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In situ simulation and its different applications in healthcare: an integrative review

Simulação in situ *e suas diferentes aplicações na área da saúde: uma revisão integrativa*

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ABSTRACT

Introduction: The in situ simulation (ISS) consists of a training technique that takes place in the real workplace as a relevant method to promote environmental fidelity in the simulated scenario.

Objective: To verify the use of the ISS in the world, to understand its applicability in healthcare.

Method: This is an integrative review, which used the following guiding question: How has in situ simulation been used by health professionals? Searches were carried out in the PubMed, SciELO, LILACS and Web of Science databases, with different combinations of the following descriptors: in situ simulation, health and medicine (in Portuguese, English and Spanish) and the Boolean operators AND and OR using a temporal filter from 2012 to 2021. A total of 358 articles were found and the inclusion and exclusion criteria were applied, following the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), and also with an independent peer review, using Rayyan, leaving 190 articles for this review.

Results: The results showed that the United States has the absolute majority of productions (97/51%), followed by Canada, but with a large numerical difference (18/9.5%). Most of the works are written in English (184/96.8%), are quasi-experimental studies (97/51%), and have multidisciplinary teams as the target audience (155/81.6%). The articles have 11,315 participants and 2,268 simulation interventions. The main ISS scenarios were the urgent and emergency sectors (114/60%), followed by the ICU (17/9%), delivery room (16/8.42%) and surgical center (13/6.84%). The most frequently studied topics were CPR (27/14.21%), COVID-19 (21/11%), childbirth complications (13/6.8%) and trauma (11/5.8%).

Discussion: The pointed-out advantages include the opportunity for professional updating with the acquisition of knowledge, skills and competencies, in an environment close to the real thing and at low cost, as it does not depend on expensive simulation centers.

Conclusion: In situ simulation has been used by health professionals worldwide, as a health education strategy, with good results for learning and training at different moments of professional training, with improved care and low cost. There is still much to expand in relation to the use of ISS, especially in Brazil, in the publication of studies and experience reports on this approach.

Keywords: Simulation Training, High Fidelity Simulation Training, Health Human Resource Training, Work Engagement.

RESUMO

Introdução: *A simulação in situ (SIS) consiste em técnica de capacitação que ocorre no local real de trabalho como um método relevante para promover a fidelidade ambiental no cenário simulado.*

Objetivo: *Este estudo teve como objetivo verificar o uso da SIS no mundo para compreender sua aplicabilidade na área de saúde.*

Método: *Trata-se de uma revisão integrativa que adotou a seguinte questão norteadora: "Como tem sido utilizada a simulação in situ por profissionais da área da saúde?". Foram realizadas buscas nas bases PubMed, SciELO, LILACS e Web of Science, com as diferentes combinações dos descritores "simulação in situ", "saúde" e "medicina" (em português, inglês e espanhol) e os operadores booleanos AND e OR, com utilização de filtro temporal de 2012 a 2021. Encontraram-se 358 artigos, nos quais se aplicaram os critérios de inclusão e exclusão, seguindo as recomendações do Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). Após revisão independente realizada por pares, com o uso do Rayyan, restaram 190 para esta revisão.*

Resultado: *Os resultados mostraram que os Estados Unidos detêm a maioria absoluta das produções (97/51%), seguidos do Canadá, porém com grande diferença numérica (18/9,5%). A maior parte dos trabalhos está escrita em inglês (184/96,8%), é quase experimental (97/51%) e tem equipes multiprofissionais como público-alvo (155/81,6%). Os artigos têm 11.315 participantes e 2.268 intervenções de simulação. Os principais cenários de SIS foram os setores de urgência e emergência (114/60%), seguidos de UTI (17/9%), sala de parto (16/8,42%) e centro cirúrgico (13/6,84%). Os temas mais estudados foram RCP (27/14,21%), Covid-19 (21/11%), complicações do parto (13/6,8%) e trauma (11/5,8%). As vantagens apontadas incluem: atualização profissional e aquisição de habilidades e competências em ambiente próximo do real e de baixo custo por não depender de dispendiosos centros de simulação.*

