

Structured simulation-based education in emergency medicine residency programs: Pavia's proposal for competence development and crisis management (Italy)

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Abstract

The growing complexity of Emergency Medicine (EM) - due to overcrowding, boarding, and the expanding social role of emergency departments - requires standardized and structured training

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models. Simulation in medicine is essential for education, training, and improving patient care. Italian EM residency programs face additional challenges, including variable training quality and limited access to simulation-based education. To address these issues, the University of Pavia has developed a five-year simulation curriculum integrated into its EM residency program. This study presents this model and evaluates its alignment with national and European standards. A descriptive comparative analysis was conducted by aligning the curriculum's learning objectives and simulation activities with the European Society for Emergency Medicine (EUSEM) Core Curriculum and the guidelines set by the Italian Ministry of Education (MIM), incorporating feedback from national associations. Each competency was classified independently as fully, partially, or not covered. The goal of this model is to standardize training quality, increase preparedness for complex emergencies, and promote a reflective professional culture. The curriculum includes more than 25 simulation sessions each year, progressing from foundational procedural and cognitive skills (Years 1-2: ultrasound, ventilation, suturing, ACLS-like scenarios) to complex interdisciplinary simulations (Years 3-4: trauma, pediatrics, resuscitation), culminating in advanced training covering leadership, ethics, medico-legal aspects and maxi-emergencies (Year 5). Training modalities include high- and low-fidelity simulations, peer-to-peer learning, and 3D-printed skill trainers. Feedback is collected after each session and annually. Facilitators are certified through SIMMED, EEDUSIM, and other accredited programs, and they undergo regular retraining. The curriculum has achieved 95% alignment with European standards and 100% alignment with Italian standards. The only gaps identified are in a few procedures, such as Extracorporeal Membrane Oxygenation and Resuscitative Endovascular Balloon Occlusion of the Aorta. Simulation-based education fills critical gaps in EM training, especially in non-technical skills, procedural readiness, and crisis decision-making. The Pavia model, although developed in a single center, aligns with national and international standards. Its innovative features, such as the use of 3D printing, integration within clinical training, and potential collaboration among different EM residency programs, suggest that it is a scalable proposal for national adoption. Broader implementation could support standardization in EM, make the specialty more attractive, and improve workforce preparedness in Italy.

Introduction

Emergency Medicine (EM) is a vital and dynamic specialty at

the frontline of healthcare. EM is responsible for the immediate evaluation, diagnosis, and management of critically ill and injured patients across all age groups and clinical conditions. Furthermore, EM physicians must coordinate care with other specialists and ensure appropriate patient disposition. This requires a broad base of medical knowledge, rapid and effective decision-making, strong communication skills, and resilience. However, in Italy, EM residency programs are currently facing several challenges due to relatively low enrolment rates. This issue is largely attributable to demanding working conditions, high burnout rates, potential risks of aggression or lawsuits, inadequate compensation, and limited career prospects.¹⁻⁸

In recent years, the role of EM has expanded beyond acute and prehospital care to encompass a wider range of responsibilities. Nowadays, the Emergency Department (ED) often serves as the primary access point for both primary and specialty care, as well as addressing social issues such as homelessness, addiction, and frailty in the ageing population (geriatric EM). This phenomenon, exacerbated by the shortage of primary care specialists,⁹ has led to an increased reliance on emergency services. As a consequence, EDs are experiencing overcrowding, which may compromise the focus on urgent and emergency situations, alongside the issue of patient boarding.¹⁰⁻¹² EM physicians are now managing a larger number of patients per shift, with increased clinical and social complexity, and for longer periods of time due to hospital bed shortages. These pressures have significantly increased the overall complexity of EM practice.

