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CREW RESOURCE MANAGEMENT: NON TECHNICAL SKILLS FOR PRE-HOSPITAL HEALTH CARE PROFESSIONALS

CREW RESOURCE MANAGEMENT: COMPETÊNCIAS NÃO TÉCNICAS PARA PROFISSIONAIS DE SAÚDE DO EXTRA-HOSPITALAR

CREW RESOURCE MANAGEMENT: COMPETENCIAS NO TECNICAS PARA PROFISIONALES DE SALUD PRE-HOSPITALAR

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ABSTRACT

In out-of-hospital care, the training of professionals focuses mainly on technical skills, giving little importance to non-technical skills, which contribute to the excellence of the teams' performance. The Crew Resource Management (CRM) is used as a tool to develop non technical skills in aviation.

Objective: To evidence the need for continuous specific training for the development of non-technical skills in out-of-hospital professionals.

Methodology: An integrative literature review was conducted using the Virtual Health Library and Pubmed databases, after formulating a research question based on the PICO methodology, obtaining a total of five primary studies.

Results: Applied the methodology, a final set of 5 studies was obtained, which do not support the existence of scientific evidence about the use of courses for the development of non-technical skills. Also, no evidence was found on the adaptation or change of the aeronautical CRM for the health industry.

Conclusion: In Portugal, it is observed the use of CRM in intra-hospital environment, namely in the operating room, but never in extra-hospital environment, an area lacking evidence of the use of training in the development of non-technical skills. Additionally, some basic needs for CRM use in the health industry in Portugal were identified, namely: (i) adaptation of CRM to the health industry; (ii) revision of initial and recurrent training programs to include CRM; (iii) definition of criteria for CRM implementation in the health industry, with special attention to the out-of-hospital setting.

Keywords: Crew Resource Management; Crisis Resource Management; Emergency Care; Non-Technical Skills.

RESUMO

No extra-hospitalar, a formação de profissionais foca-se, essencialmente, em competências técnicas, atribuindo pouca importância às competências não técnicas, que contribuem para a excelência do desempenho das equipas. O Crew Resource Management (CRM) é utilizado como ferramenta de desenvolvimento de competências não técnicas na aviação.

Objetivo: Evidenciar a necessidade de formação específica contínua para o desenvolvimento de competências não técnicas em profissionais de extra-hospitalar.

Metodologia: Foi realizada uma revisão integrativa da literatura com recurso às bases de dados da Virtual Health Library e Pubmed, após formulada uma questão de investigação

com base na metodologia PICO, obtendo-se um total de cinco estudos primários.

Resultados: Aplicada a metodologia, obteve-se um conjunto final de 5 estudos, os quais não sustentam a existência de evidências científicas acerca da utilização de cursos para o desenvolvimento de competências não técnicas. Também não foram encontradas evidências da adaptação ou alteração do CRM aeronáutico para a indústria da saúde.

Conclusão: Em Portugal, observa-se a utilização do CRM em ambiente intra-hospitalar, nomeadamente no bloco operatório, porém nunca em ambiente extra-hospitalar, área esta carente de evidências da utilização de formação em desenvolvimento de competências não técnicas. Adicionalmente, identificaram-se algumas necessidades básicas para utilização do CRM na indústria da saúde em Portugal, nomeadamente: (i) adaptação do CRM à indústria da saúde; (ii) revisão dos programas de formação inicial e recorrente para inclusão do CRM; (iii) definição de critérios para implementação do CRM na indústria da saúde, com especial atenção ao extra-hospitalar.

Palavras-chave: Cuidados de Emergência; Gestão de Recursos de Crise; Gestão de Recursos de Tripulação; Habilidades Não Técnicas.

RESUMEN

En la asistencia extrahospitalaria, la formación de los profesionales se centra esencialmente en las competencias técnicas, dando poca importancia a las competencias no técnicas, que contribuyen a la excelencia del rendimiento de los equipos. El Crew Resource Management (CRM) és utilizado como herramienta para desarrollo de competências no técnicas em aviación.

Objetivo: Evidenciar la necesidad de formación específica contínua para el desarrollo de competencias no técnicas en profesionales de extrahospitalarios.

Metodología: Se realizó una revisión bibliográfica integradora utilizando las bases de datos Virtual Health Library y Pubmed, tras formular una pregunta de investigación basada en la metodología PICO, obteniendo un total de cinco estudios primarios.

Resultados: Aplicada la metodología, se obtuvo un conjunto final de 5 estudios que no apoyan la existencia de evidencia científica sobre el uso de cursos para el desarrollo de habilidades no técnicas. Tampoco se encontraron pruebas sobre la adaptación o el cambio del CRM aeronáutico para la industria sanitaria.