Conclusão: *Em todo o mundo, a SIS tem sido utilizada por profissionais da saúde como estratégia de educação na área de saúde, com bons resultados para aprendizagem e capacitações de diferentes momentos da formação profissional e com melhora da assistência. Ainda há muito o que expandir em relação ao uso da SIS, sobretudo no Brasil, na publicação de estudos sobre essa abordagem.*

Palavras-chave: *Treinamento por Simulação; Treinamento com Simulação de Alta Fidelidade; Capacitação de Recursos Humanos em Saúde; Engajamento no Trabalho.*

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INTRODUCTION

Simulation is an increasingly recognized tool for teaching, training and assessing healthcare professionals. Having been used for many years to improve clinical care and teamwork, simulation can be carried out in different environments: off-site (simulation centers or other locations far from clinical units) or *in situ* (real clinical environment)[1].

In situ simulation (ISS) consists in a training technique that takes place in the real workplace, along the same lines as traditional clinical simulation, including the briefing steps (contextualization and detailing of the simulated scenario before application), development of the simulated scenario and debriefing (dialogues after the practice aiming at promoting reflection). It is a very promising method to promote the environmental fidelity of those involved in the simulated scenario[2].

When carried out at the professional place of work, the ISS allows evaluating the practical and critical thinking skills of a healthcare team in their work environment, encouraging the improvement of clinical practices[3]. Moreover, it allows the institution to address a series of aspects related to the healthcare processes, organizational efficiency and operational safety, including the identification of latent hazards, knowledge gaps, unmet equipment needs, environmental issues and space constraints, as well as a multitude of issues linked to human resources[4].

There is evidence of benefits, including those related to the perceived self-efficacy, that is, the perception of technical advances related to training. National studies have shown that professionals perceived the *in situ* simulation strategy as valid for professional updating and practical learning in a safe environment[5-8]. At the international level, it can be observed that simulation is widely practiced at different levels of care[9,10], also as a quick and efficient tool to implement protocols in cases of outbreaks[11-16] and can also be an acceptable approach for training the interprofessional team in primary care[17].

Despite these findings, simulation continues to be carried out preferably in simulation centers. This practice requires the presence of these spaces, technological resources and the availability of trained personnel to conduct them, which, in the vast majority of cases, do not exist in health services. This prevents the development of simulation activities by professionals who work in patient care[9]. In places that adopted ISS in their routine, the fidelity of the scenario showed a clear advantage, with a great impact on the transfer of knowledge to participants in simulated practices[18].

It is worth highlighting that the simulation carried out in simulation centers is usually related to a curriculum or the development of technical and non-technical skills in undergraduate or continuing education spaces. In this context, the inclusion of training for care teams with a focus on the health network, rather than individuals or failures, emphasizes teamwork and the development of instruction, investigation, workload distribution, surveillance and conflict resolution skills[19].

The use of clinical simulation is recent in universities, medical schools and other areas of health in Brazil. The National Curricular Guidelines for Medical Courses of 2001 and 2014 were attempts to change this scenario, promoting greater integration between teaching-service-community and providing prior skills training, through simulation, anticipating contact with real patients[20].

Training non-technical skills is much more than just a simulation activity. This training is loaded with such a plurality of skill areas, topics, multiple configurations for training and assessment procedures that it becomes a possible process to define common values and fundamental standards necessary for professional activity[21]. The ISS aims to enable teams to review and improve their skills in the real clinical environment[22].

There are few researchers dedicated to the topic in Brazil[5-8], and these are usually linked to academia and not to health care services, which may lead to the underutilization of this tool for developing better assistance by multidisciplinary health teams[23].

Therefore, as ISS is an emerging and promising learning strategy in education for health professionals, it is relevant to identify how it has been used worldwide. This study aims to understand its applicability in different environments, topics and health areas worldwide, identifying the situation in Brazil in this context.

METHOD

The integrative review was the method chosen due to its potential to capture the complexity of broad and varied perspectives of a studied phenomenon. The study followed the following steps: problem identification, literature search, data evaluation, data analysis and presentation[24]. It was also based on the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)[25].