To address this issue, EM requires a robust and standardized educational framework to ensure that aspiring specialists acquire a comprehensive set of technical and soft skills. These skills include not only technical proficiency but also leadership, communication, decision-making under pressure, situational awareness, and Crisis Resource Management (CRM). Simulation-based training has been widely recognized as an effective educational tool in medical training, allowing learners to practice clinical procedures, improve decision-making skills, and enhance teamwork abilities in a risk-free environment. The European Society for Emergency Medicine (EUSEM) has developed a comprehensive curriculum and exam (EBEEM) to standardize EM training across Europe. This approach emphasizes competency-based education that integrates clinical scenarios, procedural training, and interdisciplinary collaboration.^{6,13-17}

In Italy, the EM residency training system suffers from fragmentation, with 36 programs displaying heterogeneity in their structure, clinical rotations, content, and educational strategies. The limited use of simulation training and the uneven adoption of national and European guidelines further aggravate this variability.²⁻⁵ This lack of uniformity may result in irregular skill acquisition among residents and hinder the development of standardized national competencies. Furthermore, the absence of a shared, structured simulation curriculum limits opportunities for residents to train in realistic clinical scenarios, practice CRM, and gain confidence in decision-making in high-stakes scenarios. National and international organizations such as EUSEM, ACEP (American Academy of Emergency Medicine), SIMMED (Italian Society of Simulation in Medicine), and CoSMEU (the Italian Association of Emergency Medicine Residents), highlighted the importance of simulation-based training in developing essential and standardized skills in EM. Literature indicates that residency programs can enhance clinical competence, improve patient safety, and provide a more attractive and effective training pathway for future EM physicians by implementing structured simulation programs.^{2-4,18-22}

The objective of this study is to present and analyze a structured five-year simulation-based curriculum of the University of Pavia's EM Residency Program and to evaluate its compliance with Italian MIM and EUSEM standards. To achieve this, we conducted a comprehensive analysis of the limitations and challenges facing Italian EM residency programs, focusing on curriculum heterogeneity, access to simulation-based training, and variability in residents' skill acquisition. This assessment was based on an extensive literature review of peer-reviewed articles, institutional reports, and position papers from national and international medical organizations. In particular, multiple national surveys conducted by CoSMEU in recent years have highlighted the structural variability across Italian programs, including discrepancies in clinical rotations, educational content, and the use of simulation-based training.²⁻⁵

Materials and Methods

A detailed descriptive analysis was conducted on the structured simulation-based training model developed by the University of Pavia's EM Residency Program. The focus was on how this model integrates into the broader educational pathway. Additionally, the model was compared with Italian and European standards to evaluate its alignment with national and international training expectations, paying particular attention to its integration within the broader educational pathway.

To assess curriculum alignment, a content analysis was performed by mapping the learning objectives and activities included in our program proposal against the Italian and European EM Curricula Competency areas. The competencies included basic and advanced airway management, ultrasound, ECG interpretation, pediatric and obstetric emergencies, trauma care, Advanced Cardiovascular Life Support (ACLS), Extracorporeal Membrane Oxygenation (ECMO), Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA), ethical decision-making, and interdisciplinary teamwork. Each item was independently reviewed by three assessors with expertise in EM and simulation-based education, who classified the content as 'fully covered', 'partially covered', or 'not covered'. Discrepancies in classification were resolved through consensus. A final coverage percentage was calculated by dividing the number of competencies classified as 'fully covered' by the total number of competencies in each framework.

Currently, there is no nationally codified simulation-based curriculum for EM training in Italy. As a result, the 'Italian standard' has been established based on the official EM Training Program document published by the MIM²³ and supplemented by consensus documents from national scientific societies and organizations, such as CoSMEU, ITEMS (Italian Emergency Medicine Schools), AcEMC (Academy of Emergency Medicine and Care), as well as the Italian EM residency programs. This new framework is referred to as the 'MIM extended'. The 'European standards' are based on the EUSEM core curriculum.¹⁴ This educational proposal also includes structured resident feedback, which is systematically collected at the end of each simulation session, practical course (e.g., suturing or airway management), induction week at the program enrollment of the new residents, and annual feedback at the end of each training year. This feedback includes both qualitative comments and suggestions for improvement, which are utilized to continuously refine the curriculum.

Program description

The simulation-based curriculum developed by the University of Pavia is designed as a progressive and integrated educational pathway that enhances both technical and non-technical competencies over a five-year period. It is fully integrated within the broader structure of clinical rotations (Table 1) and theoretical instruction, which allows for the contextual application and reinforcement of newly acquired skills.

