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Emergency Team Competencies, pre-hospital emergency team competency framework: a narrative review.

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Abstract:	International data for the year 2021 report that 10% of patients using healthcare services suffer at least one adverse event. Globally, this translates into 3 million deaths due to unsafe care and an expenditure of USD 606 billion per year. It is evident that patient safety is a major issue for public and private healthcare worldwide and that it requires governance based on human factors development. From this problem stems the aim of the research, to innovate the overview, to overcome the dualistic concept of TS and NTS, to introduce a framework of competencies, in the broadest sense of the definition, and a tool for observing these competencies for the benefit of personnel who have to provide pre-hospital and intra-hospital care. A narrative review of the literature based on the Chochrane method was conducted. The items were placed within a Taxonomy divided into Areas, Items and Behaviours. The Items were explored in four rounds of discussion between the authors and were included within the three macro-areas. The current lack of literature exploring critical aspects in high-risk settings guided the drafting of the Taxonomy which, as it stands, represents a framework of purely observational skills useful for guiding clinical practice and human factors training. 38 Behaviours, 32 Elements and 8 Areas were identified as potentially observable and suitable for good daily clinical practice by professionals working in the out-of-hospital setting, respectively ranked in order of priority: communication, leadership, task management, cooperation, situation awareness, decision - making, stress & fatigue management and clinical skills. Further studies will be necessary to confirm the concrete observability of the Areas, Elements and Behaviours described in the Taxonomy, to measure the effectiveness of the tool in improving the learning curve and their concrete application in reducing the error rate. Finally, a further in-depth study

	will be used to determine the validity and reliability of the Taxonomy as a tool for assessing and monitoring the performance of operators.
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Abstract

International data for the year 2021 report that 10% of patients using healthcare services suffer at least one adverse event. Globally, this translates into 3 million deaths due to unsafe care and an expenditure of USD 606 billion per year. It is evident that patient safety is a major issue for public and private healthcare worldwide and that it requires governance based on human factors development. From this problem stems the aim of the research, to innovate the overview, to overcome the dualistic concept of TS and NTS, to introduce a framework of competencies, in the broadest sense of the definition, and a tool for observing these competencies for the benefit of personnel who have to provide pre-hospital and intra-hospital care. A narrative review of the literature based on the Chochrane method was conducted. The items were placed within a Taxonomy divided into Areas, Items and Behaviours. The Items were explored in four rounds of discussion between the authors and were included within the three macro-areas. The current lack of literature exploring critical aspects in high-risk settings guided the drafting of the Taxonomy which, as it stands, represents a framework of purely observational skills useful for guiding clinical practice and human factors training. 38 Behaviours, 32 Elements and 8 Areas were identified as potentially observable and suitable for good daily clinical practice by professionals working in the out-of-hospital setting, respectively ranked in order of priority: communication, leadership, task management, cooperation, situation awareness, decision - making, stress & fatigue management and clinical skills. Further studies will be necessary to confirm the concrete observability of the Areas, Elements and Behaviours described in the Taxonomy, to measure the effectiveness of the tool in improving the learning curve and their concrete application in reducing the error rate. Finally, a further in-depth study will be used to determine the validity and reliability of the Taxonomy as a tool for assessing and monitoring the performance of operators.

Keywords: human factors; competencies; prehospital setting; emergency; taxonomy.

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Introduction

International data referring to the year 2021 reports that 10 percent of patients using healthcare services will experience at least one adverse event during their treatment period. Globally, this translates into 3 million deaths due to unsafe care and an expenditure of $606 billion annually, just over 1 percent of the total economic output of OECD countries [1][2]. Thus, it can be seen that patient's safety is one of the most significant issues facing public and private health care worldwide, and that addressing this problem requires governance based on long-term investments focused on building mechanisms to ensure adequate levels of staffing, training, and support in the workplace [2]. The innovation of curricular pathways, in terms of quality and frequency, is a focal point that the authors want to explore and deepen [3]. Over the past 30 years, multiple training courses centered on procedural knowledge and drug control aimed at reducing drug-related adverse events [4], technical skills (TS) development, and purely clinical skills courses have been introduced. To date, based on modern techniques of investigating adverse events and near misses, the study of Non-Technical Skills (NTS) has gained increasing importance, leading to the development of training courses focused on the acquisition of such skills, but excluding these topics from the so-called technical skills. It should also be noted that the fact of insufficient consolidation of NTS within the Operational Units (OUs) is also recognized [5]. This problem gives rise to the objective of this research, which is to innovate the overview, overcome the dualistic concept of TS and NTS, and introduce a framework of competencies, in the broadest sense of the definition, and a tool for observing the latter for the benefit of personnel who have to provide relief in both the pre-hospital and intra-hospital phases, areas recognized as most exposed to the risk of human error. The Emergency Team Competencies Taxonomy thus proposes a new overview so that this "observational taxonomy" will, as research progresses, become a gold standard framework of competencies for emergency teams operating in high-risk settings.