For data collection, the PICO (Patient, Intervention, Comparison and Outcomes) strategy was used, with the following guiding question: "*How has* in situ *simulation been used by health professionals*?". Searches were carried out in the following databases: PubMed, Scientific Electronic Library Online (SciELO) and Latin American and Caribbean Literature in Health Sciences (LILACS) and Web of Science.

Once the terms and their combinations were adopted (Chart 1), the searches were limited to studies published from 2012 to 2021, considering that relatively recent articles can

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more accurately translate the context of *in situ* simulation used by health professionals worldwide. The last search in the consulted databases was carried out on March 11, 2022.

In the LILACS and SciELO databases, the strategy of expanding the search was adopted by translating the term "*in situ* simulation" into Portuguese and Spanish, as they are bases that accept multiple languages in their indexing. On Pubmed, the term '*in situ* simulation' was maintained in English as, on this platform, the variation in translation of the term did not change the search result. In the Web of Science database, the search for results within health topics was restricted, as it is a storage site with the possibility of results in the most diverse areas of knowledge.

Considering that the study analyzed studies on simulation used by healthcare professionals within their work environment, the ones that dealt with simulations carried out in a simulation center and other environments (off-site) and *in situ* simulations carried out by other areas of knowledge were excluded. Moreover, the following were also excluded: (a) articles in duplicate; (b) studies considered gray literature (editorials, theses and annals); (c) publications whose participants were not health professionals; (d) studies that deviated from the main topic, despite containing the topic of *in situ* simulation in the body of the text; (for example: simulation of cell proliferation *in situ*); (e) literature reviews.

When divided by databases, the platforms showed the following results, respectively: LILACS 19, SciELO 8, Web of Science 270, Pubmed 61, totaling 358 articles.

These 358 articles were exported to the Rayyan systematic review program to facilitate peer review[26].

The program indicated 34 articles in duplicate, seven of which were automatically excluded, as they were considered exact duplications, and 27 were indicated for analysis by the reviewers, who considered 26 articles as duplications, totaling the exclusion of 33 articles according to this criterion.

Chart 1. Literature search strategy based on the chosen databases.

Databases	Search terms
PubMed	"*in situ* simulation"
LILACS	"*in situ* simulation" OR "simulação *in situ*" OR "simulación *in situ*"
SciIELO	"*in situ* simulation" OR "simulação *in situ*" OR "simulación *in situ*"
Web Of Science	"*in situ* simulation" AND (Health OR Medical)

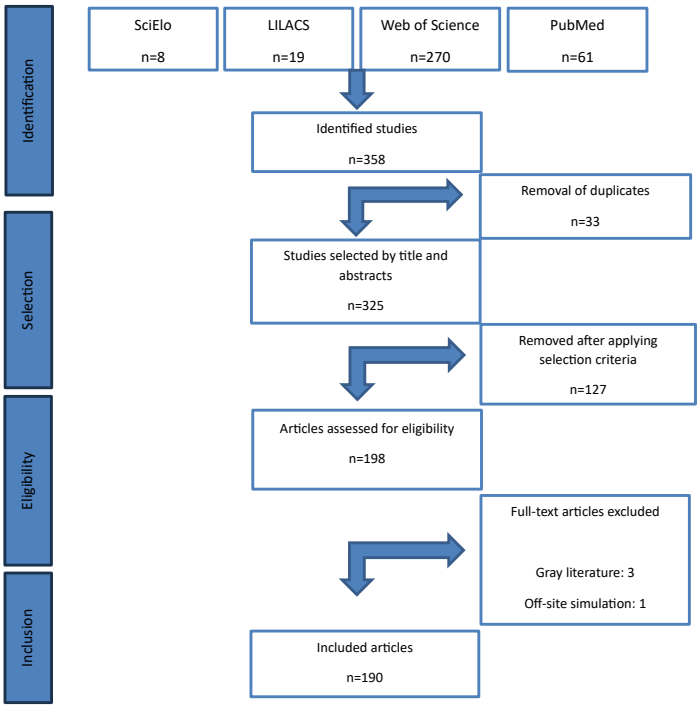
Source: prepared by the authors.

