

A Work Project, presented as part of the requirements for the Award of a Master Degree in Management from the NOVA – School of Business and Economics.

SENSEMAKING AND IMPROVISATION IN THE PRESENCE OF PROTOCOLS

| THE EMPIRICAL CASE OF PRE-HOSPITAL ASSISTANCE PROFESSIONALS |

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26th MAY 2017

Protocols are those guidelines, which if we follow at the right moment, often allow us to keep the victims as safe as possible. I see them that way, they give us security. Subject 27

Because if we limit ourselves to the knowledge that is taught inside the school and we do not have a know how based on experience, we work with our hands tied. Subject 14

ABSTRACT

This study builds on successful episodes of improvisation in the prehospital emergency context to investigate how protocols can be articulated with unexpected events. An inductive approach shows that it is crucial for the flexible treatment of protocols to confront the disparity among mental models and the reality presented. Prehospital care practitioners accomplish this through benefit and harm assessment, risk assessment and resources attributes processes. Different types of unexpected events reflect in different improvisational processes: re-evaluation of cognitive resources, unrelated knowledge sources and re-interpretation of resources. Experience, resources, contextual factors and other operators are important factors in the decision process.

Key words: protocols, sensemaking, adaptation, improvisation, contextual assessment

INTRODUCTION

When prehospital care professionals assist victims of sudden illness or trauma, they have to combine different pieces of information into a pattern so they can formulate diagnostic hypotheses and perform the treatment. These routines are embedded in clinical guidelines and knowledge transfer mechanism for a standardized approach. However, these routines might happen in the presence of exceptional situations and unexpected events. These uncommon situations often result from an uncontrolled and typically unfavorable out-of-hospital environment, which is characterized by resources restrictions, distractions and often time pressure.

Therefore, there is the need for adjustment of routines and mechanisms to the uniqueness of each situation. Health professionals have the autonomy and responsibility to provide individualized care for their patients, adjusting and providing treatment in response to such individual uniqueness (Vogus, Sutcliffe and Weick, 2010). This complementarity of circumstantial adjustment towards protocols is recognized by the professional class, which

commonly refers repertoire of these past adjustments as “outdoor experience”. For this reason, this may be the ideal empirical context to study how unexpected events trigger adaptations of protocol, and which are the processes that reflect critical thinking and improvisation.

This investigation may bring important insights both for organizations in general, since improvisation is linked with adaptation and resilience (Weick, 1993; Grøtan, Størseth, Rø & Skjerve, 2008), and specifically for organizations that rely in institutional guidelines and protocols for daily operations. Research regarding improvisation in the computer industry (Brown and Heisenhardt, 1995) shows that firms with established routines are more likely to improvise.

LITERATURE REVIEW

Prehospital care corresponds to a context that extensively relies both in clinical guidelines, such as protocols and algorithms, and organizational certifications. Like in the medicine field in general, professionals have the rules memorized through their professional training and education (Perrow 1986). However, the practical exigencies of the daily practice demand for adjustments in routines. Once again, this is common to the medical practice in general. Institutionalized guidelines are based in evidence-based medicine and accepted best practices that, in specific situations, may collide with individualized considerations and judgments made on the scene (Haidet, 2007). EBM guidelines are the result of the incorporation of evidence from clinical trials, and are supposed to guarantee the basis of doctor’s behaviors (practice) and the quality of care. However, these guidelines are oriented to ‘average cases’. Clinicians may be forced by the actual conditions of the patients to use different ‘pieces’ of knowledge embedded in protocols, combine them, or activate expertise and experience via intuition (Feder, 1999; Nicolini, 2010).

Improvisation has been studied as an unplanned but intentional response to unexpected and unpredictable events (Weick & Sutcliffe, 2007). In emergency medicine, unexpectedness is a constant and professionals must deal with it.

Previous research proposes that “physicians must be skilled improvisers’ in order effectively to handle patients’ unique idiosyncrasies as deviations from the ‘average case’”. (Haidet, 2007).

The definition of improvisation has been evolving from an adaptation perspective, as defined by Berliner (1994): “flexible treatment of preplanned material” to a spontaneous process in which intuition guides action: “Thinking and doing unfold simultaneously” (Weick, 1996). More recently, Cunha, Cunha and Kamoche (1999) aggregate some previous perspectives and introduce the domain of organization, presenting the concept of organizational improvisation: “The conception of action as it unfolds, by an organization and/or its members, drawing on available material, cognitive, affective and social resources.”

Improvisation has been classified according to levels of improvisational activity. According to Weick (1998), variations in improvisation can be ‘embellishments’, where the plan is reshaped but still recognizable, ‘variations’ where unplanned actions are added but the relationship with the original plan is clear, or ‘improvisation’ when there are radical departures from plans. In more recent studies however, improvisation concept is applied in a broader way.

Additionally, improvisation has been classified according to types of improvisation. Moorman and Miner propose a set of categories organized in tensions: collective against individual improvisation, product improvisation against process improvisations and behavioral against cognitive improvisations (Moorman and Miner 1998b).

There are other relevant concepts, such as the ‘minimal structures’ proposed by Kamoche and Cunha (2001), which is divided in social and technical structures. The paper states that “a

balance between structure and flexibility is the best way to manage the contradicting demands of control and creativity faced by organizations in highly competitive environments”. Moreover, research argues that team-level processes influence individual improvisation through the quality of interaction. Behavioral integration and team cohesion positively affect improvisation: “The greater the integration and cohesion, the better team members are prepared to improvise on an individual-level.” (Magni, Proserpio, Hoegl & Provera, 2009).

Finally, regarding the medical emergency context, empiric research has been made investigating improvisation inside the emergency room of a hospital. This investigation is based in the premise that, despite standardization and improvisation being seen as conflicting logics, they are not incompatible. Moreover, it concludes that “professionals respond both to macro-institutional constraints and to the situational requirements they face in their everyday job requirements. (...) they defer to an institutional logic of standards, while in their institutional work they improvise.” The duality of the existence and non-existence of improvisation is attributed to pressures in the institutional domain, such as professional scrutiny, and practical needs emerging in the operational realm, such as patient variability (Baptista, Clegg, Cunha, Giustiniano and Rego, 2016).

