Beyond Compliance: Understanding the Role of Clinical Practice Guidelines in Prehospital Emergency Care

Herman Tagger, M.D. | LUND UNIVERSITY

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Under the supervision of Johan Bergström, PhD

Lund 2024

Title: Beyond Compliance: Understanding the Role of Clinical Practice Guidelines in Prehospital Emergency Care by Herman Tagger

Number of pages: 67
Illustrations: 8

Keywords
Clinical practice guidelines, prehospital emergency care, ambulance care, activity theory

Abstract

Background: Clinical practice guidelines (CPGs) translate scientific knowledge into practical rules. They aim to improve safety, ensure consistency, enable quality control, and mitigate rising healthcare costs. CPGs and other written instructions are often the target or result of safety interventions in healthcare, but it is important to avoid the trap of managing documents rather than actual safety. Strict adherence to rules is often impractical due to their inherent limitations, structural incompleteness, variability in persons and processes, assumptions about users, undefined application conditions, organisational variability, and references to ideal situations. Overemphasising compliance can shift priorities, making adherence to rules an aim rather than a means to achieve goals, and leading to requests for written rules for tasks previously managed locally. It also reduces practitioners' capacity to adapt and balance competing rules, which are essential for managing safety in complex environments. By understanding practitioners' use of CPGs and their role in prehospital care, we can address conflicts and inform development of structure, content, and design more effectively.

Aim: To explore how CPGs mediate action in prehospital emergency care. This includes examining their use, understanding their role from the perspective of practitioners, and investigating how they interplay within a complex network of actions, multiple goals, objectives, and other factors.

Methods: A qualitative approach combining observational and interview data examines the actions of ambulance teams and the mediating effect of CPGs on action. Activity theory is used as a framework, analysing how CPGs function within an activity system portrayed by subject, goals or objects, rules and norms, interactions, task division, and the mediating role of CPGs.

Results: In routine situations, experienced ambulance teams tend to rely more on internalised rules and norms than on consulting CPGs. CPGs are primarily consulted to confirm rules or norms before patient interaction, especially in rare, new, or potentially chaotic situations. Additionally, CPGs are used to prepare when established rules and norms need to be individually adapted, such as in paediatric emergencies. Finally, CPGs can assist in resolving doubt in medical emergencies where immediate responses are necessary amid uncertainty. The information that experienced teams commonly need from CPGs are medication dosages, potential risks or hazards, exceptions to usual practices and occasionally to ensure no important actions have been omitted. In contrast, novice teams use CPGs as educational or training material and rely more extensively on them in practice.

Conclusion: The use of CPGs in prehospital care is subject to contextual limitations. Reading CPGs in preparation for patient contact occurs en route to scene, which limits the volume of information that can effectively be read. The same is true when confirming medication dosages in medical emergencies. Guideline developers should prioritise informed decisions based on ambulance teams' needs. Balancing CPGs' roles as both rules and tools is essential. An environment that encourages trust and informed risk-taking is key for safety and ambulance teams' ability to navigate unfamiliar and unscripted scenarios. Managing safety is distinct from administrating documents. Guideline development and usage should be grounded in practicality, reflecting the actual needs of prehospital care.

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Introduction

The practice of healthcare is accomplished by numerous rules and norms (Pyone et al., 2017). A collection of these rules exist as written language artefacts, which represent codified knowledge about work (Weichbrodt & Grote, 2010). Clinical practice guidelines can be regarded as artefacts that make recommendations to healthcare practitioners, based on systematically reviewed scientific evidence (Shekelle, 2023). The history of clinical practice guidelines can be traced back to the 1970s when growing complexity and interdependences in healthcare created an increasing need for agreements (Weisz et al., 2007). In prehospital care, treatment protocols have been used even earlier (Shah, 2006). Humans have a long history of relationship to written instructions in the practice of medicine, dating all the way back to ancient Egyptian papyri (Frey, 1985). Reliance on artefacts with codified rules of practice persists, and possibly a belief that if instructions are sufficiently systematic, comprehensive and precise, the rest will fall into place.

