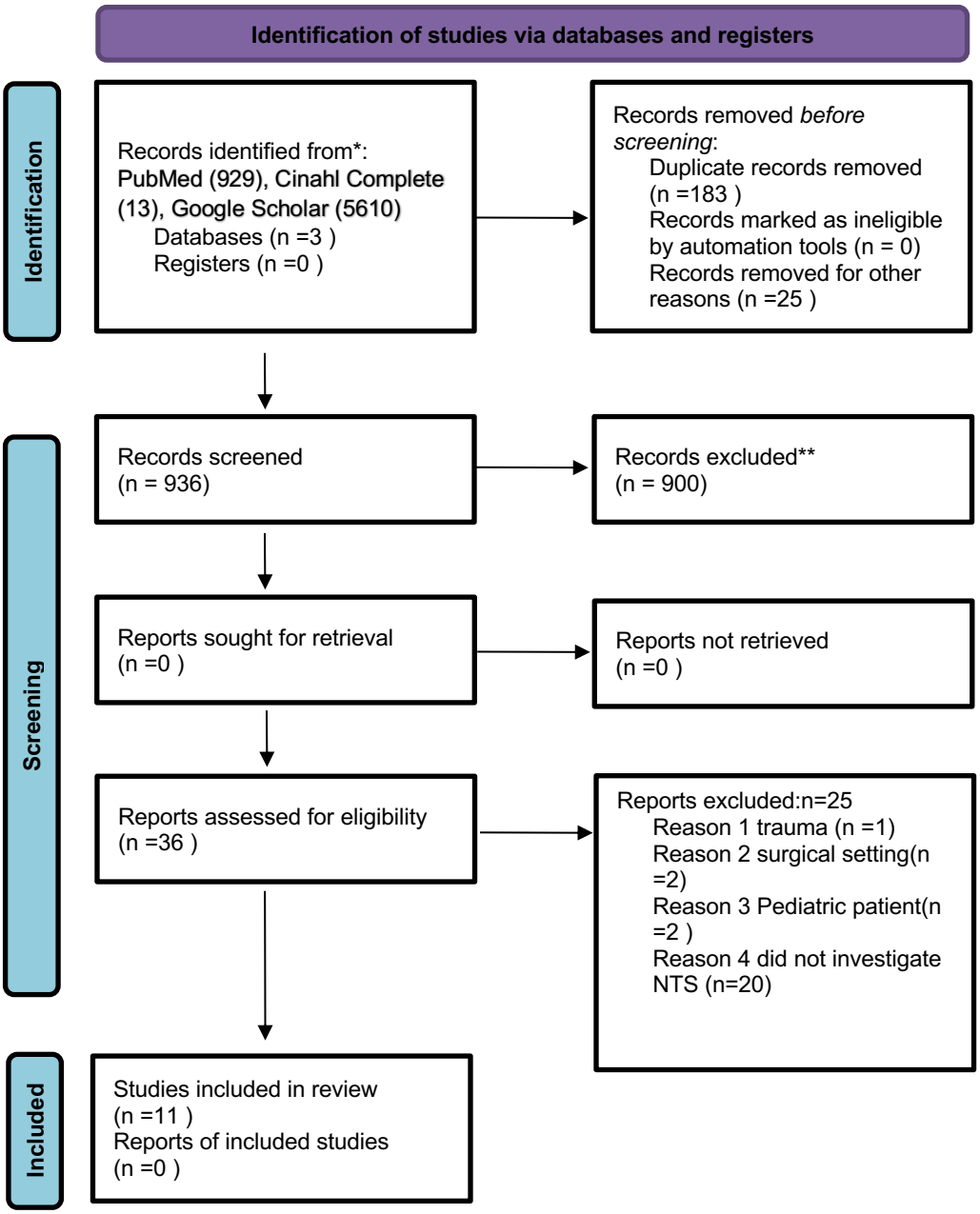
Supplementary materials/Materiali supplementari



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

Table 1. Database search table.

