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Knowledge about crime scenes and evidence management among emergency medical team professionals

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Abstract

Background To ensure that no criminal evidence has been moved or destroyed from the crime scene, emergency medical team (EMT) professionals should receive appropriate training, particularly in recognizing, collecting, preserving, and documenting evidence in both prehospital and intrahospital environments.

Aim To assess the knowledge and practices of EMT professionals in recognizing, collecting, preserving, and documenting criminal evidence.

Method A cross-sectional design utilizing an online survey was used to collect data from EMT professionals, including nurses, paramedics and physicians. Healthcare settings, including governmental, private, civil defense, and military hospitals in Jordan, participated in the study.

Results A total of 441 EMT professionals participated in the study. EMT professionals in Jordan had “moderate” levels of knowledge about recognizing and collecting forensic evidence. Moreover, their knowledge of preserving it was relatively low. The levels of knowledge were higher among physicians and paramedics compared to nurses, as well as in military and private hospitals compared to governmental ones. On the other hand, EMT professionals did perform well in documenting forensic evidence.

Conclusion Integrating the topics of forensic medicine into the undergraduate educational preparation of EMT professionals is essential. This extends to the continuous educational efforts taking place in healthcare settings, as well as highlighting them in the job descriptions of healthcare professionals, particularly in the emergency department. A graduate degree and specialization in forensic medicine are also required for EMTs in Jordan.

Keywords Crime, Forensics, Emergency medical team, Evidence management, Cross-sectional study

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Introduction

Emergency medical service (EMS) providers or emergency medical team (EMT) professionals, including emergency nurses, paramedics, and emergency medical doctors, deliver emergency medical care in various settings, such as prehospital areas and emergency departments [1]. As first responders in prehospital and hospital settings, EMT professionals may encounter situations where potential criminal activities are suspected, or they might find themselves at a crime scene and be surrounded by evidence [2]. A crime scene is defined as the physical location where potential evidence may be present, including the immediate surroundings, involved objects, traces left by perpetrators or victims, and other relevant investigative clues [3]. Evidence at a crime scene can include biological samples, photographs, drawings, videos, and documentary evidence [4, 5].

While the primary duty of EMT professionals is to provide medical care and save patients' lives, preserving the integrity of the crime scene is also crucial to ensure that justice can be served [1, 6]. Their responsibilities extend beyond medical services to include maintaining the crime scene's integrity and ensuring that traces such as footprints, fingerprints, hair, or cigarette butts are preserved and that no evidence is moved or destroyed unless critical to providing medical care [5]. Additionally, evidence may be encountered in hospital settings, particularly in emergency departments and operating rooms, when victims are transported directly from the prehospital area by medical or nonmedical personnel [4].

Several studies have identified a concerning gap in the training of EMT professionals working in emergency settings, specifically regarding their familiarity with managing crime scenes while providing urgent medical care. Improper handling, contamination, or destruction of evidence at such scenes can significantly undermine investigations, potentially resulting in wrongful convictions or allowing perpetrators to escape justice [7, 8]. Despite the critical importance of this issue, general orientation programs and continuing education courses for healthcare providers—including physicians, nurses, and paramedics—often fail to address key topics such as crime scene identification, evidence collection, preservation, and proper documentation. Consequently, many EMT professionals demonstrate insufficient knowledge and skills in this crucial area [4, 9].

Forensic education prevents potential damage and mishandling of evidence, thus supporting effective legal processes and patient care. EMT professionals must receive appropriate training in preserving, collecting, and documenting evidence in prehospital and intrahospital environments [5]. The National Center for Forensic Medicine (NCFM) in Jordan, under the Ministry of Health, offers forensic medical and criminal science services using

advanced technology to support the judicial system, public prosecution, and investigative agencies. The center oversees nationwide forensic services, including investigating judicial deaths, medical examinations, and forensic reports. It also plays a crucial role in addressing domestic violence by offering specialized clinics within the Family Protection Department. The NCFM also serves as an accredited educational hub, collaborating with universities to enhance the qualifications of medical professionals in forensic medicine [10]. However, despite the presence of such an advanced center, there remains a significant gap: there are no available national statistics or published studies assessing the actual level of knowledge or practical competencies of EMT professionals regarding forensic evidence management. While the infrastructure for forensic training exists, it remains unclear to what extent this training has been disseminated to frontline healthcare providers, particularly EMTs. Compounding this concern, national crime data report a steady rate of 20 crimes per 10,000 individuals in Jordan during 2022 and 2023, reflecting a consistent need for forensic readiness at the point of emergency care [11].