Balancing Control and Support

Written instruction for work can be approached from two fundamentally different perspectives. The first sees written instructions primarily as a set of rules or laws that need to be enforced. The second considers written instructions primarily as an aid or assistance for practitioners (Fuchs, 2013). While most would agree that there are core principles or rules that need to be followed to achieve goals in healthcare, the multitude of rules that exist can make it difficult to separate central core principles from other more arbitrary policies (Vincent & Amalberti, 2016b).

Prehospital emergency care is often complex and involves inherent risks (Pruchnicki & Dekker, 2017). Ambulance teams must adapt to unpredictable situations and decide which parts of which guidelines are appropriate in the specific case they are addressing. This places the responsibility for safety and managing trade-offs between risk and performance with the ambulance team (Pariès et al., 2019).

To create guidelines that effectively support the complex work performed in prehospital emergency care, it is important that guidelines are created with an truthful understanding of how work actually is carried out, rather than trusting assumptions about how it is carried out (Hollnagel, 2009). Because these assumptions often are oversimplifications, they cannot account for context and its accompanying constraints (Wears, 2015), and ignore that workarounds and adaptations may be necessary to accomplish objectives (Woods, 2018). The goal of this research is to explore how ambulance teams use and read clinical practice guidelines in context. A qualitative methodology, using a combination of observational and interview data is used to describe the tasks, goals, and actions in the different phases of an ambulance assignment and how clinical practice guidelines mediate actions performed by ambulance teams. Activity theory was chosen as a theoretical framework since it emphasises actions, and how these actions are mediated by a combination of artefacts, rules and norms, interactions, and task division aside from the objectives and goals pursued (Engeström & Pyörälä, 2021).

Outline and limitations

The thesis beings with a review of the history and role of clinical practice guidelines in healthcare, exploring both their reported benefits as well as a critique of guidelines. It aims to position the role guidelines in the context of prehospital care and uncover what implications for safety follow. An outline of ambulance care in north-western Skane is provided for context. Observations and interviews with ambulance teams was used to collect data. Activity theory was used as a theoretical framework because it allows for a distinction between universal rules and norms, rules and norms internalised by ambulance teams and those conveyed through written artefacts such as clinical practice guidelines. The results section represents an ambulance assignment as a series of interlinked activity systems, emphasising the mediating role of guidelines on actions in those systems. How guidelines are read and used in everyday practice can help inform decisions on content, structure and design as well as manage expectations as to what functions guidelines can be expected to fulfil, particularly in response to safety incidents.

The study's scope is limited by its small sample size and the context in which it was performed. Researching prehospital care is challenging due to variation among ambulance care systems across countries and regions (Al-Shaqsi, 2010). Guidelines in prehospital care differ significantly in both design and content across countries and regions, which in turn could influence how they are used and read. Although the results might not apply universally, the significance of understanding real work processes to inform the creation of prehospital clinical practice guidelines is emphasised.

Literature review

The history of clinical practice guidelines:

While instructions for how to practice medicine date back to ancient times (Frey, 1985), the origins of clinical practice guidelines can be traced to consensus conferences of the 1970s (Weisz et al., 2008). Increasing specialisation, complexity and interdependencies among healthcare providers encouraged the creation of guidelines based on agreement (Gosselin, 1985). Only later, the evidence-based medicine movement expanded and merged with the clinical practice guidelines movement, emphasising scientific accuracy and systematic synthesis of recommendations (Weisz et al., 2008). Early efforts at implementing guidelines were met with sometimes fierce criticisms, referring to the creation of "cookbook medicine" which limits clinicians autonomy (Harding, 1994; Woolf, 1993). Today, clinical practice guidelines occupy a fundamental and universal position in healthcare. Extensive literature on guideline development, appraisal and implementation exists (Ansari & Rashidian, 2012; Siering et al., 2013). The number of guidelines continues to increase. In Sweden, 344 national or regional clinical guidelines were published in 2018 (Eriksson et al., 2020).

Investigating the historical background of protocols and guidelines in prehospital care is more challenging. Firstly, prehospital care services are differently organised and operated across countries (Al-Shaqsi, 2010). Each prehospital care system has their own cultural and historical context. Second, the examination of clinical practice guidelines within the prehospital context is not as developed as in other areas of healthcare (Maria, 2021).