Conclusión: En Portugal se observa el uso de MRC en el ámbito intrahospitalario, particularmente en el quirófano, pero nunca en el ámbito extrahospitalario, área que carece de evidencias del uso de la formación en el desarrollo de habilidades no técnicas. Además, se han identificado algunas necesidades básicas para el uso de CRM en la industria de la salud

en Portugal, a saber: (i) la adaptación de CRM a la industria de la salud; (ii) la revisión de los programas de formación inicial y recurrente para incluir CRM; (iii) la definición de criterios para la implementación de CRM en la industria de la salud, con especial atención al entorno extrahospitalario.
Descriptores: Atención de Urgencias; Gestión de Recursos de Crisis; Gestión de Recursos de la Tripulación; Habilidades no técnicas.

INTRODUCTION

Although notable advances have been witnessed in information technology, science and diagnostic capacity, the occurrence of incidents due to lack of safety during the provision of health care is still a reality in modern health systems[1].

The World Health Organization states that, every year, many patients are harmed or die due to safety failures during the provision of health care and, the available evidence suggests that 134 million adverse events associated with the provision of care unsafe health conditions have contributed to an estimated 2.6 million deaths each year[2].

The National Plan for Patient Safety 2021-2026, aligned with the Global Action Plan for Patient Safety 2021-2030, aims to consolidate and to promote safety in the provision of health care, highlighting the principles that support the area of patient safety, such as the safety culture, communication, and the continued implementation of safe practices in contexts typical of modern health systems, such as the pre-hospital phase[3].

The training of health professionals in the area of emergency has focused essentially on technical skills for the proficient performance of specific tasks, giving little importance to non-technical skills[4]. According to the same author, evidence shows that the development of these skills may result in a reduction in adverse events and improved performance[4].

There is evidence that technical proficiency is not enough to guarantee excellent performance, as well as the proper safety of teams in high-risk environments[5].

The out-of-hospital health teams operate in unpredictable and complex environments; their actions have implications for patient safety. They must integrate the knowledge about the other areas they have already studied to non-technical skills, and to implement this valence in the initial and continuous training program of the out-of-hospital teams, in order to guarantee the best quality in the approach to the patient.

With the emergence of the use of aircraft as a means of transporting users, there is a difference in the initial and recurrent training of medical crews, when compared with the technical crews of aircraft, insofar as these are submitted to CRM – Crew training Resource Management, as a prerequisite for performing operational functions.

The awareness of the existence of differences in demand and level of knowledge and training in the development of non-technical skills, as well as the absence of this training for health professionals who are part of out-of-hospital teams, motivated us to approach/review topic, taking into account examples of training applicable to aviation and health professionals, such as the ACRM – Anesthesia Crisis Resource Management course (adapted to the field of anesthesia), replacing the term Crew with Crisis[5].

We are faced with the need to mitigate the relevance of applying specific training in the out-of-hospital area, considering the CRM – Crew Resource Management course and TeamSTEPPS; the first one is applicable in the aviation area and, the second one is adapted specifically for the healthcare industry.

The CRM, initially known as Cockpit Resource Management appears as a recommendation of the NTSB – National Transportation Safety Bureau (USA) in 1978, after two accidents with regular passenger transport aircraft, the first in 1977 in Oregon (USA) and, the second, in 1978 in Tenerife, Spain[6].

The evolution of CRM goes through the transformation from something only applicable to flight crews (Cockpit Resource Management), to something applicable to the entire crew (Crew Resource Management), and finally, in its most comprehensive phase, it adopts an aspect that includes all employees of aviation companies, changing its name to Corporate Resource Management[6].

In its program, defined by document CAP 737 Flight-crew Human Factors Handbook, from CAA UK, the development of non-technical skills is included, starting with the introduction to CRM and TEM – Threat and Error Management[6].

The course uses a system of behavioral markers, as a guide to exemplify exemplary conduct, called NOTHECS Behavioral Marker Scheme (see Table 1↗).

These are defined as essential non-technical skills in the aviation industry: Situation Awareness, Decision Making, Communication, Leadership/Supervision, Teamwork and Awareness of Performance Sharping Factors such as Stress and Fatigue.

Table 2↗ is also used as a guide for evaluating the evolution of candidates.

CRM addresses cultural and behavioral differences existing in different professional groups, as well as operational adversities during the execution of activities felt by individuals in multidisciplinary teams[6].

The CRM methodology describes and develops communication as well as other important components of teamwork, to minimize errors and increase safety and performance[7]. Increasingly, CRM principles are being adapted to healthcare environments, but there are still few studies that have addressed non-technical skills at the extra-hospital level[8].

CRM principles should be included, both in training and in the ongoing training of health professionals, resulting in better performance and better results[4]. The same author also argues that non-technical skills are essential for effective teamwork[4].

The technical aspects of healthcare and aviation are inherently different, however, the non-technical skills required in both industries are very similar[9].

