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Exploring Clinical Competencies and Ethical Reflections: A Multi-Patient Simulation-Based Training Program for Emergency Medicine Residents

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Abstract **Objectives:** This study aims to assess the proficiencies, ethical considerations, and crisis management abilities of emergency medicine residents through a multi-patient simulation program. The research investigates the impact of this training on developing skilled emergency care providers. **Methods:** Fifteen emergency medicine residents at various training levels were evaluated by two specialists across five simulation scenarios aligned with ACGME competencies. Performance in clinical decision-making, communication, and teamwork was assessed using a 5-point Likert scale and Google Forms, following obtaining informed consent. **Results:** The study lasted three days and included briefings, simulations, and debriefings. Residents demonstrated differing performance levels, excelling in patient history taking and data reassessment but facing challenges in forensic inquiries, ethical dilemmas, and team communication under pressure. Residency experience showed positive correlations with certain performance aspects. **Conclusions:** Variations in residents' performances highlight the complexities of emergency medicine and the role of simulation in identifying educational gaps. The debriefing session emphasized the importance of ethical practice and effective team communication. The debriefing session highlighted ethical conduct and effective team communication, advocating simulation-based training to improve emergency medicine competencies. Additionally, the session gathered information that would guide future research endeavors and the development of educational policies.

Key Words emergency medicine, multi-patient simulation, education policy, ethical dilemmas

1. Introduction

Emergency medicine residency programs play a pivotal role in preparing physicians to manage diverse and high-acuity clinical scenarios. The Review Committee for Emergency Medicine and the American Board of Emergency Medicine have identified a comprehensive set of milestones to guide the progression of emergency medicine residents from novice to expert, reflecting the complex skill set required in this specialty [1]. However, there is wide variability in the training experiences that emergency medicine residents receive across different programs, leading to concerns about the adequacy of training in certain areas, such as emergency ultrasound and non-technical skills [2], [3]. Simulation-based training has emerged as a valuable educational tool in emergency medicine, offering a safe and controlled environment for residents to practice and refine their clinical skills. The use of simulation in emergency medicine training has been recognized as a critical area for research and development, with the potential to address deficiencies in time-sensitive, high-stakes, and low-frequency clinical skills that could impact patient outcomes [4]–[8]. Given the evolving nature of emergency medicine training and the versatility of simulation-based learning, it is crucial to examine the impact of multi-patient simulation on the clinical skills, ethical considerations, and crisis management capabilities of emergency medicine residents [9]. Multi-patient simulation is an impor-

tant educational tool that effectively prepares students for the complicated procedures and difficulties encountered in real healthcare environments. It provides an enhanced and real-life environment that allows students to acquire basic skills and competencies necessary for confident patient care, including ensuring patient safety and privacy, effective communication, intervention skills, decision-making skills, prioritization when attending to multiple patients concurrently [10].

In this study, we aimed to address this gap by examining the performance of emergency medicine residents in a multi-patient simulation-based training program and exploring their reflections on the experience.

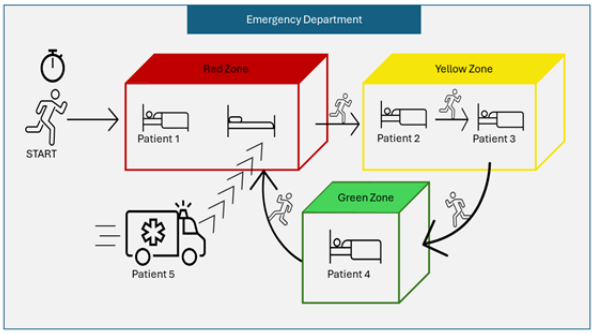

Figure 1: Setup of multiple patient simulation

2. Materials and Methods

A. Participants

Fifteen emergency medicine residents participated in the study. The residents were at various stages of their emergency medicine training. The postgraduate education duration for the residents in the study ranged from 18 to 45 months, with an average of 33.86 months. It is worth noting that in Turkey, the duration of emergency medicine specialty training is 48 months.

B. Observation

Two independent emergency medicine specialists assessed the performance of the participants using skill checklists constructed on a 5-point Likert scale. The assessment was done both visually and by video recording.

