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Learning technical skills in simulation: Shared training for medical students and advanced practice nurses

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Abstract

Introduction: As part of their initial training, advanced practice nurses (APN) and medical students (MS) benefit from distinct trainings in specific technical procedures. However, some of these technical procedures may be the same between. Implementing a shared training through simulation might hold significant potential. The aim of this research was to compare the learning impact of a shared simulation-based training for plaster and suture procedures among APN students compared to MS.

Methods: This research was a quantitative study with qualitative components. Procedural simulation training, preceded by e-learning including theoretical contributions on sutures and plasters, was systematically conducted to enhance the proficiency of wound suturing (individual stitches consisting of three loops) and plastering skills (below knee cast) among both groups of students. These students were selected through a convenience sampling. Different questionnaires and evaluation checklists were used to compare parameters between these groups. Individual semi-structured interviews were conducted for a comprehensive understanding of the participants' experiences.

Results: This study included a total of nine APNs and 13 MS. At the end of the plaster and sutures training, APN and MS showed no significant differences in performance (p-value = .30-.08), satisfaction (*p*-value = .52-.33), knowledge (*p*-value = .09-.28) or self-confidence (*p*-value = .16-.97).

Conclusions: This study reveals similar learning for technical procedures studied between MS and APN, underscoring the importance of developing interdisciplinary training courses. This study highlights the collaborative effectiveness of e-learning and procedural simulation in advancing the technical skills of both APN and medical students.

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Introduction

Since the 1960s, most industrialised countries have been facing increasing healthcare needs and a shortage of primary care physicians (Savard, Al Hakim, & Kilpatrick, 2023). In this context, nursing care has evolved to introduce the concept of advanced practice into the healthcare continuum. Advanced practice nurses (APN) are registered nurses with master's degrees and advanced education. According to the International Council of Nurses, the advanced practice nurse is defined as:

> A generalist or specialized nurse who has acquired, through additional graduate education (minimum of a master's degree), the expert knowledge base, complex decision-making skills and clinical competencies for Advanced Nursing Practice, the characteristics of which are shaped by the context in which they are credentialed to practice. (International Council of Nurses, 2020, p. 6)

APNs have additional scope of practice (Boehning & Punsalan, 2024) are crucial for the advancement of healthcare systems, improving access to care, and achieving better health outcomes for individuals while reducing healthcare expenses (Htay & Whitehead, 2021).

The first nurse practitioner program was launched at the University of Colorado in 1965 by Dr. Loretta Ford and Dr. Henry Silver (Boehning & Punsalan, 2024). Initially, APN included several clinical practice domains, such as clinical nurse specialists, nurse midwives, and nurse practitioners (Boehning & Punsalan, 2024). The evolution of this role has varied globally in response to diverse health challenges (Torrens et al., 2020). In many countries, APN is a profession that is rapidly expanding in healthcare (De Raeve et al., 2024). The European Federation of Nurses' survey on current advanced practice frameworks and development in Europe revealed significant variation in how countries define and regulate advanced practice nursing at academic and practice levels (De Raeve et al., 2024). Therefore, standards for education and practice among APNs have been implemented differently in each country (Campo et al., 2018; De Raeve et al., 2024). In some European countries, such as Belgium, advanced practice is still in its early stages, and the training program is under construction (De Raeve et al., 2024).

As part of these training programs, both clinical and non-technical skills should be taught. Clinical skills include direct clinical practice and clinical judgment; non-technical skills include research, leadership, and ethical decision-making (San Martín-Rodríguez, Soto-Ruiz, & Escalada-Hernández, 2019). Clinical simulation stands as a pivotal element in promoting these skills (San San Martín-Rodríguez et al., 2019), as it helps to narrow the gap between theory and practice (Koukourikos et al., 2021). To carry out these simulations, the International Nursing Association for Clinical Simulation and Learning (INACSL) recommends the use of healthcare simulation standards best practice (prebriefing, simulation design, facilitation, debriefing, etc.) (Watts et al., 2021a). These guidelines ensure high-quality simulation educational programs. Interprofessional collaboration, which is considered to be a pillar of APN training programs, is also a best practice (San Martín-Rodríguez et al., 2019).