PAROLE CHIAVE/STRINGA	LIMITI	TITOLO DEGLI STUDI					
S1non-technical skills or communication or situation awareness or teamwork	NO	269347	(S1 OR S4 AND S2 AND S3)**13**	4Non-technical skills in out-of-hospital cardiac arrest management: A scoping review. Academic Journal (includes abstract) Cormack, Stefanie; Scott, Steve; Stedmon, Alex Australasian Journal of Paramedicine, 2020; 17 1-8. 8p. (Journal Article - research, systematic review, tables/charts) ISSN: 2202-7270 Subjects: Heart Arrest; Prehospital Care; Teamwork; Decision Making; Communication Skills; Professional Competence			
S2Resuscitat* OR advanced life support OR cpr OR acls	NO	57660		Non-technical skills in pre-hospital care in the Czech Republic: a prospective multicentric observational study (NTS study). Academic Journal (includes abstract) Peran, David; Sykora, Roman; Vidunova, Jana; Krsova, Ivana; Pekara, Jaroslav; Renza, Metodej; Brizgalova, Nikola; Cmorej, Patrik Ch. BMC Emergency Medicine, 5/13/2022; 22(1): 1-8. 8p. (Journal Article - research) ISSN: 1471-227X PMID: NLM35562664 Subjects: Hospitals; Clinical Competence			
S3emergency medical services or ems or prehospital or pre-hospital or paramedic	NO	50752		Teamwork and leadership in out-of-hospital cardiac arrest - do these non-technical skills require attention? Academic Journal (includes abstract) Dagnell, Adam John Australasian Journal of			

				Paramedicine, 2020; 17 1-6. 6p. (Journal Article - tables/charts) ISSN: 2202-7270 Subjects: Heart Arrest Therapy; Prehospital Care; Teamwork; Leadership			
S4non-technical skills or nts or non technical skills	NO	1102		Comparison of two training programmes on paramedic-delivered CPR performance. Academic Journal (includes abstract) Govender, Kevin; Sliwa, Karen; Wallis, Lee; Pillay, Yugan Emergency Medicine Journal (EMJ), May2016; 33(5): 351-356. 6p. (Journal Article) ISSN: 1472-0205 PMID: NLM26698362 Subjects: Education, Medical; Resuscitation, Cardiopulmonary Education; Emergency Medical Technicians Education; Adult: 19-44 years; Male; Female			
"Cardiopulmonary Resuscitation"[Mesh] AND "non-technical skill" **23**	NO	3 Relationship between non-technical skills and technical performance during cardiopulmonary resuscitation: does stress have an influence?Krage R, Zwaan L, Tjon Soei Len L, Kolenbrander MW, van Groeningen D, Loer SA, Wagner C, Schober P.Emerg Med J. 2017 Nov;34(11):728-733. doi: 10.1136/emermed-2016-205754. Epub 2017 Aug 26.PMID: 28844039					
		Do technical skills correlate with non-technical skills in crisis resource management: a simulation study.Riem N, Boet S, Bould MD, Tavares W, Naik VN.Br J Anaesth. 2012 Nov;109(5):723-8. doi: 10.1093/bja/aes256. Epub 2012 Jul 31.PMID: 22850221					
		Identifying non-technical skills and barriers for improvement of teamwork in cardiac arrest teams.Andersen PO, Jensen MK, Lippert A, Østergaard D.Resuscitation. 2010 Jun;81(6):695-702. doi: 10.1016/j.resuscitation.2010.01.024. Epub 2010 Mar 20.PMID: 20304547					
("nontechnical skill" OR non-technical skill*) AND ((("Advanced Cardiac Life Support"[Mesh]) OR "Cardiopulmonary Resuscitation"[Mesh]) OR "Heart Arrest/therapy"[Mesh]) **35**	NO	**7** Feedback in advanced life support: A quality improvement initiative.Thorne CJ, Kimani PK, Hampshire S, Begum-Ali S, Perkins GD; Advanced Life Support Subcommittee of the Resuscitation Council UK.Resuscitation. 2020					