The International Organization of Oil and Gas Producers (IOGP) defines CRM as a set of cognitive, social and personal skills that complement technical skills and contribute to performing tasks efficiently and safely. Among the various variations of CRM, there are Pilots' non-technical skills (NOTECHS) in aviation, Bridge Resource Management (BRM) in the marine industry, Non-Technical Skills for Surgeons (NOTSS), Anesthetists' Non-Technical Skills (ANTS), Trauma Non-Technical Skills (T-NOTECHS) and Well Operations Crew Resource Management (WOCRM) in offshore well control[10].

CRM courses have been shown to improve leadership, problem solving, communication, situational awareness, teamwork, resource utilization and other general CRM skills of teams. The duration of training in CRM is not static, the largest include a theoretical part and practical simulations that can range from one session to six high-fidelity scenarios[11]. Currently, interprofessional training plays an important role in the education of health teams and, even, comparative protocols between different forms of team training and debriefing are being developed[12]. Still according to the authors, there is also evidence that the skills acquired through training in CRM, in a simulated environment, are transferred to the clinical environment and, consequently, lead to better results for the patient[12].

The importance of teamwork in clinical care is well evidenced, and non-technical skills, including training in the form of simulations, occupy a prominent place[13]. There are many examples of simulated training for the development of non-technical skills, namely teamwork. In some cases, the objective is measured through tools, and the suitability of such tools is still unclear, as well as the possible validation of the results obtained[14].

Following training in non-technical skills, increased self-confidence among members of anesthesia teams was reported as a preponderant factor[15].

Consequently, several organizations are using training in non-technical skills to optimize teamwork. Analytically demonstrated, several training programs have achieved positive results for patients. Despite the different team training applicable on a large scale in the health industry, CRM and its variants is the best known and probably the most appropriate training to be used when the objective is the effectiveness of the development of non-technical skills[16].

Non-technical skills are defined, as described below, and their interpretation can be adapted according to the needs of a specific industry[12].

Situation Awareness – Defined by the development of a dynamic awareness of the situation and the risks inherent in carrying out an activity, based on collecting useful information, anticipating future risks and planning future tasks[10].

Decision Making – Skills to diagnose the situation and reach a judgment to choose an appropriate course of action. Decision-making is not a linear attitude in the out-of-hospital area, but a fluid and complex process that takes place in a dynamic and unpredictable environment, with implications for user safety. Decision making is defined by the rapid identification and evaluation of the various available options, subsequent selection of the most appropriate one and its communication to the team[10,17].

Communication – Recently recognized as crucial, communication within and between teams aims to ensure safe clinical practice and effective organizational performance[18].

Leadership – Skills in guiding, supervising, managing and supporting a team while carrying out tasks to achieve previously established goals[10].

Leading means "guiding or directing" "being ahead or occupying the 1st place" and, a good leadership in health, is a prerequisite for the practice of efficient and effective care[21].

Effective leadership is associated with better teamwork results and, in emergency situations, improves team understanding[19].

Communication and leadership are two closely linked concepts, as effective leadership requires effective communication. Effective communication and leadership are considered key elements in the quality of health care, whenever the team offers an organized and timely response in an emergency[20,21].

In the out-of-hospital setting, teams are faced with unexpected scenarios and complex situations. In order to provide efficient responses, they must be continuously prepared, and there must be continuous training in communication, leadership and teamwork.

After each team intervention, the leader should meet with all the elements for a debriefing in order to promote continuous improvement[20,21].

Teamwork – Teamwork skills, in any role, to ensure completion of joint tasks[10]. Teamwork includes coordination, cooperation and conflict resolution. The familiarity of team members has been associated with better performance and a reduction in adverse events[22].

TeamSTEPPS, from a program of the DoD – Department of Defense of the USA, was adapted and developed by the Agency for Healthcare Research and Quality, Maryland, USA, has as its objective the safety of users and focuses efforts on training health professionals to the optimization of the results of the treatments given to users, through the development of communication and teamwork, between the different health professionals.

The content of TeamSTEPPS highlights the approach to the themes Team structure, Communication, Leading teams, Situation monitoring, Mutual support, Summary[23].

METHODOLOGY

For the selection of articles and formulation of the research question, the methodology PI(C)OD participants (P); intervention (I); comparison (C); results – outcome (O) (see Table 3↗). The research question serves as a guiding principle during the systematic review of the literature in order to respond to the previously established objective. For this reason, the following question was elaborated: "In out-of-hospital health professionals (participants), there is evidence to suggest that there is a need for specific training for the development of non-technical skills (interventions) that increase improvements in work and safety of the team and the patients (outcomes)".

An initial survey was carried out to define the search terms in English and their adequacy to the different databases. Subsequently, a survey was carried out using the Virtual Health Library and PubMed search engines.