Each year of the program is closely integrated with the clinical rotations and is designed around a progressive learning model, detailed as follows.

Year 1: Introduction to foundational procedural skills including point-of-care ultrasound (PoCUS) for lungs and abdomen, electrocardiogram (ECG) interpretation, oxygen therapy, basic airway management, paracentesis, and trauma base principles. The year begins with an Induction Week for newly enrolled freshmen and an early exposure to ED workflows. Peer-to-peer simulations with checklists reinforce practical learning.

Year 2: The focus shifts to more advanced procedures such as central vein access, intraosseous insertion, thoracic drainage, lumbar puncture, procedural sedation, and advanced airway management. Clinical reasoning is emphasized through case studies involving ventilation strategies for respiratory failure (conditions such as Chronic Obstructive Pulmonary Disease - COPD - and asthma), metabolic disturbances, arrhythmias, confusional states, and stroke. Basic echocardiography and diaphragmatic ultrasound are also included in the curriculum.

Year 3: The emphasis is placed on trauma and burn management, pericardiocentesis, and integration of PoCUS in cardiac arrest and shock scenarios. Simulation sessions focus on difficult airway management (e.g., surgical airway), undifferentiated emergency presentations, and communication challenges, such as delivering bad news.

Year 4: The emphasis shifts to complex scenarios involving CRM, procedural sedation in pediatrics, pregnancy-related and prenatal emergencies, and ACLS in special circumstances (e.g.,

hypothermia, drowning). Advanced techniques, such as Extracorporeal Membrane Oxygenation (ECMO), Extracorporeal Cardiopulmonary Resuscitation (ECPR), and Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA), are introduced through dedicated workshops.

Year 5: The final year consolidates clinical, ethical, and leadership competencies through high-fidelity simulations. Residents face complex clinical emergencies, including obstetric and gynecologic emergencies, labor sedation, and integrated damage control management in severe trauma and traumatic cardiac arrest. Training targets leadership, ethical dilemmas, medico-legal issues, end-of-life care, and burnout prevention, as well as system-level crisis management (e.g., maxi-emergencies, traumatic cardiac arrest). This comprehensive approach prepares trainees for real-world complexities, interdisciplinary collaboration, and system-level decision-making.

Preliminary qualitative feedback from residents has been consistently positive, particularly regarding the Induction Week, the Basic Airway and Suturing Course, the Foundational ACLS-like simulations in the first biennium, and the advanced scenarios in the third and fourth years (e.g., trauma management, cardiac arrest, metabolic emergencies). Residents have frequently described these sessions as highly engaging and impactful for both technical and non-technical skill acquisition.

To date, structured feedback has been collected from 53 residents across all five years of the program: 10 from the first year, 6 from the second, 8 from the third, 9 from the fourth, and 20 from the final year. Evaluations from all cohorts consistently reported an “excellent” or equivalent rating, particularly for the Induction Week and core procedural training modules. In addition, the simulation-based program has been described as a strong catalyst for developing a shared professional identity and a sense of belonging within the specialty.

The in-house development of skill trainers using 3D printing, made possible through collaboration with Lab3D4Med, has significantly expanded hands-on learning opportunities in key areas such

Table 1. Clinical rotations, EM training program at University of Pavia.

Clinical rotation description		Months dedicated
Year group	Department	
1 st -2 nd	ED, San Matteo Hospital – Pavia	8
	Internal Medicine or Sub-acute Care Units in Nephrology/Dialysis or Pulmonology – Pavia	2
	Poison Control Center, Maugeri Foundation – Pavia	3
	Trauma Emergency Department – San Matteo Hospital – Pavia	2
	Abdominal Ultrasound – Voghera or Stradella Hospitals	1
	Echocardiography – Maugeri Pavia or Lodi Hospital	1
	Vascular Access Service – Maugeri Pavia	1
	Pediatric ED – San Matteo Hospital – Pavia	1
	Ophthalmology ED – San Matteo Hospital – Pavia	1
	Gynecology ED – San Matteo Hospital – Pavia	1
	ENT / Vestibology outpatient services – San Matteo Hospital – Pavia	1
	Emergency Radiology – San Matteo Hospital – Pavia	1
	Emergency Observation Unit – Lodi Hospital	2
3 rd -5 th	ICU / Operating Room – Pavia, Voghera, Vigevano or Lodi Hospitals	8
	EMS (medical response units) – Pavia or Lodi	4
	ED – Lodi Hospital (shock room)	4
	Stroke Unit – San Matteo Hospital – Pavia	2
	Cardiac ICU – San Matteo Hospital – Pavia	2
	Thesis work and/or off-network electives	16