Prehospital medical care is part of emergency medicine, although the environment in which practitioners operate is quite different from the emergency room: “What makes pre-hospital care so unique is that the care is provided far away from medical support. The care is given in a changing and sometimes difficult environment. (...) Pre-hospital health-care providers use different kinds of vehicle and many types of equipment not relevant to the hospital setting. Other issues which make pre-hospital emergency care so unique is that the care is provided in an unstable environment, due to an uncontrolled volume of patients, a variable level of acuity, a lack of information, time sensitivity, stress and fatigue.” (Kovacs and Croskerry, 1999). For this reason, investigating decision making and improvisation in the out-of-hospital context may

bring relevant contributions to improvisation studies in highly structured environments. My research question is: *How to articulate protocol and unexpected events?*

METHOD

Research Context

The research question was investigated within a highly protocolized professional activity, the prehospital medical care. This activity aims to assist victims of sudden illness or trauma. The emergency medical services can either provide treatment to those in need of urgent medical care and/or arranging for a timely transportation of the patient to the definitive care unit, usually a hospital. This activity relies in a consultation and articulation entity, that not only distributes work to the professionals that are spread and organized according to geographical areas, but also provide expert support in case there is not a doctor in the scene. This activity also relies in cognitive systems, for a standardized approach to each situation. The protocols encompass general approach systems, guidelines for specific diseases and traumas and expert consultation when needed. Health professionals often perform in articulation with the authorities and the extrication teams of firefighter's units. Because of the nature of the activity, their performance is often constrained by time pressure. Additionally, the activity is characterized by recurrent minor and major incidents which can represent unexpected events.

The focus of this work was in the process of successfully stabilizing and transporting patients or victims to the hospital. This study was applied to all differentiation levels of professionals in this field, namely technicians, nurses and doctors. The study includes professionals from the center region of Portugal, covering urban centers and countryside areas. It consists in the application of semi-structured interviews, and the subsequent treatment of the data through categorization and inductive reasoning.

Data Collection

The data collection process was based on qualitative research methods. In total, 34 semi-structured interviews were conducted. From those 26 were considered valid, as they narrated an episode in which there was an unexpected event triggering improvisational activities. I examined either episodes in which adaptations to the protocol were necessary for the professionals to complete their job in the most successful way possible, cases in which there was no protocol, or situations where the ideal resources were not available. The sample was composed by 10 technicians, 13 nurses and 3 doctors, with a geographical distribution of 6 professionals from Lisbon, 14 from Viseu and the remaining from disperse areas. The interviews were conducted face-to-face or by videoconference.

The script of the semi-structured interview was built according to the Critical Incident Technique guidelines. After defining the aim of the activity and the plans and specifications, a list of open questions was made regarding the unfolding of the occurrence (Flanagan 1954). In addition to the interviews it was possible to speak informally with several professionals, to better understand the context, the organizational specificities and mechanisms.

Analytical Approach

The treatment of the data was based in the principles of inductive theory, combined with iteration between ethnographic data and theoretical constructs (Van Maanen, 1979).

The Grounded Theory approach by Gioia is characterized by 3 stages of coding and categorization. In the first phase, I analyzed the interviews' transcripts and developed a preliminary list of 84 descriptive codes using respondents' terms. After seeking similarities and differences among these codes, it was possible to consolidate them into broader categories, reaching a more manageable number of 32 categories.

In the second stage a theoretical perspective is adopted, by reflecting upon the emerging themes and in the possible concepts they may suggest ‘to help us describe and explain the phenomena we are observing’ (Gioia, Corley and Hamilton 2013). At this stage I took a descriptive perspective, identifying 6 factors that influence the perception-decision process by health professionals: cognitive systems, contextual evaluation, experience, social-material conditions, resources and self-preservation behaviors. Additionally, from an analytical point of view, I identified mindful processes that allow for adaptation: assessment of benefit and harm, risk level assessment, assessment of resources’ attributes, re-interpretation of resources, re-evaluation of cognitive resources, unrelated knowledge sources. In total, this stage resulted in 12 second order categories.

Finally, in the third step the themes and concepts are merged into ‘second order aggregate dimensions’ (Gioia, Corley and Hamilton 2013). Sensemaking mediators, assessment processes and adaptive processes are the third order dimensions in this study (Figure 1: Data Structure).

Annex 1 consist of a table with proof quotes, first-order categories, second-order categories and third order dimensions.