The search in the different databases was limited by language and publication date, including articles written in English and published between 2012 and 2022. Table 4↗ shows the strategy used for the search carried out in April 2022.

Therefore, out of a total of 26 potentially relevant studies, only 5 were included in this integrative literature review. After analysis and application of the inclusion criteria, 1 study was eliminated for being duplicated and 20 were excluded after analyzing the title and abstract (see Table 5↗).

In order to assess the level of evidence, methodological quality and strength of the studies, we adopted the tables according to Joanna Briggs[24] whose information is summarized in Table 6↗.

RESULTS

After analyzing the selected articles, the results of the integrative literature review will be presented and systematized in Chart 1↗ and Figure 1↗.

DISCUSSION

In all primary studies analyzed, there is a need for training in non-technical skills, whether in an aviation model, adapted or created specifically for health. In a transversal way, the participants in the studies were unanimous in their opinions, expressed through interviews, answering questionnaires or during practical simulations, referring that their participation contributed to the development of non-technical skills, reduction of errors and increase of patient safety.

In the study called "Simulator-Based Air Medical Training Program Christoph Life: From concept to course", several participants underwent training in CRM (including the use of a simulator), between 2013 and 2014, and 13 helicopter crew teams (26 professionals), participated in the training program. In order to assess knowledge in terms of the fundamentals of CRM, questionnaires were distributed in the pre and post training phase. It was observed that 58% of the participants claimed to know the fundamentals of deliberate communication in emergencies, according to the CRM. The Cristoph Life program was evaluated as very positive and useful in daily work, helping to avoid mistakes and improve communication skills. Examples like the Cristoph Life program were observed in pla-

ces where members of the medical teams received training to obtain the title of crew member, in which there was a need to provide training in all areas applicable to aircraft crew members, with CRM being the first course given[25].

There are advantages to combining technical training with non-technical training. For this purpose, an observational tool was developed to be used as a debriefing guide for training applied to doctors, nurses, midwives and managers linked to the delivery rooms of six Italian hospitals. This tool promotes peer involvement during the debriefing. Training simulation participants to use this tool can favor feedback without judgment between peers and, above all, provide some kind of specific message based on a set of actions that make the delivery room safer[26].

In the study "Participant evaluation of simulation training using crew resource management in a hospital setting in Hong Kong", the development of the content of a CRM simulation training program, applied to four different departments and adapted to their specific needs, was highly valued. This adapted program was considered as the first step in developing a culture of valuing skills and increasing safety in healthcare organizations[27].

Considered as an increase in team and user safety, we have the example of the study "Simulation Training in Mountain Helicopter Emergency Medical Service: A Multidisciplinary Team Training Concept", in which a CRM course was developed (including the use of a simulator), whose purpose was to optimize the operational reality. This course proved to be effective in improving user safety, improving the crew's resource management skills in complex medical environments, improving team safety and increasing self-confidence in managing complex situations, with consequent improvement in decision-making[28].

CRM training has the potential to increase patient safety by reducing possible communication failures. In a post-training phase, there was an increase in the non-technical skills of the participants, namely in terms of communication skills in a critical environment[29].

Given the analogy of two industries with complex activities such as aviation and health, due to the good results presented by CRM in the aviation industry, several practical studies, including theoretical and practical training of CRM, begin to be considered, and in some cases, used as a booster in the development of non-technical skills for non-technical crew members. It should be noted that the practice of using simulators has been adopted more and more, with the aim of adapting to health, the concepts of "Evidence Based Training".

Universal characteristics, shared strategies, standardized work flow and action, are the most important aspects to highlight, for the provision of safe health care in the operating room, obtained through training, namely through training in "non-technical skills", which the Civil Aviation Crew Resource Management (CRM) so well exemplifies[30]. According to this author, whether in a cockpit or in an operating room, teamwork is fundamental and the team members, the professionals, have a technical role, but also a role of integration and inclusion in the team[30]. He justifies it, adding that an operating room can be compared to an airplane cockpit insofar as it is a complex structure, operated "hands on" by surgeons and anesthesiologists and where other professional extracts such as technicians and nurses are integrated. Hence, risky behaviors are carried out by Health Professionals, behaviors that are very similar to Pilots, which often affect patients in the operating room[30].

In the out-of-hospital context, similarly to flight crews and health professionals performing team functions, in the operating room environment, all work is carried out in an orderly and methodical manner, with high complexity and in a hostile environment. In this way, the development of non-technical skills can contribute to the increase of the teams' cooperation skills and, consequently, to patient safety.

It should be noted that all studies considered non-technical skills as basic principles, understood as necessary to promote cultural change, emphasized as crucial for behavioral change to occur and which will consequently lead to the much-desired patient safety culture.