The analysis of the remaining 325 articles occurred by reading the titles and abstracts through independent reading by two authors, and as there was no disagreement between them, 127 articles were excluded and 198 were selected for reading in full, with a further eight articles being excluded, thus leaving 190 articles to comprise the sample. The selection process for articles included in this review is shown in the PRISMA[25] flowchart below (Figure 1).

The authors independently read the articles included in the sample to extract data using a specific form created to gather the following information: Author; Country of study; Continent; Language; Journal; Years of publication compiled into blocks; Study design; Level of Evidence (level I - meta-analyses of controlled and randomized clinical studies; level II - experimental design study; level III - quasi-experimental studies; level IV - qualitative non-experimental studies or descriptive studies; level V - case reports or experience reports; and level VI - expert opinions or based on regulatory or legal standards)[27]; Goal; Target Audience; Objective of the intervention; Methodology used; Number of participants; Number of simulation sessions; Thematic area (surgery, internal medicine, pediatrics, collective health or gynecology and obstetrics); Place of performance; Covered topic; Results and Conclusions.

To organize the information, studies with a quantitative, qualitative and mixed methods approach were differentiated. Subsequently, a narrative synthesis of the data was carried out using thematic analysis[28].

Figure 1. Flowchart of steps used for sample selection.



Source: Prepared by the authors based on the PRISMA[25] recommendation.

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RESULTS

Table 1 shows the characterization of the selected studies, according to continent, language, year of publication, type of study and level of evidence, demonstrated by numbers and corresponding percentages.

The analysis of the articles showed that the United States has the absolute majority, with 97 articles (51%), followed by Canada with 18 articles, showing a large numerical difference (9.5%). Only seven studies (3.7%) were conducted in Brazil. Thus, the majority of the 184 studies are written in English (96.8%), with four in Portuguese (2.1%) and two in Spanish (1%).

An increase in publications was observed in the last four years (70.53%), showing that ISS has been more applied and studied.

When the studies are divided according to type, the majority of 97 (50.05%) were quasi-experimental, with level of evidence III, followed by 63 descriptive studies (33%), and 11 qualitative ones (5.8%), both with level of evidence IV (38.8%).

Regarding the target audience, studies involving multidisciplinary teams predominated, with 155 publications (81.6%), followed by nursing, with only 14 studies (7.4%).

Table 2 shows the characterization of the studies based on thematic areas, according to the target audience, covered topic and scenario/sector.

In relation to the place where the simulations were carried out, there was a predominance in the urgency and emergency sector, with 114 studies (60%), with the majority of simulations carried out in Internal Medicine with 54 studies (47.4%) and Pediatrics with 40 studies (35%). Next, we have the ICUs with 17 studies (9%), of which eight are in Internal Medicine (47%) and eight in Pediatrics (47%). The Delivery room had 16 studies (8.42%), of which nine studies were in Obstetrics (56.25%) and 6 in Pediatrics (37.5%). The Surgical center had 13 studies (6.84%), of which ten (76.9%) were in Surgery.

When we analyze the areas individually, we see that ISS has been most applied in Internal Medicine, with 71 studies (37.3%), followed by Pediatrics with 59 (31%) and Surgery with 20 (10.5%).

The most frequently discussed topics in the ISS, according to the studies, were CPR with 27 publications (14.2%), followed by COVID-19 with 21 publications (11%), delivery complications with 13 publications (6.8%) and trauma with 11 (5.8%).

Table 3 shows the characterization of the studies based on the type of intervention and number of simulated activities.

Regarding the type of intervention, 85 (44.7%) studies were on permanent education (defined as such or that had regular activities), followed by 81 (42.6%) with isolated training, which were classified as continuing education.

Table 1. Characterization of the selected studies, according to continent, language, year of publication, type of study and level of evidence.