In the United States, prehospital care services were criticised for a lack of treatment protocols in 1966 (Shah, 2006), which prompted their creation and implementation into prehospital care (Rosen et al., 1980). In Australia, guidelines and protocols have been used in prehospital care since the 1970s (Maria, 2021). The Joint Royal Colleges Ambulance Liaison Committee (JRCALC) in the united kingdom published their first guidelines in 2000 (Irving & Millins, 2014). In Sweden, ambulances prior to the 1980s were regarded as primarily a transportation service without a need for extensive medical expertise (Björnstig, 2004). Ambulances were often operated by the city firemen (Andrews, 1973) and the training required was a short course consisting of driving instructions, extrication technique, defibrillation and basic CPR (Totten, 1993). Later, the requirements for ambulance personnel were raised, mandating that each ambulance had to have at least one registered nurse (Björnstig, 2004). Ambulance services in Sweden have had a physician medical director since the 1990s (Holmberg et al., 1998). Each county developed and maintained their own prehospital care guidelines (Brismar et al., 1996). During the 2000s national guidelines for ambulance services were created by SLAS – an organisation that unifies physician medical directors (Eriksson, 2012). However, some regions, like Skane have opted to continue to use local guidelines.

The Complexity of Emergency Care

When a new assignment is received, the characteristic sound prompts the ambulance team to reach for their waist-mounted radios. They adjust the device to view the screen and read the priority and nature of the emergency. Sometimes they are dispatched to a minor trauma, a fall, or a patient with fever or shortness of breath. Sometimes the call is of a more serious nature, possibly a major trauma or a cardiac arrest. High stakes, uncertainty, and urgency are characteristic of prehospital emergency care (Rosen et al., 2017). At scene, a wrong action could have serious consequences, but so also, can inaction, or delays to an essential treatment. When a call is assigned, it is impossible to predict exactly how it will unfold or what challenges the team will encounter. But that's the nature of prehospital emergency care – it is an unpredictable field.

Modern healthcare has been described as the most complex human system constructed by humans (Gluck, 2008). Rather than just 'a system', it represents a complex network of numerous systems and subsystems (Wears & Sutcliffe, 2019). These interconnected systems (and subsystems) exert mutual influence, resulting in both visible and unseen effects. Rapidly evolving scientific knowledge, new technologies, continuous changes, complex functions and overlap make work in modern healthcare challenging. Some parts of the healthcare system are more susceptible to unsafety than others. Emergency care demands extensive adaptability but leaves little time to prepare and limited opportunities to control circumstances (Vincent & Amalberti, 2016a). Emergency departments are often used as examples of systems that are intractable, meaning they are systems that are difficult to fully comprehend, describe, predict or control (Hollnagel, 2012).

Complexity in this context emerges from numerous factors: the interplay of various elements, the urgency imposed by time constraints, the need for concurrent evaluations and treatments, but also, the unpredictable fluctuation in demand and the inconsistency of the resources available to address those demands. Regardless of other circumstances, a fundamental cause of complexity in healthcare is ever present, the mystery of the human body and its sometimes unpredictable response to illness, injury or treatments (Bitan, 2017). Patients may present with life-threatening illnesses or injuries that require immediate recognition and treatments. Other times, seemingly unwell patients are not found to have any detectable disease at all. The most challenging requirement may be to recognise when apparently healthy patients actually suffer critical illness.

Recognising the seriousness of the challenge, emergency departments are armed to the teeth. Batteries of blood tests, x-rays or CT-scans are used as instruments of reconnaissance. If uncertainty persists, additional expertise is accessible through consultations with specialists. In the end, patients can be admitted to the hospital or monitored to exclude instances when healthcare is sought prematurely, before signs of disease become evident. Outside of the hospital setting, the prehospital arena faces comparable difficulties, but has less resources available to tackle the challenge. Ambulance teams hurry to the frontlines with only the equipment carried in their backpacks or stowed in the ambulance. They do not have access to many of the diagnostic tests used in hospitals (Donn, 2017), and quick decisions are required on scene, without time for prolonged monitoring or observation. All the while, the need for actions must be balanced against the potential delays these actions may yield in transport to the hospital. Resources are further stretched when responding to multiple injured patients that require care.