C. Simulation Scenarios

The six competency headings in the 2021 current guide of the Accreditation Council for Graduate Medical Education of Residents (ACGME) were used as a guide for evaluation criteria, simulation, and scenario flow planning. The study involved five consecutive patient simulation scenarios. The 1st case was minor pediatric head trauma, the 2nd case was ectopic pregnancy, the 3rd case was tension pneumothorax, the 4th case was anaphylaxis, and the 5th was acute coronary syndrome. The simulation application started from the first room and progressed to other rooms, respectively, with the guidance of the general practitioner or nurse (Figure 1). Cases that could not be completed on time as required by the scenario were presented to the physician again during the simulation. The simulation utilized an advanced computer-assisted simulator that was designed specifically for adult emergency scenarios. It involved a group of 9 medical students who took different roles, including three simulated patients, four simulated patient relatives, one general practitioner, and a nurse. An administrative staff member performed the role of a security personnel. The role players were given training beforehand.

D. Evaluation

The residents' performance during the simulation sessions was evaluated using a 5-point Likert scale (1 point is the lowest, 5 points is the highest). It was planned to measure 7 practice objectives in the first case, 9 in the second case, 11 in the third case, 8 in the fourth case and 16 in the fifth case. The evaluation was conducted using Google Forms, allowing for structured and standardized assessment of the residents' competencies and skills demonstrated during the simulations. The Likert scale was used to assess various aspects of the residents' performance, including clinical decision-making, communication, teamwork, and overall management of the simulated cases.

E. Data Collection

Data on the residents' performance and the specialists' observations were collected during the simulation sessions. The evaluations were anonymized to ensure confidentiality and impartial assessment. The data collected from the Google Forms were then compiled for further analysis.

F. Statistical Analysis

The data collected from the evaluations were meticulously analyzed to assess the residents' performance across diverse simulation scenarios. Statistical analysis was conducted with statistical software (SPSS, version 24.0; SPSS Inc, Chicago, IL, USA). Descriptive statistics were utilized to briefly summarize the data set, providing an overview of performance metrics. A Pearson correlation analysis was conducted to explore the potential relationship between the participants' experience and their success rates. The analysis revealed the extent to which experience correlates with performance outcomes. Statistical significance was determined at a threshold of $p < 0.05$.

3. Results

The whole study lasted a total of 3 days. 15 residents were individually involved in a 5 min brief, 15.5 min average simulation practice and 22.5 min debriefing session.

In the first case, which involved pediatric minor head trauma, the residents demonstrated the worst performance in "make the correct assessment according to the approach algorithms for head trauma under 2 years of age". However, they exhibited the best performance in "take a focused anamnesis." (Table 1). For the second case, which focused on ectopic

pregnancy, the residents' worst performance was failing to "uses a language free of value judgments while explaining this process to patients and their relatives." Conversely, their best performance was "Re-evaluates the data received from another physician in an objective manner and makes his/her own judgment." (Table 1).

In the third case, which involved pneumothorax, the residents' worst performance was in "conducts forensic inquiries and keeps/ensures that the report is kept." On the other hand, their best performance was objectively "Objectively re-evaluates the patient's data received from another health professional and makes his/her own decision." (Table 2).

In the fourth case, which focused on anaphylaxis, the residents' worst performance was in "provides anaphylaxis management with a correct algorithm", while their best performance was in "assesses the patient immediately." (Table 2).

In the fifth case, which centered on acute coronary syndrome, the residents' worst performance was in "manages the process effectively by making a correct task distribution (distributes tasks to the nurse and practitioner in CPR management)", whereas their best performance was in "takes a focused anamnesis of the patient from the paramedic with correct and necessary questions (does not waste time with unnecessary questions)." (Table 3).

When the relationship between simulation practice performance and residency experience was examined, a positive relationship was found between experience and performance in the following items in the first and fifth cases:

In the first case; "perform primary and secondary assessment of the patient", "take a focused anamnesis", "be able to educate patients about simple discharge and readmission", "understand the anxiety of the patient's relatives and carry out the process within the framework of mutual understanding."

In the fifth case; "takes a focused anamnesis of the patient from the paramedic with correct and necessary questions (does not waste time with unnecessary questions).","Administers CPR and administers medications at the right time (Adrenaline should not be administered before 2nd shock, amiodarone should not be administered before 3rd shock)","transfers the process to the patient's relatives correctly and completely. (Be an active listener, do not use medical jargon, provide information in the right environment, respond satisfactorily to all questions of the patient's relatives)" and "do not order tests other than troponin and ECG." (Table 3).