During their initial training, advanced practice nurses (APNs) benefit from some simulation for nontechnical and technical skills. Some of these technical procedures, such as suturing or plastering procedures, may be shared between APNs and medical students (MS) training programs. The implementation of shared simulation-based training between APNs and MS could offer significant impact.

Theoretical framework

The development of shared training between APNs and MS during their training could be an interesting approach. These programs have the potential to play a crucial role in fortifying interdisciplinary skills, fostering improved mutual understanding, and laying the groundwork for enhanced collaboration in the future (Kauff et al., 2023). The broader integration into initial training programs, especially within procedural simulation, could significantly enhance their impact and effectiveness. This shared approach aims to ensure technical proficiency between APNs and MS.

Implementation of SimZone serves as a valuable approach to align methods and objectives in simulation (Roussin, Sawyer, & Weinstock, 2020). These SimZones offer a conceptual framework, delineating learning goals, event types, learner profiles, and simulation details. Ranging from zero (automatic feedback) to four (real debriefing and development), SimZone One, which is focused on teaching fundamental clinical skills, aligns with Miller's skills assessment pyramid, associating knowledge and skills levels (Roussin & Weinstock, 2017). Practical achievements in this SimZone are assessed by field experts, ensuring that learning is acquired. This approach provides a strong conceptual framework to guide skill assessment and the development of a simulation-based learning path in this study. Our study advocates for integrating interdisciplinary technical simulations for APNs and MS early in their education. We aimed to evaluate and compare the impact of a shared simulation training program on suturing and plastering skills in both groups.

Methods

Study design

A longitudinal cohort study was performed to address the following research question: What is the impact of a shared procedural simulation training on suture and plaster cast among APN students and MS in initial training? In this study, the term 'procedural simulation training' refers to simulations designed to teach technical procedures. "Shared design" indicates that both APN and MS undergo the same simulation training, with similar learning objectives, instructors, and content. The term 'initial training' describes the level of the course program provided before obtaining the diploma.

Sample

The APN sample consisted of students in the second year of a master's program. Their training involved two years of master's studies following a bachelor's degree in nursing. Currently, there is no specialization for APNs; the training remains general for all APN students. These students are already qualified nurses, with some having prior work experience as nurses before starting their master's program to become APNs.

The medical student sample comprised students in the third year of their master's program. Their education includes three years of undergraduate studies followed by three years of master's studies, after which they specialize in their chosen field. At this stage, these students have completed clinical internships during which they have performed various technical procedures.

Procedural simulation

Design of simulation

The APN training program in Belgium started in 2021. However, the legislation governing this training is still pending. Identification of key technical procedures was the first step, with plastering and suturing identified as the most relevant based on a survey of Belgian physicians and emergency nurses. A simulation training program was developed to teach these skills. Such simulations are already used for MS and reflection was made to extend them to APN.

The shared simulation training was designed in accordance with the Healthcare Simulation Standards of Best PracticeTM (Watts et al., 2021b). This design was analyzed and discussed by a group of experts in simulation, emergency medicine and nursing. The Standards of Best Practice: Simulation-Enhanced Interprofessional Education (Sim-IPE) (Decker et al., 2015) and Simulation guidelines and best practices for Nurse Practitioner programs (Lioce et al., 2020) served as the foundation for this shared training. They were used to guarantee the educational quality of the simulations. The general objective of this training was to be able to perform five single sutures (each consisting of three loops) and a below-knee cast. The practice of wound suturing was carried out on a pig's trotter, and the plaster was made directly on the learners. The simulation exercises were validated for relevance by teachers from these departments.

E-learning courses

Prior to the study, participants received an initial email explaining the objectives of the study, progress, and anticipated utilization of results. A subsequent email was sent containing questionnaires for suturing and plasters (experience, knowledge, self-efficacy) to be completed before the e-learning course for the pretest (T0). They could complete the questionnaire online or return it on paper on the day of the training. Participants were then invited to complete in the online e-learning module (SimZone Zero), which explained the necessary equipment and required guidance on how to perform the technical procedure. Experts in simulation and emergency medicine created this e-learning for medical students prior to this study.