ED, Emergency Department; ENT, Ear, Nose, and Throat (otorhinolaryngologist), ICU, Intensive Care Unit.

as suturing, ultrasound-guided percutaneous analgesia, stellate block for refractory arrhythmias, and bleeding control.²³⁻²⁶

All activities take place in the Clinical Skills' Lab of University of Pavia and are supervised by certified instructors. All facilitators have completed formal instructor training programs provided by the Italian Society for Simulation in Medicine (SIMMED), and, in some cases, through joint initiatives with European institutions, such as the EEDUSIM program (training in hEalthcare EDUCation with SIMulation).²⁷ Additional training has been carried out at our simulation center, including the 'train-the-trainer' courses, as well as in collaboration with other accredited simulation centers, like SimuLearn. All courses are validated by experienced certification professionals, and annual re-training is organized to maintain and update instructional standards.

The simulation program encompasses over 25 structured sessions delivered annually and includes a wide range of modalities to ensure a comprehensive learning experience. Residents engage in both low- and high-fidelity simulation scenarios and participate in peer-to-peer simulation workshops. Various evaluation tools are employed throughout the curriculum, including structured checklists, guided debriefing sessions, and self-assessment forms. These components are designed to foster reflective learning and track progression over time.

Results

In comparison with the Italian standards, the University of Pavia's curriculum demonstrates a high degree of alignment. It covers the full spectrum of learning objectives defined by the MIM, which include critical emergency scenarios, procedural skills, communication, ethical decision-making, and system coordination. The program also provides structured training in essential technical skills such as airway management, ventilatory support, vascular access, trauma care, and bedside diagnostics. Furthermore, the curriculum incorporates simulation training for paediatric, obstetric, psychiatric, and toxicological emergencies, reflecting the multidisciplinary approach highlighted in national guidelines. For the European comparison, we based our evaluation on the Core Curriculum of the EUSEM, which outlines the key knowledge, skills, and attitudes expected from emergency medicine specialists across Europe. Our curriculum closely aligns with EUSEM standards, particularly in areas such as non-technical

skills (leadership, teamwork, CRM), procedural simulation, interdisciplinary case management, and progressive development of clinical reasoning.

The only partial alignment noted with both EUSEM and Italian standards pertains to highly specialized procedures such as ECMO, ECPR, and REBOA. Although these procedures are not routinely performed by residents, they are included in our curriculum from year 4 onward through theoretical sessions and dedicated workshops.

Overall, the simulation curriculum of the University of Pavia covers approximately 95% of the EUSEM standards and 100% of the 'MIM-extended' training objectives (Table 2). The 100% alignment with the MIM-extended is based on the full coverage of all competencies listed in the official Italian EM residency documents, along with the inclusion of additional advanced procedures such as ECMO, ECPR, and REBOA, which are not explicitly required by national standards.

Discussion

Italian EM residency programs have experienced declining enrollment rates, mainly due to challenging working conditions and a perceived lack of career stability. In response to this issue, the University of Pavia has introduced a structured, five-year simulation-based training program that covers trauma management, advanced airway techniques, pediatric emergencies, and team-based crisis resource management. By providing hands-on experiences in a risk-free environment, this program aims to enhance clinical decision-making and procedural proficiency. Moreover, it is fully integrated with formal teaching methods through lectures, seminars, and both hospital and prehospital rotations.