Although there is a growing use of aeronautical CRM in the clinical setting, the gap, increasingly evident, of the lack of suitability of CRM for health is undoubted and notorious, both in the intra-hospital and extra-hospital environment. In the extra-hospital case, at national level, there is no evidence of the use of aeronautical CRM, or any other course, for the development of non-technical skills.

Although there are numerous experiences of using CRM in the health area, there is a lack of training for the development of non-technical skills in the continuous training programs of the various institutions. In the case of aeronautical CRM, this is integrated in the continuous training program of air operators, there is initial and recurrent training, in a three-year cycle, where all topics of initial training are addressed[31].

Study Limitations

Based on the analysis of the articles that resulted from the research, it is not possible to state that there is enough scientific evidence to infer that the existing trainings increase improvements in the work and safety of the health teams, as well as in the safety of patients. It would have been important to observe the real impact of the application of these trainings in the health area. This was a limitation of this study, which happens because there are no scientific studies that clearly demonstrate the benefits of using these training courses in clinical practice, when intervening with teams. There is a need for future investigations that would contribute to the academic literature on this subject, given that it would be interesting if primary studies were carried out, with more representative samples, that could explore the application of these training courses in various health institutions, as a strategy for development of non-technical skills in continuing education programs.

CONCLUSION

After an integrative review of the literature on the need for specific continuous training for the development of non-technical skills in out-of-hospital professionals, we concluded that there are training available, whose main objective is related to the improvement of performance, through the reduction of errors and consequent increased safety, both for the team and the patient.

Evidence of the use of two of the main courses in the health industry, TeamSTEPPS and CRM, was observed, with a greater number of uses of the latter, especially in operational areas.

CRM, initially used only in aviation, has undergone adaptations over the last few decades, and has been adopted by other industries such as naval, oil, nuclear and health. It was found that, despite the preference for using this course in training activities at health institutions, there is no evidence of its transversal suitability for the health industry.

TeamSTEPPS, on the other hand, has undergone adaptations since its creation by the US Department of Defense, both for use by institutions linked to work in a conflict environment, as well as by institutions providing health care, or in the intra-hospital operational aspect, or in the field of management. In the operational area, and regarding TeamSTEPPS, it is used with the aim of increasing the quality of teamwork, with a view to increasing patient safety.

It should also be noted that, in the analyzed studies, the use of CRM does not respect one of its basic principles, which is related to continuous training. In the reviewed articles, there is no evidence of the inclusion of CRM in the continuous training plans of the institutions that chose to test it, opting to use it as an isolated specific training.

In out-of-hospital terms, there is evidence of the use of CRM in an emergency medical helicopter service environment, with joint training of flight crews and medical passengers. However, there is a lack of evidence of CRM adaptation to the operational specificity of the health industry and inclusion in the continuous training program.

We can conclude that the use of CRM as a tool for developing non-technical skills, aims to improve teamwork and operational safety of teams and, consequently, of patients, but without any adaptation to the health industry. In Portugal, there is no scientific evidence of the use of CRM except for aviation.

Therefore, there would be a need for investments in CRM training for out-of-hospital health professionals, and the subsequent carrying out of studies that corroborate or exclude the need for this training.

Authors' contributions

MD: Coordination of the study, study design, collection, storage and analysis of data, review and discussion of results.
MM: Study design, data analysis, review and discussion of results.
MG: Study design, data analysis, review and discussion of results.
All authors read and agreed with the published version of the manuscript.

Ethical Disclosures

Although literature review studies do not require approval from ethical organizations, it is important that they are faithful to the data obtained through the primary studies and all scientific documents consulted. It is considered that all these ethical aspects have been ensured.
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Table 1 – NOTHECS Behavoiural Marker Scheme.↖

Categories	Elements	Example Behaviours (positive)
Co-operation	Team building and maintaining	Establishes atmosphere for open communication and participation
	Considering others	Takes condition of other crew members into account
	Supporting others	Helps other crew members in demanding situations
	Conflict solving	Concentrates on what is right rather than who is right
Leadership and managerial skills	Use of authority and assertiveness	Takes initiative to ensure involvement and task completion
	Maintaining standards	Intervenes if task completion deviates from standards
	Planning and co-ordinating	Clearly states intentions and goals
	Workload management	Allocates enough time to complete tasks
Situation awareness	System awareness	Monitors and reports changes in system's states
	Environmental awareness	Collects information about the environment
	Anticipation	Identifies possible future problems
Decision making	Problem definition/ diagnosis	Reviews causal factors with other crew members
	Option generations	States alternative courses of action. Asks other crew members for options
	Risk assessment/option choice	Considers and shares risks of alternative courses of action

Source: Flight-crew human factors handbook CAP 737, P. 182[6].