Design

This review was developed using a search strategy based on the Chochrane method [6]. The literature search was conducted in the databases of Medline, PsycInfo, CINAHL, EMBASE, Medline plus, SCOPUS, Ovid, and Google Scholar. The search terms were (Non-Technical Skills [Title]) AND (Technical Skills [Title]) AND (prehospital) AND (emergency department) OR (Human Factors in emergency) OR (NTS) AND (English[lang]) AND ("2002/01/01" [PDAT]: "2022/10/30"[PDAT]); TI Non-Technical Skills AND TI Technical Skills AND TI prehospital TI emergency department OR AB Human Factors in emergency AND LA English. The additional search terms for the other databases were human factors in prehospital - human factors in emergency medicine - non-technical skills in prehospital - non-technical skills in emergency medicine - adverse event in emergency medicine - adverse event in prehospital. Studies in the elected literature were manually consulted and those that met the criteria were included. Literature from the aviation, aerospace, and military industries was also analyzed. The literature was elected based on the inclusion criteria and scientific relevance following author comparison sessions. The literature search was conducted during the time period ranging from July 2022 to October 2022. Table 1 summarizes the steps related to the literature search.

Table 1 - Summary of steps related to bibliographic research

Search terms
(Non-Technical Skills [Title]) AND (Technical Skills [Title]) AND (prehospital) AND (emergency department) OR (Human Factors in emergency) OR (NTS) AND (English[lang]) AND ("2002/01/01" [PDAT]: "2022/10/30"[PDAT])
TI Non-Technical Skills AND TI Technical Skills AND TI prehospital TI emergency department OR AB Human Factors in emergency AND LA English
Human factors in prehospital, human factors in emergency medicine, non-technical skills in prehospital, non-technical skills in emergency medicine, adverse event in emergency medicine, adverse event in prehospital.
Databases
PubMed, Medline, PsycInfo, CINAHL, EMBASE, Medline plus, SCOPUS, Ovid Medline and Google Scholar.
Inclusion criteria
Empirical data, report, systematic review, meta-analysis, scoping review and narrative review with relevance for non-technical skills and technical skills in the emergency department, pre-hospital setting, aviation, military and aerospace sector, publications in English, time frame 2002 – 2022, open access publications and studies available through university credentials.
Exclusion criteria
Publications not in English, time frame 2002 – 2022, publication not in time frame 2002 – 2022.
Expanded inclusion criteria
Literature that was not included in the reporting period and was scientifically relevant was discussed before being excluded.
Result
1045 studies, of which 913 were ineligible because they did not meet the inclusion criteria and the remaining 135 studies were identified as potentially eligible. At the end of the second stage of analysis, 89 studies were excluded because they were either not relevant to the research objective or delved into taxonomies of technical or non-technical skills already included.

Subsequently, the elected studies were discussed in four rounds of virtual meetings aimed at identifying eligible and relevant competencies for the construction of the Taxonomy. The internal classification of the observational tool was divided into Areas, Elements and Behaviours. The competencies found to be eligible at the end of the discussion rounds were subsequently discussed to identify their priority level and placement within the Taxonomy. Behaviours included in the grid were discussed in the same rounds, also taking into consideration techniques, acronyms and tools that emerged during the study of the elected literature.

Inclusion Criteria

Original research, primary studies, reports, narrative, systematic reviews, meta-analyses, and scoping reviews that delved into, discussed, and evaluated at least one domain of technical or non-technical skills, included in the time frame 2002 - 2022, were included. Literature that was not included in the examined time period and was scientifically relevant was discussed before being excluded. All articles written in English were included. All open access, full text studies that could be found through university credentials were included.

Exclusion Criteria

Literature that was duplicated, lack of access to the full text of the article, not relevant to the purpose of the study, that was not published in English, and that had been conducted in settings other than the Emergency/Urgency, out-of-hospital rescue setting, aviation, military, and/or aerospace setting were excluded.