		Oct;155:189-198. doi: 10.1016/j.resuscitation.2020.07.032. Epub 2020 Aug 20.PMID: 32827586				
		Cardiac arrest leadership: in need of resuscitation?Robinson PS, Shall E, Rakhit R.Postgrad Med J. 2016 Dec;92(1094):715-720. doi: 10.1136/postgradmedj-2015-133738. Epub 2016 Jun 8.PMID: 27281816				
		Utility and assessment of non-technical skills for rapid response systems and medical emergency teams.Chalwin RP, Flabouris A.Intern Med J. 2013 Sep;43(9):962-9. doi: 10.1111/imj.12172.PMID: 23611153 Review.				
		Relationship between non-technical skills and technical performance during cardiopulmonary resuscitation: does stress have an influence?Krage R, Zwaan L, Tjon Soei Len L, Kolenbrander MW, van Groeningen D, Loer SA, Wagner C, Schober P.Emerg Med J. 2017 Nov;34(11):728-733. doi: 10.1136/emermed-2016-205754. Epub 2017 Aug 26.PMID: 28844039				
		Identifying non-technical skills and barriers for improvement of teamwork in cardiac arrest teams.Andersen PO, Jensen MK, Lippert A, Østergaard D.Resuscitation. 2010 Jun;81(6):695-702. doi: 10.1016/j.resuscitation.2010.01.024. Epub 2010 Mar 20.PMID: 20304547				
		Do technical skills correlate with non-technical skills in crisis resource management: a simulation study.Riem N, Boet S, Bould MD, Tavares W, Naik VN.Br J Anaesth. 2012 Nov;109(5):723-8. doi: 10.1093/bja/aes256. Epub 2012 Jul 31.PMID: 22850221				
		Effect of a specific training intervention with task interruptions on the quality of simulated advance life support: A randomized multi centered controlled simulation study.Truchot J, Michelet D, Philippon AL, Drummond D, Freund Y, Plaisance P.Australas Emerg Care. 2023 Jun;26(2):153-157. doi: 10.1016/j.auec.2022.10.001. Epub 2022 Oct 12.PMID: 36241582 Clinical Trial.				

((("Cardiopulmonary Resuscitation"[Mesh]) AND "Clinical Competence"[Mesh]) AND "Heart Arrest/therapy"[Mesh]) AND "Patient Safety"[Mesh] **3**	NO	1Do technical skills correlate with non-technical skills in crisis resource management: a simulation study.Riem N, Boet S, Bould MD, Tavares W, Naik VN.Br J Anaesth. 2012 Nov;109(5):723-8. doi: 10.1093/bja/aes256. Epub 2012 Jul 31.PMID: 22850221				
(("Cardiopulmonary Resuscitation"[Mesh]) AND "Communication"[Mesh]) AND "Patient Care Team"[Mesh]**42**		2Teamwork and leadership in cardiopulmonary resuscitation.Hunziker S, Johansson AC, Tschan F, Semmer NK, Rock L, Howell MD, Marsch S.J Am Coll Cardiol. 2011 Jun 14;57(24):2381-8. doi: 10.1016/j.jacc.2011.03.017.PMID: 21658557 Free article.				
		Identifying non-technical skills and barriers for improvement of teamwork in cardiac arrest teams.Andersen PO, Jensen MK, Lippert A, Østergaard D.Resuscitation. 2010 Jun;81(6):695-702. doi: 10.1016/j.resuscitation.2010.01.024. Epub 2010 Mar 20.PMID: 20304547				
("Clinical Competence"[Mesh]) AND "Anesthesiology"[Mesh] AND "non-technical skills" **46**	10 anni	2Importance of non-technical skills in anaesthesia education B Radhakrishnan 1, Manisha D Katikar 2, Sheila Nainan Myatra 3, Parshotam Lal Gautam 4, Stalin Vinayagam 5, Richa Saroa 6 Affiliations Indian J Anaesth . 2022 Jan;66(1):64-69. doi: 10.4103/ija.ija_1097_21. Epub 2022 Feb 3. Expand PMID: 35309030 PMCID: PMC8929322 DOI: 10.4103/ija.ija_1097_21				
		Basic concepts for crew resource management and non-technical skills.Flin R, Maran N.Best Pract Res Clin Anaesthesiol. 2015 Mar;29(1):27-39. doi: 10.1016/j.bpa.2015.02.002. Epub 2015 Feb 20.PMID: 25902464 Review.				
(("Resuscitation"[Mesh]) AND "Emergency Service, Hospital"[Mesh]) AND "Patient Care Team"[Mesh]**92**	10 anni	1Examining non-technical skills for ad hoc resuscitation teams: a scoping review and taxonomy of team-related concepts.Evans JC, Evans MB, Slack M, Peddle M, Lingard L.Scand J Trauma Resusc Emerg Med. 2021 Dec 4;29(1):167. doi: 10.1186/s13049-021-00980-5.PMID: 34863278				
(("Leadership"[Mesh]) AND "Communication"[Mesh]) AND "Emergency Medical Technicians"[Mesh]**12**	10 anni	1Non-technical skills in paramedicine: A scoping review.Bennett R, Mehmed N, Williams B.Nurs Health Sci. 2021 Mar;23(1):40-52. doi: 10.1111/nhs.12765. Epub 2020 Sep 8.PMID: 32734658 Review.				