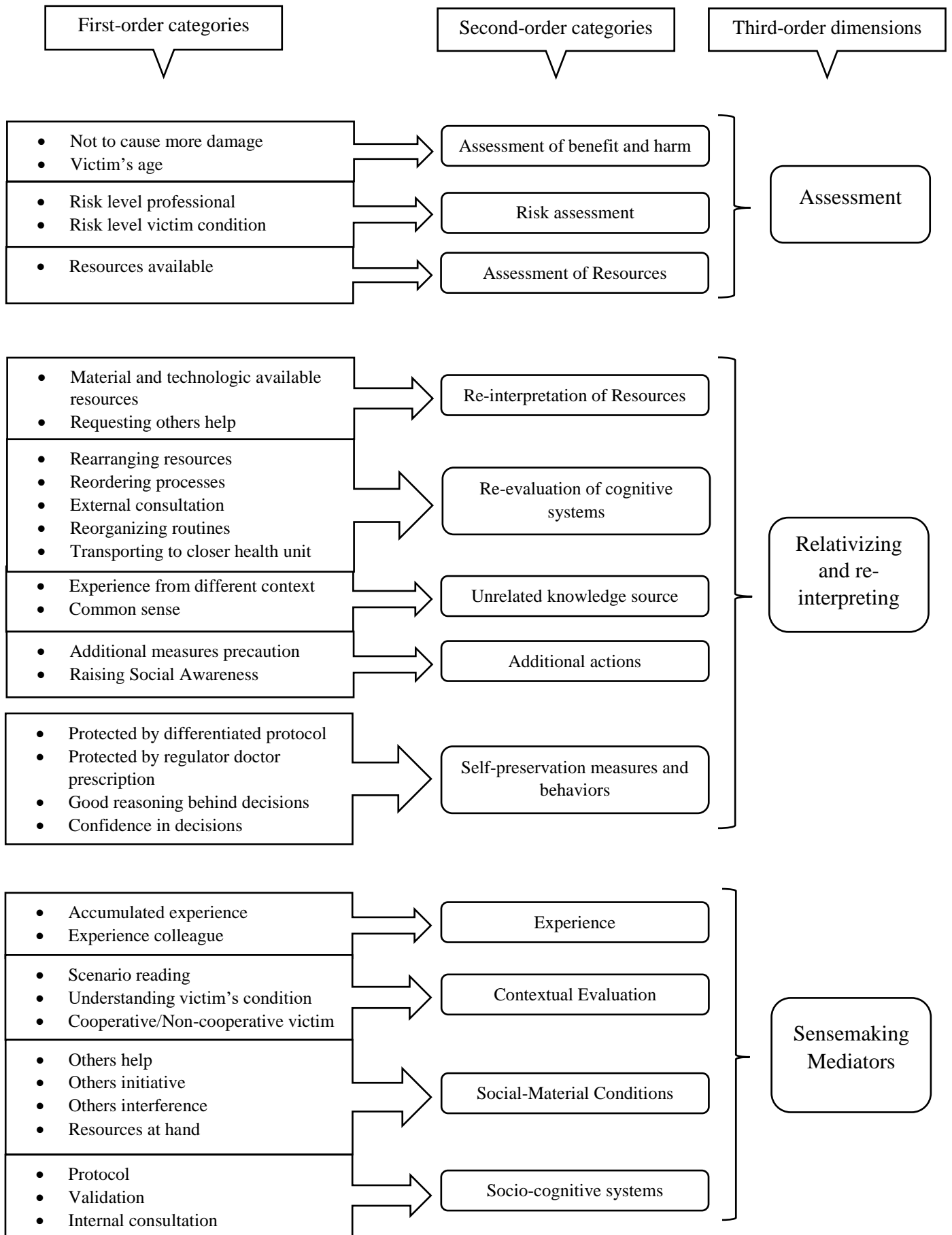


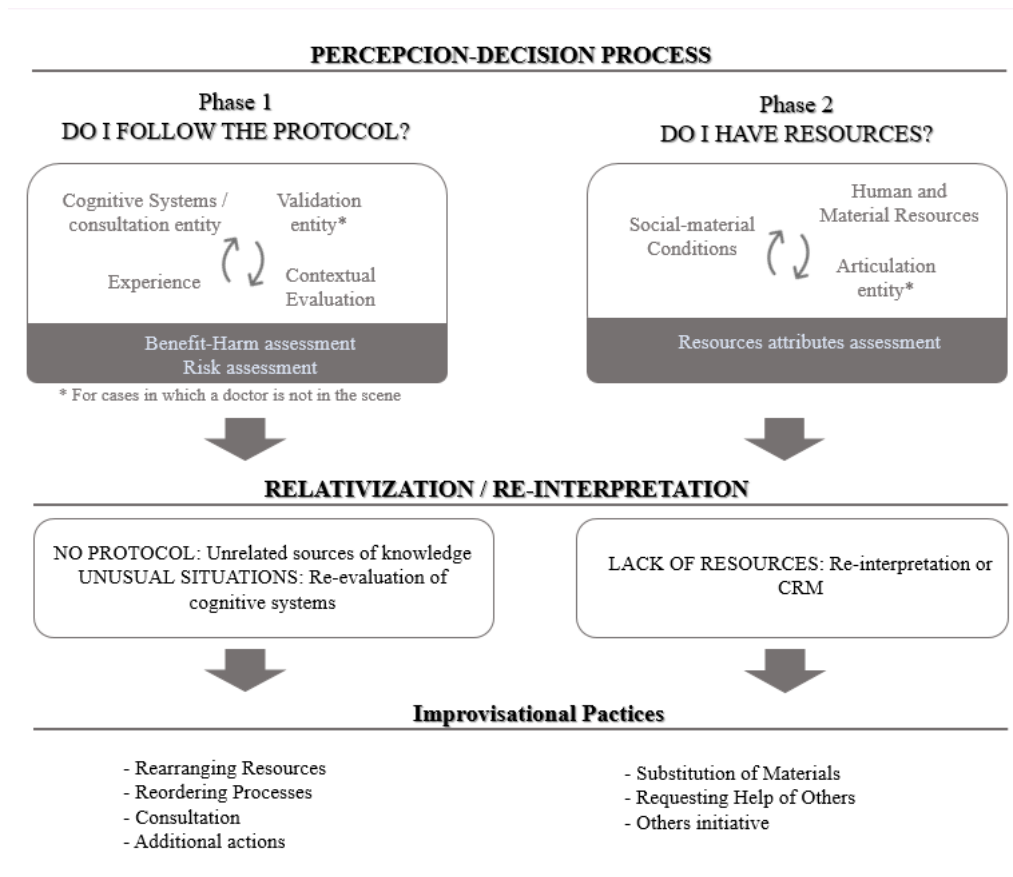
Figure 1: Data Structure

FINDINGS

The interpretative analysis was built on the insight that, in a highly-routinized context, unexpected events trigger sensemaking processes (Weick 1995). The first phase consists in a descriptive approach regarding the perception and decision process generalized to each episode. The factors influencing the process were identified, providing a list of concepts to reflect upon. By confronting the improvisational practices with the unexpected events, I concluded that for different triggers there were different acknowledging processes influencing the different solutions found. Therefore, it seemed interesting to situate the triggers in time and understand where do they fit in the decision process and the respective implications.

Afterwards, it was possible to identify patterns and to understand that if the trigger of the adaptation was in the first phase, that adaptation would be characterized by specific mindful processes different from the ones originated by a trigger in the second phase. I observed that unexpected events may imply either a non-fit between protocols and the situation, or a non-fit between the resources available and the resources needed to apply the appropriate protocol. This leads to a split of the decision process in two different phases, each one corresponding to the questions ‘Is there a protocol? Do I follow that protocol?’ and ‘Do I have the resources?’. The organization of the concepts listed before resulted in a decision-perception framework, which allowed the sequent understanding of adaptive processes according to a procedural nature or a resource based nature.

We identified two key facilitating processes leading to the improvisational practices. The ones that allow for the acknowledgement and understanding of the unexpected event were named ‘assessment processes’. The ‘adaptive processes’ often start with the conclusions from the former and reflect the adaptation resulting from those (Figure 2).



NO PROTOCOL: Unrelated sources of knowledge
UNUSUAL SITUATIONS: Re-evaluation of
cognitive systems

LACK OF RESOURCES: Re-interpretation or
CRM

- Rearranging Resources
- Reordering Processes
- Consultation
- Additional actions

- Substitution of Materials
- Requesting Help of Others
- Others initiative

Figure 2: Sensemaking model

Sensemaking mediators

Sensemaking mediators are the factors found to influence the perception-decision process, which is divided in two often but not always sequential phases.

Cognitive systems encompass the clinical guidelines that practitioners know by hard. They include general approaches and specific protocols. In situations that are not so easy to diagnose and decide treatment, there is a complementary knowledge transfer mechanism which allows practitioners in the field to share opinions and ask for expert advice. The consultation entity has ‘regulating doctors’ that can both provide advice and request external advice, by establishing contact with the anti-poison department or the hospital that the patient is headed for instance.

For the less differentiated teams, the ones that do not include a physician, some protocols may require validation. The validation entity is responsible for confirming procedures such as drugs administration when the team is composed by a nurse and a technician.

Both the victim's assessment and the scenario reading are relevant for the understanding of victim's clinical condition. For instance, in case of trauma, it is very important to look at the scenario: "if I see an accident in which the car glass has an application point from which it splinters, I know the person thumped his head in the glass even if he does not remember" (subject 20). Also, contextual evaluation provides information on the factors conditioning practitioners' performance, such as safety conditions and interference of others.

Experienced professionals have 'outdoor' repertoire which make their decisions faster and more suitable to the exceptional situations: "The experience comes from recognizing situations and over time developing action strategies for different typical cases" (Gunnarson and Stomberg, 2009). Furthermore, research found the way information is interpreted and discussed vary among novices and experts. Experts differ from novices in clinical decision-making strategy by their ability to focus and be selective. In addition to their accumulated knowledge, expertise, and experience, experts organize their information into meaningful parts (Kassirer, 1989).

The human and material resources available at the scene, or in a reachable distance, constitute the social material conditions. They include third parties present in the scene, as well as their belongings and tools.