Data extraction and analysis

Data on author, publication date, study design, study objective, setting, human factors investigated, human factors elected, main findings and conclusions were extracted. The purpose of the data extraction summary tables was to sum up the main findings that emerged and organize the items to be discussed by the authors afterwards. Data extraction was conducted independently by the authors. Disagreements were discussed until consensus was reached at all stages of extraction, inclusion in the areas, items, and behaviours relevant to the creation of the Taxonomy.

Prior to the start of the discussion rounds, data were summarized descriptively and narratively to facilitate content analysis of each study and recognition of the skills explored. It should be specified that the data extracted were heterogeneous with each other due to the different contexts in which the research was conducted. At the end of the data extraction phase, the data were critically discussed in rounds of virtual meetings, the purpose of which was to identify disagreements, formulate new points of view, and explore the value and usefulness of the items that emerged. The skills found to be eligible were schematized in a mapping grid (Table 2) that includes the items found to be eligible for the next round. Finally, an additional round dedicated to framing the competencies within the categories of Areas, Elements, and Behaviour took place.

Results and Discussion

1045 studies were searched, of which 913 were not eligible because they did not adhere with respect to the inclusion criteria, and the remaining 135 studies were identified as potentially eligible. At the end of the second phase of analysis, 89 studies were excluded because they were not relevant to the research objective or because they delved into taxonomies of technical or non-technical skills already included. Of the 46 studies included, 13 were reviews, 12 were reports, 6 were observational studies, 4 were validity and reliability studies 2 qualitative studies, 2 scoping reviews, 2 textbooks, 2 systematic reviews, one mix-method study, one cross-sectional study, and one trial. 33 studies were conducted in the healthcare sector, 8 in aviation, and 3 in the aerospace industry.

At the end of the literature review and the first 4 rounds of discussion, 38 Behaviours, 32 Elements, and 8 Areas were identified, respectively ranked in order of priority: *Communication, Leadership, Task Management, Cooperation, Situational Awareness, Decision - Making, Stress & Fatigue management, and Clinical Skills.*

Table 2 - Mapping of the behavioural markers, elements, competence domains explored in the included studies and multi-stage development of the ETC observational tool.

Mapping of the behavioural markers, elements, competence domains explored in the included studies and multi-stage development of the ETC observational tool

Competencies explored	Phase 1: literature	Elements explored	First Round		Second Round		Third Round		Fourth Round	
			Inclusion	Exclusion	Inclusion	Exclusion	Inclusion	Exclusion	Inclusion	Exclusion
Decision making	[14][28][34][35][36][42][45][46] [47][48][49]	Problem solving	●		Δ		Δ		Δ +	
		Standard		o	o		o		●	
		Cognitive flexibility	●		Δ		Δ		Δ +	
		Decision aids	●		Δ		Δ		Δ +	
		Diagnosis	●		Δ		Δ		Δ +	
		Generation of options	●		Δ		Δ		Δ +	
		Risk assessment	●		Δ		Δ		Δ +	
		Checking the results	●		Δ		Δ		Δ +	
		Shared mental models		o	o		●		Δ +	
		Teamwork	●		Δ		Δ		Δ +	
Situational awareness	[14][20][27][28][34][35][36][39] [40][41][42][43][44]	Information gathering	●		Δ		Δ		Δ +	
		Analysis	●		Δ		Δ		Δ +	
		Anticipating	●		Δ		Δ		Δ +	
		Shared mental models		o	o		●		Δ +	
		Environmental awareness		o	o		o		●	
		Scene management		o	o		o		●	
		Self-awareness		o	o		●		Δ +	
		Team situation awareness		o	o		o		●	
		Time management		o	o		o		●	
		Data management	●		Δ		Δ		Δ +	
Task management	[10][25][33][34][35][36][37]	Distribution of tasks	●		Δ		Δ		Δ +	
		Preparing	●		Δ		Δ		Δ +	
		Prioritizing		o			●		Δ +	
		Time management		o	●		Δ		Δ +	
		Resource management	●		Δ		Δ		Δ +	
		Role awareness		o	●		Δ		Δ +	
		Task analysis	●		Δ		Δ		Δ +	