Briefing, prebriefing and simulation

On the simulation day (T1), participants were asked to complete paper questionnaires about sutures and plasters (knowledge, self-efficacy, learning satisfaction and self-confidence) for a pre-test before the prebriefing. A standardized briefing was then given by an emergency physician (EP) in a first room. During this briefing, the EP explained the training process, the material, the objective and the simulation principles. The EP then gave a prebriefing with theoretical overview and a demonstration of the procedure (SimZone One) in the simulation room. First, the EP showed the whole technical procedure, then she repeated the act more slowly, explaining the different steps. The students took turns to make plasters and sutures in the simulation room. For the plasters, they realized a below-knee cast to another participant. For the sutures, they realized a simple wound with three loops on the pig's feet.

The participants then actively participated in the procedure, with the EP asking questions and providing corrections as necessary. After the simulation session, they completed the same questionnaires as at the beginning of the training (T2) (knowledge, self-efficacy, learning satisfaction and self-confidence).

Facilitators

The EP leading the training sessions holds a one-year university certificate in simulation, with specialized training in debriefing with good judgment (Rudolph, Simon, Dufresne, & Raemer, 2006). With over 25 years of clinical experience, this EP is also experienced in mentoring students during formative and certification sessions, ensuring a well-rounded and adaptive teaching approach tailored to the needs of each participant.

Debriefing

At the end of the training, the instructors used the Promoting Excellence and Reflective Learning in Simulation (PEARLS) framework for debriefing (Eppich & Cheng, 2015a). The PEARLS framework helps structure debriefing into four phases: setting the stage, reactions, description and analysis, and summary. It guides facilitators to first create a safe learning environment, explore emotional responses, review key events, and then analyze performance before concluding with actionable takeaways for future improvement (Eppich & Cheng, 2015a). Participants were then filmed performing the procedure for a final evaluation by a panel of experts (T3). They then participated in individual face-to-face interviews (T4) where they shared their views on the training program, their expectations, satisfaction levels, and any suggestions for improvement.

Recruitment

A non-probability convenience sampling method was used for this study, with the sample consisting of final year students from two different healthcare professional groups: medical students and APN students. All students from both disciplines were included in this study. The only exclusion criterion for participation was the lack of consent from an individual participant.

These simulation sessions were included in their course programs, either as part of their emergency internship (MS) or as part of their professional integration course (APN). Participation in these sessions was not compulsory. Participants were invited based on their availability through email communication from the Center for Medical Simulation at the University of Liège. To limit confounding bias, some efforts were made to standardize the training by using the same simulation-trained instructor and a standardized simulation session with clearly defined objectives. In addition, differences in experience in performing the technical procedures studied were assessed using the experience questionnaire.

Data collection

Planning

This study was conducted between October 2022 and January 2023. Several training sessions were organized to support small-group instruction for students. Data were collected through paper questionnaires for the simulation day and online for the time before the e-learning.

Assessment instruments

The non-validated questionnaires (covering socio-demographic data, experience, knowledge, self-efficacy, and performance with plasters) were developed by the research team, which included experts in simulation, one emergency physician and one emergency nurse. These questionnaires were created because no specific tools for these variables were available in the literature. Before use, the questionnaires were reviewed and validated by six experts in simulation, emergency medicine, and statistics

The observation grid for plaster casting performance was sent to three EPs. Experts validated overall understanding and relevance using a Likert scale (ranging from 1 = “not at all relevant” to 7 = “very relevant”). The questionnaires were considered validated if the mean scores were greater than or equal to six and the interquartile range was less than or equal to one. This score had to be maintained for two consecutive rounds of Delphi. This questionnaire was validated in three Delphi rounds. The psychometric properties of the questionnaires were not measured. The other questionnaires (satisfaction, self-confidence and performance on sutures) are validated in the literature.