The articulation entity coordinates activities among different medical assistance means (e.g. ambulances, helicopters and medical vehicles), and with other operators, including police and firefighter units. Moreover, it can establish contact with the subsequent intervenient in the emergency medicine channel, usually the hospital that the patient is headed to. This contact

may have the goal of confirming the availability of a specific room or medical team needed for continuing the patient's treatment.

The results obtained in this phase are similar to results Gunnarsson and Stomberg (2009) obtained when interviewing ambulance's nurses and investigating the factors influencing decision making. They divided the influencers in incident, external factors, communication and cooperation, knowledge, and ethical dilemmas. Where external factors encompass time and distances, security/threat and environment, and cooperation encompasses other operators and colleagues.

Assessment Processes

➤ *Benefit-harm assessment*

After arriving at the scene of an accident, or at the place the patient is waiting, prehospital medical assistance professionals evaluate the victim condition and try to understand the scenario in order to have a clear idea of the victim's state. In a regular situation, they think about the appropriate protocol for that situation and immediately apply it. However, some cases do not unfold in such way since practitioners need to take into account unusual circumstances.

When there is something not found as planned, such as a trauma victim that had already been moved, practitioners may ponder whether the protocol is beneficial to the victim. In this case following the protocol could aggravate the victim's condition.

We decided only to lift the arm. There was no practical immobilization. And that was the transport with higher comfort to that victim. So, in that case I didn't follow the trauma protocol. Based on the complaints of the victim, we adapted to what there was. (...) Because the pain is a symptom. The pain causes big variations in the person's blood pressure, etc. It will entail everything. Subject 20

The decision is made combining the insights from the contextual evaluation with the accumulated experience of each practitioner. They analyze the extent to which the protocol fits the situation, and act accordingly.

➤ Risk assessment

The first issue to evaluate when arriving at the scene is whether the safety requirements are met. Only then the practitioners can step in and fulfill their mission. In the interviews, the two main types of threatening scenarios are the ones including violent patients or relatives and the ones consisting of car crashes. In some exceptional situations, practitioners decide to intervene even when the safety requirements are not met. For instance, when they find a victim in a very critical condition and they know if they wait they might lose that life. This is illustrated by this retrospective rationale:

Because if we had applied the protocol, ideally, we should have waited by the extrication unit to tell us: “you can approach the victims”. But we also knew that if we did not do it at that time, there would be another fatal victim. (...) The main decision was if we would run the risk of approaching him inside the car without the safety conditions, because the vehicle was not stabilized. The extrication unit said that there was the risk of fire and explosion. Subject 13

After the contextual evaluation, practitioners acknowledge consequences for the victim of not receiving medical care immediately, as well as the risk they take by providing that care without their safety guaranteed. Their decision is based in a comparative ponderation between the two. If the risk for the victim is high and the perceived risk for the practitioner is low, they may decide it is worthy to intervene.

But, although we must respect all safety requirements, we know that when we do not respect, some may bring bigger risks than others. If there is a house burning, and it is not viable for us to go inside for instance; if there are an electrocuted and we have no means to know if the

electricity is already off. There are situations in which we have more risk or less risk. Subject

13

➤ *Resources attributes assessment*

After deciding they have conditions to provide medical care and what is the appropriate protocol for the situation, the next step is to put it in practice. However, there were several interviews reporting lack of the resources needed to accomplish that, such as materials and medications not available or communication systems' failures. Practitioners must consider the attributes of the resources needed so they can find those attributes in the resources available.

We were supposed to have an expert kit for doing tourniquets in members, which at the moment we did not had yet. (...) The venous tourniquets never do a good tourniquet as it would be necessary in that case, so what we used was a bandage. It's the way we have of containing a big bleeding, as it was the case. (...) It was the best option to keep the bleeding under control.

Subject 29

The I-care system [communication system] was not working (...) We needed to send an ECG to the consulting entity, because we needed their opinion to know what we should do. (...) By chance I had my personal phone with me, I had cellphone internet, and so I took a photo to the electrocardiogram and I sent it to 3 colleagues I knew that were working in the consultation entity in that moment. Subject 19

A spectator was there, and had a box of a warning triangle (the ones that need to be used in case of accident). Those boxes are morales rigid, and we used it to immobilize the arm. (...) "this is already immobilized, it might not be with a wood splint but it is with a plastic splint." It's the same (...) That was well done and functional. Subject 10

Even if this is not a conscious rationale, it is implied in the description of the episodes.

Often those are things of the moment. We don't even know how we remember those things. But if they are there, it happens. Subject 19

Adaptive processes: Relativizing and Re-interpreting

Before describing and analyzing adaptive processes, it is important to note that self-protection measures and behaviors are a priority for practitioners.

When it is possible to apply the protocol but medical assistance professionals decide not to, they always adopt self-protection practices and behaviors. For technicians, the protocol says when the patient does not breathe, it must be assumed the heart does not beat, therefore it prescribes ventilations and compressions. There is an example of an episode in which technicians could feel the pulse so they did not perform the compressions with the intent of not causing harm. They asked for differentiated support – a doctor and a nurse – and they acted protected by their protocol, which did not include the compressions.

The consultation entity may have an important role in this matter since when there is not a doctor in the scene, technicians and nurses may adapt or extend to protocol with the validation of the doctor providing advice. It works like a prescription made by a doctor inside a hospital, but it is recorded by phone instead of paper.

Even when there is no validation, that typically happens for one of two reasons: either the practitioner has confidence in what he is doing and has a good reasoning behind the decision, or the validation is not possible for communication's failures and the practitioner is confident in that practice as well. This confidence comes mostly from accumulated experience.

➤ Substitution of task knowledge: Unrelated knowledge sources

For the unexpected events that cannot be related with a protocol, the solutions found may be based on experience from contexts that are not related with prehospital assistance. Common sense may arise as a tool for handling that kind of situations. For instance, appealing to family in situations of victims that do not want to collaborate. When facing a Social Emergency situation, in which there is an old lady that lives in conditions of “extreme insalubrity”, and that person resists the transportation to the hospital. Practitioners must convince the lady without any kind of guidelines or training. A strategy that is described is asking for a relative help, someone that is a reference for the patient. Additionally, in episodes consisting of suicide attempts, it may be necessary to calm the victim down, and the strategy used is making the person feel understood instead of criticized. Asking for the motives and letting the person talk. Besides, it is common to appeal to the positive side of life, such as the family.

Personal experience is also a useful tool in this kind of episodes. For instance, an unknown dog may represent an obstacle to the prehospital assistance by impeding the access to the victim. The person in question has a strategy to approach unknown dogs that comes from previous experiences. The action of getting down on our knees is described as having a calming effect on dogs, making them feel confidence in that person.

➤ Adapting to exceptional situation: Re-evaluation of cognitive systems

There may be two motives triggering this process: the protocol can be applied but it is not beneficial for the victim, the procedures could be a source of pain for the victim and aggravate her condition; or it is impossible to apply the protocol because of patients’ characteristics and clinical conditions, for instance the fact that a patient is over weighted implying he does not fit in a stretcher or in the ambulance in the usual way. Another victim’s characteristic relevant to the viability and adaptation of protocols is the patient being under 18 years-old. In case of

children, not only the procedures can be more traumatizing/damaging for the victim, but they are also more difficult to the practitioners since the scale is smaller and the victim does not cooperate as an adult.

