



St. Paul Hospital Millennium Medical College

Post Graduate Study Program

Effectiveness of simulation-based training in improving critical decision making and procedural skills among emergency and critical care medicine residents at St. Paul Hospital Millennium Medical College.

A mixed method study

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**A Thesis submitted to the Department of Emergency and Critical Medicine;
Presented in Partial fulfillment of the Requirements for the Degree of
Emergency Medicine and Critical Care at St. Paul Hospital Millennium
Medical College.**

Addis Ababa, Ethiopia

November, 2025

Academic Thesis Submission Guide

Name of investigator	Dr. Fasil Taye (ECCM Resident)
Full title of the research project	Effectiveness of simulation-based training in improving critical decision making and procedural skills among ECCM residents at SPHMMC.
Duration of the project	6months(April 1 to September 30, 2025)
Study Area	St. Paul Hospital Millennium Medical College
Total Cost of the project	38,550ETB
Source(s) of Funding	St. Paul Hospital Millennium Medical College Finance
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ACKNOWLEDGEMENT

First and foremost, I would like to express my deepest gratitude to my advisors Dr. Yemane G. and Dr. Melaku E. for their unreserved guidance and support throughout this thesis work. Next, I would like to thank St. Paul Hospital Millennium Medical College Post Graduate Study Program for providing me the chance for doing this thesis.

ACRONYMS AND ABBREVIATIONS

ECCM	Emergency and Critical Care Medicine
SBT	Simulation-Based Training
SPHMMC	Saint Paul's Millennium Medical College
SPSS	Statistical Package for Social Sciences

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ABSTRACT

Background: Simulation-based training is a relatively new instructional method in the medical education of low-income countries due to too much patient flow and shortages health-care personnel. A little is known about its effectiveness particularly among emergency and critical care medicine (ECCM) residents.

Objective: To assess the effectiveness of simulation-based training in improving critical decision making and procedural skills among ECCM residents at St. Paul Hospital Millennium Medical College, 2025, Ethiopia.

Methods: A mixed-methods study was conducted from April to September, 2025. All 1st to 3rd year emergency and critical care medicine residents were included for the quantitative and three respondents were selected purposively for the qualitative data. Data were collected using a self-administered and interviews questions for quantitative and qualitative parts respectively. Descriptive statistics were used and the data was presented using percentages and frequencies for the quantitative part. Thematic analysis was employed for the qualitative data. Finally, the results obtained from both the quantitative and qualitative data were triangulated.

Result: A total of 51 ECCM residents participated in the study. The study evaluated the effectiveness of simulation-based training (SBT) based on clinical decision-making, procedural, and non-technical skills domains. Following simulation-based training, 76.5% [95% CI: (62.79, 88.19)] of ECCM residents demonstrated high overall competency. Specifically, 60.8% showed improvement in clinical decision-making, 64.7% in procedural skills, and 86.3% in non-technical skills.

Conclusion and Recommendations: This study evaluated the effectiveness of SBT based on three domains. The result revealed respondents demonstrated relatively higher level of competency in the non-technical followed by procedural skill, and critical decision making skills. Integrating simulation learning in the current curriculum and applying it effectively would improve professional skills of the trainee. For future researchers, longitudinal studies involving randomized control trials would provide a better and strong evidences on simulation-based learning.

Key words: simulation based training, critical decision making skills, Procedural skills, and emergency medicine.

1. INTRODUCTION

1.1. Background

Simulation-based training (SBT) or learning refers to a way in which a real-work environment scenarios are replicated in a simulated environment that is intended for the purpose of having an excellent practical assessment and management skills [1, 2]. In the context of emergency and critical care medicine (ECCM), simulated- based training involves simulated clinical cases that helps ECCM personnel to develop their practical skills in a safe, controlled and well-organized environment that further enhances emergency preparedness [1].

SBT can be provided through various methods, including standardized patients, role-playing, human patient simulator (low-, medium-, and high-fidelity manikins), skill stations, and computer-based critical thinking simulations [3]. For ECCM training, high fidelity manikins are frequently utilized that involves procedural trainings like intubation, chest-tube drainage, and other important clinical skills [1, 4]. SBT is not only involves the technical skills needed by the clinician but also the non-technical ones that are integral for providing a safe and quality cares for patients and families [5].

Inadequate clinical knowledge, skills, and experience are associated with poor patient outcomes in all disciplines including ECCM [6]. A less effective SBT has a negative impact on ECCM professionals, patients, and their families. For ECCM professionals, poor SBT is related to inadequate knowledge and poor practical skills, poor critical thinking and decision-making skills, poor confidence, and increased errors in real work environments. A negative impact on health-care professionals is directly related to poor patient outcomes such as increased mortality and morbidity. It is also related to increased anxiety, decreased trust, and negative experience for families [7-9]. This study will show effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at St. Paul Hospital Millennium Medical College.

1.2.Statement of the Problem

SBT is becoming common in all disciplines particularly in emergency department and it has brought a paradigm shift through improving the overall clinical competency [10]. It is relatively new instructional methods in the medical education of low-income countries due to too much patient flow and shortages of health-care personnel [10].

There are limited findings on the effectiveness of SBT on ECCM, but there are few studies in other disciplines like nursing and midwifery that focus on the effect of SBT on practical and decision making skills. A study conducted in Australia on the effectiveness of simulation in nursing students revealed that SBT has an impact on the overall competencies of the students [11]. In Ethiopia, there are limited studies on the effectiveness of SBT, particularly on ECCM. A study conducted in the five public universities of Ethiopia revealed that, SBT was effective on the overall students' clinical performance [12]. A study conducted among undergraduate anesthesia students of Gondar and Mekelle universities indicated that there is improvement on the overall skill and competency after provision of simulation-based education [13, 14].