The following variables were collected at various times during the study (T0, T1, T2, T3 and T4):

- Socio-demographic and experience (T0)
- Knowledge (T0, T1, T2)
- Self-efficacy (T0, T1, T2)
- Student Satisfaction and Self-Confidence in Learning (T1, T2)
- Performance (T3)
- Qualitative Interviews (T4)

Data analysis

For quantitative data, Rx64 Commander® (version 4.2.2) was used for all statistical analysis. Descriptive statistics were performed to examine the socio-professional characteristics of our two groups, using tests of proportions (chi-squared) expressed as rates and percentages. Statistical tests were used to compare the different variables of the two procedures with respect to the initial training of the two groups. Mann-Whitney tests were performed for asymmetric variables. Other statistical tests were conducted on changes in these variables (APNs/medical students/all) throughout the course (T0, T1, T2). The Wilcoxon signed rank test was used for statistics measured over two time periods. The Friedman test was calculated to examine changes in various variables over three time points when the distribution of residuals deviated from normality. Subsequently, for significant Friedman test results, pairwise comparisons were conducted using the Wilcoxon test (T2-T0, T2-T1, T1-T0), employing the Bonferroni method ($p = .017$). Quantitative variables were described by the median and interquartile ranges when the normal distribution was not respected. For all statistical interpretations, the alpha level was set at a standard of 5%. The different variables and their explanations are represented in Table 1.

For qualitative data, the researcher used a voice recorder on his computer to record the responses of interviews. The researcher then listened to the recordings again and transcribed them manually. A second researcher checked the quality of the transcriptions to avoid errors. For each interview, the researcher fluoridated the various verbatims that identified in the answers to each question. Then, he grouped these verbatims into themes for each question. For both APN and medical students, this thematic analysis was carried out for each question. The researcher then noted the frequency of the themes' appearance for each question. Finally, the themes were reviewed by three researchers to ensure consistency.

Ethical considerations

This study was approved by the ethical committee of Liege University's Medicine Faculty (reference number: 2022/195). All participants provided written informed consent to participate in the study. Additionally, they signed an authorization allowing for filming. Pseudo-anonymization was implemented for questionnaires and videos. This pseudo-anonymization consisted of assignat a specific code to each student to safeguard their identity (unique 6-letter codes).

Results

Study sample

A total of 22 students participated in this study, including nine APN students and 13 medical students. Table 2 summarizes the experience with sutures and plaster casts and the sociodemographic characteristics of the sample.

Quantitative results

The variables studied were analysed at different times during the study for APNs and medical students in initial training. The evolution of the variables at different times according to training was analysed for sutures and plaster casts (Table 3).

For sutures, the difference in knowledge at T0 between the two groups was significant (< 0.01), with the medical students having more knowledge than the APN students. The difference in sense of self-efficacy between the two groups was highly significant at T0 (< 0.001), significant at T1 ($p = .02$), and not significant at T2 ($p = .4$). Medical students had a higher sense of self-efficacy than APNs at both T0 and T1. The differences in satisfaction, self-confidence, and performance variables compared at different times in the two groups studied were not statistically significant.

For plaster casts, the differences between the two groups regarding knowledge, satisfaction, and self-confidence at the three time points were not significant. Only the difference in the sense of self-efficacy between the two groups was significant at T1 ($p = .02$) and T2 ($p = .01$) and was higher among the medical students than among the APNs at T1 and T2. The difference in plaster cast performance between the two groups studied was not significant.

Qualitative results

Based on post-session interviews, the participants, especially APNs, recognized the value of the teaching approach for sutures, though opinions varied for the plaster casts. While suture skills were perceived as fully acquired, proficiency in casts, particularly for APNs, was viewed as partial, prompting a desire for more practice. Both groups expressed overall satisfaction, highlighting the effectiveness of a small-group procedural simulation supervised by an EP. This approach was commended for providing a learning environment characterized by limited stress and safety that was conducive to the participants learning from their mistakes. Participants suggested improvements, including more theoretical content in the plaster casts e-learning module, a precise equipment list, and summary sheets outlining key procedural elements. They also underlined the importance of interdisciplinary training in the future. These training courses would provide a better understanding and knowledge of other disciplines. The detailed qualitative analyses are available in Appendices (Appendix A and B).

Discussion

This study examined how future APNs and physicians acquire technical skills in interprofessional simulation. The emergence of APNs in global healthcare systems, tasked with specific medical procedures, underscores the significance of this research. Previous literature has highlighted a gap in comparing the training performance of APNs and physicians (Johnson et al., 2019).