Table 3 depicts the Practice objectives of Case 5 and residents' experience. The relationship between residency experience and their success was investigated using Pearson correlation analysis. Practice objective 4- To be able to face a technical failure in a cool-headed manner (to be able to create an alternative quickly without reacting to the defibrillator not working), Practice objective 15- Provides correct leadership to the team in any situation. (Resists disruptions and unstable patient management stress) and Practice objective 16- Keeps a record of the technical failure and notifies the relevant units. (Keeps a record.) could not analyzed due to insufficient sample size.

Non-structured debriefing sessions revealed that the participants found the application to simulate crisis management in the emergency department in a very realistic way. They expressed surprise at encountering such serious simulations, indicating that the experience exceeded their expectations.

Furthermore, the majority of the participants reported that in the first case (pediatric minor head trauma), they opted for imaging due to family pressure and a reflex to avoid legal situations, despite it being off-label. In the second case (ectopic pregnancy), some participants neglected to ensure the confidentiality of the patient diagnosed with a pregnancy outside of marriage, realizing the importance of meeting with the patient in a private and appropriate environment. In the third case (pneumothorax), most participants recognized the misdiagnosis of the practitioner early and performed the correct diagnosis and effective patient management but skipped the forensic report requirement. In the fourth case (anaphylaxis), some participants realized during the feedback session that they had misremembered the adrenaline dose. In the fifth case (acute coronary syndrome), some participants emphasized the importance of team communication and attributed their failure to communicate effectively with the nurse to the environment's differences.

4. Discussion

The implementation of multi-patient simulation as a learning technique necessitates meticulous preparation and execution. Prior investigations have employed a limited number of patients and participants in their training endeavors. Conversely, in our research, we concurrently incorporated five distinct patient scenarios while affording fifteen individuals the opportunity to engage in this simulation activity [11]–[13].

Emergency physicians usually work in high-pressure environments requiring rapid decision-making with critically ill patients. This is a significant training milestone identified by the ACGME (Task Switching, PC-8) [14]. Emergency physicians experience interruptions at an average frequency of every 9-14 minutes and the frequency of interruptions tends to rise as the number of patients being attended to simultaneously increases. Efficiently managing task switching and prioritization is crucial in the field of emergency medicine [15]–[21].

The residents' performance in the simulation scenarios revealed both strengths and areas for improvement. Especially, low-priority tasks were easily neglected in the multitasking setting. Identifying specific areas where residents demonstrated suboptimal performance, such as failure to use language free from value judgments and neglect to ensure patient confidentiality, underscores the importance of addressing ethical considerations and effective communication in emergency medicine practice [22], [23].

The feedback sessions provided valuable insights into the residents' reflections on their performance and the impact of

Cases	Mean±SD	Residency Experience	Total
Case 1 Trauma		r	p
1. Perform primary and secondary assessment of the patient.	4.37 ± 0.72	0.541	0.037
2. Take a focused anamnesis.	4.43 ± 0.56	0.573	0.026
3. Make the correct assessment according to the approach algorithms for head trauma under 2 years of age.	3.50 ± 1.32	-0.055	0.846
4. Evaluate the patient's need for examination.	3.67 ± 1.19	-0.143	0.610
5. Interpret the examination performed.	3.82 ± 1.45	0.307	0.286
6. Be able to educate patients about simple discharge and readmission.	3.93 ± 1.15	0.542	0.037
7. Understand the anxiety of the patient's relatives and carry out the process within the framework of mutual understanding.	4.30 ± 0.75	0.670	0.006
Case 2 Ectopic Pregnancy			
1. Re-evaluates the data received from another physician in an objective manner and makes his/her own judgment.	4.60 ± 0.43	0.161	0.566
2. Ask a woman of childbearing age presenting with abdominal pain about LMP (last menstrual period) and pregnancy status. Performs focused PE (pulmonary embolism) to exclude other conditions that may cause abdominal pain.	3.57 ± 1.39	0.224	0.423
3. Uses data from a patient presenting with abdominal pain in differential diagnosis.	3.60 ± 0.74	0.278	0.316
4. Performs Beta HCG in a female patient presenting with abdominal pain/requests abdominal USG evaluation and considers contraindications to imaging modalities until pregnancy status is clear.	3.30 ± 1.15	-0.088	0.756
5. Recognize that the present pathology is an indication for urgent OB/GYN consultation.	3.30 ± 1.18	0.103	0.714
6. Provides clinical judgment by analyzing objective data obtained from appropriate investigations.	3.30 ± 1.15	0.287	0.299
7. Manages pregnancy out of wedlock within the framework of ethical principles by prioritizing patient privacy.	2.90 ± 1.82	-0.173	0.537
8. Uses a language free of value judgments while explaining this process to patients and their relatives.	2.63 ± 1.73	-0.029	0.918
9. Does not allow workload intensity/distractions to prevent detailed evaluation of a patient.	3.47 ± 1.20	0.325	0.237