Characteristics	Frequency	%	Cumulative
Continent			
North America	115	60.53	115
South America	8	4.21	123
Africa	3	1.58	126
Europe	43	22.63	169
Asia	16	8.42	185
Oceania	5	2.63	190
Antarctica	0	0	190
Total	190	100%	190
Language			
English	184	96.84	184
Spanish	2	1.05	186
Portuguese	4	2.11	190
Others	0	0	190
Total	190	100%	190
Year of publication			
2012 - 2013	7	3.68	7
2014 - 2015	24	12.63	31
2016 - 2017	25	13.16	56
2018 - 2019	53	27.90	109
2020 - 2021	81	42.63	190
Total	190	100%	190
Type of study and level of evidence			
Experimental study - II	8	4.21	8
Quasi-experimental study - III	97	51.05	105
Descriptive study - IV	63	33.16	168
Qualitative study - IV	11	5.79	179
Mixed study - IV	7	3.68	186
Experience report - V	4	2.11	190
Total	190	100%	190

Source: prepared by the authors.

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Table 2. Characterization of studies based on thematic areas, according to target audience, covered topic and scenario/sector.

	Internal medicine n:71		Pediatrics n:59		Surgery n: 20		Others/ Multiple[a] n:18		Obstetrics n:16		Anesthesiology n:1		Mental health n:1		Collective health / Family medicine n:4		
Público Alvo																	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	TOTAL
Multiprofessional team	56	78. 9	49	83.0	17	85.0	18	100.0	11	68.75	0	0	1	100.0	3	75.0	**155**
Nurses	8	11.3	2	3.4	1	5.0	0	0	2	12.5	0	0	0	0	1	25.0	**14**
Physicians	2	2.8	2	3.4	1	5.0	0	0	1	6.25	1	100.0	0	0	0	0	**7**
Medical Residents	2	2.8	1	1.7	1	5.0	0	0	1	6.25	0	0	0	0	0	0	**5**
Undergraduate students	2	2.8	4	6.8	0	0	0	0	0	0	0	0	0	0	0	0	**6**
Others	1	1.4	1	1.7	0	0	0	0	1	6.25	0	0	0	0	0	0	**3**
Total	71	100%	59	100%	20	100%	18	100%	16	100%	1	100%	1	100%	4	100%	190
Covered topic																	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	TOTAL
CPR	13	18.3	14	23.7	0	0	0	0	0	0	0	0	0	0	0	0	**27**
COVID 19	17	23.9	0	0	1	5.0	2	11.1	0	0	1	100.0	0	0	0	0	**21**
Trauma	2	2.8	3	5.1	6	3.0	0	0	0	0	0	0	0	0	0	0	**11**
Sepsis	3	4.3	3	5.1	0	0	0	0	0	0	0	0	0	0	0	0	6
Delivery complications	0	0	1	1.7	0	0	1	5.5	11	68.75	0	0	0	0	0	0	**13**
Patient safety	1	1.4	0	0	2	5.0	3	16.7	0	0	0	0	0	0	0	0	**6**
Others	35	49.3	38	64.4	11	55.0	12	66.7	5	31.25	0	0	1	100.0	4	100.0	**106**
TOTAL	71	100%	59	100%	20	100%	18	100%	16	100%	1	100%	1	100%	4	100%	190
Sector																	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	TOTAL
Urgency / Emergency	54	76.0	40	67.8	10	50.0	7	39.0	3	18.75	0	0	0	0	0	0	**114**
Delivery room	0	0	6	10.2	0	0	1	5.5	9	56.25	0	0	0	0	0	0	**16**
ICU / CCU	8	11.3	8	13.5	0	0	0	0	0	0	1	100.0	0	0	0	0	**17**
Surgical center	0	0	0	0	10	50.0	1	5.5	2	12.5	0	0	0	0	0	0	**13**
Ambulatory	2	2.8	1	1.7	0	0	0	0	0	0	0	0	0	0	3	75.0	**6**
Ward	3	4.3	0	0	0	0	0	0	1	6.25	0	0	1	100.0	0	0	**5**
Others	4	5.6	4	6.8	0	0	9	50.0	1	6.25	0	0	0	0	1	25.0	**19**
TOTAL	71	100%	59	100%	20	100%	18	100%	16	100%	1	100%	1	100%	4	100%	190

[a]Within this category, data relating to articles that had application to multiple teams and which articles were not clear regarding the relevance and quantification of participants in each area were included. Therefore, these are studies that talk about its systematic application in different areas in health services.
Abbreviations: CPR - Cardiopulmonary resuscitation; ICU/CCU - Intensive Care Unit/Critical Care Unit
Source: prepared by the authors.

