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Evolution of simulation-based training in Italian emergency medicine residency programs: results from a national longitudinal survey (2022-2024)

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Abstract

Simulation-Based Education (SBE) is increasingly recognized as a key component of Emergency Medicine (EM) training. In Italy, where EM residency programs are relatively recent, national initiatives have been developed to promote and standardize the use of simulation within postgraduate training. A national survey was conducted among all Italian EM residency programs in 2022 and repeated in 2024 to assess changes in the use of simulation-based education. The survey explored the frequency and duration of simulation activities, available infrastructure, instructor qualifications, and the integration of simulation into training and assessment. Response rates were high in both years (91% in 2022 and 84% in 2024). The proportion of programs offering simulation-based training increased from 45% to 57%. High-fidelity simulation showed a moderate increase, while procedural skills remained the main focus of simulation activities. Crisis Resource Management (CRM) and non-technical skills training were reported in a minority of programs. The number of certified simulation facilitators increased, although access to simulation centers remained uneven. Simulation was rarely used for assessment purposes. Simulation-based education in Italian EM residency programs is gradually expanding, although important disparities remain in access to infrastructure and trained faculty. Future efforts should focus on strengthening faculty development, improving access to simulation resources, and integrating simulation more systematically into curricula and assessment processes.

Key words: simulation-based education; emergency medicine residency; faculty development; Crisis Resource Management (CRM); high-fidelity simulation.

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Introduction

Emergency Medicine (EM) is a relatively new specialty in Italy, where the first residency programs were launched as recently as 2009.[1] The Italian EM residency is a five-year training program based on the European Curriculum developed by the EUSEM board at the beginning of 2002 and revised in 2019.[2]

EM residents are expected to acquire the knowledge and skills necessary for managing the acute aspects of illness and injury affecting patients with undifferentiated physical and behavioral disorders. They must also develop a comprehensive understanding of the structure and functioning of both pre-hospital and in-hospital emergency medical systems. In recent years, there has been a growing emphasis on the importance of teamwork, team building and the dynamics of interprofessional collaboration in emergency care. Simulation is widely adopted educational method in Anglo-Saxon countries and is increasingly recognized as a powerful tool in medical education. Its use has been associated with improved learning outcomes and enhanced patient safety. A substantial body of literature—including original research, systematic reviews, and meta-analyses—has demonstrated the effectiveness of simulation in fostering both technical and non-technical competencies through deliberate practice and structured feedback.[3-4]

The Coordination of Emergency Medicine Residents (Coordinamento degli specializzandi di medicina di emergenza urgenza, CoSMEU) is the national association of EM trainees in Italy. Its mission is to promote standardized EM training, protect interests of EM residents in training, develop educational opportunities and formalize specific academic paths.

In 2022 CoSMEU and Italian Society of Simulation in Medicine (Società Italiana di Simulazione in Medicina, SIMMED) jointly launched the SIMinMEU project, with the objectives of integrating simulation as a certified component of training, conducting educational research, and standardizing faculty development for simulation instructors.

During the study period, a national two-day (16-hour) facilitator training program was organized by the University of Padua in collaboration with CoSMEU and under the patronage of SIMMED. The course was offered free of charge to all Italian Emergency Medicine residency programs, with each school invited to nominate one participant. A total of 24 participants attended the program

The course provided foundational competencies in simulation-based education and included theoretical and practical sessions on patient safety and simulation principles, the SimZones framework, scenario design, briefing and strategic familiarization, simulation session management, structured debriefing techniques, crisis resource management and non-technical skills, with hands-on facilitation practice and small-group exercises.

In this project, an initial survey was developed to characterize simulation-based activities within Italian Emergency Medicine residency programs. This initiative also resulted in a national training program for facilitators and a peer support community among EM simulation faculty. Two years later, the same questions were re-administered to assess whether any changes had occurred. This research explores how simulation-based education evolved across all EM residency programs in Italy between 2022 and 2024.

The aim of this study is to investigate the evolution in the use of simulation-based activities within Italian Emergency Medicine residency programs between 2022 and 2024, within the collaborative framework established between CoSMEU and SIMMED.

Materials and Methods

Study design

An initial anonymous electronic survey was distributed via email in June 2022 to one designated representative from each Italian Emergency Medicine residency program. The same set of questions was re-administered in 2024 to allow for longitudinal comparison. All active Emergency Medicine residency programs at the national level were invited to participate; the increase in the total number of programs between 2022 and 2024 reflects the establishment of new training sites during the study period**.** The survey consisted of multiple-choice and free text questions, created using Google Forms (Google Inc., Mountain View, CA, U.S.A.). The survey was composed of 22 structured items exploring the presence, organization and characteristics of simulation-based education within Emergency Medicine residency programs. Question domains included: use of simulation in assessment, frequency of simulation activities by year of training, types of simulation modalities offered (e.g. skills lab, high-fidelity simulation), availability of dedicated simulation centers, faculty training and certification, use of interdisciplinary simulation, integration of simulation into the formal curriculum, coverage of non-technical skills and crisis resource management, and availability of certified life support courses (e.g. ALS, ACLS, PHTLS, PALS).