Integrating structured simulation into EM residency programs is crucial for improving training standards in Italy. Simulation allows trainees to develop key competencies in a safe environment, ultimately enhancing patient safety and clinical competence. The Pavia model offers a structured and progressive curriculum that prepares residents for real-world emergencies while aligning with international best practices. Multiple studies have demonstrated the effectiveness of simulation in enhancing both diagnostic and procedural competencies. For instance, simulation-based training has been shown to be effective in teaching cardiac auscultation skills, enabling learners to significantly improve their ability to

Table 2. Comparative Table - Pavia Curriculum vs. EUSEM and Italian Standards.

Competency Area	EUSEM standards	MIM-extended standards	Pavia Curriculum
Basic Airways Management	Yes	Yes	Fully
Advanced Airways Management	Yes	Yes	Fully
POCUS	Yes	Yes	Fully
ECG Interpretation	Yes	Yes	Fully
Pediatric Emergencies	Yes	Yes	Fully
Obstetric/Gynecologic emergencies	Yes	Yes	Fully
Trauma Management	Yes	Yes	Fully
BLS - ACLS	Yes	Yes	Fully
Leadership and Ethical Decision-Making	Yes	Yes	Fully
Interdisciplinary Teamwork	Yes	Yes	Fully
ECMO, ECPR, REBOA	Yes (but optional)	Not mentioned	Partial

PoCUS, Point-of-care ultrasound; BLS, Basic Life Support; ACLS, Advanced Cardiac Life Support; ECMO, Extracorporeal Membrane Oxygenation; ECPR, Extracorporeal Cardiopulmonary Resuscitation, REBOA, Resuscitative Endovascular Balloon Occlusion of the Aort

recognize and differentiate heart murmurs.²⁸ Similarly, in the area of regional anesthesia, simulation has demonstrated measurable benefits in skill acquisition and increased confidence among novice learners.²⁹ Furthermore, the recent Delphi consensus conducted in France by Thiebaud et al. emphasized the importance of a structured national approach to developing simulation-based content for EM residents, reaffirming its pivotal role in standardizing and improving the quality of training.³⁰ In addition to traditional medical training, simulation-based education has also been shown to enhance non-technical skills such as teamwork, communication, leadership, situational awareness, and decision-making under pressure.

Simulation fosters a safe environment that encourages a ‘culture of error’, where mistakes are perceived as learning opportunities rather than failures. This approach encourages reflective practice and emotional resilience – skills that are crucial in EM but are often overlooked in traditional curricula.^{2,30–32} Importantly, simulation plays a key role in developing a shared professional identity within the specialty-elements that can strengthen long-term engagement.³³

The five-year progressive simulation-based training framework ensures that residents gain competencies in a wide variety of emergency scenarios. The provided curriculum map (Figure 1) illustrates a systematic approach for developing foundational skills in the initial years, progressively introducing more complex and interdisciplinary training. Advanced simulations in the later years focus on leadership, crisis management, and ethical decision-making, providing a comprehensive training experience. A comparison with the curricula of the MIM and EUSEM shows that Pavia’s model aligns well with Italian and international standards, emphasizing evidence-based, simulation-driven training.^{13–15}

A potential criticism of this curriculum is the early introduction of invasive procedures – such as central venous access, intraosseous insertion, thoracic drainage, lumbar puncture, and advanced airway management – as early as the second year. However, this approach is an intentional educational strategy to

ensure that residents start some rotations, such as Intensive Care Unit rotations, with adequate preparation. Early exposure enhances resident’s confidence, decision-making abilities, and safety. This proactive training ensures that when they encounter real patients, they are not only proficient in the techniques but also have the essential cognitive frameworks needed for effective decision-making. Ultimately, we believe this strategy significantly improves both patient safety and the overall quality of learning, shaping more competent and confident medical professionals.

Although ECMO, ECPR, and REBOA are not routinely included in Italian standards - and are only partially referenced in EUSEM guidelines - they are integrated into our program through theory and targeted workshops. We believe that a modern EM specialist cannot afford to be unfamiliar with the theoretical underpinnings, clinical applications, and basic technical skills related to these advanced interventions. Their increasing role in the management of cardiac arrest, including traumatic and hypothermic, hemorrhagic and refractory shock, particularly in prehospital settings, underscores their relevance^{34–38}. Furthermore, the evolution of portable extracorporeal technologies makes these strategies more feasible across various care settings.³⁹ Notably, the French EM curriculum, as well as several national scientific publications and guidelines (such as SAMU - Service d’Aide Médicale Urgente Guidelines and Recommandations de la SFMU),^{40,41} fully integrates ECMO, ECPR and REBOA training within their educational programs. Including these topics in our curriculum reflects a forward-looking, multidisciplinary and internationally aligned approach.