Because professionals learn the principles and evidence used in the creation of algorithms (Kovacs and Croskerry 1999), they can flexibly arrange them in accordance to victim's condition and characteristics, external factors, or resource constraints.

- Rearranging resources

This process is often triggered by situations in which the protocol cannot be applied. However, the principles behind the guidelines in the protocol are taken into account and reproduced in the closest way possible. There is an adaption of resources in the most adjusted way possible.

Usually if there is a lower limb fracture, we put one [splint] on each side, so that the leg is immobilized. In that situation, I had to put splints like this [draws triangle shape] – almost a carpentry job. (...) It was an adaptation from a normal to an exceptional situation, and is one of those in which we had no other option. We couldn't align the injured limb because there was resistance in every way we tried to move it. Subject 1

The patient was a big big lady, she weighted about 180 kilos. (...) There is no protocol for transportation of overweight patients. (...) There was a problem: the lady did not fit inside the ambulance as a regular patient. (...) There was a jump regarding the security protocol, because the lady should be seated. She couldn't be lying down for being able to breathe better. But we did not have the support to hold her standing, she did not fit the regular stretcher. So, we put on top of the stretcher the reinforced one [that was holding the lady] and we tied them together with the stretcher's ribbons. And all the material we had and that could not break was arranged to support the lady. There was also a person sustaining the stretcher from behind, during the transportation. (...) The security conditions were improvised. Subject 5

- Reordering Processes

Sometimes it is beneficial for the victim to skip a step and then come back to it later. Situations in which the evaluation of the victim cannot be made as usual, for instance because the victim does not cooperate. It is necessary to take measures when practitioners cannot make sense of the situation as usual.

Moreover, when it is not possible to validate some step, because of problems such as network failures, and when the practitioners are confident that step is necessary for the completion of the medical assistance, they perform it. As soon as they have the opportunity, they inform the consulting entity. This is valid for initiating transports without having a destination defined, or for administering a medication (in the case of nurses) that the practitioner knows is critical for the victim stabilization.

The protocol says "you initiate transportation after communicating the data to the articulation entity. With the destination already defined" (...) What I did was initiating transportation without informing the entity, because I had no means to do it. (...) I got signal after 15 minutes, so we stopped before entering the highway and waited for validation. Subject 17

Upon our arrival, the victim was agitated and non-cooperative. At the time, we could not understand what was wrong with him. The only parameter we could evaluate was the blood pressure, and it was quite high. (...) We have not always been able to ask for differentiated support with only this information (...) The protocol was the normal course of action: evaluating the victim. We have not been able to evaluate exhaustively, as we do with most victims. With only a little bit of information, very little, we managed to jump a step and then come back to complete it. Subject 22

Reordering work has been defined by previous research as “changing the sequence in which pieces of the overall project were completed”. Professionals leverage on their knowledge of the work progression (Becky and Okhuysen, 2011).

- External consultation

The internal consultation, provided by the consulting entity, is a common organizational practice integrated in the protocol. On the other hand, in some especial cases the consultation might be external. For instance, when the victim has a medical history regarding the condition presented, there may exist a professional that follows her and is familiar with the situation. In those cases, the consulting entity might establish contact with that professional, typically a doctor, to ask for directives regarding procedures such as doses for drugs administration

She basically had an extremely fast heartbeat. (...) Our protocol for the treatment of this kind of rhythms specifically is a protocol only for adults. (...) her mother had the number of the cardiologist following her in Coimbra. The coordination entity doctor agreed to talk to him. (...) The doctor indicated what was the doses and took the responsibility for that doses out of our protocol. He promptly said "Based on her age, her weight and on her medical history - there had been recurrent situations - you must administrate x dose". Subject 18

➤ Substitution of Materials and requesting the help of others: Re-interpretation of Resources

This process contraposes the ideal resources’ characteristics to the social-material conditions in the scene. In this way professionals find the best alternative option available. All the examples given in the resources assessment section are examples of substitution of material and technological resources. The alternatives found encompass professional belongings (bandages), personal belongings (cellphone), or third-parties’ belongings (triangle box).

Besides, there is the possibility that something along the process of providing medical care does not unfold as usual. For instance, difficulties may arise in reaching the scene or the place in which the victim is waiting. Also, it happens the medical team is occupied with the victim and there is some additional task to do, such as recovering a limb that was amputated, that requires the manipulation of uncommon tools such as the machines in a quarry. Moreover, there may be material resources needed for the assistance that are not included in the medical team's material but are usually available next to the scene. For instance, ice can be found in any restaurant or bar. Therefore, resources may be allocated to actions that escape the aim of prehospital assistance.

We received the address by phone. When we arrive there, we went through the street twice, we asked people where was that door number, and no one knew. Everyone confirmed the street name, that is, the street and the district was right. The only thing that was wrong was the door number, it didn't exist. And we knew the door were inside the condominium, which was new, it was one month old. So, we made an entire poor district (bairro social) searching for the door and being our guide. Subject 19

It was the ambulance team itself, together with the GNR and the rest of the workers who came to the construction site in the meantime, that were able to go to the machine and take the arm off. Subject 29

When we have an amputated limb, we should put it in a bag and then wrap it in ice. And we do not have ice in the ambulance. But we managed, together with firefighters, to get it. We were close to a hotel or resort or something like that, and we were able to mobilize people to go to the hotel to order ice, and we got lots of ice. These are things that we end up having to turn to other people because we really do not have at the place. Subject 29

DISCUSSION

The results of this study are aligned with the findings of Kovacs and Croskerry (2009) which define critical thinking in emergency medicine as “the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning or communication, as a guide to belief or action” (Croskerry et al, 2009).

This work sheds light on the micro mechanisms that constitute the sensemaking route of the articulation of protocols and unexpected events, and it emphasizes improvisational outcomes. It is proposed that the process of improvisation in a highly standardized organizational environment includes assessment and adaptive processes that confront protocols with situational specific context.

The assessment stage may include a benefit-harm ponderation, risk comparative ponderation, resources attributes analysis or every possible combination of this processes. In the case of the first and the last one, being aware of the principles behind mental models allows for a confrontation with reality that results in a quantification of their compatibility. Regarding risk comparative ponderation, there is a comparative confrontation of the perceived potential impact for the victim against potential risk for the health professional. The processes described are not always the result of a structured reasoning process. Therefore, they may in part be related with contextual rationality concept, which assumes that the significance of an action (as a rational action) may depend on the context, rather than on a full awareness of the reasons or a causal efficacy reasoning (Townley, 2008).