("Cardiopulmonary Resuscitation"[Mesh]) AND "Communication"[Mesh]**159**	10anni	2Standardising communication to improve in-hospital cardiopulmonary resuscitation.Lauridsen KG, Watanabe I, Løfgren B, Cheng A, Duval-Arnould J, Hunt EA, Good GL, Niles D, Berg RA, Nishisaki A, Nadkarni VM.Resuscitation. 2020 Feb 1;147:73-80. doi: 10.1016/j.resuscitation.2019.12.013. Epub 2019 Dec 28.PMID: 31891790 Clinical Trial.				
		Relationship between non-technical skills and technical performance during cardiopulmonary resuscitation: does stress have an influence?Krage R, Zwaan L, Tjon Soei Len L, Kolenbrander MW, van Groeningen D, Loer SA, Wagner C, Schober P.Emerg Med J. 2017 Nov;34(11):728-733. doi: 10.1136/emermed-2016-205754. Epub 2017 Aug 26.PMID: 28844039				
("Clinical Competence"[Mesh]) AND "Resuscitation"[Mesh] AND "Non-technical skills"**32**	10anni	4Relationship between non-technical skills and technical performance during cardiopulmonary resuscitation: does stress have an influence?Krage R, Zwaan L, Tjon Soei Len L, Kolenbrander MW, van Groeningen D, Loer SA, Wagner C, Schober P.Emerg Med J. 2017 Nov;34(11):728-733. doi: 10.1136/emermed-2016-205754. Epub 2017 Aug 26.PMID: 28844039				
		An observational study of technical and non-technical skills in advanced life support in the clinical setting.Peltonen V, Peltonen LM, Salanterä S, Hoppu S, Elomaa J, Pappila T, Hevonoja E, Hurme S, Perkonoja K, Elomaa T, Tommila M.Resuscitation. 2020 Aug;153:162-168. doi: 10.1016/j.resuscitation.2020.06.010. Epub 2020 Jun 16.PMID: 32561474				
		Feedback in advanced life support: A quality improvement initiative.Thorne CJ, Kimani PK, Hampshire S, Begum-Ali S, Perkins GD; Advanced Life Support Subcommittee of the Resuscitation Council UK.				
		Comparison of two training programmes on paramedic-delivered CPR performance.Govender K, Sliwa K, Wallis L, Pillay Y.Emerg Med J. 2016 May;33(5):351-6. doi: 10.1136/emermed-2014-204404. Epub 2015 Dec 23.PMID: 26698362				