In Ethiopia, while SBT is increasingly incorporated into residency training programs, its effectiveness in enhancing specific skills, such as critical decision-making and procedural skills, is unknown. As far as the researcher's effort, there is no study in Ethiopia particularly in the current study area that focuses on the effectiveness of SBT on the critical decision making and procedural skills. The other limitation or gap in this issue is there are no tools to measure the effectiveness of SBT in terms of critical care decision making and procedural skills both quantitatively and qualitatively particularly for ECCM professionals. Therefore, the main aim of this study was assess the effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at St. Paul Hospital Millennium Medical College (SPHMMC).

1.3. Significance of the study

The primary aim of this study was to determine the effectiveness of SBT in improving critical decision making and procedural skills among ECCM residents at St. Paul Hospital Millennium Medical College (SPHMMC). The study's findings will provide useful information to various stakeholders such as emergency department teams including ECCM department and hospital managers for establishing effective SBT strategies to improve patient outcomes.

For policymakers, the study will support to design SBT strategies that enhance better knowledge, skills, and decision making capacities of ECCM residents. The findings of this study will also provide frameworks for researchers to further investigate the effectiveness of SBT on the overall physicians' skills.

2. LITERATURE REVIEW

2.1. Effectiveness of SBT on Critical decision making

Studies showed that SBT improves clinical reasoning and situational awareness, particularly in dynamic environments like emergency and critical care units. A meta-analytic study in Canada indicate that high-fidelity simulations are positively associated with critical decision making and clinical reasoning of students' that further have impacts on patient safety and quality of care [15].

Others studies also showed that SBT is associated with critical decision making skills in which it has a tendency to improve critical decision making capacity of ECCM residents through assessing situations, making rapid and accurate diagnosis and implement appropriate emergency managements. Studies indicated that integrating SBT in learning has a higher tendency to improve the decision making skills of learners when compared to the counter-one [16-19]. Another study also narrated that since SBT improves communication and increases the level of satisfaction in learning and confidences, it has a significant association with critical decision making ability [18, 20].

2.2. Effectiveness of SBT on procedural skills

SBT provides opportunities for healthcare professionals for deliberate practice, allowing them to perform tasks such as a controlled setting with a good clinical skills that leads to a good patient outcomes. A meta-analytic study in USA indicated that that SBT is effective in improving clinical performance, especially for complex procedures [21].

Studies in Cyprus and China also revealed that integrating SBT showed a significant improvements in technical skills of surgical residents and medical trainees [22, 23]. Several studies indicated that SBT is associated with improved clinical skills and a good emergency preparedness among healthcare professionals [22, 24, 25]. A study conducted in Ethiopia indicated that SBT improved students' procedural knowledge and skills [12].

There are different mechanisms suggested by studies in which SBT has a positive impact on the procedural skills of learners. SBT boosts confidence and self-perceives skills in performing complex procedures. Durable skill retention and reduced procedural complications are the results demonstrated through simulation learning that improve the overall quality of patient care [22, 26, 27].

3. OBJECTIVES

3.1.General Objective

To assess the effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at St. Paul Hospital Millennium Medical College, 2025, Ethiopia.

3.2.Specific objectives

- I. To assess the effectiveness of simulation based training in improving critical decision making among ECCM residents at St. Paul Hospital Millennium Medical College, 2025, Ethiopia.
- II. To assess the effectiveness of simulation based training in improving procedural skills among ECCM residents at St. Paul Hospital Millennium Medical College, 2025, Ethiopia.
- III. To explore the experiences of ECCM residents regarding the role of simulation-based training in enhancing their critical decision-making and procedural skills.

4. METHODS AND MATERIALS

4.1.Study Area and Period

The study was conducted at SPHMMC from April 01, 2025 to September 30, 2025. It is one of the largest tertiary teaching Hospital in Ethiopia located in Gulele sub city of Addis Ababa, the capital city of Ethiopia and was established in 1969 G.C. It has the capacity of providing service to an average of 300,000 patients annually. It is one of the biggest tertiary and teaching hospitals in Addis Ababa, giving both undergraduate and different postgraduate programs. It is also the first hospital to provide integrated modular and hybrid problem-based medical curriculum in Ethiopia. It also provides simulation-based learning to medical residents. SPHMMC employs more than 2800 clinical, academic, and administration staffs. As of reports in 2023, more than 400 medical residents are training in the hospital. The ECCM residency program is started as an academic program in 2015 and currently, the hospital is providing training for more than 50 ECCM residents. The emergency OPD serves about 800-1000 patients per month. On the other hand, the ICU has 14 beds and it has about 26 admissions per month [28].

4.2.Study Design

A mixed (quantitative and qualitative) descriptive cross-sectional study design over 06 months was conducted

4.3.Population

4.3.1. Study Population

All 1st to 3rd year ECCM residents.

4.3.2. Study unit

All 1st to 3rd year ECCM residents.

4.4.Eligibility criteria

4.4.1. Inclusion criteria

Residents who have attended at least one SBT session were included.

4.4.2. Exclusion criteria

Those who has never attended any simulation training and those who are unwilling to participate were excluded.