This surge in criminal activity imposes an extra burden on Jordanian EMT professionals, who may suddenly find themselves at a crime scene or treat potential victims in the emergency department without the necessary forensic training to preserve critical evidence. The absence of formal assessments and the limited integration of forensic principles into healthcare curricula highlight an urgent need for comprehensive, specialized forensic assessment and education tailored to EMTs and other first responders. In light of these gaps, the present study aims to assess the knowledge and practices of EMT professionals in recognizing, collecting, preserving, and documenting criminal evidence.

Methods

Study design, sample, and settings

This study employed a quantitative, cross-sectional design to assess the knowledge and practice of EMT professionals regarding the recognition, preservation, collection, and documentation of crime scene evidence.

This study was conducted in the prehospital and emergency department settings of hospitals in Jordan. A convenience sampling approach was employed to collect data from a sample of EMT professionals, including emergency nurses, paramedics, and emergency medical doctors. The questionnaire was prepared using Google Forms®. Then, the link was distributed to the emergency department managers at the participating healthcare settings. The emergency department managers distributed internally within their teams through social media platforms. Additionally, it was converted into a QR code and posted on the emergency room announcement boards

after obtaining the necessary permissions from the hospital.

The target sample size, which was calculated via an 80% confidence level and a 5% margin of error, was determined to be 164 participants. However, the researchers ultimately recruited a larger sample of 441 EMT professionals. The inclusion criterion for this study was that participants be EMT personnel employed in prehospital or emergency department settings.

Data collection and ethical considerations

Data was collected through an online questionnaire. The questionnaire was distributed through official letters sent to hospitals and Civil Defense centers, which included a QR code linking to the online survey. Additionally, the link to the questionnaire was shared with the emergency department managers at participating locations, as well as it was shared on healthcare-focused social media pages and professional groups to broaden participation. Upon accessing the survey via the QR code or link, participants were presented with a cover page that included an introduction to the study purpose, the inclusion criteria, and a statement indicating that completing and submitting the questionnaire would be considered as providing informed consent.

This study was conducted following the 1964 Helsinki Declaration. Participation was entirely voluntary, and EMT professionals were informed that they could withdraw from the study at any point before submission. Data was collected anonymously using an online survey platform, and no personally identifiable information was gathered. The first author securely downloaded the responses and stored the data on a password-protected personal computer. Ethical approval for the study was obtained from the Ethics Committee of the Department of Applied Medical Sciences at the Prince Al Hussein bin Abdullah II Academy for Civil Protection.

Instrument

The adopted instrument was developed by Lee and Moon [12]. As the participants completed the questionnaire online, the tool authors reported Cronbach's alpha of 0.92, indicating an acceptable level of reliability. Face and content validity testing were also conducted by three experts in the field of forensic medicine [12]. Data collection was conducted in English, and a pilot study was performed; however, no significant issues were encountered.

To collect data about EMT professionals, nine questions were asked regarding personal information, including gender, age, education level, income, position, employment period, hospital level, crime scene experience, and additional forensic training experience.

Data analyses

The researchers used the Statistical Package for the Social Sciences (SPSS) version 25 [13] to analyze the data. Based on the level of measurement, descriptive and inferential statistics were used for data analyses. The researchers used a significant level of $\alpha < 0.05$ for the inferential statistics. The descriptive statistics, including means and standard deviations, as well as frequencies and percentages, were used to describe the sample characteristics and variables. Additionally, Pearson's r test was used to examine the relationship between the respondents' overall score on crime-related recognition and forensic evidence management. Analysis of variance (ANOVA) was used to determine the difference between EMT professionals in crime-related event recognition and forensic evidence management.

Results

Sample characteristics

The present study reports findings based on a sample of 441 EMT professionals, comprising nurses ($n=200$, 45.4%), EMS paramedics ($n=215$, 48.8%), and physicians ($n=26$, 5.8%), predominantly males (72.1%). Most participants held a bachelor's degree (58.3%), with total experience ranging from 9 to 14 years (25.9%). Notably, more than half of the participants (51.5%) were employed in the Civil Defense, a paramilitary governmental service in Jordan. A significant proportion of the participants reported not receiving any forensic education or training during their formal education (72.8%) or after graduation (69.8%). Detailed demographics are presented in Table 1.

Adequacy of forensic medicine practices

In the current investigation, respondents were asked to evaluate the adequacy of their forensic medical practices. The results presented in Table 2 demonstrate that a substantial proportion (i.e., 46%) of the participants rated their practices concerning forensic identification as "inadequate." Similarly, nearly half of the participants expressed that their practices were suboptimal in various aspects, including the collection of forensic evidence (41%), preservation of forensic evidence (41%), and recording of forensic evidence (43.5%).