(("Cardiopulmonary Resuscitation"[Mesh]) AND "Patient Care Team"[Mesh]) AND "Treatment Outcome"[Mesh]**19**	10 anni	1The effect of team-based CPR on outcomes in out of hospital cardiac arrest patients: A meta-analysis.Kim S, Ahn KO, Jeong S.Am J Emerg Med. 2018 Feb;36(2):248-252. doi: 10.1016/j.ajem.2017.07.089. Epub 2017 Jul 30.PMID: 28793963 Review.				
("Patient Care Team"[Mesh]) AND "Quality Improvement"[Mesh] AND "non technical skills"**10**	10 anni	1Interventions to improve team effectiveness within health care: a systematic review of the past decade.Buljac-Samardzic M, Doekhie KD, van Wijngaarden JDH.Hum Resour Health. 2020 Jan 8;18(1):2. doi: 10.1186/s12960-019-0411-3.PMID: 31915007				
"Clinical Competence"[Mesh]AND "non technical skills"**450**	10 anni	1Non-technical skills required to recognise and escalate patient deterioration in acute hospital settings.Large C, Aldridge M.Nurs Manag (Harrow). 2018 May 30;25(2):24-30. doi: 10.7748/nm.2018.e1707. Epub 2018 May 2.PMID: 29718603 Review.				
“non-technical skills” AND “resuscitation” **5610**	10 anni	6Relationship between non-technical skills and resuscitation performance of nurses' team in in-situ simulated cardiac arrest EJ Kim, KR LeeKorean Journal of Adult Nursing, 2015 Resusc Plus. 2021 Oct 8:8:100171. doi: 10.1016/j.resplu.2021.100171. eCollection 2021 Dec.				
		Measuring non-technical skills during prehospital advanced cardiac life support: A pilot study Philippe Dewolf 1 2, Maïté Vanneste 1, Didier Desruelles 1, Lina Wauters 1 Affiliations Expand PMID: 34693380 PMCID: PMC8517196 DOI: 10.1016/j.resplu.2021.100171Resusc Plus . 2021 Oct 8:8:100171. doi: 10.1016/j.resplu.2021.100171. eCollection 2021 Dec.				
		Relationship between non-technical skills and resuscitation performance of nurses' team in in-situ simulated cardiac arrest EJ Kim, KR Lee - Korean Journal of Adult Nursing, 2015 – synapse.koreamed.org				

		Non-technical skills in the out-of-hospital cardiac arrest: is it time for a pit stop? S Cormack - British Paramedic Journal, 2019 - ingentaconnect.com Aims: To ascertain an understanding and identify if there are barriers to the use of non-technical skills (NTS) in an out-of-hospital cardiac arrest (OHCA) by student paramedics. Methods…				
		[LIBRO] Safety at the sharp end: a guide to non-technical skills R Flin, P O'Connor - 2017 – taylorfrancis.com				
		[PDF] Non-technical skills in healthcare S Prineas, K Mosier, C Mirko… - … of patient safety and …, 2021 – library.oapen.org				

Table 2. Summary of selected studies

AUTHORS	GOALS	TYPE OF STUDY/SETTING	MATERIALS E METHODS	RESULTS/CONCLUSION
Peltonen V. et Al.2018	Evaluate association between NTS e TS in 20 real situations of advanced life supports	Prospective Observational study. Intra-hospital Setting	Team composed of a resuscitator and two intensive care nurses with experience and specific ALS training in a University Hospital in Finland	The association between the total NTS score and that of the TS was significant, with slope equal to 0.48, 95% CI 0.34-0.61, $p < 0.001$, when the total NTS score increases by 1, the total TS score increases by 0.48. Furthermore, this study demonstrates that both the total scores and the scores of the various subcategories of TS and NTS are correlated (slopes 0.29 - 0.39, $p < 0.001$): in particular, the strongest association was found between the total score of the NTS and the subcategories of the TS "chest compressions", "rhythm control" and "quality of defibrillation" (slopes 0.37 - 0.56, $p < 0.01$).
Dewolf P. Et Al.,2020	Evaluate the effectiveness of NTS training in advanced life support situations.	Systematic review	The search was carried out according to Prisma GL, using PubMed, Embase, WoS, Eric, Cinahl and Cochrane Library. The risk of bias was assessed using a literature-validated tool, the Medical Education Research Study Quality Instrument (MERSQI). The studies included in the review were 40 (of which 23 randomized controlled studies, 6 "test/retest" studies, 4	This systematic review suggests simulation as a training methodology on NTS, with a focus on improving leadership skills, communication and stress management, fundamental elements for effective technical performance.