		Reflection		o	o	●	—
		Workflow assessment	●		Δ	Δ	Δ +
Communication	[7][8][9][10][11][12][13][14][15][16][17]	Autority	●		Δ	Δ	Δ +
		Assertive	●		Δ	Δ	Δ +
		Proactive communication		o	o	●	Δ +
		Respect		o	●	Δ	Δ +
		Empathy		o	●	Δ	Δ +
		Professional	●		Δ	Δ	Δ +
		Rapport		o	●	—	—
		Ethical	●		Δ	Δ	Δ +
		Listening		o	o	o	●
		Clarity and relevance	●		Δ	Δ	Δ +
		Circularity	●		Δ	Δ	Δ +
		Standard	●		Δ	Δ	Δ +
Leadership	[7][8][14][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32]	Briefing	●		Δ	Δ	Δ +
		Leadership Style		o	o	●	Δ +
		Planning	●		Δ	Δ	Δ +
		Transformational leadership		o	o	●	—
		Conflict management	●		Δ	Δ	Δ +
		Debriefing		o	o	o	●
		Followership		o	o	o	●
		Respect		o	o	o	●
		Sharing	●		Δ	Δ	Δ +
Cooperation	[9][20][28][38][39]	Management	●		Δ	Δ	Δ +
		Teamwork	●		Δ	Δ	Δ +
		Supporting others	●		Δ	Δ	Δ +
		Sharing		o	●	Δ	Δ +
		Request for help	●		Δ	Δ	Δ +
Stress/fatigue management	[40][42][50][51]	Manages pressure	●		Δ	Δ	Δ +
		Empathy		o	o	●	Δ +
		Emotional Intelligence		o	o		●
		Resilience	●		Δ	Δ	Δ +

		Coping strategies	o	•	Δ	Δ +
		Stress factors	•	Δ	Δ	Δ +
		System awareness	o	o	•	Δ +
		Standard	•	Δ	Δ	Δ +
Clinical skills	[45][52]	Knowledge and application of procedures/guidelines	•	Δ	Δ	Δ +
		Understanding of legal regulations	o	o	•	Δ +
		Quick look	o	o	o	•

Legend : • Inclusion/Exclusion o Not yet investigated Δ Under review Δ + Review confirmed Δ — Revision not confirmed — Item excluded

Communication

The Safety Human Incident & Error Learning Database (SHIELD), a document summarizing Safety Occurrence Reporting and Analysis systems (SORAS), explores the tools adopted by the maritime and aviation industry to improve communication strategies. The most common errors recorded can be traced to an inappropriate approach by personnel to other professionals around them. Failure to communicate, leaving out important details, not being sure that the receiver has heard, not conveying the message clearly, represent dangerous behaviours, especially during an emergency [7]. Evans JC, Evans MB, Slack M, Peddle M, Lingard L highlighted that circular communication is a good strategy to understand whether the receiver has understood and received the information. Gradual assertiveness was effective when disagreements were present within the work team. This helped even the junior professional to assert his or her point of view against experienced practitioners [8]. Implementation of standardized communication patterns is recommended to reduce the loss of important data, reduce timelines, and establish shared mental models [9][10]. S.B.A.R is the reference model, but the literature does not mandate one; it recommends the adoption of a single method by OUs belonging to the same departments [11][12]. In the out-of-hospital setting, additional distracting variables related to the implemented technology (signal disturbance, line disconnection) and the working environment should be considered. The described communication models, circular communication and feedback emerge as vital tools for delivering the right care to patients, including with the help of telemedicine [13].

In the field of Civil Aviation, the relevant regulations issued by the European Aviation Safety Agency (EASA) suggest that communication should take place by means appropriate to the operational context. Professionals are required to communicate in a clear, concise, understandable, complete and correct manner, introducing the "5 Cs" rule. Professionals must actively listen when involved, demonstrating through feedback that they have understood the content of the message conveyed.

Information sharing must follow the same procedures to avoid distortion of the message conveyed [14].

In the Briefing and Debriefing of teams, communication must be used to implement all its strategic valences to establish the right atmosphere of collaboration, assign roles and responsibilities, settle doubts and requests, and mitigate emotions or discomfort experienced during activities [15].

Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. pointed out that effective communication fosters the creation of a universal learning environment, where professionals are encouraged to let information flow freely, regardless of degree of authority. The result is thus a moment of professional growth that stimulates each team member to improve his or her performance [16][17].

Leadership

Dagnell AJ. pointed out that NTS and leadership can improve the critical phases and quality of cardiopulmonary resuscitation [18]. Herzberg, S., Hansen, M., Schoonover, A., Skarica, B., McNulty, J., Harrod, T. et al. examined the correlation between teamwork abilities and observed adverse events in the out-of-hospital setting. Logistic regression analysis showed that the odds of error decreased by 28% for each point gained on the Clinical Teamwork Scale (OR 0.72, 95% CI 0.59-0.88) [19].