Most items were closed-ended with dichotomous (yes/no) or multiple-choice response formats; selected questions allowed multiple responses to capture the coexistence of different educational activities within the same program. Data were analyzed descriptively as frequencies and percentages. The complete survey instrument is provided in the Supplementary Material.

The participation in the study was voluntary, independent, and without incentives offered. Since all data were collected, such that individual subjects could not be identified or exposed to risks or liabilities, the evaluation was deemed exempt from institutional review approval by the local Ethics Committee.

Data about demographics, numbers and type of simulations per year, duration and location where it took place were collected. Also, there were collected data about the educational offer, including technical procedures and certified courses.

Data analysis

Data was downloaded from Google Forms and analyzed by our team members. Data were downloaded from Google Forms and analyzed using descriptive statistics. Comparisons between 2022 and 2024 were performed using the Chi-square test or Fisher's exact test for categorical variables, as appropriate. A p-value < 0.05 was considered statistically significant. Given the exploratory nature of the study and the limited sample size, no formal multivariable analyses were performed. All analyses were conducted using SPSS IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA).

Results

During the study period, a national training program for simulation facilitators was implemented, resulting in the training of 24 facilitators. In 2022, 30 out of 33 Emergency Medicine residency programs responded to the survey, while in 2024, 32 out of 38 programs participated. In 2022, 15 of 30 Emergency Medicine residency programs (50%) reported providing simulation-based training, compared to 22 of 32 programs (68.8%) in 2024; however, although this difference did not reach statistical significance (Fisher's exact test, $p>0.05$), it suggests a positive trend. Simulation session duration ranged from 1 to 8 hours, with a median duration of 4.0 hours (IQR 2.0-4.0) in both 2022 and 2024.

Regarding the types of simulation-based activities offered in 2022, Emergency Medicine residency programs provided both skills lab activities and high-fidelity simulation in equal measure. By 2024, high-fidelity simulation was reported in 63% of programs. In this study, high-fidelity simulation refers to immersive, scenario-based training activities conducted with high-fidelity manikins or advanced simulation technologies in a realistic clinical environment. The most commonly offered activities include vascular access and airway management, followed by suturing, chest tube insertion, and ultrasound training sessions, nerve block.

Crisis Resource Management (CRM) and other non-technical skills were included in simulation-based training activities in 23.3% of Emergency Medicine residency programs in 2022. Findings showed consistency across the two years, with no significant changes in key indicators. Regarding simulation centers, in 2022, residents reported that 10 programs (33.3%) had a simulation center within the university hospital that was not accessible, 9 programs (30%) had access to their university's simulation center, and 11 programs (36.6%) had no simulation center available in either the hospital or university. In 2024, 15 programs (46.9%) reported an inaccessible simulation center, 6 (18.8%) had access, and 11 (34.4%) had no simulation center at all. In 2022, only five programs (16.6%) reported having certified simulation facilitators, compared with eleven programs (34.4%) in 2024. Although this increase did not reach statistical significance (Fisher's exact test, $p>0.05$), it suggests a positive trend in faculty development. About certified courses offered during the five-year EM training program, 70% EMr programs provide ALS (Advanced Life support) /ACLS (Advanced Cardiovascular Life Support) certification, of which 4 EMr also provide PHTLS (Prehospital Trauma Life Support) / PTC (Prehospital Trauma Care) / ITLS (International Trauma Life support) courses and 4 others PALS (Pediatric Advanced Life Support) / EPALS (European Pediatric Advanced Life Support) certifications. Their availability remained overall stable over the study period. In 2022, simulation was not used as an assessment method in the annual exams of any Italian Emergency Medicine

residency program. By 2024, only two programs had incorporated simulation into their examination process.

Discussion

This longitudinal evaluation reveals incremental progress in the integration of simulation-based education (SBE) within Italian Emergency Medicine (EM) residency programs from 2022 to 2024. The increase in simulation adoption while modest, aligns with trends documented in other national contexts, underscoring the importance of faculty development and institutional backing.[5]

The stable session duration (median 4 hours, IQR 2–4) compares favorably with international benchmarks,[6] where focused, high-fidelity scenarios are employed for maximal educational impact. Indeed, the growth in high-fidelity use (from ~50% to 63%) reflects rising institutional investment and is consistent with evidence supporting immersive simulation to enhance both technical and non-technical competence.