			observational studies and 7 studies with other designs).	
Stærk M. Et al. 2022	Observe, through "in situ" simulations, what happens in the first minutes of the treatment of a patient in cardiac arrest.	Prospective observational study. Multicentric Intra-hospital setting.	The study was conducted in 4 hospitals in Denmark. 36 unannounced "in situ" simulations were carried out in various departments in which a team was present (composed of department staff or an anaesthetist-resuscitator, an anesthesia nurse, another doctor and two Sundhedsassistants) called to intervene in a scenario of a patient with chest pain, who subsequently experienced cardiac arrest with a shockable rhythm. At the end of each session, a debriefing was carried out by analyzing the video recording.	Using unannounced "in situ" simulations, delays in recognizing cardiac arrest, in starting chest compressions, in calling the resuscitation team, and in delivering the first shock were detected. These delays have been attributed in part to the numerous barriers affecting NTS: lack of communication or communication that is not well understood, absence of early and effective leadership, confusion in the distribution of roles and actions to be taken.
Kim,S. et Al., 2018	To determine the outcomes of cardiopulmonary resuscitation performed on patients with out-of-hospital cardiac arrest	Systematic review with Meta-analysis Out-of-hospital setting	The systematic review was carried out on PubMed, Embase and Cochrane Library. The quality of the studies was assessed using the PRISMA and GRADE systems. A total of 4 articles with samples ranging from 105 to 14,129 patients in	The meta-analysis shows that patients who received CPR performed by a Teamwork had a greater probability of survival to discharge (with OR 1.68, 95% CI 1.48-1.91) and better neurological recovery (with OR 1.52, 95% CI 1.31-1.77). Regarding ROSC, no significant difference was detected (OR 1.59, 95% CI 0.76-3.33). The results obtained could be related to the

			out-of-hospital cardiac arrest were reviewed. The patient outcomes taken into consideration were: restoration of spontaneous circulation (ROSC), survival until discharge, neurological recovery (defined CPC – Cerebral Performance Category).	organization, the professionalism of the team and the NTS (leadership and communication).
Krage R et Al.,2017	Investigate the relationship between NTS and TS in situations in which external stressors are present.	Randomized controlled crossover trial. Simulated-based.	The study was conducted at a University Center in the Netherlands.Thirty anesthetist-resuscitation doctors participated in two different scenarios that required the same treatment (patient with chest pain and shockable rhythm); in one there were external stressors (family member who interrupts the team leader at the crucial moment and continuous radio noise) while in the other there were no. The performances were video recorded and analyzed by two independent researchers. The Non-Technical Skills were assessed using a validated tool, the ANTS (Anaesthetist' Non-Technical Skills), which includes 15 items grouped into 4 subcategories: Task Management, Team	The ANTS scale score, representative of NTS, was significantly lower in the scenario in which external stressors were present (p value < 0.001). A positive correlation was observed between non-technical and technical performance in the scenario with external stressors (r = 0.67, 95% CI 0.40-0.83, p<0.001), while this correlation was not observed in the other scenario (r = 0.15, 95% CI 0.22 – 0.49, p = 0.42). Stress negatively affects cognitive functions such as attention and memory: this is reflected in the deterioration of the non-technical performance of the team leader and consequently of the technical performance of the team.