Psychosocial science argues that team effectiveness is not a direct consequence of good leadership. A characteristic that determines good teamwork is the social climate, which falls within the responsibilities of all professionals involved. The professional experience of the one who plays the role of leader is not a variable that ensures adequate exercise of this skill. The key to increase levels of group effectiveness is to optimize that climate [20].

Currently, the most recent studies support the transformational and ethical leadership style [21][22], which includes 6 leadership models [23]. All the mentioned styles have different characteristics; these may be effective in certain situations and ineffective in others. Studies specify the importance of staff's knowledge of the various leadership approaches and the necessity of a comprehensive interpretation, as situations, changing rapidly, may need a corresponding and quick change in style to ensure a favourable outcome for the patient with a subsequent increase in job satisfaction for the practitioners. [14][24][25].

Given this for granted, it is important to point out that conflicts are universally recognized as one of the causes of delays within health care facilities and greatly affect the social climate of the team[26] at this juncture the leader goes on to represent a key figure in the management of these kinds of events[27]. There are basically four models of conflict management: competitive, evasive, permissive and collaborative. Of all of them, the first three are ineffective in ensuring a good degree of teamwork, as they cause increased levels of tension or lead to avoidance of having to engage in discussions that

are deemed irrelevant. In fact, avoiding confrontation inevitably leads to the onset of a problem, consequently reflecting on the quality of care delivered [8][26][28][29].

The briefing phase, in which the leader acts as moderator, aims to plan activities, analyzing one's competencies and the situation in which one is going to work. To structure the work, the following should be discussed: current situation, who is in the team and degree of competence, who is best suited for a particular patient and what crisis so that an effective use of human resources is implemented [7][8][30]. The Debriefing phase aims to discuss the services provided, behaviours used and any mistakes made, helping to alleviate some conflicts and motivate the team to overcome the fear of negative repercussions [8][17][31][32].

Task management

Within the team, the figure of the leader and the briefing phase are particularly relevant. Sharing goals, information and priorities should be preeminent to set a common course of action, encouraging "shared mental models" [33]. In addition, by preparing the team to act according to a predefined pattern, it is possible to identify any issues that can be resolved even before the team has to act; understaffing, the need for multiple resources (human and non-human), and the discussion of any doubts with respect to one's role/task can be corrected quickly, reducing the risk of error [34][35]. In this regard, managing workloads with the help of proper leadership styles is relevant, with the aim of maintaining a balance [36] and avoiding work overload for some and inactivity for others. Cummings GG, Tate K, Lee S, Wong CA, Paananen T, Micaroni SPM et al. revealed that the implementation of these models of physical and mental preparedness and the diffusion of a collaborative climate reduce staff dissatisfaction and skill enhancement [25]. Nevertheless, the health care environment requires flexibility and operational adaptability as the patient's clinical conditions can change rapidly [10]. To cope with these changes, which could also result from inaccurate information conveyed by other professionals, staff should be prepared to question their line of action, claiming the goals, actionable strategies, and priorities already set [37].

Cooperation

The emergency setting and the out-of-hospital setting require active cooperation among providers to reduce response time and maximize effectiveness. Numerous taxonomies include this area within them, in the aviation, military, and healthcare sectors [9][20][28][38], as positive correlations have been found between effective communication, leadership, cooperation, and organization [39]. These skills are found to be a dependent variable with respect to the others; in fact, the lack of one of them alters the social climate within the team.

To maximize cooperation among professionals, studies pointed out that is necessary to provide support whenever necessary, including providing feedback on the delivered performance or implemented behaviours. In this context, it is also important to be able to accept such support or request it when needed, taking advantage of effective communication models that do not incentivize judgment activity [9][20][39].

Situational Awareness

All elements that produce better situational awareness (SA) and cognitive flexibility are associated with less stress, less fatigue, and lower frequency of unsafe behaviours in EMS crews [40].

SA involves several domains: the Work Environment, the Patient, the Providers, and information from different sources. The understanding of the environment in which the provider interacts helps to identify what is happening in order to anticipate what will happen. It is necessary to establish action plans based on the occurrence of various events, not limited to the study of a single evolution of the patient's clinical condition. Therefore, areas previously mentioned, in particular effective communication, shared mental models, and confrontation models focused on problem solving, also play a role [39].

The UK Civil Aviation Authority classifies SA into three levels of awareness:

- Information gathering.
- Understanding and analysis.
- Anticipation.