Procedural skills such as vascular access, airway management, chest tube placement, nerve block, and ultrasound remain the most frequently reported simulation activities in our sample, confirming their central role in EM training. This finding is consistent with international literature identifying procedural and resuscitation skills as core targets of simulation in Emergency Medicine curricula.[7-11] In contrast, only 23.3% of Italian programs reported explicitly addressing Crisis Resource Management (CRM) and non-technical skills. This limited formal integration is noteworthy given the strong evidence supporting CRM-focused simulation in improving situational awareness, leadership, teamwork, and decision-making in high-acuity settings. Importantly, improvements in non-technical skills during simulation-based team training have also been associated with better clinical performance and improved patient outcomes in high-risk scenarios such as cardiac arrest and major trauma management. International surveys have similarly reported variability in the emphasis placed on teamwork and professionalism within simulation programs, even in well-established training systems.[12-13] Together, these findings suggest that while simulation is increasingly adopted for technical and procedural training, the systematic inclusion of CRM and non-technical skills remains an area for further development within Italian EM residency programs.

Infrastructural disparities persist, as over one-third of programs still lack full access to simulation centers in 2024. This echoes broader challenges highlighted in literature, where inequity in simulation resources can limit curricular standardization.[14] The increased number of certified facilitators (from 16.6% to 34.4%) is a promising development, directly addressing one of the key enablers for sustainable SBE highlighted in training models.

Despite advances, the incorporation of simulation into summative assessments remains rare (just 2 programs in 2024), reflecting the global challenge of integrating SBE into formal evaluations. Best practices advocate for validated simulation-based assessment tools, but their adoption is often hindered by resource constraints and need for faculty training.[15-16]

Certified courses (e.g., ALS, PHTLS, PALS) remain widespread, being offered in approximately 70% of programs, but are often delivered as stand-alone components. Although ALS/ACLS, PALS and similar life support courses do not represent high-fidelity simulation in the strict sense, they were considered in this study as they can be conceptually aligned with SimZone 2,[17] which focuses on the acquisition and reinforcement of technical skills, algorithms and standardized procedural training—core elements of early competency development in Emergency Medicine. Their inclusion allows a more comprehensive description of structured training pathways within Italian residency programs. As suggested by the literature, these courses should be complemented by longitudinal and context-specific simulation modules to enhance skill retention and transfer into clinical practice.[18]

The effectiveness of simulation-based training is supported by robust evidence for technical skills acquisition, procedural performance, and adherence to clinical algorithms, particularly in high-risk, low-frequency scenarios typical of Emergency Medicine. Extensive literature also supports the role of simulation in improving non-technical skills, such as teamwork, communication, leadership, decision-making and situational awareness, especially through team-based and scenario-based training.

Within this framework, the application of the SimZones model offers a valuable conceptual structure for designing longitudinal and progressive simulation curricula. By aligning educational strategies with learners' levels and specific learning objectives, SimZones allow a structured progression from the acquisition of technical skills and standardized procedures (SimZone 1–2) to integrated team-based performance, crisis resource management and management of complexity (SimZone 3–4). This approach is particularly relevant for Emergency Medicine training, where learners are required to develop both high-level technical proficiency and advanced non-technical skills in dynamic, time-critical environments. In the Italian context, previous studies have highlighted the progressive integration of simulation within Emergency Medicine residency programs, alongside significant heterogeneity in access to resources, faculty expertise and curricular organization.[19-20] Notably, some schools have already embedded simulation as a structured component of their curriculum, such as the University of Padua since 2016, while recent national publications have described the implementation of longitudinal simulation curricula in other Italian centers.[21] Future studies are warranted to assess the degree to which these experiences align with the principles of SimZones and support a structured progression of competencies across training levels.

Limitations

Key limitations include reliance on self-reported data, which may harbor reporting bias, and potential heterogeneity in survey interpretation across programs. While the high response rates strengthen generalizability, objective measures of simulation quality and learning outcomes were not captured.

Conclusions and future directions

This study highlights the early but meaningful progress in integrating simulation-based education within Italian Emergency Medicine residency programs. To translate these developments into a robust national training framework, it will be essential to expand the pool of certified simulation instructors, improve equitable access to simulation infrastructure across institutions, integrate high-fidelity and CRM-focused scenarios into curricula, and implement validated simulation-based assessment tools. Efforts like the SIMinMEU project, promoted by CoSMEU and SIMMED, can play a pivotal role in supporting these objectives by fostering collaboration, sharing best practices, and ultimately contributing to the establishment of a sustainable, high-quality, and standardized simulation model for Emergency Medicine education in Italy.

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Online supplementary materials
Survey instrument (full questionnaire)

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Contributions: conceived and designed the survey: MC, MDC, GZ, PI, GM. Analyzed the data: MC, MDC and GM. Wrote the paper: MC, MDC, GZ, PI, GM. All authors approved the final version of the manuscript.

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Ethics approval and consent to participate: not applicable. This is a national survey promoted by CoSMEU and not involving patients.

Consent for publication: our manuscript doesn't contain any individual person's data in any form.

Informed consent: all residents chose to fill in the form in an anonymous way, knowing that the results could be published.

Availability of data and materials: all data underlying the findings are fully available.

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