Table 1: The relationship between residency experience and their success (Practice objectives of Case 1 and Case 2)

Cases	Mean±SD	Residency Experience	
Case 3 Pneumothorax		r	p
1. Objectively re-evaluates the patient's data received from another health professional and makes his/her own decision.	4.37 ± 0.81	0.419	0.120
2. Identifies tension pneumothorax and takes action for early stabilization.	3.10 ± 1.53	-0.233	0.403
3. Diagnoses pneumothorax by physical examination and prevents the patient from being sent for untimely/risky investigations.	3.13 ± 1.55	-0.297	0.282
4. Considers the option of bedside USG / suggests bringing the Portable X-Ray device.	2.93 ± 1.50	0.062	0.834
5. Decides on needle decompression at an early stage.	3.33 ± 1.60	-0.159	0.571
6. Performs needle decompression in a timely and successful manner.	3.60 ± 1.39	-0.210	0.452
7. Re-evaluates the patient after needle decompression and reviews the post-procedure status with imaging.	3.50 ± 1.41	-0.242	0.384
8. Audibly declares the need for thoracic tube placement	2.23 ± 1.49	0.152	0.587
9. Performs thoracic surgery consultation.	3.70 ± 1.37	0.045	0.873
11. Conducts forensic inquiries and keeps/ensures that the report is kept.	1.67 ± 1.41	-0.046	0.872
Case 4 Anaphylactic Shock			
1. Intervenes in a more critical situation in a timely manner without waiting for the previous patient to finish.	4.70 ± 0.37	0.417	0.122
2. Goes to the patient's room and recognizes the drug-related reaction at an early stage.	4.73 ± 0.32	0.467	0.079
3. Assesses the patient immediately.	4.73 ± 0.32	0.467	0.079
4. Diagnoses anaphylaxis early with focused anamnesis and PE (pulmonary embolism).	4.33 ± 0.86	0.418	0.121
5. Takes the patient to the intervention room. Administers adrenaline with appropriate dose and method in the early period.	3.90 ± 1.23	0.411	0.128
6. Provides anaphylaxis management with a correct algorithm.	3.83 ± 1.06	0.465	0.081
7. Re-evaluates the patient after stabilization.	4.20 ± 0.82	0.282	0.309
8. Provides the necessary information to the patient by exhibiting a professional attitude that protects the team despite the patient's accusatory attitude towards the nurse after stabilization.	4.07 ± 1.25	0.005	0.986

Table 2: The relationship between residency experience and their success (Practice objectives of Case 3 and Case 4)