Levels of knowledge in forensic medicine

This study evaluated participants' knowledge of key aspects of forensic medicine. The findings revealed that the participants exhibited a moderate level of knowledge in recognizing forensic evidence, with a mean score of 2.98 out of 5 ($SD=1.16$). Similarly, the participants' knowledge of collecting forensic evidence was moderate, with a mean score of 7.13 out of 13 ($SD=1.16$). On the other hand, the participants' average score in preserving forensic evidence was 1.98 out of 4 ($SD=0.82$). In

Table 1 Sample characteristics (N = 441)

Variable	Frequency (%)
Gender	
Males	318 (72.1)
Females	123 (27.9)
Job	
Nurse	200 (45.4)
EMS-paramedic	215 (48.8)
Physician	26 (5.8%)
Level of Education	
Diploma	142 (32.2)
Bachelor	257 (58.3)
Masters	42 (9.5)
Years of Experience	
<1 Year	90 (20.4)
1–3 years	101 (22.9)
4–8 Years	45 (10.2)
9–14 years	114 (25.9)
>14 Years	91 (20.6)
Work Sector	
Civil Defense	227 (51.5)
Governmental Hospital	102 (23.1)
Military Hospital	49 (11.1)
Private Hospital	63 (14.3)
Received Forensic Education/Training at University	
No	321 (72.8)
Yes	120 (27.2)
Received Forensic Education/Training after Graduation	
No	308 (69.8)
Yes	133 (30.2)

Table 2 Self-Rating of perceived adequacy of forensic medicine practices (N = 441)

Variable	Self-Rating		
	Not adequate (n/%)	Partially Adequate (n/%)	Adequate (n/%)
How do you find your practices regarding forensic identification?	201 (45.6)	92 (20.9)	148 (33.6)
How do you find your practices regarding the collection of forensic evidence?	222 (50.3)	140 (31.7)	79 (17.9)
How do you find your practices regarding the preservation of forensics?	181 (41.0)	119 (27.0)	141 (32.0)
How do you find your practices regarding the recording of forensic evidence?	192 (43.5)	107 (24.3)	142 (32.2)

contrast, they performed better in documenting forensic evidence, obtaining a mean score of 6.41 out of 8 (SD = 1.20) (Table 3).

Differences in forensic medicine knowledge scores based on demographic variables

The study results indicated that neither gender nor level of education had a significant effect on total forensic

Table 3 Levels of knowledge in forensic medicine scores (N = 441)

Variable	Mean	SD*	Min. Ob-tained score	Max. Ob-tained score	Possible scale score range
Total identification of forensic evidence	2.98	1.156	0	5	0–5
Total collection of forensic evidence	7.13	2.164	2	12	0–13
Total preservation of forensic evidence	1.98	0.828	0	4	0–4
Total documentation of forensic evidence	6.41	1.203	1	8	0–8
Total knowledge	18.49	3.542	7	26	0–30

medicine knowledge scores. Nevertheless, significant distinctions were observed among different job categories. Specifically, EMS paramedics had higher knowledge scores (M = 18.80) than nurses (M = 16.70), with a significant p-value of 0.01. Furthermore, experience was identified as an important demographic variable, demonstrating substantial differences in forensic knowledge scores. Participants with more experience scored higher

than those with fewer years of experience ($F = 14.33$, $p = 0.001$).

The work setting also emerges as a factor contributing to notable distinctions in the findings. The results indicate that participants in private and military hospitals achieved higher scores than their counterparts in civil defense and governmental hospitals, yielding a statistically significant outcome ($F = 4.77$, $p = 0.001$). Furthermore, participants were asked about their exposure to forensic education or training during their time at university. Respondents with confirmed exposure to forensic education ($M = 18.93$) attained significantly higher forensic knowledge scores compared to those who reported no exposure ($M = 17.33$) ($p = 0.001$). A similar pattern arose when participants were asked about postgraduate forensic education or training. Those who received such education or training ($M = 18.98$) obtained higher forensic knowledge scores than those who reported no such exposure ($M = 17.38$), resulting in a statistically significant difference ($p = 0.001$) (see Table 4).

Discussion

Emergency medical service professionals frequently serve as the first point of contact for victims or perpetrators in various medical settings [2, 14]. They are responsible for administering prompt medical care. Hence, they must possess fundamental knowledge of forensic medicine to carry out their duties effectively to provide comprehensive care that addresses all the needs of individuals, especially if they have been exposed to any assaults or injuries [2, 15, 16]. The present study aimed to evaluate the level of proficiency of EMT professionals in evidence collection and management, including evidence preservation and the recording of crime scene evidence.