This classification aims to structure the process of analyzing and verifying the information gathered, preventing the practitioner from skipping steps [41]. Applied to the health care environment, and particularly the out-of-hospital setting, SA is important in determining whether any intervention is necessary [14][20][28].

The World Health Organization includes two aspects to be considered: self-awareness, based on the analysis of their own skills, knowledge, and limitations imposed by the training acquired; and awareness of the team in which they are going to work, which includes the analysis of the skills of each member [35]. Thus, a fair allocation of human resources can be fostered, managing staff appropriately according to the difficulties that may be encountered. Rowland, M., Adefuye, A. O., & Vincent-Lambert, C. pointed out that SA is divided into three distinct levels: the first involves the identification of the patient's clinical signs/symptoms; the second involves the use of past experience

and prior knowledge to better understand the meaning of these elements in light of the goals set; and the third, built on the first two, involves the ability to anticipate and project problems in the near future. The provider is then able to anticipate what is likely to happen [42].

Scene assessment (environmental safety), including inherent distractors and hazards, should be done systematically to avoid superficial analysis of the scene. As the practitioner approaches the scene, he or she will consider information that he or she will subsequently have to process to decide whether the scene is safe or not. The literature on the matter recommends that the time spent on this phase should be extended in order to safely assess the patient's clinical condition [36][43][44].

Regarding time management the evidence appears to be still poorly explored. There is evidence of the well-known phenomenon of frequent misalignment between "chronological time" and "perceived time" by an individual, which leads to behaviours of "task fixation" at the expense of maintaining awareness of the big picture of ongoing activities. Bennett, R., Mehmed, N., & Williams, B. point out that good awareness of the timing with which certain interventions are carried out helps reduce potential fixation errors [36].

Decision Making

In pre-hospital setting, there are several standardized evaluative-decisional algorithms (X.A.B.C.D.E. method, S.A.M.P.L.E. etc.....). The decision-making area aims to promote a standardized patient approach and thinking methodology that focuses on rational analysis and interpretation of information, with the purpose of reducing the use of intuitive thinking. Fletcher G, Flin R, McGeorge P, Glavin R, Maran N, Patey R., included the Cognitive Active Flow (CAF) model highlighting the critical steps of reasoning through the sequence of: situational assessment, problem identification, diagnosis formulation, and risk assessment [34][35]. In the field of Civil Aviation, EASA-issued reference regulations recommend the use of decision aids to reduce the risk of error and the occurrence of cognitive bias [14]. Sedlár, M., & Kaššaiová, Z. included three additional steps: implementation of the decision, reassessment of the decision, and maintenance of standards [27]. Implementation of guidelines is recommended to deliver quality care as opposed to formulating a decision-making process based on experience alone, as guidelines are designed by studying large and representative samples of the population; Clinical Practice Guidelines (CPGs) are intended to improve healthcare professionals 'decision-making by clearly describing and evaluating scientific evidence [45].

Despite this, therapeutic decisions can deviate from the guideline as long as the decision-making process is based on empirical and objective data [27]. This is also supported by the World Health Organization, which recommends the use of decision support models, data mining, and predictive models [35].

The DECIDE model is a resource for healthcare executives to make better-performing decisions [46]. T-DODAR is a decision-making tool used in aviation and later applied to the surgical setting [47]. As for the pre-hospital setting, there is currently no tool that supports decision-making. From the authors of this study, the acronym C.I.R.C.L.E was developed as the first version of cognitive aid.

C.I.R.C.L.E. is divided into two phases, which take up elements already discussed in the previous paragraphs:

- **Clinical analysis**: patient assessment. Search for information, signs and symptoms (Remote and upcoming pathological history, X.A.B.C.D.E., S.A.M.P.L.E etc...).

- **Identification and treatment**: Analysis, understanding of information gathered, discussion with team members, problem identification and treatment. Plan A, Plan B and Plan C design. For each plan formulated, it will be helpful to analyze the potential risks or complications that might occur.

- **Resolution - Re-evaluation**: Evaluation of the clinical outcome and possible resolution of the problem. Alternatively, implementation of new strategies.

- **Consequences and developments management**: management of complications and implementation of strategies to control the evolution of the patient's clinical condition.

- **Location and transportation**: consideration of the geographical location in which one is located. Consideration will be given to the need for additional resources (Fire Department, Law Enforcement, EMS), their proximity, clinical condition of the patient and the time factor.

- **Evaluation in continuous**: re-evaluation, continuous monitoring and possible changes in strategy based on the patient's clinical evolution.