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Table 3. Characterization of studies based on the type of intervention and number of simulated activities.

Type of intervention	Frequency	%
Class/Demonstration	12	6.3
Continuing Education	81	42.6
Evaluation	10	5.3
Permanent Education	85	44.7
No information	2	1.1
Total	190	100%
Simulated activities	**Frequency**	**%**
From 1 to 10	113	59.5
From 11 to 20	26	13.7
From 21 to 30	8	4.2
From 31 to 40	8	4.2
From 41 to 100	8	4.2
> 100	5	2.6
No information	22	11.6
Total	190	100%

Source: prepared by the authors.

Chart 2 shows the evidence associated with studies of continuing education interventions and, in general, it can be observed they are related to patients, the professionals' technical and non-technical skills, patient safety and the teaching/learning process, as highlighted in the chart below:

It was possible to identify some advantages in the results related to *in situ* simulation as an opportunity to update and acquire knowledge, professional skills and competencies[5]. Other results include the improvement in teamwork and individual learning, and the ability to offer greater realism and transferability, at low cost[61,89,90].

Furthermore, it allows improved performance in real clinical scenarios, helping to reveal important latent risks and the implementation of corrective measures[77,91,92].

Considering the data extracted from the articles, a total that exceeds 2,268 simulation interventions and 11,315 participants stands out, since it was not possible to extract this information from 29 articles, as shown in Chart 3.

DISCUSSION

The use of ISS allowed the approach of several useful topics in the most different areas of knowledge, disciplines and cultures, being reproduced in different places worldwide,

Chart 2. Evidence associated with the studies that showed results of continuing education interventions.

Evidence associated with patients	Better outcome for general emergency patients[31]; Better blood glucose control for pediatric patients; Reduction in weighted mortality adjusted to the risk of septic shock[32]; Increase in the number of patients referred to the allergy unit[33]; Better patient comfort in the emergency department[34].
Evidence associated with the professionals' technical skills	Improvement in pediatric airway management[35]; Improved accuracy in recognizing signs and symptoms of patients with clinical deterioration and provision of effective initial interventions[36]; Increased adherence by professionals to different care guidelines[10,37,38]; Improvement in teamwork performance of professionals in resuscitation[39-42]; Improvement in the correct management of anaphylaxis[33]; Improvement in trauma simulation assessment scores[43]; Improving teamwork in intubation[44]; Improvement in the performance of pediatric trauma care[45]; Improvement in the timely use of resources when responding to crises[13,46]; Improvement in levels of knowledge in ECMO[47]; Improved accuracy in recognizing signs and symptoms of patients with clinical deterioration and provision of effective initial interventions[36];

continue...

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Quadro 2. Conitnuation.

Evidence associated with the professionals' non-technical skills	They contributed to a significant improvement in professionals' confidence in relation to the procedures[48-50]; Improved communication[13,46,51,52]; Improved teamwork[4,22,32,39,53-56]; Improvement in leadership capacity[57-59]; Improvement in interprofessional collaboration[60]; Improves the identification of professionals' roles[49]; Improving team familiarity with devices, equipment and environment[61]; Improvement in the professionals' emotional response[62]; Improvement in the professionals' comfort and satisfaction[50,63].
Evidence associated with patient safety	Improvement in the identification of latent safety threats in the clinical care environment[13,46,49,64-70]; Promotes a culture of patient safety[22,42,71-75]; It makes it possible to mitigate risks to patient safety[2,4,64,67,76-79]; Identify areas that require additional education to improve patient safety[72,80]; Provides an environment to safely train interventions[72,81,82].
Evidence associated with the teaching-learning process.	Adequate use of educational resources[83]; Better learning results[61,83-85]; Enables interprofessional education[57]; Allows adults to learn in a safe environment[36]; Reliable to evaluate the professionals' clinical performance[66,86]; Allows simulation training with few resources[77,72,87,88].

Source: prepared by the authors.

Chart 3. Characterization of the selected studies, according to the number of participants and number of simulated activities per thematic area.