Table 2 – Script for evaluating the candidates' progress.↖

Very poor	Poor	Acceptable	Good	Very good
Observed behaviour directly endangers flight safety	Observed behaviour in other conditions could endanger flight safety	Observed behaviour does not endanger flight safety but needs improvement	Observed behaviour enhances flight safety	Observed behaviour optimally enhances flight safety and could serve as an example for other pilots

Source: Flight-crew human factors handbook CAP 737, P. 183[6].

Table 3 – Criteria used to formulate the question in Investigation.↖

P	Participants	Who was the object of study?	Out-of-hospital health professionals
I	Interventions	What was done?	To identify the need for continuous specific training for the development of non-technical skills
C	Comparison		
O	Outcomes/results	What are the main results?	Improvements in the work and safety of the team and patients
D	Design	How was the evidence collected?	Search in different databases

Table 4 – Research strategy.

Database	Search formula	Limiters
Virtual health Library Pubmed	(emergency care [MeSH Terms]) AND (non-technical skills) OR (crisis resource management) AND (crew resource management [MeSH Terms])	Publication date: between 2012 and 2022 English language

Table 5 – Inclusion criteria.

Selection criteria	Inclusion criteria
Participants	Health professionals
Interventions	
Study context	Studies in- and out-of-hospital contexts
Design	Quantitative and qualitative studies
Type of studies	Primary sources
Information presented	In the abstract contain the words "Crew Resource Management" or "Crisis Resource Management" and "non-technical skills".
Year of publishing	2012-2022

Table 6 – Level of evidence and quality of studies[24].

Title of the article	Joanna Briggs Level of Evidence (2014)
Simulation – Based Air Medical Training program Cristoph life: From Concept to Course	Quasi-experimental Designs Level 2d
Crisis Resource Management in the Delivery Room: Development of Behavioral Markers for Team Performance in Emergency Simulation	Qualitative Level 3
Participant evaluation of simulation training using Crew Resource Management in a hospital setting in Hong Kong	Cross-sectional study Level 4d
Simulation Training in Mountain Helicopter Emergency Medical Service: A Multidisciplinary Team Training Concept	Quasi-experimental Designs Level 2d
More explicit communication after classroom-based crew resource management training. Results of a pragmatic trial	Quasi-experimental Designs Level 2d

Chart 1 – Results of the Integrative Literature Review.

Title / Authors	Aim	Type	Methodology	Results	Conclusion
Simulation-Based Air Medical Training program Cristoph Life: From Concept to Course Marcel Winkelmann; Lars, Friedrich; Christian Schoter; Andreas Flemming; Hendrik Eismann; Lion Sieg; Philipp Mommsen; Christian Kretek; Christian Zeckey (2016)	To apply the innovative Cristoph Life aeromedical training program to medical teams (doctors and paramedics) in different scenarios with the aim of assessing the level of knowledge of participants in CRM through a questionnaire based on the non-technical skills included in the CRM course. To submit participants to theoretical and practical CRM training with high-fidelity simulation and to assess possible increments in knowledge and performance, through parameterized evaluation of each non-technical competence.	Quasi-experimental Designs	Cristoph Life aeromedical training didactic teaching program, which includes theoretical and practical training for two days, in which participants are subjected to 12 complex scenarios that include worsening of the patient's condition and emergencies during the flight. Ambulance simulators, medical treatment room, emergency room and a simulator built based on the Messerschmidt-Bolkow-Blohm/Kawasaki Heavy Industries BK-117 helicopter are used, configured with equipment similar to that used in German emergency medical helicopters, this uses high-fidelity SimMan3G/adult patient simulator (Laerdal Medical AS, Stavanger, Norway) and pediatric patient simulator (Gaumard Pediatric HAL S3005/2-year-child (Gaumard Scientific, Miami, FL). The helicopter is remotely controlled by an operator and features two-axis movement (including real helicopter sound/vibrations). It is equipped with cameras inside to provide the collection of images and sound of participants during training and enable interactive debriefing.	Between 2013 and 2014, 13 teams (26 professional) helicopter crews participated in the training program. In order to assess knowledge in terms of the fundamentals of CRM, questionnaires were distributed in the pre and post training phase. 58% of the participants claimed to know the fundamentals of deliberate communication in emergencies according to the CRM. The Cristoph Life program was assessed as very positive and useful in daily work, helping to avoid mistakes and improve communication skills.	The training program presents favorable results and is considered a valuable tool. Additional studies are needed to confirm long-term effects.

Chart 1 – Results of the Integrative Literature Review.