Blended learning

Our findings showed that simulation did not significantly improve knowledge, contradicting earlier studies (Mariani, Ross, Paparella, & Allen, 2017;

Table 1 – Variables and Explanations

Variables		Categories	Modality of Response	Explanations
Socio-demographic and experience	Type of study	Qualitative nominal – binary	APN training - medical training	Participants were asked to select the type of study they were pursuing: APN training or medical training.
	Gender	Qualitative nominal – binary	Male – Female	Participants were asked to select their gender: male or female.
	Age	Quantitative continuous	In years	Participants were asked to indicate their age in years.
	Study level	Qualitative nominal - binary	Second year of Master APN – Third year of Master medicine	They had to select their year of study from: second year of Master APN or third year of Master medicine.
	Professional experience	Qualitative nominal – binary	Yes – no	Participants were asked to indicate whether they had ever worked as a nurse or doctor prior to the study.
	Years of professional experience	Quantitative continuous	In years	If they had previously worked as a nurse or doctor, they were asked to indicate the number of years of professional experience.
	Preliminary training for plasters and sutures	Qualitative nominal – binary	Yes – no	Participants were asked to indicate whether they had received suture and plasters training (theorical and/or practical) prior to this study.
	Previous observation of sutures / plasters	Qualitative nominal – binary	Yes – no	Participants were asked if they had ever observed casting or suturing during their clinical training.
	Sutures performed beforehand	Qualitative nominal – binary	Yes – no	Participants were asked to indicate whether they had ever had the opportunity to perform sutures prior to the study.
	Preliminary plastering	Qualitative nominal – binary	Yes – no	Participants were asked to indicate whether they had ever had the opportunity to make plaster casts prior to the study.
Knowledge		Quantitative discrete	0-20	The questionnaire consisted of 20 true-or-false questions designed to evaluate theorical knowledge of sutures and plaster casts procedures and material. The cumulative correct answers determined a score out of 20 (0 = wrong answer, +1 = correct answer). This questionnaire had already been used in previous training courses at the medical simulation center.
Self-efficacy		Quantitative discrete	0-20	The questionnaire aimed to assess students' confidence in acquiring technical skills (sutures and plasters). Students indicated their agreement level for each item using a scale from zero ("strongly disagree") to five ("strongly agree"). They estimated their knowledge, capacity for intervention, and technical skills in their learning path. The overall score, obtained by summing each item, was then calculated as a score out of 20.

(*continued on next page*)

Table 1 (continued)

Variables	Categories	Modality of Response	Explanations
Satisfaction	Quantitative discrete	0-20	The study employed the Student Satisfaction with Learning Scale (SSLS) and Confidence in Learning Using Simulation Scale (CLUSS) scales to evaluate satisfaction and self-confidence in simulation, as proposed by Jeffries (Jeffries, 2005). In both surveys, students assigned a score from one ("totally disagree") to five ("totally agree") for each statement. The total scores for SSLS and CLUSS were determined by summing the scores for each item.
Self-confidence	Quantitative discrete	0-20	
Performances	Quantitative discrete	0-20	Following the training, students were recorded executing various technical procedures, including making five individual stitches (each consisting of three loops) and applying below knee cast. These recordings underwent a blind assessment by four EP who specialize in acute medicine, utilizing a validated suture performance grid (Bottet et al., 2019). This grid had been used to evaluate students in an Objective structured clinical examination (OSCE). The plaster cast performance evaluation grid was validated beforehand by the panel of experts. Experts assigned scores to each item on the grids, ranging from zero ("very inadequate") to four ("very good"), and recorded general comments if necessary. Grid scores were calculated by summing individual item scores, and an average score, based on assessments from various experts, was calculated on a scale out of 20.

Table 2 – Sociodemographic and Experience Variables

Variables n (%)	APN students (n = 9)	Medical students (n = 13)
Gender		
Male	1 (11%)	7 (54%)
Female	8 (89%)	6 (46%)
Age (in years) median	29	24
Study level		
Second year of master APN	9 (100%)	NA
Third year of master medicine	NA	13 (100%)
Professional experience		
Yes	7 (77%)	0 (100%)
No	2 (33%)	13 (0%)
Years of professional experience median*	4	0
Preliminary training for plasters and sutures	2 (22.2%)	3 (23.1%)
Previous observation of sutures/plaster casts	7 (77.8%)	13 (100%)
Sutures performed beforehand	2 (22.2%)	12 (92.3%)
Preliminary plastering	2 (22.2%)	7 (53.8%)

Note. NA = not applicable.
* For participants who answered yes to the question about professional experience.