Additionally, this simulation-based approach could also play a role in annual competency assessments during residency, as seen in systems like the UK’s Annual Review of Competence Progression (ARCP) and the Objective Structured Clinical Examination (OSCE) used in the US and Canada to assess clinical skills.^{42,43} Dedicated centers equipped with 3D printing capabilities can significantly enhance training by offering cost-effective skill trainers and simulation models, as demonstrated by institutions like the

1st YEAR		2nd YEAR		3rd YEAR		4th YEAR		5th YEAR				
INDUCTION WEEK		BASIC LOCO-REGIONAL ANAESTHESIA		ILIAC FASCIA, SERRATUS, ESP		THEORY + SIMULATED CASES	TRAUMA + BURNS	COMPLEX BURN SCENARIOS				
POCUS	INTRODUCTION	THEORY + SIMULATION TOPICS	BASIC ECHO-CARDIO		INTOXICATIONS				MAXI EMERGENCY SCENARIOS			
	E-FAST		DYSPNEA			COPD, EMBOLISM, PNEUMONIA, ASTHMA	CRM SCENARIOS	COMPLEX TEAM MANAGEMENT	LEADERSHIP			
	LUNGS		VENTILATION			CPAP, NIV, HFNC						
	ABDOMEN		ARRHYTHMIAS			BRADY, TACHY	ATLS LIKE SIMULATIONS		PROCEDURAL SEDATION AND ANALGESIA IN PEDIATRICS			
	COMPRESSION US (CUS)		SHOCK			CONFUSIONAL STATE	PHTLS LIKE SIMULATIONS					
	ECG INTERPRETATIONS		STROKE			SKILL LAB	DIFFICULT AIRWAY					
	ABG		CENTRAL VEIN ACCESS, INTRA-OSSEUS			SIMULATIONS	PERICARDIOCENTESIS		PREGNANT EMERGENCIES			
SKILLS LAB	OXYGENATION TECHNIQUES		THORACIC DRAINAGE				ECLS PARTICULAR CASES					
	BASIC AIRWAYS		LUMBAR PUNCTURE				HYPOTHERMIA DROWNING					
	PARACENTESIS		ADVANCED AIRWAY MANAGEMENT				HYPERBARIC CASES					
	TRAUMA BASE		DIAPHRAGM ECHO				ECLS					
	SUTURE		PROCEDURAL SEDATION AND ANALGESIA			UNDIFFERENTIATED SIMULATIONS	ECMO		OBSTETRIC AND GYNECOLOGIC EMERGENCIES, LABOR SEDATION			
	SIMULATION BLSD LIKE		ACLS LIKE SIMULATIONS				REBOA					
PRACTICE PEER TO PEER WITH CHECKLIST		PRACTICE PEER TO PEER WITH CHECKLIST		PRACTICE PEER TO PEER WITH CHECKLIST			ADVANCES LOCO REGIONAL ANAESTHESIA		MEDICO-LEGAL ASPECTS			
PRACTICE PEER TO PEER WITH CHECKLIST		PRACTICE PEER TO PEER WITH CHECKLIST		PRACTICE PEER TO PEER WITH CHECKLIST			MIXED SCENARIO SIMULATIONS		PREVENTION OF HEALTHCARE BURNOUT			

Figure 1. Map of the simulation-based EM program proposed by the University of Pavia. POCUS, Point-Of-Care Ultrasound; ECG, ElectroCardioGram; ABG, Arterial Blood Gas; LAM, Laryngeal Mask Airway; BLSD, Basic Life Support Defibrillator; ESP, Erector Spine; COPD, Chronic Obstructive Pulmonary Disease; CPAP, Continuous Positive Airway Pressure; NIV, Non-invasive Ventilation; HFNC, High-Flow Nasal Cannula; ACLS, Advanced Cardiac Life Support; ATLS, Advanced Trauma Life Support; PHTLS, Prehospital Trauma Life Support; CRM, Crisis Resource Management; PALS, Pediatric Advanced Life Support; ECLS, Extracorporeal Life Support; ECMO, Extracorporeal Membrane Oxygenation; REBOA, Resuscitative Endovascular Balloon Occlusion of the Aorta; EM, Emergency Medicine.