4.5.Sample Size Determination

All EMCC residents from 1st to 3rd year participated in the quantitative portion, while three residents, one from each batch, were selected for qualitative data

4.6.Sampling technique and procedure

For quantitative data, a census was used; all ECCM residents who fulfill the inclusion criteria were included in the study. For qualitative one, three participants were purposively selected from each batch of Emergency and Critical Care Medicine residents for in-depth interviews. Purposive sampling was used to identify participants who had a simulation-based training and could provide rich insights into their experiences. The selection aimed to capture diverse perspectives across batches, ensuring variation in exposure, confidence, and engagement with simulation scenarios. A total of three participants one per batch was considered sufficient for qualitative thematic analysis, as the focus was on exploring depth and meaning rather than statistical generalizability.

4.7.Study variables

Effectiveness of simulation: critical decision making skill domain, procedural skill domain, and non-technical skill domain

Sociodemographic: age, gender, year of residency, and year of clinical experience

4.8.Operational definitions

Overall higher perceived effective: Based on the scores of each item and bloom's taxonomy, when an ECCM professional scores greater than or equal to 80% (≥ 36) from all domains, the SBT were regarded as higher perceived effective. For each domain, higher perceived effectiveness was considered when ECCM professional scores greater than or equal to 80% (≥ 17 for critical decision making skills, ≥ 12 for technical or procedural skills, and ≥ 7 for non-technical skill domains).[29, 30].

Lower perceived effective: when the score is below 80% (< 36), the SBT were regarded as lower perceived effective [29, 30].

4.9.Data collection tools and procedures

Data were collected using a self-administered questionnaire that has been developed from previous studies. It has three parts including the socio-demographic and simulation effectiveness measurement for quantitative data and interview for qualitative data. SET-M tool was used to measure effectiveness to SBT. The tool originally had four domains namely pre-briefing, learning,

trust, and debriefing because the original tool doesn't directly measure the effectiveness of SBT among ECCM residents and it mainly focuses on the aspects of the simulation process. However, it was modified to the context of the current study into three domains including critical decision making skills, procedural skills, and non-technical skills each containing seven (7), five (5), and three (3) items respectively and each item has a score ranging from one (1) to three (3). Based on the scores of each item and bloom's taxonomy, when an ECCM professional scores of greater than or equal to 80% (≥ 36), the SBT were regarded as higher perceived effective. Whereas, when the score is below 80% (< 36), it was regarded as lower perceived effective. The tool was adapted from previous studies and modified to the context of this study. For each domain, higher perceived effectiveness was considered when ECCM professional scores greater than or equal to 80% (≥ 17 for critical decision making skills, ≥ 12 for technical or procedural skills, and ≥ 7 for non-technical skill domains). After calculating total or domain-specific scores, Bloom's taxonomy was applied indirectly to determine the threshold at which performance reflects higher-order competency. [29, 30].

4.10. Data Quality control

The questionnaire was adapted from previous literatures & modified in to our context. It was prepared first in English and it was translated into Amharic, and then retranslated back to English by an expert who is fluent in both languages to maintain its consistency. Training was given for data collectors and supervisor. A Pre-test was done before the actual data collection at Black Lion Specialized hospital and any ambiguity or unclear issues were modified accordingly. Double data entry was employed involving two respondents at the same time to minimize data entry errors including typing errors and missing values. Data collection process was strictly followed day to day by the supervisor and principal investigators.

4.11. Data processing and Analysis

Questionnaire was checked for completeness, coding, and entered in to Epi-info 7.2 & exported to SPSS-26 for analysis. For quantitative data, descriptive statistics was used and the data were presented using percentages and frequencies. For the qualitative one, the recorded data were transcribed into word, imported into NVivo-15 qualitative data analysis software. NVivo- was used for coding the transcripts, organize data, and group related codes into themes and thematic (theme-one, two, and three consists of 6, 4, and 6 codes respectively) analysis done. The results obtained from quantitative and qualitative data were triangulated and discussed in detail.

4.12. Ethical consideration

Ethical clearance (reference number Pm23/103) was obtained from the ethical review board of St. Paul Hospital Millennium Medical College and permission letter was obtained from St. Paul Hospital Millennium Medical College. Each study participant was adequately informed of the necessary information about the research; the right to withdraw at any time during the interview, the importance of their participation in this research, and confidentiality was maintained, and also, they were informed about the information collected used solely for the purposes of this study. Finally, written and verbal consent was obtained before data collection from each participant.

5. RESULT

5.1.Sociodemographic characteristics

A total of 51(all ECCM residents) are participated in the study with a 100% response rate. Majority of the study participants were male 41(80.4%) and most of the residents (94.1%) were in the age group of 25-34 with a mean age of 30.25 years and a standard deviation of ± 3.045 years. Regarding the academic year, most of the residents (45.1%) were first year and 31.4% were in their third year residency program. Concerning their clinical experience as a physician, more than half (54.9%) had less than five years of experience. Regarding simulation-based training, most of the respondents (82.3%) reported that it was provided sometimes and 13.7% stated it was never given.

Table 1: Sociodemographic characteristics to assess the effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at Saint Paul's Millennium Medical College, 2025, Ethiopia

Variables	Category	n (%)
Age	25-34	48 (94.1)
	≥ 35	3 (5.9)
Gender	Male	41 (80.4)
	Female	10(19.6)
Academic year	1 st	23 (45.1)
	2 nd	12 (23.5)
	3 rd	16 (31.4)
Year of clinical experience as a physician	< 5 years	28(54.9)
	≥ 5 years	23(45.1)
How often simulation-based training is given in your in your clinical attachment	Always	1 (2.0)
	Often	1 (2.0)
	Sometimes	42 (82.3)
	Never	7 (13.7)

Note: n-frequency, %-percentage]