The stage encompassing relativizing and re-interpreting processes allows for the achievement of a solution according to the results of the assessment stage. It may include the replacement of task knowledge with sources unrelated with medicine, the re-evaluation of mental models that

allows the shape of protocols according to situation, and the re-interpretation of material and human resources available at the scene. Once again, it is essential to know the principles behind protocols for the decision making in this phase. While the assessment stage is cognitive, this stage may imply the action at the same time as a solution comes up in the practitioners' mind. Therefore, the first phase that consists of acknowledging the unexpected event is comparable to 'a diagnoses', and the second which comprises the achievement of a solution is comparable to the 'treatment'.

Results show that contextual perception and assessment processes, together with experience, are the basis for adaptation and improvisational practices in a high structured and standardized procedure environment. Principles such as constant re-evaluation and contraposition of contextual information and protocols' principles play a determinant role in successful improvisation. Therefore, if organizations want to promote a flexible but reasoned approach to protocols they may foster the learning of the principles in which guidelines were built on. In contexts in which guidelines are not taught in school as it happens with nurses and doctors, this may be costly to achieve. In those cases, organizations could promote periodical revision of guidelines so employees could reason and discuss about the practices and the why's.

The methodology used brought some difficulties found along the development of this study. Regarding the institutions that employ prehospital care professionals, it was difficult to attain a formal authorization to perform the study, and the observational internship that could complement the data from interviews was not allowed. Additionally, few professionals volunteered for the study, which turned the sample into a convenience sample (even if partially). Unfortunately, there is not a balance regarding the different differentiation levels of professionals composing the sample.

In fact, results show there are differences between technicians and more differentiated professionals, namely nurses and doctors, regarding the feedback on the importance of

experience, the team dynamics and the understanding of improvisation as an exceptional tool. Investigating the two group separately could bring relevant insights.

Moreover, it would be interesting to make a comparable study including successful and unsuccessful events to find out more about these assessment and adaptation mechanisms and to highlight differences between successful and unsuccessful episodes.

CONCLUSION

Even in highly protocolized organizational settings, improvisation can have a crucial role in the daily achievement of goals and successful fulfillment of the organizational purpose.

Contextual evaluation is a crucial step for adopting a flexible perspective on organizational guidelines. The confrontation of reality with mental models is the basis the development of practices that reflect a pondered adjustment of protocols. However, there is a pre-requisite for this process to work, which is that practitioners know the principles behind guidelines. As such, organizations must promote a culture that stresses the knowledge about those principles.

Moreover, the assessment processes that allow for contextual evaluation are not always structured and fully rational: organizations should promote the discussion on the decision-making mechanisms and variables that constitute these processes as a route for increased awareness and critical thinking.

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ANNEX 1

Proof Quotes Table

Proof Quotes	1st order categories	2nd order categories	3rd order dimensions
<p>(14) <i>Since a short-time ago, our protocols do not differentiate between only stop ventilating and the heart stopping. So, if patient does not breathe we have to assume the heart does not beat. (...) We will do ventilations and compressions - causing pressure on the chest. Let us think: If the heart is beating with a certain rhythm and I am compressing, what am I doing? (...) we worked around the protocol not to cause more damage.</i></p> <p>(20) <i>So, we decided only to suspend/lift the arm, there was no practical immobilization. And that was the transport with higher comfort to that victim. So, in that case I didn't follow the trauma protocol. Based on the complaints of the victim, we adapted to what there was. (...) We are the ones that must adapt to the victim, not the victim to us. Because the pain is a symptom. The pain causes big variations in the person's blood pressure, etc. It will entail everything.</i></p>	Not to cause more damage	Assessment of benefit and harm	Assessment
<p>(7) <i>Because it is a child, often we ponderate a little bit more. (...) it is more traumatizing for a child than for an adult.</i></p> <p>(28) <i>When the victim is a child, we nurses go as well more apprehensive, more anxious, because obviously access a vein in a child is much more difficult than in an adult. In the children, they are not so visible, they have a much smaller caliber. And then there is the cry, the screams, the ward off.</i></p>	Victim's age		
<p>(13) <i>[we followed the protocol] except for the safety requirements, which is the first question we must evaluate: if we have the conditions to act. But, although we must respect all safety requirements, we know that when we do not respect, some may bring bigger risks than others. If there is a house burning, and it is not viable for us to go inside for instance; if there are an electrocuted and we have no means to know if the electricity is already off. There are situations in which we have more risk or less risk.</i></p>	Risk level professional	Risk level assessment	

<p>(13) <i>Because if we applied the protocol, ideally, we should have waited by the extrication unit to tell us: “you can approach the victims”. But we also knew that if we did not do it at that time, there would be another fatal victim. (...) The main decision was if we would run the risk of approaching him inside the car without the safety conditions, because the vehicle was not stabilized. The extrication unit said that there was the risk of fire and explosion.</i></p>	<p>Risk level victim</p>		
<p>(15) <i>'We need to do a tourniquet. What materials are available? There is this instrument which is necessary.' We proceeded to that in the most adjusted way possible.</i></p> <p>(29) <i>We supposedly have an XPTO kit for doing tourniquets in members, which at the moment we did not had yet. (...) we ended up having to resort to bandages. In this case, we used bandages to contain the hemorrhage. (...) As those are situations that happen [regularly], we typically evade the protocol. The venous tourniquets never do a good tourniquet as it would be necessary in that case, so what we used was a bandage. It's the way we have of containing a big bleeding, as it was the case. (...) we had to opt by the bandage. It was the best option to keep the bleeding under control.</i></p>	<p>Resources assessment</p>	<p>Resources' attributes assessment</p>	
<p>(10) <i>A spectator was there, and had a box of a warning triangle (the ones that need to be used in case of accident). Those boxes are morales rigid, and we used it to immobilize the arm. (...) "this is already immobilized, it might not be with a wood splint but it is with a plastic splint." It's the same (...) That was well done and functional.</i></p> <p>(19) <i>By chance I had my personal phone with me, I had cellphone internet, and so I took a photo to the electrocardiogram and I sent it to 3 colleagues I knew that were working in the consultation entity in that moment. One of them immediately opened my message, asked about it, and from that moment onwards I got his attention. I started to talk to him: “Look, I am in ambulance x, region y, the I-care</i></p>	<p>Material and technologic available resources</p>	<p>Re-interpretation of resources</p>	<p>Relativizing and re-interpreting</p>