Cases	Mean±SD	Residency Experience	
Case 5 Acute Coronary Syndrome (ACS)		r	p
1. Takes a focused anamnesis of the patient from the paramedic with correct and necessary questions. (Do not waste time with unnecessary questions.)	4.30 ± 0.90	0.590	0.021
2. Manages the process effectively by making a correct distribution of tasks (distributes tasks to the nurse and practitioner in cardiopulmonary resuscitation management.)	2.57 ± 0.92	-0.030	0.916
3. Applies safe defibrillation correctly and on time. (Appropriate energy is selected by performing rhythm/pulse analysis every two minutes. Care is taken to remove the oxygen source, apply the gel to the appropriate place, not to touch each other and not to touch anyone.)	2.80 ± 1.49	0.043	0.879
5. Conduct the CPR (cardiopulmonary resuscitation) process correctly and effectively. (Apply shockable arrest management in the correct algorithm in line with the above steps)	2.77 ± 1.28	0.310	0.261
6. Instruct cardiac marker and 12 lead ECG when ROSC (return of spontaneous circulation) is achieved.	3.97 ± 1.32	0.451	0.092
7. Be able to diagnose ACS in the early period. (Should not waste time in making the diagnosis by showing focused differential diagnosis skills)	3.90 ± 1.12	0.300	0.278
8. Gives the medication order (dosage and route of administration) to the nurse correctly (1 mg IV adrenaline puff at 3-5 min intervals after 2nd shock, 300 mg (2 ampules) amiodarone IV puff with 20 cc syringe diluted with 5% Dextrose after 3rd shock, 70-100 IU)	3.13 ± 1.03	0.412	0.127
9. Administers CPR and medications at the right time (Adrenaline should not be administered before 2nd shock; amiodarone should not be administered before 3rd shock).	2.97 ± 1.36	0.541	0.037
10. Performs Cardiology consultation after the examination.	4.07 ± 1.33	0.461	0.084
11. Transfers the process to the patient's relatives in a correct and complete manner. (Be an active listener, do not use medical jargon, provide information in a correct environment, and respond satisfactorily to all questions of the patient's relatives)	4.03 ± 0.95	0.558	0.031
12. Do not order tests other than troponin and ECG.	3.13 ± 1.38	0.516	0.049
13. Has accurate and sufficient scientific knowledge about arrest and ACS management (General evaluation of the process)	3.23 ± 1.28	0.494	0.061
14. Ensures that the patient is admitted to the Coronary ICU (intensive care unit) early. (Admits the patient regardless of the nurse saying, "Should we admit the patient before the troponin is out?").	3.70 ± 1.36	0.440	0.101

Table 3: Practice objectives of Case 5 and residents' experience

the simulation-based training. The residents' recognition of the challenges they faced, such as family pressure influencing clinical decisions and the importance of maintaining patient confidentiality, demonstrates the value of experiential learning in raising awareness of ethical and legal considerations in emergency medicine practice. It is possible to provide this learning with simulation-based training [24], [25].

The residents' realization of the importance of meeting ethical and legal requirements, such as obtaining forensic reports and accurately remembering medication doses, reflects the potential of simulation-based training to enhance clinical competencies and address knowledge gaps [26], [27].

The residents' emphasis on the importance of team communication and experience in effective CPR management highlights the significance of teamwork and interprofessional collaboration in emergency medicine practice. These reflections align with the broader discussions on defining teamwork in emergency medicine and the role of simulation in promoting effective team-based care [28], [29].

5. Limitations

Our study has several limitations. Firstly, the study's generalizability may be limited by the specific context and characteristics of the participating emergency medicine residents. The sample size and demographic composition of the residents may not fully represent the diversity of emergency medicine training programs and resident populations. Additionally, the assessment of residents' performance and reflections was based on self-reported data and observations by emergency medicine specialists. Finally, the study's reliance on a single training intervention may limit the exploration of alternative or complementary educational approaches in emergency medicine training. Future research could explore the integration of multi-patient simulation with other educational modalities to optimize the training and development of emergency care providers.

6. Conclusion

In conclusion, the multi-patient simulation-based training program provided valuable insights into the performance of emergency medicine residents in managing diverse and challenging clinical scenarios. The findings underscore the complex nature of emergency medicine practice and the diverse skill set required for effective crisis management. The identification of specific areas for improvement, such as ethical considerations, communication, and clinical decision-making, highlights the value of simulation-based training in addressing knowledge gaps and enhancing clinical competencies. The residents' reflections on their experiences further emphasize the potential of simulation-based training to raise

awareness of ethical, legal, and teamwork considerations in emergency medicine practice. These insights contribute to the ongoing efforts to advance simulation-based education and promote the development of competent and reflective emergency care providers.

Author Contributions

Study Conception: MOA,SA,HG; Study Design: MOA,CO,SEA; Supervision: MOA,SYI,CO; Funding: N/A; Materials: MOA,MB; Data Collection and/or Processing: MOA,SEA; Statistical Analysis and/or Data Interpretation: GO; Literature Review: MOA,SYI; Manuscript Preparation: MOA and Critical Review: CO,SYI

Ethical Approval

This study was approved by Bursa Uludağ University Clinical Research Ethics Committee (Date: 11.20.2019, Decision no. 2019-19/27).

Conflict of interest

The authors declare no conflict of interests. All authors read and approved final version of the paper.

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