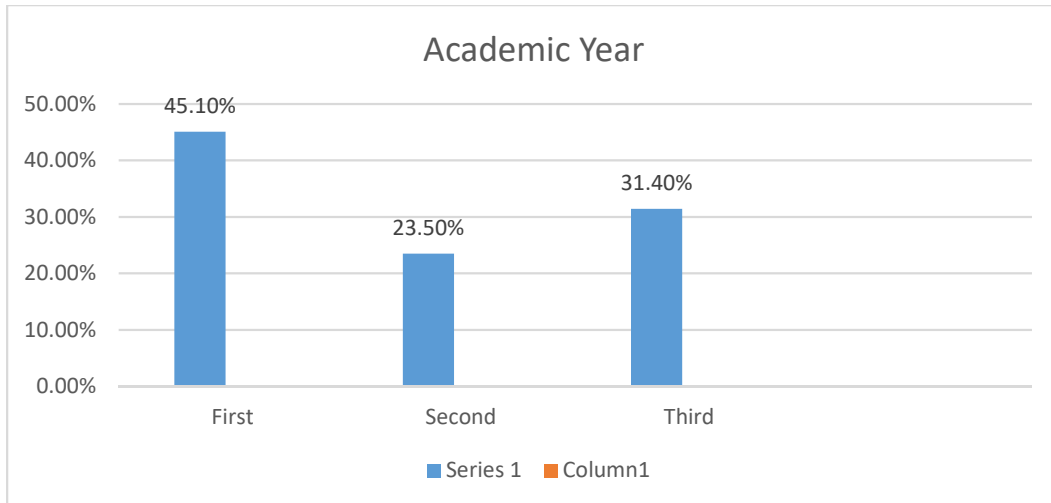


Figure 1: Distribution of academic residency year to assess the effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at Saint Paul's Millennium Medical College, 2025, Ethiopia

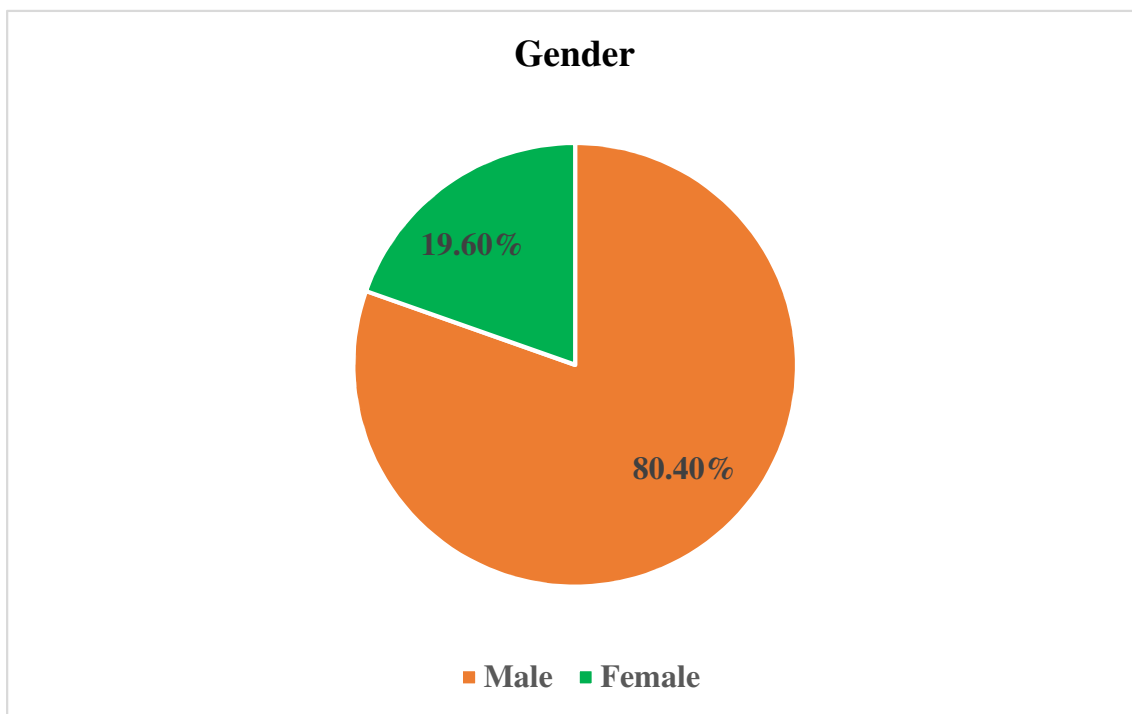


Figure 2: Gender distribution to assess the effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at Saint Paul's Millennium Medical College, 2025, Ethiopia

5.2.Simulation based training

The study evaluated the simulation-based training across three domains. Overall 76.5% [95% CI: (62.79, 88.19)] of the participants demonstrated high competency with a mean score of 38.14 ± 4.32 and the remaining 23.5% scored in the lower competency category. Across domains, 60.8% of residents showed improvement in critical decision making, 64.7% in the procedural skills, and 86.3% in non-technical skills. Nearly half (49%) of the respondents strongly agreed that simulation improved their ability to recognize and responds to changes in patient conditions. Additionally, 60.8% strongly agreed that the training increased their confidence in performing interventions. 56.9% reported improved understanding of emergency medications. Furthermore, 54.9% reported better ability to think critically.