Table 3 – Analysis of Suture/Plaster Training Variables

Variables	Times	Suture Training			Plaster Cast Training		
		APN Students (n = 9) P50 (P25-P75)	Medical Students (n = 13) P50 (P25-P75)	*p*-Value	APN Students (n = 7) P50 (P25-P75)	Medical Students (n = 13) P50 (P25-P75)	*p*-Value
Knowledge	T0	13 (13-14)	15 (14-17)	**< .01***	18 (15-18)	15 (14-17)	.23
	T1	16 (15-17)	16 (15-18)	.46	19 (15.5-19)	18 (16-19)	.97
	T2	15 (15-16)	17 (15-17)	.09	18 (16-18)	18 (17-19)	.28
Self-efficacy	T0	12.3 (11.3-14)	16 (15-17.3)	**< .001***	5.3 (3-8)	12 (7.3-14)	.10
	T1	15.3 (13-16.3)	17 (16-17)	**.02***	12 (7.65-13.65)	15.3 (14-17.3)	**.02***
	T2	17.7 (17-18)	19.3 (17.7-19.3)	.40	15.3 (13-17)	18.6 (17.3-19.3)	**.01***
Satisfaction	T1	15.2 (12.8-16.8)	16 (14.4-16.8)	.92	15.2 (12-16)	16 (15.2-16)	.20
	T2	20 (20-20)	20 (18.4-20)	.52	20 (18.8-20)	19.2 (16.8-20)	.33
Self-confidence	T1	16.5 (14.5-17)	15.5 (15-16.5)	.50	15 (14.5-16.75)	14.5 (14-15.5)	.40
	T2	16.5 (16-18.5)	16.5 (16-18.5)	.16	17.5 (16.25-18)	17 (16-18.5)	.97
Performance	T3	14 (14-17)	16.5 (15-16.5)	.30	16 (15.5-17)	17.25 (16.625-17.5)	.08

Note. APN = advanced practice nurse.
* Statistically significant

Padilha, Machado, Ribeiro, Ramos, & Costa, 2019; Warren, Luctkar-Flude, Godfrey, & Lukewich, 2016). We believe that the sequence of e-learning and simulation sessions influenced the results. Notably, only e-learning for plaster application effectively mitigated significant knowledge disparities observed at the onset of training between APNs and medical students.

E-learning improves the knowledge of learners, especially among groups lacking previous training (Elshareif & Mohamed, 2021; Feng et al., 2013). However, several studies advocate for its use as a supplementary tool alongside traditional teaching methods or within simulation contexts (McDonald, Boulton, & Davis, 2018). No gaps in suturing knowledge were found, potentially attributed to learners' pre-existing knowledge from prior experiences. Our findings suggest that e-learning based on students' prior experience could enhance knowledge. Simulation facilitates the practical application of knowledge within an experiential context (Avadhani, 2017; Boling & Hardin-Pierce, 2016). E-learning and simulation are regarded as essential, indispensable, and interdependent components (Avadhani, 2017) to enhance self-efficacy, self-confidence, and satisfaction (Alrashidi et al., 2023). However, regarding new procedures, extending simulation sessions to allow for repeated practice may be advisable, fostering a high level of self-efficacy, even among novices.

At the onset of the suturing training, a significant disparity in self-confidence was observed between the two groups, which was mitigated using simulation. Similar to previous studies, APNs experienced a boost in their confidence (Fadale, Tucker, Dungan, & Sabol, 2014; Secheresse, Usseglio, Jorioz, & Habold, 2016; Warren et al., 2016), though their confidence level remained lower than that of the medical trainees. This discrepancy may be due to variations in initial training, prior procedural experiences or teaching methods. Conversely, in plaster cast training, in which participants started with similar levels of experience, the difference in confidence reversed as training progressed, especially among medical trainees. This shift may be linked to the nature and definition of their profession, as learners who are confident in their abilities may be attracted more to medical careers (Jovic et al., 2015). Certainly, differences in teaching methodologies likely exist between physicians and nursing profiles, influenced by cultural norms and educational traditions. These disparities could significantly affect how individuals respond to simulations and perceive their competencies. For example, medical education often focuses on diagnosis and treatment, while nursing emphasizes patient care and communication. This leads to different simulation approaches: physicians focus on technical skills, while nurses prioritize patient care and teamwork. Understanding these differences is crucial for improving training and fostering collaboration in healthcare (Laschinger & Tresolini, 1999; Rukadikar, Mali, Bajpai, Rukadikar, & Singh, 2022).