Sterling, M. R., in the Space Flight Resource Management (SFRM) model, defines decision-making as a critical element since the steps of this appraisal contribute to create more effective situational awareness. Each step, therefore, is referred to as a "window of awareness" [42][48]. Hall C, Robertson

D, Rolfe M, Pascoe S, Passey ME, Pit SW. tested the effectiveness of TEMPIST, a medical emergency management and treatment protocol, in a simulated ER environment by observing team error rates. The authors highlight that by applying the TEMPIST Manual, physicians halved their teams' error rates. All teams in the study reduced error rates by at least 20 percent when they had access to the Emergency Protocol Manual. Overall, there was a 54 percent reduction in errors in all four scenarios [49].

Stress and Fatigue management

In this review, psycho-emotional aspects are not exhaustively explored, in scientific literature, however, some advice can be found. Improving the management of non-technical aspects in emergencies is an important part of training providers, in order to deal with increasingly challenging events of longer duration and frequency [40]. The management of fatigue and stress is closely associated with situational awareness, communication, and the social climate that is established in a team. These elements directly contribute to increased levels of emotional pressure, which are also related to the environment in which the operators have to work. Improved situational awareness and cognitive flexibility are associated with less stress, less fatigue, lower frequency of unsafe behaviour, and less involvement in safety-related incidents among EMS crew members [42]. Flowerdew L, Gaunt A, Spedding J, Bhargava A, Brown R, Vincent C et al. identified major stressors for emergency department (ED) personnel, analyzing positive and negative behaviours associated with working under pressure and considering interventions that can improve ED team functioning. Leadership and teamwork were found to be mediating factors between objective stress (e.g., workload) and subjective stress. Participants described the impact of high operational pressure on communication practices, departmental overview, staff and patient management [50]. Ranasinghe, P., Wathurapatha, W.S., Mathangasinghe, Y. investigated the impact that emotional intelligence (EI) can have on pressure and stress management. It should be specified that this research was conducted on medical students, but it was found that higher EI is associated with better academic performance among final-year medical students. In addition, higher EI was observed in those who had a higher level of self-satisfaction, just as self-perceived stress was lower in those who had a higher EI [51].

Clinical Skills

Peltonen V, Peltonen LM & Salanterä S evaluated the association between non-technical and technical skills in real ALS situations in a hospital setting. This study presents for the first time an association between NTS and TS in real ALS situations in hospital, and the results suggest that NTS and TS are not independent skills, but have a positive association with each other [52]. In this regard, the ETC Taxonomy proposed here integrates "Clinical Skills" within it to overcome the concept that often separates TS from NTS, thus determining a single "map" of necessary skills. Elements and behaviours proposed by the international associations that issued the previously described assessment protocols (Italian Resuscitation Council, National Association of Emergency Medical Technicians, European Resuscitation Council, American Heart Association) have been included.

First, providers should be aware of the tools within the Emergency vehicle, know their limitations and the interaction between them. They should be familiar with the location of each piece of equipment within the vehicle. That must be related with the knowledge of all the equipment useful to perform the main skills, control of their compliance, eventual sterility and proper functioning.

Any deviation from the guidelines is possible if it is based on objective data discussed with team members, to reduce the risk of choosing a therapeutic path based on intuitive thinking. Although the intuition of the experienced practitioner should not be ruled out systematically, especially when he or she has gained sufficient experience to recognize signs/symptoms related to an immediate risk to patient survival, the systematic approach should be applied by all staff, especially those with limited experience, to encourage practice and build solid training for future practice.

Conclusions

The proposed Taxonomy has 8 Areas, 32 Elements and 39 Behaviours identified as potentially observable and suitable for good daily clinical practice by professionals working in the pre-hospital setting.

Limitations of the study

The lack of literature exploring all critical aspects in high-risk settings guided the writing of the Taxonomy, which, currently, solely represents an observational skills framework useful for guiding clinical practice and training in human factors, given the heterogeneity of the elected studies. In the near future, further insights that confirm the concrete observability of the Areas, Elements and Behaviours described in the Taxonomy are certainly desirable. Equally important will be the evidence that emerges from testing that measures the effectiveness of the tool in improving the learning curve of healthcare professionals of human factors and its concrete application for reducing error rates in the pre-hospital setting. Finally, a further in-depth analysis will be used to determine the validity and reliability of the Taxonomy as a tool for assessing and monitoring providers' performance.