Thematic Area	Total Participants	Total Simulated Activities
Internal medicine	3,851	988
Pediatrics	3,406	494
Surgery	1,293	516
Obstetrics	133	63
Anesthesia	12	36
Mental Health	53	8
Collective health/Family medicine	130	55
Interprofessional/Others	2,437	108
Total	11,315	2268

Source: prepared by the authors.

considering the fact that it respects and adapts to the characteristics of local services, without requiring large extra investments for its performance.

Moreover, it demonstrated several advantages related to its use, reinforcing literature findings and strengthening evidence that its use brings several benefits to care, professionals and patients, as demonstrated in other studies that used the ISS and stated significant gains in confidence, both for experienced professionals and for teams in their early stages of training[7,94].

In this context, confirming the findings of other studies that indicated advantages similar to those found in this review[2,89,95], ISS offers an opportunity to complement the overworked team and compensate for temporary losses due to sick leave or quarantine[94].

When performed with planning and coherence, the ISS offers an opportunity to complement technical skills, especially those focused on urgency and emergencies, such as training in trauma care, cardiopulmonary resuscitation (adult and pediatric), actions in the COVID-19 pandemic , sepsis management, birth complications, among others, shown in 114 of the 190 selected articles. In Brazil, the use of ISS was used in

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scenarios of cardiorespiratory arrest[5,6,8], sepsis[7] and Covid-19[96]. Regarding the development of non-technical skills, we have as an example its use in promoting patient safety[2,4,32,36-38,64,67,76-79,97], a safe institutional environment[29,30,92] and self-management in situations of crisis [18,57-59,98,99], of the teams, without the need for travel, without the use of high-cost simulation centers and with a real projection of the participant's routine. It is noteworthy that ISS is especially important when used in high-risk clinical scenarios with time pressure[94].

The use of *in situ* simulation was also associated with increased clinical reasoning and teamwork capacity, with an overall improvement in the participants' theoretical practice and practical skills[100]. When one observes the scenarios in which they were applied, one can associate the findings with other studies that strengthen the obtained data[5,30,43,85,101].

Several articles using ISS to optimize patient safety showed better clarity of team members' roles in relation to medication administration carried out in the clinical environment[95,102-104] and the ability to identify latent safety threats attenuated by practice[2,4,13,46,49,64-70,76-79,89,95,105].

Training programs for multidisciplinary teams[4,11,12,22,32,39,53-56,95,106,107] using ISS have been shown to effectively improve the technical and non-technical skills of health professionals for managing emergency situations, in addition to optimize learning, both at individual's and team's levels[90]. Thus, ISS can be valuable to improve patient safety, as it allows the practice of care team dynamics within a real clinical environment[4].

In simulations in the urgency and emergency sector in the area of pediatrics, studies on training stand out using protocols that showed good performance in work dynamics, such as Pediatric Advanced Life Support (PALS)[6,32,43].

For Maloney (2018), emergency units favor the use of ISS because they require early identification and management of critical situations by health teams, which must be previously trained for quick and accurate intervention[108].

A study with ISS in a pediatric intensive care unit showed a trend towards fewer admissions, a reduction in the morbidity level at the time of admission, a reduction in the length of ICU stay and mortality, which are relevant aspects in the quality of care and patient safety[109].

Studies have also shown good results in perinatal care training, significantly improving response times to postpartum hemorrhage in labor and delivery teams with clinical experience, and also decreasing the rate of obstetric trauma and C-section births[75,110].

ISS has also been used to identify and reduce risks during the transport of neonatal patients. One study even promoted changes in transport policy for imaging exams[111]. Another study showed an improvement in general performance and teamwork in orotracheal intubation in trauma care[43].

Studies have also shown success with simulated emergencies in therapies such as extracorporeal membrane oxygenation (ECMO) and the team's performance during a simulated emergency at the bedside in the coronary unit, making it possible to simulate the invasive procedure necessary to solve the case[47,112].

The COVID-19 pandemic, in fact, was an incentive for a series of transformations, from clinical practice structures, to changes in the implementation of education and research, which required determination, innovation, creativity and adaptability by hospital teams in many circumstances[15].