			Working, Situation Awareness, Decision Making.	
Kim Ej et al.,2015	Exploring the correlation between NTS and TS in cardiopulmonary resuscitation performed by teams of nurses in "in situ" simulations of cardiac arrests.	Prospective observational study Simulated-based	The study involved a total of 28 teams of nurses from various departments of University Hospital in Seoul (South Korea). An algorithm provided by the American Heart Association was used to evaluate technical skills; they were recorded thanks to a skills reporting system connected directly to the simulator (Resusci Anne Simulator®). Non-technical skills were instead assessed through the 5 sectors developed by Anderson et al. (a total of 15 items divided into leadership, communication, mutual supervision, compliance with standards and guidelines, management of activities). The conduct and performance evaluation (carried out by industry experts with the help of video recordings of the simulations) were supervised by a specialist doctor in Emergency Medicine and a nurse from the BLSD training center. Differences in CPR performance by non-	The first 5 minutes of were taken into consideration every scenario. The nursing teams were divided into two groups (“high scores” and “low scores”) based on the median scores recorded in non-technical skills. The CPR technical performance scores of the group with higher scores and the group with lower scores in non-technical skills showed a statistically significant difference ($U = 43.5$, $p = 0.014$). Among the subareas of non-technical skills, there was a significant difference in CPR performance between the higher and lower scoring groups in communication ($U = 49.5$, $p = 0.026$), supervision of each other's actions ($U = 31.5$, $p = 0.005$) and compliance with standards and guidelines ($U = 30.5$, $p = 0.003$). Regarding leadership and work management, although the group with higher scores of non-technical skills showed higher scores in technical skills, the difference was not statistically significant ($p > 0.05$). The results of the study showed that there was a significant difference in CPR technical performance based on the level of non-technical skills of nurses: teams with a higher level of NTS achieved higher scores in CPR technical performance than teams with a lower level. The results highlighted an important correlation between technical performance in CPR and three of the subcategories of

			technical skill level were compared using the Mann-Whitney U test.	non-technical skills: communication, mutual supervision and compliance with standards and guidelines. Regarding leadership, no significant differences were found ($p > 0.05$), despite it being widely recognized in the literature as a crucial element in CPR.
Cormack S. et al. 2020	Identify which NTS are relevant to teams managing out-of-hospital cardiac arrest	Scoping review Extra-hospital	The search was performed on Medline, Amed, Cinahl, PsycInfo, PsycArticles. A total of 12 articles were reviewed, of which the majority were simulation-based.	There are 3 most common NTSs associated with teams managing cardiac arrest: leadership, communication and teamwork. Among their positive effects we highlight: reduced work overload, improved situation awareness, minimization of interruptions and greater adherence to guidelines.
Cormack S., 2019	Identify which NTS are relevant to teams managing out-of-hospital cardiac arrest	A mixed methods study Extra-hospital Setting	The search was performed on Medline, Amed, Cinahl, PsycInfo, PsycArticles. A validated questionnaire was administered to 50 students.	Studies have highlighted that the evidence is insufficient to demonstrate an association between NTS and OHCA; however, communication, leadership and situational awareness were essential. Barriers to NTS included lack of understanding of roles, lack of clinical skills, and poor ability to Care planning.
Radhakrishnan et Al., 2022	The importance of NTS in the education of resuscitators	Review	Exploring the importance of NTS in anesthetist education	TS and NTS are interdependent. Recent SRs identify the tools necessary for the evaluation and teaching of NTS; further studies should investigate the psychometric capabilities of the tests.

Bennet R. et al., 2021	Non-technical skills in paramedicine	A scoping review	Ovid Medline, EMBASE, Scopus, CINHAL and PsychINFO	Identify the essential elements of NTS in extra-hospital contexts: communication, decision making, leadership, situational awareness, Teamwork and task management.
Riem N.et Al,2012	Investigates the correlation between TS and NTS in crisis resource management	Observational study Simulation based	50 anesthesia trainees managed a cardiac arrest scenario secondary to malignant arrhythmia	TS and NTS were significantly correlated with each other ($r=0.45$, $P<0.05$).
Jennifer Truchot et Al.,2023	Investigates the effectiveness of a training session in advanced support of vital functions, aimed at reducing interruptions in emergency contexts	Multicentric RCT Simulation based	21 emergency nurses and doctors were randomly assigned to two groups: in the experimental group there were interruptions in performance, while in the control group they were absent. The NTS were evaluated with the TEAM score. The time to interruption of ALS maneuvers and the depth and frequency of chest compressions were also measured.	The characteristics and abilities of the two groups were similar. Similar results were obtained in the two groups through evaluation with the TEAM score. However, further studies are needed to strengthen the results obtained.