The emergency medical team professionals who participated in the study included ER nurses, paramedics, and physicians. Given the differences in their educational preparation and job descriptions in Jordan, it was expected that their knowledge and practices regarding forensics would vary, as presented in the results. Nurses receive minimal education about forensic medicine during their training [17, 18], whereas paramedics and physicians are better prepared [19]. Furthermore, the job descriptions of nurses in Jordan do not highlight the role of forensics in detail, unlike those of paramedics and physicians, where forensics is more prominently featured. Paramedics, as the common first responders to provide medical services in prehospital settings, are exposed to more situations in which they are required to be aware of the forensic implications of their practice [20]. Upon arriving at healthcare settings, physicians and nurses conduct a thorough patient assessment; at this point, physicians hold a greater obligation toward forensic

Table 4 The differences among groups in levels of knowledge ($N = 441$)

Variable	t or F	p ^s	Mean	SD
Gender	-0.587	0.558		
Males			18.44	3.88
Females			18.63	2.46
Job	-2.52	0.012*		
Nurse			16.7	3.84
Paramedics			18.8	3.35
Physicians			19	3.10
Level of Education	1.82	0.163		
Diploma			18.35	3.62
Bachelor's degree			18.71	3.27
Masters			17.64	4.65
Years of Experience	14.33	< 0.001**		
< 1 Year			16.62	3.67
1–3 years			16.91	3.38
4–8 Years			18.53	2.21
9–14 years			19.25	4.05
> 14 Years			19.87	3.09
Work Sector	4.77	0.003*		
Civil Defense			18.09	3.69
Governmental Hospital			18.21	3.79
Military Hospital			19.57	2.78
Private Hospital			19.57	2.63
Received Forensic Education/ Training at University	-3.5	0.001*		
No			17.33	4.7
Yes			18.93	2.88
Received Forensic Education/ Training after Graduation	-3.8	< 0.001**		
No			17.38	4.45
Yes			18.98	2.94

Note: t for Independent Samples t-test, F for ANOVA, p = significance level, * Significance at $\alpha = 0.05$, ** Significance at $\alpha = 0.001$

medicine than nurses do, and they are the common EMT team leaders in hospital settings [19, 21].

The findings from the current study indicate that nearly half of the participants rated their practices as “inadequate” in several critical areas of forensic medicine, including the identification, collection, preservation, and recording of forensic evidence. The reported inadequacies might stem from several factors. First, many healthcare professionals receive minimal to no specific training on forensic protocols during their education, which could lead to uncertainties and errors in handling forensic tasks [22]. Second, the absence of standardized protocols across various healthcare institutions in Jordan can contribute to inconsistent practices, which complicates efforts to uniformly collect, preserve, and document forensic evidence.

This study on the levels of knowledge in forensic medicine in Jordan utilized objective methods to assess the participants' comprehension of forensic medicine.

Similar efforts have been conducted and reported in the literature in different international settings [19, 23]. The study findings indicated a conservative moderate level of knowledge among the participants in various aspects of forensic medicine. This finding highlights the multiple gaps in covering the topic of forensic medicine in the basic educational preparation of EMT professionals. The gaps extend to the continuous education efforts at practice settings, as well as the minimal details of their presence in the job descriptions of all EMT professionals.

This study concluded that the participants possessed a moderate level of knowledge in identifying forensic evidence, which is consistent with previous studies conducted by Özden, Özveren, and Yılmaz (2019) [23] and the study of Kalayci, Yazici, and Küpeli (2014) [24]. This result implies the opportunity for enhancement in the EMT's levels of knowledge regarding the diverse categories of forensic evidence identification and management processes.

Similarly, the participants' knowledge of collecting forensic evidence was found to be at a moderate level, which is less than what is required for better handling of forensic evidence; at the same time, it is consistent with prior research [15, 19, 23, 24]. This finding suggests that EMT professionals may have some understanding of the procedures and techniques for collecting forensic evidence when the need arises and a crime scene is suspected or identified. On the other hand, the participants' average score in preserving forensic evidence was 1.98 out of 4, which is unsatisfactory given its importance. The same results were reported in the literature in this regard [16, 23]. Preserving forensic evidence is crucial to maintaining its integrity and ensuring its admissibility in legal proceedings, so further training and education may benefit this area [2, 24].