<p><i>[communication system] is not working and so I am sending you the ECG. Please go to the doctor's office and show it to him." And he did as I said. (...)</i></p>			
<p>(19) <i>We received the address by phone. When we arrive there we went through the street twice, we asked people where was that door number, and no one knew. Everyone confirmed the street name, that is, the street and the district was right. The only thing that was wrong was the door number, it didn't exist. And we knew the door were inside the condominium, which was new, it was one month old. So we made an entire poor district (bairro social) searching for the door and being our guide.</i></p> <p>(29) <i>when we have an amputated limb, we should put it in a bag and then wrap it in ice. And we do not have ice in the ambulance. But we managed, together with firefighters, to get it. We were close to a hotel or resort or something like that, and we were able to mobilize people to go to the hotel to order ice, and we got lots of ice. These are things that we end up having to turn to other people because we really do not have at the place.</i></p>	<p>Requesting others help</p>		
<p>(1) <i>Usually if there is a lower limb fracture, we put one [splint] on each side, so that the leg is immobilized. In that situation I had to put splints like this [draws triangle shape] – almost a carpentry job. (...) It was an adaptation from a normal to an exceptional situation, and is one of those in which we had no other option. We couldn't align the injured limb because there was resistance in every way we tried to move it.</i></p> <p>(5) <i>The patient was a big big lady, she weighted about 180 kilos. (...) There is no protocol for transportation of overweight patients. (...) There was a problem: the lady did not fit inside the ambulance as a regular patient. (...) There was a jump regarding the security protocol, because the lady should be seated. She couldn't be lying down for being able to breathe better. But we did not have the support to hold her standing, she did not fit the regular stretcher. So, we put on top of the stretcher the reinforced one [that was</i></p>	<p>Rearranging resources</p>	<p>Re-evaluation of cognitive systems</p>	

<p><i>holding the lady] and we tied them together with the stretcher's ribbons. And all the material we had and that could not break was arranged to support the lady. There was also a person sustaining the stretcher from behind, during the transportation. (...) The security conditions were improvised.</i></p>			
<p>(17) <i>The protocol says "you initiate transportation after communicating the data to the articulation entity. With the destination already defined" (...) What I did was initiating transportation without informing the entity, because I had no means to do it. (...) I got signal after 15 minutes, so we stopped before entering the highway and waited for validation.</i></p> <p>(22) <i>Upon our arrival, the victim was agitated and non-cooperative. At the time, we could not understand what was wrong with him. The only parameter we could evaluate was the blood pressure, and it was quite high. (...) We have not always been able to ask for differentiated support with only this information (...) The protocol was the normal course of action: evaluating the victim. We have not been able to evaluate exhaustively, as we do with most victims. With only a little bit of information, very little, we managed to jump a step and then come back to complete it.</i></p>	<p>Reordering Processes</p>		
<p>(18) <i>She basically had an extremely fast heartbeat. (...) Our protocol for the treatment of this kind of rhythms specifically is a protocol only for adults. (...) her mother has the number of the cardiologist following her in Coimbra. The coordination entity doctor agreed to talk to him. (...) The doctor indicated what was the doses and took the responsibility for that doses out of our protocol. He promptly said "Based on her age, her weight and on her medical history - there had been recurrent situations - you must administrate x dose."</i></p>	<p>External Consultation</p>		
<p>(16) <i>We knew the patient had a TCE and in Viseu we did not had response from neurosurgery. The idea was to contact the articulation entity to lead us, or to call an</i></p>	<p>Reorganizing routines</p>		

<p><i>heli, to Coimbra. (...) But I tried to intubate him and I couldn't. (...) "In this condition, the patient will not arrive at the hospital in Viseu alive, he will drown in blood." (...) We have another kind of tubes, called laryngeal masks, that do not completely protect the airway but they help to ventilate patients. And that was the decision: "I don't have the airway assured so I cannot transport to Coimbra, but at least I will arrive to Viseu."</i></p>			
<p><i>(7) A two year old child had an object in the lunges that later was confirmed to be a been. (...) Regarding that clinical condition, we should do the orotracheal intubation and make the transportation with ventilation. It was not possible to intubate (...) we opted to transport to Viseu hospital, there was a specialized team ready to intervene. (...) And then she had to go to Coimbra's pediatric hospital.</i></p>	<p>Transporting to closer health unit</p>		
<p><i>(2) [the bus] got inside the premises of a house. The owners were not home and there were two dogs that approached us. (...) I got down, why? Because everytime I have to face an unknown dog, I do that. When I get down the dogs feel confidence. (...) I always do it when I have some risky situation with a dog.</i></p> <p><i>(26) it was a truly improvised situation, because I was saying what I would say if I was in a bar with a sad friend. Because in terms of training there are nothing to guide us on that. (...) build an empathic connection.</i></p>	<p>Experience from different contexts</p>	<p>Unrelated knowledge sources</p>	
<p><i>(26) in our training the psychiatric breakouts are approached very superficially. And we work a lot with common sense and we try to find the words, not the best words, but the words that will cause less harm. Because everything you could say can trigger a reaction in a person that is already emotionally unstable. You must work that part without having the tools. At the moment, I thought I was being futile with phrases such as 'Não faça isso', 'Não queira acabar com a sua vida'. To see which one would result. (...) 'Think about your family'</i></p>	<p>Common Sense</p>		

<p>(30) <i>It is not written anywhere how we should persuade a person to go to the hospital. It must be our strategy, our ability at that moment to pick up on certain points that we think can make her go to the hospital. Let's see if she's very attached to any relative. Usually this family member can convince her. (...) We give our opinion, try to be truthful and explain "it is better to go to the hospital for this and this" but many times when they are not so receptive with us we try to find someone of reference.</i></p>			
<p>(21) <i>it was not a medical emergency once again, it was a social one. (...) this man was transported by us to the day care institution were he would usually go. And we went there to identify what we have seen at the house, which is an atypical situation. This does not happen regularly. (...) we did not transport to the hospital but we did not left him at home either. (...) It was not our job to take to the hospital a person that is stable, that has no health problem. He would go to the hospital, to the doctor, then he would be discharged and everything would come back to what it was before.</i></p>	<p>Raising Social Awareness</p>	<p>Additional actions</p>	
<p>(31) <i>After talking with the regulator doctor there was medication administered that was not part of the protocol. (...) We administered a diuretic drug, fozemide, in order to diminish the intracranial hemorrhage that we suspected. Either an hemorrhage or an edema, there was something doing a mass effect. (...) In the intra-hospital context we would use manitol, the first line diuretic drug. Fozemide is used for pulmonary edemas.</i></p>	<p>Additional measures</p>		
<p>(14) <i>Since a short-time ago, our protocols do not differentiate between only stop ventilating and the heart stopping. So, if patient does not breathe we have to assume the heart does not beat. (...) We will do ventilations and compressions - causing pressure on the chest. Let us think: If the heart is beating with a certain rhythm and I am compressing, what am I doing? (...) we worked around the protocol not to cause more damage. (...)</i></p>	<p>Protected by differentiated protocol</p>	<p>Self-preservation measures and behaviors</p>	