Other sources of complexity compound the challenges of ambulance care. Navigating traffic with lights and sirens while safely responding to the sometimes-unpredictable behaviour of other drivers. The uncontrolled setting upon arrival that may force advanced medical treatments to be delivered on the side of the road or on a nightclub dancefloor. Extracting patients through long corridors, across rugged terrain, or down narrow flights of stairs, sometimes with ongoing CPR. There are calls that require cooperation and collaborations with other actors like family/community members, firefighters, home care personnel or law enforcement to achieve goals. Every action and interaction holds the potential for success, but also represents a vulnerability for misunderstandings and error.

It is no surprise that sometimes things do not go as planned. Complexity in systems is connected to disasters (Perrow, 1999). Intrinsic risks surface when teams encounter intractable situations (Hollnagel, 2012), when margins for error are slim, and time is in short supply. In prehospital emergency care, it can happen when least expected and in the most challenging environments. But that is the nature of prehospital emergency care– it is an unpredictable field and risk an inseparable part of it.

Adverse events in prehospital emergency care

Given that risk is an inseparable part of prehospital emergency care, how often do things go wrong? Measuring safety in prehospital care is more difficult than it may first appear (O'Connor, O'Malley, Oglesby, et al., 2021). How frequent adverse events are depends on how an adverse event is defined. Studies display a considerable variation in reporting, and there is no universally agreed upon definition or methodology. A systematic review reported a mean of 5,9 incidents per 100 records in prehospital care (O'Connor, O'Malley, Lambe, et al., 2021). Reviewing records identified on average 9,9 incidents per 100 records, while only 0,3 out of 100 were reported in incident reports. A Swedish study counted 4,3 adverse events per 100 records (Hagiwara et al., 2019). However, the highest priority calls (Priority 1) had a notably higher rate of 16,5 incidents events per 100 calls. Amalberti (2005) studied systems by fatalities per catastrophic exposure. The average rate for healthcare was reported to be one fatality to 10^4 encounters. Emergency trauma care was rated less safe, with safety levels comparable to mountaineering or combat aviation. Adverse events in prehospital emergency care are common. But what are the causes of patient safety incidents in prehospital care?

Hagiwara's (2019) study describes some causes for adverse events. Both wrong action - and inaction were attributed as causes. Major contributors to adverse events were problems related to documentation, but also, deviations from standards of care. Deviation from standards of care, or non-adherence to procedures, rules or guidelines also appears as a prominent theme in incident investigations (Wrigstad et al., 2017). Many investigations conclude with interventions that target adherence (Kellogg et al., 2017). Although adherence to guidelines is described to be fundamentally connected to patient safety, reported statistics on adherence in prehospital care are varying. A systematic review of adherence counted rates ranging from an exceptionally low 7.8% to a more satisfactory 95% (Ebben et al., 2013). The varying rates are interpreted to indicate that many patients do not receive appropriate care. Preventing adverse events and improving patient safety is both an ethical and moral obligation (Bonney 2014). Would better adherence rates help reduce the number of adverse events?

Clinical practice guidelines and their advantages

While "protocols" and "clinical practice guidelines" are often used interchangeably, they are not synonymous. Ebben (2013) describes protocols to be tools for the application of guidelines. For simplicities sake, this thesis uses the term "clinical practice guidelines" to encompass both.

Clinical practice guidelines (CPGs) provide recommendations on managing patients with specific medical conditions. These recommendations are derived from scientific evidence or best available expertise (Shekelle, 2023). CPGs and protocols have come to play a significant and expanding role in prehospital care (Cone, 2007). Adherence to guidelines is linked to improved outcomes (Lugtenberg et al., 2009) as well as improved patient safety (Ricciardi & Cascini, 2021). They also serve to ensure consistent care and reduce unwarranted variations in treatments (Grimshaw & Russell, 1993). Through guidelines a standard is created, against which quality can be measured (Berg et al., 1997; Bhaumik, 2017; Taipale & Hautamäki, 2021). Moreover, guidelines are reported to help to address increasing costs of healthcare by eliminating practices that are unnecessary or unsupported by scientific evidence (Weisz et al., 2008).

The advantages of clinical practice guidelines according to published literature include:

1. **Improved Patient Outcomes:** Adherence to clinical practice guidelines is reported to be associated with improved patient outcomes (Lugtenberg et al., 2009).