Title / Authors	Aim	Type	Methodology	Results	Conclusion
Crisis Resource Management in the Delivery Room: Development of Behavioral Markers for Team Performance in Emergency Simulation Fabrizio Bracco; Gabriele de Tonetti; Michele Masini; Marcelo Passareli; Francesca Gerettose; Danilo Celleno (2018)	To develop an observational tool based on the 15 key points of the CRM to be used in the delivery room. This tool was used as a guide for debriefing and peer feedback based on non-technical skills.	Qualitative	They used the observational tool with specific behavioral markers for team performance in a simulated emergency delivery room inspired by CRM key points. Each observer provided peer-to-peer feedback using the CRM tool and explicitly referring to specific behavioral markers that were notable in the current setting. Each observer, after the debriefing, evaluated the CRM observational tool.	101 observational forms were collected, but only 72 were analyzed. After each form, participants were asked to rate the usefulness of the tool in terms of its usefulness and ease of use: 70% of observers considered the tool useful for metacognition, 79% of observers considered the tool useful, and 66% considered it easy to use. Inter-rater reliability was assessed using a modified version of the Fleiss Kappa, falling within a "fair agreement" range.	The tool was assessed in terms of its usefulness in triggering reflection on one's actions during daily practice, its usefulness in providing peer feedback after simulation, and its ease of use. All three items received a high score, indicating that the instrument was well received. This tool encourages peer involvement during the debriefing. Training simulation participants to use this tool can favor feedback without judgment between peers and, above all, provide specific message based on a set of actions that make the delivery room safer. Limitations. Difficulty using the tool; Inapplicability of some CRM items.

Chart 1 – Results of the Integrative Literature Review.

Title / Authors	Aim	Type	Methodology	Results	Conclusion
Participant evaluation of simulation training using Crew Resource Management in a hospital setting in Hong Kong Christina KW Chan; Eric HK So; George Wy Ng; Teresa Wl Ma; Karen Kl Chan; Ly Ho (2016)	To develop a simulation-based training program using the CRM adapted to healthcare professionals from four different departments (gynecology/obstetrics; anesthesiology/operating room; intensive care unit; accident/ emergency) belonging to the Hong Kong regional hospital.	Cross-sectional study	First phase: Training in CRM for 2000 health professionals (doctors and nurses). Second phase: Training through a 3-day seminar for future CRM trainers. At this stage, candidates willing to become trainers were initially selected. These established the specific needs of their peers in order to adapt training to the particularities of each department. A total of 40 professionals completed this phase becoming certified trainers. Third phase: Collection of impressions and evaluation of the program. In this phase, 380 professionals were selected to participate in the evaluation of the program and its need by completing a questionnaire divided into two sections, one containing specific questions directly related to non-technical skills and another with open questions, appropriate to the culture and local reality.	The results of the program were demonstrated through the responses of 319 of the 380 selected to participate in the third phase, as 61 did not complete the questionnaire. The average levelof satisfaction, on a scale of 1 to 10, for Teamwork and Collaboration, level of communication between doctors and nurses and patient safety were 6.5, 6.2 and 7.1 respectively. The factors that prevented achieving levels of excellence in communication and teamwork were: the different types of personality among colleagues, many tasks at the same time, a culture that does not allow the expression of opinions, lack of standardization of communication and fear of making a mistake.	The development of the content of a CRM simulation training program adapted to the specific needs of each department was highly valued by all participants. This tailored program is just the first step in developing a culture of safety in organizations and health.

Chart 1 – Results of the Integrative Literature Review.

Title / Authors	Aim	Type	Methodology	Results	Conclusion
Simulation Training in Mountain Helicopter Emergency Medical Service: A Multidisciplinary Team Training Concept Urs Pitsch; Jurgen Knapp; Ludwig Ney; Armin Berner; Volker Lischke (2016)	Adaptation of the CRM course, including the use of a simulator for the practical part and optimization for the local operational reality, with a working approach of multidisciplinary teams (doctor, paramedic, pilot and mountain rescuer) of the mountain rescue helicopter service.	Quasi-experimental Designs	During the 1-year period (January to December 2015), 20 physicians and 20 paramedics were evaluated in simulation-based training sessions using an anonymous questionnaire. This pre- and post-training questionnaire allows each participant to self-evaluate non-technical skills. The simulated training lasts for 2 days, in which participants go through 5 different complex scenarios.	Completion of 40 self-assessment questionnaires, pre and post simulated training, based on the assessment of non-technical skills. The results show that simulation training based on the key points of the aviation CRM led to an increase in self-confidence in managing complex situations and in making structured decisions.	Simulation-based training based on CRM key points contributes to: Improved user safety; Improvement of crew resource management competence in complex medical environments; Improved team safety; Increased self-confidence in managing complex situations; Improved decision making.

Chart 1 – Results of the Integrative Literature Review.