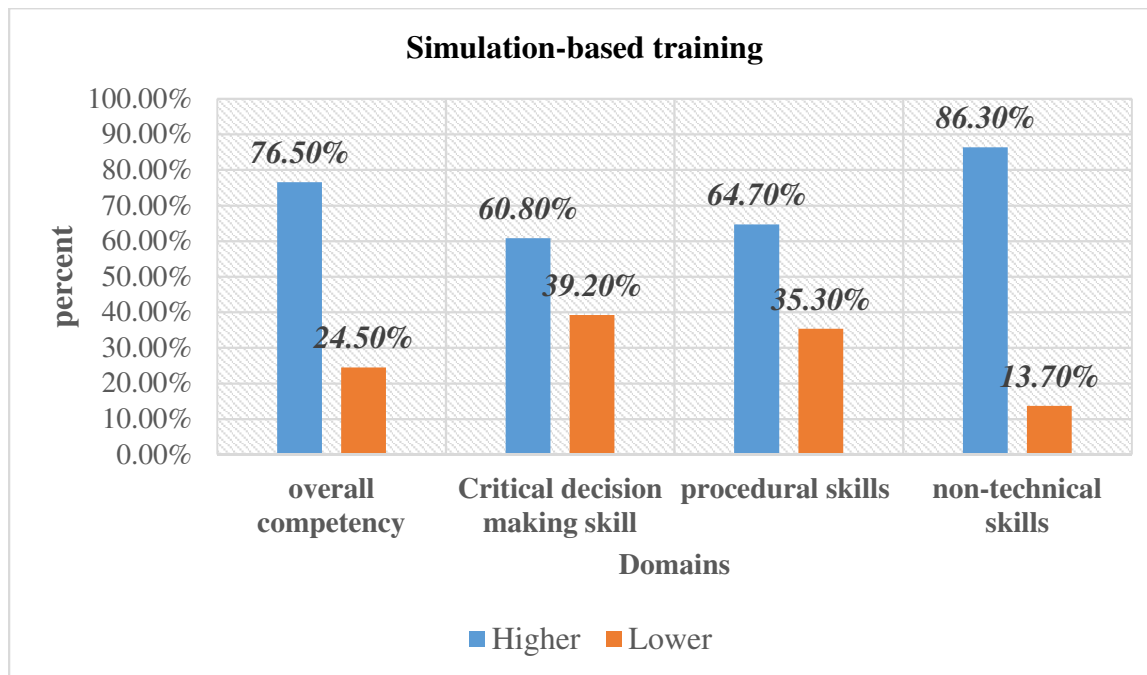


Figure 3: Level of overall, critical decision making, procedural skills, and non-technical skills competency among ECCM residents at Saint Paul’s Millennium Medical College, 2025, Ethiopia

5.2.1. Theme-1: Improving Critical Decision Making skills

Participants explained SBT helped them to shift from theoretical reasoning to more critical, practical decision making. They underlined improvement in prioritization and adaptability during emergency situations. R1 stated: “Simulation training fundamentally shifted my approach from a theoretical, “textbook” mindset to a more practical and resilient one. Before, I would think through a problem sequentially. Now, I have a much better ability to maintain situational awareness under

pressure. I've learned to quickly prioritize the most critical actions, delegate tasks effectively, and mentally run through "if-then" scenarios in real-time. It's less about memorizing a single right answer and more about being able to adapt dynamically when a situation changes, which it often does in a real emergency."

Furthermore, simulation also improved their knowledge and confidence in real life scenarios and high pressure emergency situations. As stated by R2: *"Simulation trainings provide knowledge and skill which helps us to be confident enough to face real life scenarios and to make life saving decisions. Unlike real life scenarios simulation trainings do have time freedom which helps us to develop our skills through repeated exercises and helps us to learn decision making."* R3 mentioned: *"Simulation training helps to discuss systematically in high pressure emergency environment. This approach changes to closed loop leadership and fellowship."*

5.2.2. Theme-2: Improving practical or procedural skills and non-technical skills

The study demonstrated that 64.7% of the participants had a higher overall competency in the procedural skill domain. Several indicators supported this improvement. More than half (56.9%) strongly agreed that they were confident in providing emergency interventions that foster patient safety, and 51% reported strong confidence in applying evidence-based practice in patient care. In addition, 60.8% strongly agreed that they gained a better understanding of procedural techniques, while 43.1% felt more confident in performing emergency assessment skills. Repetition in simulation also contributed to skill acquisition, with 49% strongly agreeing that repeated practice increased their competence.

Regarding non-technical skills, the majority (86.3%) of residents demonstrated higher overall competency. Nearly two-thirds (66.7%) strongly agreed that they were confident in teaching patients about their illness and interventions, and about three-fourths (76.5%) strongly agreed that they were more confident communicating with patients.

Study participants emphasized that SBT is vital in enhancing their practical and procedural skills. They also stated that simulation training improved non-technical skills like patient teaching and communication. As one the respondents noted: *"The training was invaluable for building muscle memory and confidence in key procedures. Furthermore, getting immediate feedback errors—*

like a minor break in sterile technique or a missed communication checkpoint—ingrained a much higher standard of practice that I now carry with me consistently.”