<p><i>And that was what I did not do. According to the protocol I should have done it, but I didn't. Meanwhile the doctor and nurse team arrived, and they did not do that either. And we carried on with what me and my colleague were doing, but protected by their protocol.</i></p>			
<p>(31) <i>If the regulator doctor tells you “do this” and you know that adds value, I think no one will decline. In the end it is a medical prescription, even if is by phone, because the calls are recorded. If something happens is the same thing as in the hospital when a doctor makes a prescription in paper or in the IT system.</i></p>	<p>Protected by regulator doctor prescription</p>		
<p>(20) <i>There, the surface wouldn't be favorable. But you have to know how to justify your decisions. If I arrive to the hospital and someone ask me: "this man fall 3 meters and you didn't immobilize him, why?" I have to know how to argument and justify my non-immobilization.</i></p>	<p>Good reasoning behind decision</p>		
<p>(25) <i>I was thinking about other situations because it would not be expected that in that time, it was not described on the literature that that happens. My colleague tried to understand... He was also finding it weird, but then we tried to understand the background of the person. (...) [The most important factor was] the experience [of colleague]. I think it was fundamental because if I was alone, from my experience, I would immediately start to look for new answers instead of waiting.</i></p> <p>(28) <i>The doctor I was with helped me diminishing the anxiety and stress levels, because he was a very experienced doctor in the area of pre-hospital assistance, despite being quite young. (...) The fact that I was accompanied with the person I was. I knew that, if not me, it would be him. One of us would be able to establish a venous access, wherever it was.</i></p>	<p>Experience colleague</p>	<p>Experience</p>	<p>Sensemaking Mediators</p>
<p>(17) <i>Network failures (...) Difficulty to validating protocol. (...) Often I know where the patient must go, but in the last week... I had a situation in which I initiated transport with an infarct. I did it</i></p>	<p>Accumulated experience</p>		

<p><i>because I knew the patient should go to Vila Real. However, Vila Real had to accept the patient. I rode 20 minutes before being able to establish contact with the articulation entity. (...) My decision was based on the experience of what comes next: either the adequate destination unit or knowing that the validation/articulation entity would do exactly as I did.</i></p> <p>(29) <i>It comes from the things we are used to do. Because we have had several cases of trauma in which, if static tourniquets (as they are called) do not exist, which are ideal for the situation, we had already improvised with bandages in other situations. As we got good results, we grabbed that.</i></p> <p>(31) <i>I did the diazepam suggestion to control the motor response. The diuretic medication was suggested right after by the doctor. I have not thought about that. Experience can sometimes trick us. You are formatted to a certain medication in the hospital context, and because you don't have it in the outdoor context, you do not remember you have another one that can do the same effect by a different route. It is not what you call 'first line', but you can also use it.</i></p>			
<p>(27) <i>No one tells us when we should move a victim inside the ambulance. Sometimes we have aggressive relatives of the victim, or we have hostile environments surrounding us, and even with a victim in PCR with a doctor on his way, the best for the victim and for us is to move her inside the ambulance. It is the responsibility of the team leader to manage these situations: evaluate the scenario, all the variables, and decide in the moment.</i></p>	Scenario Reading	Contextual Evaluation	
<p>(20) <i>While my colleague approached the victim right away, I went to the scene and wanted them to explain me 'by the book' how and where did the victim fall. The cinematic of the trauma is very important. For instance, if I see an accident in which the car glass has an application point from which it splinters, I know the person thumped his</i></p>	Understanding victim's condition		

<p><i>head in the glass even if he does not remember”</i></p> <p>(21) <i>Based on what we could observe in a first impact, when we saw the house. That is, when you see medication spread around the house, several boxes of the same medication, you understand it is not organized. (...) If she does not follow the therapy, she does not take the medication, that is, she is not oriented to take the medication on time. Then she is in a risky situation.</i></p>			
<p>(26) <i>The fact that I tried to read the person even before approaching her and I did not found her threatening. The external factor [influencing the episode] was the scenario reading, which is the second thing we do. After being sure the safety conditions are met, we see everything around us and try to understand without anyone telling it to us, what could have happened there.</i></p>	<p>Cooperative/Non-cooperative victim</p>		
<p>(24) <i>The young man condition aggravates to cardiorespiratory arrest and his mother initiates resuscitation maneuvers guided by me. [One relevant factor for the success in this episode was] the fact that the mother collaborated.</i></p> <p>(29) <i>When we have an amputated limb, we should put it in a bag and then wrap it in ice. And we do not have ice in the ambulance. But we managed, together with firefighters, to get it. We were close to a hotel or resort or something like that, and we were able to mobilize people to go to the hotel to order ice, and we got lots of ice. These are things that we end up having to turn to other people because we really do not have at the place.</i></p>	<p>Others Help</p>	<p>Social Material Conditions</p>	
<p>(27) <i>When we took him out of the car, in those few minutes we were doing maneuvers, we had 'mirones', we had a lot of people looking at the scene. It was in a complementary itinerary very busy in terms of traffic. And one of the decisions I had to make, which was a bit hard for me was: do I put him inside the ambulance, or not?</i></p>	<p>Others Interference</p>		
<p>(10) <i>Someone had thought about it before me, and I took the hint: a spectator was</i></p>	<p>Others Initiative</p>		

<p><i>there, and had a box of a warning triangle (the ones that need to be used in case of accident) (...) He was actually already holding the triangle box in his hand, with that intent [of doing the immobilization]. He approached me and asks “-Do you think this can work?”, and I answered “-I think so, and that is very well thought.”</i></p> <p>(29) <i>We had the advantage of establishing an efficient tourniquet because the people that were at the scene, who probably had knowledge of first aid, established a tourniquet previously. That helped that ours was efficient.</i></p>			
<p>(15) <i>'We need to do a tourniquet. What materials are available? There is this instrument which is necessary.' We proceeded to that in the most adjusted way possible.</i></p> <p>(19) <i>There are a lot of stuff we do around protocol because we do not have material that would be useful to have.</i></p>	<p>Resources at hand/ available</p>		
<p>(27) <i>Protocols are those guidelines, that if we follow at the right moment, often allow us to keep the victims as safe as possible. I see them that way, they give us security.</i></p>	<p>Protocols</p>	<p>Socio-cognitive systems</p>	
<p>(21) <i>Social Emergency (...) That depends also on who is in the other side of the line, in the validation entity. If that person allows for that articulation or not, because this was not our role. But it was not our job either to take to the hospital a person that is stable, that has no health problems. He would go to the hospital, to the doctor, then he would be discharged and everything would come back to what it was before.</i></p> <p>(17) <i>Difficulty to validate protocol. (...) I initiated transportation without validation, cause I had no means to communicate with validation/articulation entity. In this kind of situations, they understand and do not raise any problems. (...) It is influenced by the security they feel in your voice [when you communicate your decision].</i></p>	<p>Validation</p>		
<p>(31) <i>A medication for stabilizing the motor response was administered. It was a borderline procedure in terms of protocol,</i></p>	<p>Internal consultation</p>		

<p><i>because it depends on how you understand the situation. If the motor response he was having was the result of a convulsive process, I would not need medical orientation to administer the drug. If I understood that could be something else... There is a frame of the episode that is relevant in this context. I thought I should talk to the doctor before the procedure.</i></p> <p>(31) <i>After talking with the regulator doctor there was medication administered that was not part of the protocol. (...) It was an orientation from the regulator doctor. I suggested the diazepam to control the motor response. The diuretic medication was suggested right after by the doctor. I have not thought about that.</i></p>			
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