	8 (16.7)	-
Specific treatment	20 (41.7)	11 (22.9)	17 (35.4)
Station 4			
Recognizing mustard toxicity	15 (31.3)	-	33 (68.7)
PPE and decontamination application	28 (58.3)	3 (6.3)	17 (35.4)
Supportive treatment	42 (87.5)	3 (6.3)	3 (6.3)
Specific treatment	28 (58.3)	3 (6.3)	17 (35.4)
Station 5			
Recognizing cyanide toxicity	8 (16.7)	-	40 (83.4)
Supportive treatment	39 (81.3)	9 (18.8)	-
Specific treatment	5 (10.4)	2 (4.2)	41 (85.4)

The number and ratio of those evaluated as sufficient according to the stations and evaluation titles are given in Table 2.

Table 3. The Comparison of the Emergency Medicine Residents' Descriptive Data and Success Status

	At least 1 Sufficient n=20 (41.7)	Insufficient n=28 (58.3)	p
Institution working at			
Institution with a Medical Toxicology unit	17 (50.0)	17 (50.0)	**0.013**
Institution without a Medical Toxicology unit	3 (21.4)	11 (78.6)	
Working Time in Assistantship			
24 months and less	5 (17.9)	23 (82.1)	**0.001**
over 24 months	15 (75.0)	5 (25.0)	
Prior CBRN Training			
Yes	12 (70.6)	5 (29.4)	**0.007**
No	8 (25.8)	23 (74.2)	
Prior CBRN Case Management			
Yes	7 (70.0)	3 (30.0)	0.070
No	13 (34.2)	25 (65.8)	
Prior Simulation-Based Training			
Yes	16 (66.7)	8 (33.3)	**0.001**
No	4 (16.7)	20 (83.3)	

The comparison of the descriptive data of Emergency Medicine residents and their success in at least one station is presented in Table 3.

Considering the station evaluations of the residents, Station 1 was ranked as the most realistic station with 18 people (37.5%), followed by Station 3 (29.2%) and Station 2 (22.9%). Sixteen participants (33.3%) ranked Station 1 and Station 3 as the most successful station whereas stations 2 and 5 were described as the most difficult station by 14 people (29.2%).

DISCUSSION: There are deficiencies in toxic terrorism readiness training programs in emergency medicine residencies around the world that indicate the emergency medicine residents may be undertrained in terms of knowledge, skills and management [5]biological, radiological and nuclear (CBRN. A simulation-based clinical skill exam, prepared by experts in toxicology, was developed and administered to measure the clinical skill levels of emergency medicine residents about toxic terrorism. The results indicted a need to create reproducible training modules about toxic terrorism for emergency medicine residency curriculum.

In the present study, when the descriptive and educational data of the emergency medicine residents were compared with their success in at least one station, statistically higher proficiency rates were detected in those who worked as a resident for over 24 months, received CBRN training, and received simulation-based training. James et al. [6] found that mean scores obtained in the examinations for the medical knowledge and general clinical competence levels of 59 emergency medicine residents during the six years increased significantly with the years of education. This study is comparable with the data reported in the literature showing level of knowledge and success increased with years in training. This findings supports implementation of a toxic terrorism/CBRN training program for emergency medicine residents.

When the results were evaluated on the basis of stations, the most challenging station was found to be the station where acute radiation syndrome was simulated. Sheikh et al. [8] conducted a study of 113 emergency medicine residents in three US hospitals and found that most had never attended training on the use of radiation detectors nor attended radiation training in the last five years. For this reason, this can be interpreted as an expected result.

Based on a review of the literature, the authors did not identify any prior study that measures the clinical skill levels of emergency medicine physicians who will be the first to encounter, diagnose, and manage cases of toxic terrorism. For this reason, the present study is valuable because it is the only study in this field that developed a simulation-based clinical skills test on toxic terrorism cases.

LIMITATIONS: There were five scenarios prepared for this simulation which does not encompass all cases of toxic terrorism. More detailed data can be obtained with a larger selection of clinical cases. During the exam, consecutive days were chosen to minimize participant interaction and discussion of the cases, but it was not possible to completely prevent this. Although the emergency medicine specialization curriculum is theoretically common among institutions, the emergency medicine specialization training program differs by program and could effect the overall results.

CONCLUSION: A standardized simulation-based assessment and evaluation method was developed in this study to measure the clinical skills of emergency medicine residents when managing cases of toxic terrorism. The data obtained from this study reveal the need to develop a core training curriculum on CBRN/toxic terrorism and the need for repetition in training programs with measurable evaluation methods for emergency medicine residents on the medical management of this rare but significant threat to society._

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