2. **Standardisation of Care:** Guidelines ensure a standardised approach to care for all patients, and enhanced reliability of emergency medical services (Grimshaw & Russell, 1993).

3. **Patient Safety:** Clinical practice guidelines are reported to improve patient safety (Ricciardi & Cascini, 2021).

4. **Quality Management:** Guidelines provide a benchmark against which the quality of care can be measured, enabling continuous improvement (Berg et al., 1997; Bhaumik, 2017).

5. **Reduced costs:** By eliminating practices that do not have a scientific basis for improved outcomes, the overall costs of healthcare are reduced (Weisz et al., 2008).

The science of translating evidence into practice, or in other words to get clinicians to do what guidelines recommend is referred to as implementation science (Bauer et al., 2015). Theories in implementation science focus on three areas of attention according to Nilsen (2015); understanding how research is used in real life, investigating what factors influence how things turn out, and evaluating the outcomes. Despite their described advantages in enhancing safety and other aspects of healthcare, clinical practice guidelines often see less than optimal adherence, raising questions about their effectiveness. This paradox, where guidelines are described as highly advantageous yet not consistently followed, leads to asking why don't healthcare workers simply do what guidelines prescribe?

Critique of clinical practice guidelines

Safe and high-quality emergency care is a more complex question that cannot be answered by just following instructions. Many factors that influence guideline adherence have been identified in the published literature. These factors are either classified as intrinsic, related to the guidelines themselves or extrinsic, related to factors outside of the guidelines themselves. Intrinsic factors relate to for example guideline length, complexity, ambiguity and perceived usefulness or relevance (Cochrane et al., 2007; Gupta et al., 2016). Extrinsic factors relate to organisational factors, workload, or attitudes among healthcare providers (Gallione et al., 2022). Guideline implementation has been criticised for often taking a guideline and then trying to modify work practices to fit (Gupta et al., 2016). However, implementing guidelines in healthcare is so complex that it can be considered a science of its own (Beauchemin et al., 2019).

Guidelines are reported to expand the gap between the planning and execution of work (Wears & Hunte, 2014). Written instructions for work are often underspecified (Hollnagel, 2008) and fully detailing how tasks should be performed is neither possible nor desirable in most complex work systems (Clarke, 2000). Put differently, guidelines will not specify that you ought to lay your emergency backpack on a surface and unzip it to access its contents. Instead, these are actions that are assumed, and in the example with a backpack unlikely to be a source of any significant problems. However, other assumptions made about how tasks are performed may. One assumption that frequently causes problems is the difficulty of accounting for the time necessary to complete a task (Almklov & Antonsen, 2019).

There are also other assumptions about work that guidelines struggle to account for. Hollnagel (2009) describes the difference between work-as-imagined and work-as-done. In other words, the way in which work is performed when imagining or discussing it is not the way in which tasks actually are performed on scene. Because imagining how tasks are performed lacks context and the continuous adaptations necessary by practitioners according to the situational demands. When imagining work, there is instead an abstract performance where tasks are completed sequentially, virtually instantly and without any unexpected difficulties or problems. Without a thorough understanding of work-as-done (Hollnagel et al., 2015), guidelines can prescribe tasks in ways that are impractical,

which could help explain why guidelines in prehospital care consistently receive low scores in applicability (Martin-Gill et al., 2023).

A further way to demonstrate the difference between work -as-imagined and -as-done is through a simple exercise of imagination. Suppose you are to perform a primary survey on a patient using an ABCDE approach. Naturally, the first step would be to assess the airway by looking, listening to the airway sounds and so on. When imagining work tasks being performed, actions follow a step-by-step sequence and are completed one after another. However, when done in a real-life scenario, a multiplicity of information is immediately available, such as the position, appearance, or level of alertness of the patient. Contextual factors are also unaccounted for when imagining work. Therefore, you are unlikely to have imagined performing the assessment with the patient lying on the side, stuck between a bathtub and a toilet stool. The way tasks are performed may be quite different from how we imagine them to be performed. Given that the abstract representations of work, with tasks following a predetermined sequence (but being almost instantly completed), may not fully correspond to the reality of how work is performed, overemphasising adherence may paradoxically decrease safety by reducing the capability to adapt to unpredictable circumstances (Pariès et al., 2018; Vincent & Amalberti, 2016a), and by creating further uncertainty when unscripted situations are encountered (Fuchs, 2013).