Title / Authors	Aim	Type	Methodology	Results	Conclusion
More explicit communication after classroom-based crew resource management training. Results of a pragmatic trial Inge Verbekk-Van Noord; Martine C. de Brujine; Jos W. R. Twisk; cathy van Dyck; Cordula Wagner (2015)	To evaluate the impact of a theoretical training in aviation CRM, lasting 2 days, given in the Medical Emergency Departments in terms of oral communication and non-technical skills.	Quasi-experimental Designs	Pragmatic control before and after training to assess the impact of training on participants. Four teaching hospitals were selected for the execution of this study carried out in the emergency departments, in both direct intervention and control areas. Physicians and nurses were observed regarding their non-technical skills using the EPOC (Explicit Professional Oral Communication) methodology. The maximum observational peak was reached after 30 minutes of observation of the interaction between professionals, with only 3 EPOC results being analyzed; human interaction, environmental anticipation and overall average EPOC. The evaluation criteria underwent changes between training and observation days in order to determine levels in patient safety aspects and error management culture.	A significant increase in human interaction and in the general average EPOC was achieved in the post-training phase, the same was not verified regarding environmental anticipation. This meant a 25% increase in communication quality.	There is a significant increase in non-technical skills in a post CRM training phase. It is considered, therefore, that this study contributes to the validation of the assertion that training in CRM has the potential to increase patient safety by reducing possible communication failures, as these are a vital tool in patient care in a critical environment.

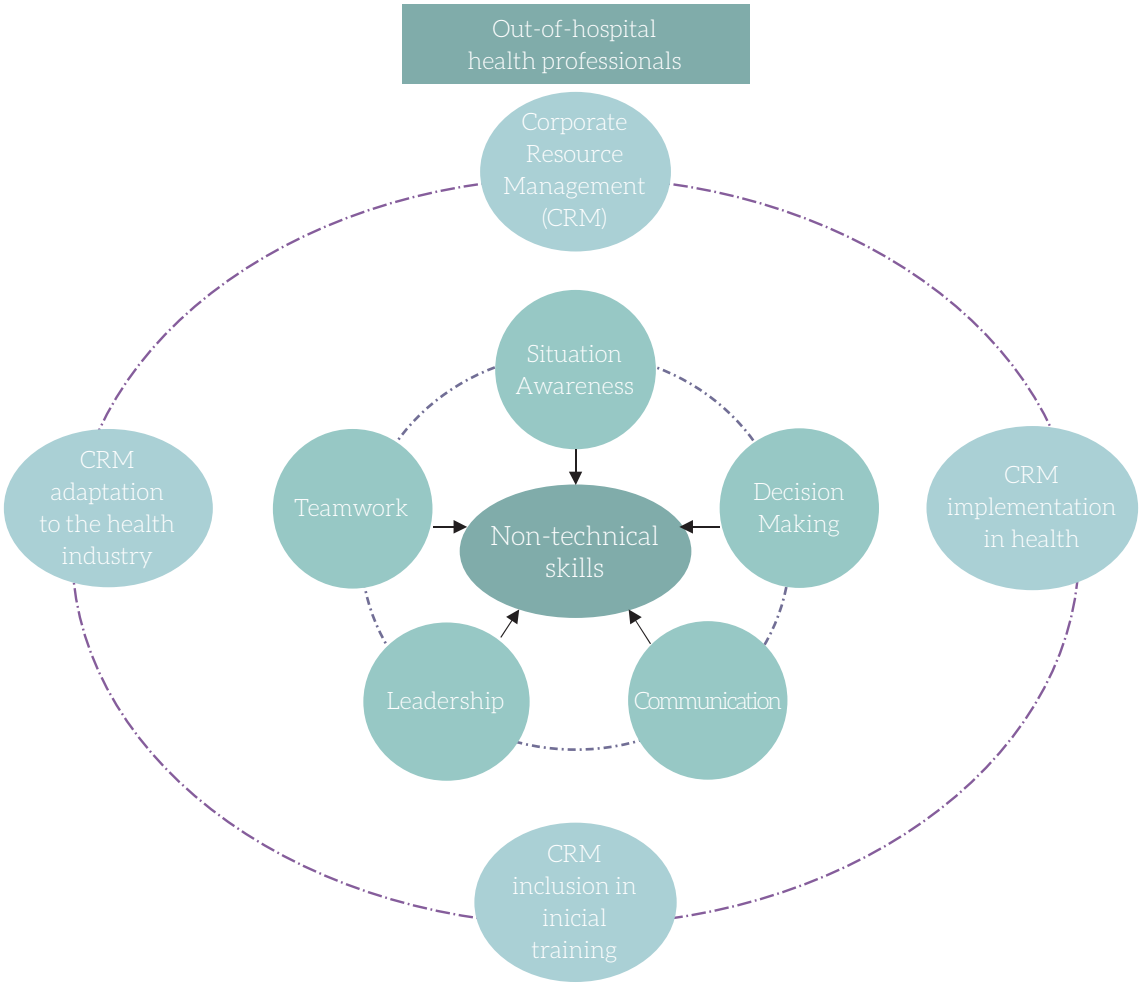


Figure 1 – Summary of results.[↖]