In contrast, the participants performed better in documenting forensic evidence, which is consistent with literature reports [14, 23]. This indicates a relatively high level of knowledge in documenting forensic evidence. It involves accurately recording and describing the collected evidence. This finding confirms the existence of dissociation between the knowledge and practice related to forensic medicine. Therefore, efforts to optimize educational preparation should focus on bridging this gap. Introducing new educational techniques and methods, such as simulation, in addition to other educational strategies, may help in this regard [25].

Notably, while previous studies concerning the levels of knowledge in forensic medicine in Jordan could not be found, to the best of the authors' knowledge, there are other studies available that highlight the role of forensic medicine in areas such as evaluating the seriousness of physical injuries in domestic violence cases [21] and examining assaulted women to establish the integrity of

the hymen [26]. These studies provide valuable insights into the practical applications of forensic medicine in Jordan.

Differences in forensic medicine knowledge scores based on demographic variables

These findings suggest that job category and years of experience have an impact on forensic medicine knowledge. Paramedic employees demonstrated higher knowledge scores, potentially indicating greater exposure or training in forensic medicine within their job roles, which also applies to physicians, especially in hospital settings, where they lead the care plan for victims. This disparity could be attributed to the nature of their job responsibilities, which often require them to be the first responders in emergency situations, including those involving legal and forensic considerations. Such situations necessitate a foundational understanding of forensic medicine, which appears to be reinforced through either direct experience or targeted training within their roles [19, 27]. This finding is consistent with a study in Turkey [28], which revealed that physicians and paramedics possess a greater level of forensic knowledge than nurses. Additionally, participants with more years of experience had higher knowledge scores, suggesting that practical experience and exposure to forensic situations and cases where crimes are suspected contribute to a deeper understanding of the subject matter and its role in medico-legal consequences [15, 24]. The findings concluded that graduate education professionals knew less than undergraduates, which can be attributed to the fact that graduate education in the specialty of forensic medicine for all EMT professionals is minimal and not readily available at the local level, requiring it to be sought elsewhere, outside Jordan. However, this finding is inconsistent with Çalışkan and Özden's (2012) study [28], which reported that EMT practitioners with postgraduate education have a higher level of knowledge than those with undergraduate education.

The type of hospital environment plays a crucial role in the forensic readiness of healthcare professionals. The higher scores observed in private and military hospitals could be attributed to several factors. Military hospitals often have strict protocols and a structured training regimen that includes forensic medicine due to the nature of military operations and the potential for legal repercussions [29]. Private hospitals, on the other hand, may offer more resources for continuous professional development and might attract more specialized personnel who have received better forensic training [30].

Limitations

This study used a convenience sampling approach, which may limit the generalizability of the findings to all

Jordanian emergency medical team (EMT) professionals. However, efforts were made to reach a broad range of EMTs across various hospitals and Civil Defense centers to enhance diversity within the sample. Additionally, the exclusion of non-English studies due to language constraints may have reduced the comprehensiveness of the literature review; nonetheless, the review focused on widely cited and high-quality English-language sources to ensure relevance and credibility. The study relied on self-reported data, which may not accurately reflect actual skills in managing forensic evidence. People might have over- or underestimated their skills. Despite these limitations, the study provides valuable insights into the knowledge of EMT professionals regarding crime scenes and forensic evidence management.

Conclusion and recommendations

The study's findings suggest moderate knowledge among the participants in recognizing and collecting forensic evidence, whereas their knowledge in preserving it was relatively lower. They performed better in documenting forensic evidence. Further research and training in forensic medicine in Jordan can enhance knowledge and skills in all aspects of forensic evidence handling, ultimately contributing to the effective application of forensic medicine in legal contexts.

These findings underscore the need for further attention to forensic education and training in emergency medical services. This needs to be integrated for practicing EMTs and including forensic education within the continuous education efforts at the healthcare facilities. It is recommended given the substantial percentage of participants lacking such educational opportunities.

The findings of this study also indicate the need to enhance the current forensic medicine curriculum to produce proficient graduates in forensic medicine at the graduate level. Revising the forensic curriculum by augmenting instructional and experiential hours is recommended. The proposed modification would enhance the ability to participate in thorough observation and analysis, thereby increasing the competency of nurses and EMS professionals in forensic medicine.

Abbreviations

EMT	Emergency medical technique
EMS	Emergency medical services
ER	Emergency room
ANOVA	Analysis of variance
SD	Standard deviation

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Author contributions

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Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to [Data collected from institutions under control of general security forces] but are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate

Access permission and ethical approval have been granted by the Research Committee of Prince Al-Hussein Bin Abdullah II Academy for Civil Protection, as per Official Letter No. 18/6/31/2060. Informed consent was obtained from all study participants.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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