Additionally, they reported that repeated practice and immediate feedback from their mentor helped them embody the techniques and preserve high standard practice. As stated by respondents: *“Practice makes perfect simulation trainings do provide time to develop practice and procedural skill which helps us to develop confidence to face real life scenarios.” “Simulation training: significantly improve procedural skills by providing a safe, controlled, and repeatable environment for practice.”*

Table 2: Level of competency to assess the effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at Saint Paul’s Millennium Medical College, 2025, Ethiopia

Critical decision making domain			
Variables	Responses		
	SA n (%)	SWA n (%)	DA n (%)
I am better prepared to respond to changes in my patient’s condition.	25(49.0)	26(51.0)	0
I am more confident in my ability to prioritize care and interventions	31(60.8)	20(39.2)	0
I developed a better understanding of emergency medications	29(56.9)	22 (43.1)	0
I felt empowered to make clinical decisions.	27(52.9)	24(47.1)	0
I had the opportunity to practice my clinical decision making skills.	26(51.0)	24(47.1)	1(2.0)
I am confident in making real-time decisions under pressure	17(33.3)	34(66.7)	0
Simulation scenarios improve my ability to think critically	28(54.9)	21(41.2)	2(3.9)
Overall competency in critical decision making skill	Higher	31 (60.8)	
	Lower	20 (39.2)	
Procedural skills domain			
I am more confident of my emergency assessment skills.	22(43.1)	29(56.9)	0
I am more confident in using evidence based practice to provide patient care	26(51.0)	25(49.0)	0
I am more confident in providing emergency interventions that foster patient safety	29(56.9)	22(43.1)	0
I developed a better understanding of the techniques	31(60.8)	20(39.2)	0

Repetition in simulation increased my competence	25(49.0)	19(37.3)	7(13.7)
Overall competency in procedural skill	Higher	33 (64.7)	
	Lower	18(35.3)	
Non-technical skills domain			
I am more confident in my ability to teach patients about their illness and interventions.	34(66.7)	17(33.3)	0
I am more confident in my ability to report information and consult to health care team.	36(70.6)	15(29.4)	0
I am more confident in communicating with my patient.	39(76.5)	12(23.5)	0
Overall competency in non-technical skill	Higher	44 (86.3)	
	Lower	7 (13.7)	
Overall competency	Higher	39 (76.5)	
	Lower	12 (23.5)	

Note: n-frequency, %-percentage, SA-strongly Agree, SWA, Somewhat Agree, DA-Disagree

5.2.3. Theme-3: Realism and challenges in challenges in transforming simulation skills to the real emergency situations

This study also tried to explore what aspects of simulation made respondents feel that they were in a real practical environment. Participants stressed that the sense of realism in simulation exercises was a big part of what made them learn well. They described how both the physical fidelity (use of real or realistic equipment) and psychological fidelity (emotional and cognitive engagement) enhanced authenticity and immersion during practice. One of the participants explained: *“One of the aspects of simulation that made interactions and practices feel authentic was the physical fidelity which is using the actual equipment. The psychological fidelity is another aspect that is related to the realism of the simulations in which the ‘patients’ or other role-players acted stressed and unpredictable, and the facilitators introduced unexpected complications. This created genuine stress and a sense of urgency that forced me too emotionally and mentally engage as if it were real.”* Another participants noted that: *“It's scientific background and practicalities in real environment make it realistic.”*

Furthermore, this study tried to explore the presence of challenges in transforming simulation skills to the real emergency situations both in critical decision making and procedural skills. The respondents reported that: *“The human physiology by itself is a great challenge when you try to implement procedural and practical skills that you’ve developed from simulation trainings.”* Another participant listed on multiple factors influencing this gap: *“The key challenges are the*

physiological response in a real event is more intense. Resource limitations: real-world settings might not have the exact tool or medication immediately at hand, requiring on-the-fly adaptation. Team dynamics: working with a brand-new, ad-hoc team under real pressure tests communication and leadership skills in a way that is hard to fully simulate.” “Conceptual complexity, unclear leadership, and equipment unavailability are also challenges in transforming simulation skills to the real emergency situations” as described by one of the respondents.

Table 3: Qualitative result showing improvement in critical decision making and practical/procedural skills development and realism and Challenges of Simulation to assess the effectiveness of simulation based training in improving critical decision making and procedural skills among ECCM residents at Saint Paul’s Millennium Medical College, 2025, Ethiopia

Themes	Codes	Illustrative Quote	Participant
Changes in critical decision making skill	Shift from theoretical to practical mindset	“Simulation training fundamentally shifted my approach from a theoretical, ‘textbook’ mindset to a more practical and resilient one...	P1
	Situational awareness	“...I have a much better ability to maintain situational awareness under pressure.”	P1
	Prioritization of critical actions	“...I’ve learned to quickly prioritize the most critical actions.”	P1
	Delegation and teamwork	“...delegate tasks effectively...”	P1
	Confidence in life-saving decisions	“Simulation trainings provide knowledge and skill which helps us to be confident enough to face real life scenarios and to make life saving decisions.”	P2

	Systematic discussion under pressure	“Simulation training helps to discuss systematically in high pressure emergency environment.”	P3
Practical/Procedural Skills Development	Muscle memory	“The training was invaluable for building muscle memory and confidence in key procedures.”	P1
	Learning from feedback/errors	“...getting immediate feedback errors... ingrained a much higher standard of practice.”	P1
	Repeated practice	“Practice makes perfect... simulation trainings do provide time to develop practice and procedural skill...”	P2
	Safe, controlled, repeatable environment	“Simulation training significantly improve procedural skills by providing a safe, controlled, and repeatable environment for practice.”	P3
Realism and Challenges of Simulation	Physical fidelity	“The physical fidelity was high... using the actual equipment or very realistic replicas made interactions feel authentic.”	P1
	Psychological fidelity / stress	“...role-players acted stressed and unpredictable... created genuine stress and a sense of urgency.”	P1
	Challenge of human physiology	“The human physiology by itself is a great challenge when	P2

		you try to implement procedural and practical skills.”	
	Conceptual complexity	“Conceptual complexity... are challenges for transforming simulation skills to real emergency situations.”	P3
	Equipment unavailability / resource limitation	“...Real-world settings might not have the exact tool or medication immediately at hand, requiring on-the-fly adaptation.” P1, P3	P1, P3
	Team dynamics / leadership	“...working with a brand-new, ad-hoc team under real pressure tests communication and leadership skills...” P1, P3	P1, P3

6. DISCUSSION

This study evaluated the effectiveness of simulation-based training (SBT) across three competency domains: clinical decision-making, procedural skills, and non-technical skills. It also explored participants' perceptions of realism and the challenges they faced when transferring simulation-acquired abilities into real clinical settings. Overall, 76.5% of residents demonstrated improved competency following SBT, highlighting its strong educational value in strengthening both technical and cognitive skills among ECCM trainees.