Mayo Clinic and Stanford University.^{18,24} The most immediate concern is the availability of resources to support such a structured simulation program. However, this challenge also presents an opportunity for inter-institutional collaboration between EM training programs. By sharing access to facilities, instructors, and materials, programs can promote sustainability and educational equity. Moreover, simulation training does not necessarily require high-cost, high-fidelity setups; many effective training experiences can be conducted using low- or medium-fidelity tools and minimal resources.⁴⁴⁻⁴⁶ It is essential for each EM residency program, or a network of collaborating programs, to include at least one or two trained simulation facilitators per site to initiate and maintain structured, simulation-based projects.

Beyond its educational applications, simulation has substantial potential as a research tool. According to Chaplin *et al.*,⁴⁷ simulation-based research offers unique opportunities to explore complex healthcare questions, particularly those involving rare events or critical scenarios that are difficult to study in real-life setting due to ethical or logistical constraints. Simulation centers can thus serve not only as hubs for clinical education but also as laboratories that further the advancement of emergency care through complete and reproducible studies.⁴⁷ Although our curriculum is fully integrated with the clinical rotations of the University of Pavia, we believe that this simulation-based model can be effectively adapted even in EM residency programs with different training structures. Its modular and progressive design allows flexible integration into diverse institutional settings, ensuring alignment with both theoretical education and clinical practice. Future studies should evaluate the long-term impact of these training strategies on professional performance and patient outcomes. Standardizing this model across Italian universities and fostering closer collaboration among them could enhance the quality and attractiveness of EM medicine residency programs. We hope this contribution can be proposed to the other national EM residency programs for further improvement, discussion, and sharing. Proposals and different hands-on experiences and reports from different sites will ultimately lead to a systematic integration of the simulation-based approach in the National EM residency education.

Limitations

This study may be limited to a single-center experience, which could restrict the generalizability of its findings. Although the described model has proven to be feasible and well-integrated into our institution, the availability of resources, organizational culture, and local priorities may differ significantly across other training programs. Therefore, multi-center implementation and evaluation are needed to validate broader applicability. Additionally, although qualitative resident feedback was regularly collected, simulation effectiveness was not assessed through Randomized Controlled Trials (RCTs) or systematic surveys. The absence of RCTs limits the strength of causal inferences regarding the direct impact of the curriculum on clinical performance, knowledge retention, or clinical changes. Future research should explore more robust study designs to quantify educational effectiveness and long-term benefits.

Conclusions

The Italian EM residency system faces significant challenges, including low enrollment rates, fragmented training quality, and limited access to simulation-based learning. However, innovative educational strategies, such as the structured five-year simulation-

based curriculum implemented at the University of Pavia, provide a promising solution.

To enhance the quality of EM training, it is essential to align national training programs with EUSEM guidelines, expand the use of simulation, and adopt a progressive skill acquisition framework. The proposed curriculum not only emphasizes progressive skill acquisition but also incorporates innovative elements like 3D printing, ethical reasoning, burnout prevention, and a focus on teamwork and leadership. These additions reflect the complexities of real-world emergency care and prepare residents for both clinical and systemic responsibilities.

By drawing from the experience of national organizations such as CoSMEU, SIMMED, and ITEMS, and aligning with National and European standards (e.g. MIM and EUSEM curricula), this model promotes standardization across training programs. This could enhance the quality and consistency of EM training nationwide. Such initiatives have the potential to attract more residents to the specialty and ultimately strengthen the emergency care workforce and EM identity in Italy. We believe that a broader implementation of this approach might represent a crucial step towards modernizing and unifying EM education in our Country.

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