Performance

In this study, MS and APN students showed no significant difference in suturing and casting skills. A previous study also found that APNs and doctors had similar clinical performance in online patient simulations initially (Johnson et al., 2019). As the simulations progressed, both groups demonstrated improvement, leading to the disappearance of differences in practice and highlighting the significance of standardized simulation training (Johnson et al., 2019). Another study found that APNs performed laser capsulotomies just as well as experienced ophthalmologists (Moussa et al., 2023). This similarity in outcomes was attributed to the advanced training and extensive clinical experience of APNs, who often handle a wide range of cases (Moussa et al., 2023). Past research, however, has provided nuanced perspectives on the equivalence of performance (Hoang, Singh, & Singh, 2021). In a study on rapid ECG interpretation for myocardial infraction, the diagnostic accuracy and interpretation sensitivity improved with the level of training (Hoang et al., 2021). APNs with more than ten years of experience demonstrated diagnostic proficiency equivalent to that of fifth-year physician assistants but remained inferior to that of expert physicians (Hoang et al., 2021). This suggests that standardized training and experience are crucial factors in achieving comparable performances among healthcare professionals.

The complexity of tasks can have a significant impact on procedural simulation (Haji et al., 2016). For simple tasks, performance remains steady, regardless of training. For instance, a study showed no difference in infection rates between MS and experienced doctors (Singer et al., 1995). However, in complex tasks like microsurgery, differences in performance between surgical assistants and surgeons become apparent (Rodriguez, Yañez, Cifuentes, Varas, & Dagnino, 2016). Simulations seems able to effectively teach basic techniques but can't replace real-world experience for more advanced technical abilities. Achieving the level of expertise demonstrated by expert professionals requires extensive practice and knowledge reinforcement, which may be impractical and resource-intensive within a simulation setting. Therefore, it would be worthwhile to look more closely at the simple acts to be taught to APNs for which procedural simulation would be genuinely efficient, so as not to allocate human and material resources for unattainable objectives (Marshall, 2012).

Interdisciplinary training

This study integrated MS and APN in a shared training without causing significant differences in student satisfaction, performance, or self-efficacy. These findings suggest the potential for future interdisciplinary training, which could mitigate tribalism within healthcare settings (Braithwaite et al., 2016).

Students suggested that shared training enhanced their learning. They also emphasized the value of interdisciplinary interactions for gaining insights into other professions and for fostering effective teamwork in the future. A wealth of research has illustrated the capacity of simulation to diminish tribalism and enhance interprofessional collaboration. (Bolous et al., 2022; Eppich & Cheng, 2015b). For example, research has revealed that simulation-based training leads to increased communication and cooperation among healthcare professionals, as well as greater appreciation for the expertise and perspectives of other disciplines. Simulation encourages interprofessional collaboration by bringing together students from various disciplines in a shared simulated clinical environment, fostering a sense of teamwork and mutual respect (Zechariah, Ansa, Johnson, Gates, & Leo, 2019). Through shared experiences and interactions, students gain a deeper understanding of each other's roles and contributions to patient care, breaking down barriers and promoting a more cohesive healthcare team (Bendowska & Baum, 2023).

Addressing these challenges necessitates a systematic approach informed by implementation science principles, with a focus on understanding the factors that facilitate or hinder the adoption and integration of evidence-based practices in real-world settings. By applying implementation science methodologies, educators and healthcare institutions could better identify the barriers and facilitators to implementing interdisciplinary simulations (Connolly, De Brún, & McAuliffe, 2022).

Limitations

This study may be affected by selection bias, as participants were included without prior selection and had diverse educational backgrounds. The small sample size limits the generalizability of the findings, thereby warranting caution. Moreover, medical students had prior suturing experience while APNs did not, potentially influencing their technical skills. Despite training APN and medical students at different times, efforts were made to standardize the instruction by using the same simulation-trained instructor and standardized simulation sessions with clearly defined objectives. Furthermore, to ensure consistency throughout the sessions, the same member of the research team attended them all.