Implications for practice

The literature on NTS and TS, as anticipated, is heterogeneous and developed in very different settings. The Taxonomy Emergency Team Competencies (Table 3) discussed here (in the latest version reached, 3.3.5), selected the main behaviours judged suitable for clinical practice. Nonetheless, the evolution of knowledge in these matters is constantly growing, thus leading to the need for its periodic review. The experience of personnel working on a daily basis in the pre-hospital setting is also considered a relevant contribution to the revision process. In this regard, the Taxonomy has already been proposed in various training courses with advanced simulation for territorial care staff before its current version, with the intention of identifying possible errors and improving its comprehensibility.

These training experiences convinced the authors that, for an effective implementation of the ETC tool within operational units, it is necessary to conduct training sessions specifically dedicated to the discussion and practice of the behaviours described within it, taking advantage of the didactic methodology of medium- and high-fidelity simulation. The same personnel deputed to conduct the training moments to be delivered, the construction of the simulation scenarios and related debriefings, will need to be sufficiently educated and trained in the concepts underlying the ETC Taxonomy, as well as in the methodologies of training professional adults.

The authors hope to publish in the near future some guidelines for a methodology of training and observation through the use of the ETC Taxonomy tool.

Table 3 – Emergency Team Competencies Taxonomy (ETC)

AREAS	ELEMENTS	BEHAVIOURS
COMMUNICATION	**Listening** **Clarity and relevance** **"Close loop"** **Standard phraseology** **Assertiveness**	• Demonstrates willingness to listen with empathy. • Makes sure that the recipient is ready and able to receive information. • Delivers messages clearly, comprehensibly, concisely, comprehensively, correctly. • Confirmation is expected after making a request or giving orders. • Uses acronyms, abbreviations, sequences, etc. (S.B.A.R., ATMIST, ABCDE). • Maintains his point of view respectfully (Doubt – Worry – Request – Action). • Activates to limit non-essential talks and interruptions in critical situations.
LEADERSHIP	**Leadership Style** **Briefing and Planning** **Conflict Management**	• Adapts leadership to the situation and the group. • Shares the vision, goals, thoughts and actions with others to achieve better results. • Performs Briefing and Debriefing (i.e.: PARTO, AREU, HATMOS). • Involves colleagues in planning and coordinating activities. • Calm in conflicts and able to negotiate alternative solutions.
TASK MANAGEMENT	**Priorities setting** **Time optimisation** **Resource Management** **Task distribution** **Role Adherence**	• Sets the right priorities and is flexible in changing them. • Considers time constraints/deadlines. • Identifies and uses all available resources (human and otherwise). • Balances the workload within the team. • Knows the assigned tasks and the associated limitations.
COOPERATION	**Coordination and Integration** **Supporting others** **Sharing** **Call for help**	• Collaborates actively with colleagues, shows adaptability. • Is attentive to colleagues' work, helps if necessary. • Asks for help promptly when needed. • Shares information, doubts and concerns. • Knows how to give and receive feedback honestly and respectfully.

AREAS	ELEMENTS	BEHAVIOURS
SITUATIONAL AWARENESS	**Information gathering** **Understanding and analysis** **Anticipation**	• Actively searches for information related to: Patient Status, Environment, Timing. • Organizes information and analyses it critically. • Verifies the assumptions made and is willing to update the "mental model". • Identifies distracting factors (interruptions, noise, etc.). • Anticipates possible developments and consequences of actions.
DECISION – MAKING	**Diagnosis** **Options** **Risk Assessment** **Review**	• Involves the team periodically in the diagnosis process. • Decides about the action plan (stay and play; scoop and run). • Evaluates different options (risks and benefits) and considers alternative plans. • Periodically reviews the decision made and is available for changes. • Uses decision aids (i.e.: C.I.R.C.L.E., DODAR-T, DECIDE, FORDEC).
STRESS & FATIGUE MANAGEMENT	**Stress factors** **Emotions** **Coping strategies**	• Recognizes sources of stress and the effects on oneself and on team members. • Shares own psychophysical condition with the group (emotional debriefing). • Has good management of personal stress and emotions.
CLINICAL SKILLS	**System awareness** **Compliance with standards** **Knowledge and application of procedures/guidelines** **Understanding of legal regulations** **Quick look**	• Shows familiarity with systems, their limits and interactions. • Able to locate each item of the equipment within the operational space. • Knows and applies procedures, guidelines, algorithms and international standards. • Justifies to colleagues any deviation from established standards. • Demonstrates adherence with the rules of conduct, applicable regulations and legal responsibilities. • Recognizes obvious clinical signs, interprets posture, non-verbal and para-verbal language to establish the patient' status.

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