A notable proportion of residents (60.8%) demonstrated higher competency in the critical decision-making domain. Several specific indicators support this finding: 60.8% strongly agreed they felt more confident in their ability to prioritize care, 56.9% reported a better understanding of emergency medications, and 54.9% strongly agreed that simulation improved their ability to think critically. In addition, nearly half (49.0%) reported feeling better prepared to respond to changes in patient condition, and 51.0% strongly agreed they had opportunities to practice clinical decision-making skills during simulation. Although only 33.3% strongly agreed they were confident making real-time decisions under pressure (with 66.7% somewhat agreeing), the combined strong and somewhat agree responses indicate a meaningful gain in trainees' situational awareness and clinical reasoning. These quantitative results were reinforced by qualitative accounts in which participants described how scenarios prompted prioritization, rapid reassessment, and dynamic decision processes. This pattern aligns with previous reports that immersive simulation supports critical thinking and clinical reasoning by exposing learners to realistic complex scenarios [31 - 33].

The procedural domain showed clear improvement, with 64.7% of residents classified as having higher overall competency. Item-level results indicate that simulation strengthened several aspects of hands-on practice: 60.8% strongly agreed they developed a better understanding of procedural techniques, 56.9% strongly agreed they felt more confident in providing emergency interventions

that foster patient safety, and 51.0% strongly agreed they were more confident using evidence-based practice to inform patient care. Repetition and immediate feedback also played an important role: 49.0% strongly agreed that repetition in simulation increased their competence, while many respondents reported that real-time feedback improved technical proficiency. These findings are consistent with literature suggesting that deliberate practice and guided feedback in high-fidelity simulation accelerate procedural skill acquisition and preserve patient safety during learning [22, 26, 34, 35].

SBT was also shown to enhance non-technical skills such as communication, teamwork, and patient education as mentioned by both the quantitative and the qualitative data. This domain has the highest overall gain where 86.3% of participants achieved higher competency. Most participants strongly agreed that SBT improved their communication and teaching abilities — 76.5% strongly agreed they were more confident communicating with patients and 66.7% strongly agreed they were more confident teaching patients about their illness and interventions. Furthermore, 70.6% strongly agreed they were more confident in reporting information and consulting with the health care team. Qualitative data supported these quantitative results: trainees emphasized that simulation provided safe opportunities for feedback, reflection, and practice of teamwork and communication, which promoted behavioral change and enhanced collaborative problem solving. These improvements in non-technical skills mirror findings from other contexts where simulation has been shown to foster leadership, empathy, and interdisciplinary communication.

Participants consistently highlighted realism (both physical fidelity and psychological immersion) as a key factor driving engagement and learning. Scenarios that approximated the stress, unpredictability, and urgency of real emergencies promoted experiential learning and emotional engagement, which participants described as essential to encoding cognitive and procedural responses. Immediate, structured feedback during debriefing and repeated practice were repeatedly cited as mechanisms that consolidated skills and built “muscle memory.” At the same time, respondents identified barriers to transferring simulation learning to real clinical practice, including the unpredictability of real patient physiology, limited resources in actual clinical settings, and variable team composition and dynamics. These contextual differences likely explain

why gains observed in simulation do not always translate seamlessly to practice and echo prior work documenting environmental and organizational barriers to full transfer of learned skills [37].

By presenting matched quantitative and qualitative data, this study demonstrates that SBT not only improves measurable competencies across cognitive, technical, and non-technical domains but also provides insight into how and why those gains occur. The particularly strong impact on non-technical skills suggests that simulation is an effective platform for developing communication, teamwork, and teaching behaviors that are difficult to train in routine clinical exposure. For training programs, these results support integrating regular, scenario-based simulation with deliberate practice cycles and structured debriefing to reinforce both procedural and interpersonal competencies.

7. LIMITATIONS OF THE STUDY

. This study did not examine factors associated with the effectiveness of simulation-based learning. It relied primarily on self-reported measures of confidence and perceived competency, which may not accurately reflect actual performance. Contextual factors specific to the study setting—such as resource availability, instructor expertise, and local case mix—may also limit the generalizability of the findings. Although the qualitative data provided valuable insights into learners’ perceptions, it could not quantify the extent to which skills acquired in simulation translated into improved patient outcomes. Additionally, pre- and post-training competency assessments were not conducted due to budgetary and logistical constraints, as well as the absence of a validated assessment tool. The study is also susceptible to social desirability bias. The relatively small sample size prevented the examination of associations between variables, and because the study included only ECCM residents, the results may not be generalizable to other residency programs or broader medical and health sciences education contexts.

8. CONCLUSION

This study assessed the effectiveness of simulation-based training in improving critical decision-making, procedural, and non-technical skills among ECCM residents. The findings showed that the majority of residents (76.5%) demonstrated higher overall competency after SBT. Improvements were noted in all domains, with the highest gains in non-technical skills (86.3%), followed by procedural (64.7%) and critical decision-making skills (60.8%).