Conclusions

Our study highlights the effectiveness of procedural simulation in achieving similar levels of technical skills acquisition among future APNs and physicians. Despite the varying backgrounds and experiences of our participants, the findings underscore the potential of such a training method to foster equal levels of satisfaction, performance, and self-efficacy across the diverse group. Moreover, the role of e-learning in learning pathways appeared to be an important tool in promoting autonomous learning. In the future, we feel it is imperative to explore how cultural norms within each discipline may influence learning processes and devise strategies for the optimal implementation of interdisciplinary simulation training.

Declaration of competing interest

The authors declare no conflict of interest.

Appendix A. responses to the qualitative questionnaire on plasters

1. Do you think this type of teaching is necessary for your training?	APN (n = 7)	Medical students (n = 13)
• An interesting part of overall training	7	12
• Not interesting for future professional practice	4	2
• Allows you to acquire general knowledge	3	4
• Useful for future work	3	4
2. Do you think you have fully mastered the technique required?	**APN (n = 7)**	**Medical students (n = 13)**
• Partially acquired	5	9
• Still need to practise/train	5	4
• Acquired knowledge first points	2	7
• Difficult to do alone / need help and supervision	2	2
3. What are your first impressions of the plaster training course?	**APN (n = 7)**	**Medical students (n = 13)**
• Partially acquired	7	9
• Still need to practise/train	3	7
• Acquired knowledge first points	3	1
• Difficult to do alone / need help and supervision	4	1
4. Did this course meet your personal expectations?	**APN (n = 7)**	**Medical students (n = 13)**
• This course met personal expectations	4	12
• No or low personal expectations of the course	4	1
• More theoretical information	0	1
5. What do you see as the positive aspects of this training?	**APN (n = 7)**	**Medical students (n = 13)**
• Ability to perform the act/practice	4	9
• Presence and skills of a field physician	4	3
• Learn by watching others in small groups	1	4
• Not doing it on a real patient/right to make a mistake	0	6
6. What suggestions would you make to improve this training course?	**APN (n = 7)**	**Medical students (n = 13)**
• No suggestions for improvement	3	3
• Being able to repeat the act several times	3	0
• More time/sessions for training	2	4
• Interdisciplinary training	4	7
• Putting more detail into e-learning	1	5

Appendix B. responses to the qualitative questionnaire on sutures

1. Do you think this type of teaching is necessary for your suture training?	APN (n = 9)	Medical students (n = 13)
• Interesting in training	8	13
• Actions they must/could take in future practice	7	5
• Not useful for future career orientation	4	0
• I already had the opportunity to do so as part of an internship	0	3
2. Do you think you have fully acquired the technical skills required for suturing?	**APN (n = 9)**	**Medical students (n = 13)**
• Fully acquired	7	12
• Still need to practise / train	4	1
• Already notions/experiences of the act	2	6
• Need help/Supervision	1	2
3. What are your first impressions of the suture training course?	**APN (n = 9)**	**Medical students (n = 13)**
• Good training overall	7	10
• Presence of a physician	5	2
• Popular course format/simulation	6	4
• Possibility of practising	3	4
4. Did this course meet your personal expectations?	**APN (n = 9)**	**Medical students (n = 13)**
• This course met my personal expectations	5	12
• No or low personal expectations of the course	1	0
5. What do you value most about this course?	**APN (n = 9)**	**Medical students (n = 13)**
• Presence and assistance of a physician	6	4
• Putting it into practice	3	6
• Training in small groups/ambiance	2	5
• First time safety in simulation	2	5
6. What suggestions would you make to improve this training course?	**APN (n = 9)**	**Medical students (n = 13)**
• No suggestions for improvement	6	3
• E-learning improvement	1	1
• Organizing training earlier in the curriculum	0	4
• Learning new points	0	3
• Produce and distribute summary sheets	0	2

CRediT authorship contribution statement

Sabrina Chevalier: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Méryl Paquay:** Writing – original draft, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Sylvie Krutzen:** Investigation, Formal analysis, Data curation. **Alexandre Ghuysen:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization. **Samuel Stipulante:** Writing – review & editing, Validation, Supervision, Conceptualization.

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