The predominance of ISS applied to multidisciplinary teams demonstrates that it has been used for continuing education, as it leads to greater planning for responses to the complex and growing problems observed in the current context[93]. Thus, the participants review the relationships between their professions, increase mutual understanding, and explore ways to combine their knowledge to improve service provision, patient safety, and quality of care[113].

Although ISS is recognized as a promising field of simulation, unlike the international scenario, where its use is already consolidated in sporadic training programs for health professionals[114], few studies are yet identified on the use of this strategy in Brazil[5,6, 96].

It is noteworthy, however, that such results should not be used as evidence for lack of ISS use, as it must be considered that continuing education professionals are not always involved with academia. Thus, there is a hypothesis that its use is not being published in journals, and/or systematically monitored regarding its results. One of the arguments that support this hypothesis is the fact that Mobile Emergency Care Services (SAMU, *Serviços de Atendimento Móveis de Urgência*) in Brazil have a Permanent Education Center (NEP, *Núcleo de Educação Permanente*), based on different legislation such as GM Ordinances 2048/02, 1863/03, 198/04, 1996/07, 1010/12, 278/14, among others, which frequently deal with ISS. Nevertheless, it was not possible to identify articles on such training in this review[101,105]. Therefore, it would be appropriate to encourage the monitoring of the results of such strategies, and publications to disseminate and increase the level of evidence about their advantages[57].

It is worth highlighting the great use of ISS for multidisciplinary training (155/190 articles selected). This strengthens interprofessional collaborative practice which, according to SILVA[115], promotes the collective construction of therapeutic projects, sharing of uncertainties, co-accountability of professionals responsible for care and communicative action.

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The specific actions of each profession involved in health care promote the development of profession-specific skills[115].

The sparse use of ISS for the education and training of uniprofessional teams, for example, multiple medical specialties working together (multidisciplinary) is observed.

The training of Swiss physicians based on pediatric simulation (mainly *in situ*) is a multidisciplinary one, covering technical and non-technical skills and often employing high-tech manikins[98].

In Belgium, the use of recurrent training based on *in situ* simulation had a positive effect on the development of leadership in the neonatal nursing teams; moreover, in this service repeated participation in continuing education in simulation had a positive effect on these results, regardless of the number of years of previous experience[58]. In the United States of America, regularly scheduled pediatric simulations in the emergency department have resulted in improved staff performance over time in expected resuscitation tasks[32].

In Brazil, professionals have observed that the strategy of using *in situ* simulation as a continuing education tool is valid for professional updating and practical learning in a safe environment[5].

Therefore, we recommend the ISS as a useful instrument for training students and health workers at different levels of care and it should be encouraged by managers of health care and education institutions, for practice applied by employees, teachers, students and managers.

A limitation of this study comprises the different characteristics of training and configuration of work teams, as well as the health system of each country, which prevents the generalization of the results.

CONCLUSIONS

The results showed the diverse use of ISS worldwide, demonstrating that its application has grown significantly in recent years. Among the advantages related to ISS, the opportunity to update and acquire knowledge, skills and professional competencies stands out. Its use allowed the improvement in teamwork and individual learning, the ability to offer greater realism and transferability, at a low cost, as it eliminates the high costs of implementing and maintaining a simulation center.

Furthermore, the use of ISS allows an improved performance in real clinical scenarios, helping to reveal important latent risks, and allowing the implementation of corrective measures.

It can be observed that there is still a lot to expand in relation to the use of this resource, especially in Brazil, with regard to the publication of studies and experience reports on this approach. Only five articles published by Brazilian authors were found, applied to urgency and emergency situations in a hospital environment, among the 190 selected for the study.

Therefore, it is suggested that experimental studies be carried out, in different areas of multiprofessional knowledge, to increase evidence on the impact of continuing education using ISS within the characteristics of our country's education and health systems.

AUTHORS' CONTRIBUTION

Marcos Maciel Candido Justino dos Santos: Author, responsible for the research. Sara Fiterman Lima and Gerson Alves Pereira Junior: advisors and reviewers. Carine Freitas Galvão Vieira and Alexandre Slullitel: Reading, data collection and application of the exclusion criteria for full-text articles and bibliographic review. Elaine Cristina Negri Santos: Reading, data collection, peer review.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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