Participants reported that realism, repeated practice, and immediate feedback contributed to their learning, while challenges such as limited resources, varying team dynamics, and the unpredictability of real patient physiology affected the transfer of skills to real settings.

Overall, the study indicates that SBT is a valuable educational approach that enhances residents' readiness for emergency and critical care practice.

9. RECOMMENDATIONS

9.1 Recommendations for Teaching Institutions

1. Integrate SBT into the formal ECCM curriculum with clear learning objectives aligned to clinical competencies.
2. Increase the frequency and consistency of simulation sessions, ensuring that all residents have adequate exposure across residency levels.
3. Strengthen high-fidelity simulation environments by ensuring availability of appropriate equipment, realistic scenarios, and structured debriefings.
4. Adopt standardized simulation frameworks (e.g., SET-M, Bloom's taxonomy) to guide training, assessment, and evaluation.
5. Incorporate interprofessional simulations to enhance teamwork and collaborative communication among ECCM, nursing, anesthesia, and ICU staff.

9.2 Recommendations for Hospital and Program Leadership

1. Allocate adequate resources (equipment, space, trainers, and time) to sustain and expand simulation-based learning.
2. Create a protected simulation schedule that does not conflict with clinical duties, ensuring consistent participation.
3. Promote a culture of patient safety by encouraging the use of simulation for practicing rare, high-risk, and time-sensitive procedures.
4. Implement periodic assessments to monitor residents' progression and identify areas requiring targeted simulation reinforcement.

9.3 Recommendations for Future Researchers

1. Conduct longitudinal studies to assess long-term skill retention and real clinical performance after simulation training.
2. Use pre- and post-intervention evaluations to measure the direct impact of SBT on competency improvement.
3. Employ randomized controlled trials to generate stronger evidence on the effectiveness of simulation-based learning.

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11.ANNEXES

11.1. Annex-1: Information sheet and consent form

General Information and Request for Participation

My name is Dr. Fasil Taye (ECCM, resident). I am ECCM resident in St. Paul Hospital Millennium Medical College. I am doing a research on effectiveness of simulation based training in improving critical decision making and procedural skills. I would like to get your permission for participating in this study as a study participant.

Your participation is voluntary and no any fee charged for you. You don't have to answer any particular question if you prefer not to respond. Everything you respond will be kept confidential. I want to assure you that your participation in the study will not affect you and your institution. Your name will not be used in any report, but your ideas and suggestions will help me to attain my objective.

General instructions

- No need of writing your name
- ✓ In all cases where answer **options** are available, please **circle** your option in the box provided
- For **blank spaces** provided **write your answer** over there.
- For **order** typed questions please tick (✓) preferred level of agreement in column.

Thanks you in advance for your honest cooperation

Dr. Fasil Taye

Cell phone: 0989209167, E-mail: fasil.taye@sphmmc.edu.et

Consent form

My name is Dr. Fasil Taye (ECCM, resident). I am ECCM resident in St. Paul Hospital Millennium Medical College. I am doing a research on effectiveness of simulation based training in improving critical decision making and procedural skills. You are randomly selected to participate in this study, because your response is vital. Your name will not be written on this form. Any of the information you provided will be kept confidential by using code numbers and used only for the research purpose. There are no potential risks that may cause any harm on participants who are involved in this study. Your participation is only based on your willingness to participate and no direct benefit by participating in this study. Filling this questionnaire will not take more than 10 minutes. I would like to appreciate your voluntary participation and honestly response for each question.

For more information you can contact:

Name: Dr. Fasil Taye

Telephone: 0989209167

E-mail: fasil.taye@sphmmc.edu.et

Based on the above information, are you volunteer to participate?

A) Yes

B) No

If yes, Signature: _____ Date _____

11.2. Annex-II: Questionnaire

Please read the instructions carefully before every question and provide your response

appropriately.

Part-I: Socio-demographic characteristics

No	Questions	Response
1	Age	
2	Gender	Male Female
3	Year	1 st 2 nd 3 rd
4	Year of clinical experience as a physician	-----
5	How often simulation-based training is given in your in your clinical attachment	Always Often Sometimes Never

Part-II: Simulation effectiveness measurement

Please encircle the most appropriate answer you think of for the following Likert-scale questions.

3=strongly agree, 2=somewhat agree, and 1 disagree)

Critical decision making domain			
	ST.A	SW. A	D.A
I am better prepared to respond to changes in my patient's condition.	3	2	1
I am more confident in my ability to prioritize care and interventions	3	2	1
I developed a better understanding of emergency medications	3	2	1
I felt empowered to make clinical decisions.	3	2	1
I had the opportunity to practice my clinical decision making skills.	3	2	1
I am confident in making real-time decisions under pressure	3	2	1
Simulation scenarios improve my ability to think critically	3	2	1
Procedural skills domain			
I am more confident of my emergency assessment skills.	3	2	1
I am more confident in using evidence---based practice to provide patient care	3	2	1

I am more confident in providing emergency interventions that foster patient safety.	3	2	1
I developed a better understanding of the techniques	3	2	1
Repetition in simulation increased my competence	3	2	1
Non-technical skills domain			
I am more confident in my ability to teach patients about their illness and interventions.	3	2	1
I am more confident in my ability to report information and consult to health care team.	3	2	1
I am more confident in communicating with my patient.	3	2	1

Part-III: FGD or interview guide for qualitative part

1. How did simulation training change your approach to emergency decision making?
2. How did simulation training help you to have a good practical/procedural skill?
3. What aspects of simulation felt more realistic?
4. Were there any challenges in transforming simulation skills to the real emergency situations both in critical decision making and procedural skills (emergency interventions)?
What were they?