Clinical practice guidelines have a dual role: on one hand they promise safe, efficient, and high-quality care when adhered to, but are on the other hand impossible to follow rigidly and rely on practitioners to apply them in dynamic situations. Paradoxically, overemphasis on strict adherence can sometimes decrease safety. But managing safety in complex work such as prehospital emergency care involves more than just managing adherence to written instructions or managing documents. The next section will explore safety management systems and how safety and the role of written instructions depends on system characteristics.

Managing safety in prehospital care

Managing safety in complex work systems is very hard and often counterintuitive (Dixon-Woods, 2010). When billboards were used to alert drivers of accident risks, accidents on those roads did not decrease; but in fact, increased (Hall & Madsen, 2022). However, as difficult it may be, there is a moral and ethical obligation to continuously improve safety in healthcare (Bonney, 2013). To this end, actions are required to be taken at all levels. In Sweden, management of patient safety is written into law– the patient safety act (2010:659). This law defines medical injuries as suffering, bodily or psychological harm, or illness, including death, which could have been avoided if appropriate measures had been taken during the patient's contact with healthcare services. Serious incidents are reported to the Health and Social Care Inspectorate. There is also national action plan for improved patient safety, created by the national board of health and welfare (2020).

Although extensive effort has been invested into safety in healthcare, goals have not yet been met (Bates et al., 2023; Wears & Sutcliffe, 2019). Traditionally, patient safety has been described as reactive, that is, measures are undertaken after an incident has occurred (Hollnagel et al., 2015, p. 26). The focus has been on incident reporting and the analysis of incidents, often using root cause analysis (Ahlberg et al., 2020) and risk assessments using tools such as Healthcare Failure Mode and Effect Analysis (HFMEA). Investigations often reveal that failure to adhere to procedures, routines or guidelines are common causes of accidents, and analysis leads to interventions that often target guidelines or other written instructions (Ahlberg et al., 2020). Reemphasising or creating written instructions is frequently performed in response to a patient safety incident (Kellogg et al., 2017).

However, relying on guidelines or other written instructions to prevent recurrence of incidents does not appear to have a strong effect (Hibbert et al., 2018; Kellogg et al., 2017; Kwok et al., 2020). Some authors advise against overdependence on guidelines for safety management. Hutchinson et al. (2022) cautions against the risk of focusing more on managing safety documentation than on actual safety. Investigations using root-cause analysis (Vincent (Martin-Delgado et al., 2020;), may promote a reductionist view that assumes that one or a handful of causes of incidents can be found and fixed (Vincent, 2004), which often fails to fully comprehend incidents or prevent their recurrence. Rather than depending on written instructions for work, the responsibility for safety lies with the practitioners.

> "Safety results from people being skillful at judging when and how (and when not) to adapt
> procedures to local circumstances" (Dekker, 2001, p. 383)

In prehospital emergency care, negotiating different priorities and managing trade-offs is an essential skill for safety (Pruchnicki & Dekker, 2017). Unfortunately, guidelines often do not help in resolving these kind of conflicts. Bypassing some recommendations or using workarounds may be essential to effectively be able to achieve other work goals (Andersson et al., 2019). Applying a simple rule – If condition X then perform action Y ignores that the most difficult decision may be to determine if the condition applies or not (Klein et al., 2016). Demanding strict adherence to guidelines can paradoxically reduce safety by limiting the options and capacity to adapt to changing circumstances (Pariès et al., 2018; Woods, 2018). The degree to which safety can be created by written guidelines and procedures depends on system characteristics. Measures that are effective in some contexts like aviation can potentially create vulnerabilities in other types of systems that require different degrees of adaptability (Pariès et al., 2018; Vincent & Amalberti, 2016a). Expectations for what written instructions for work can achieve must be carefully considered and balanced in accordance with the properties of the system they are implemented in.

Prehospital emergency care is characterised by low predetermination and low predictability. How an emergency will unfold and what actions will be appropriate is impossible to predict beforehand. Furthermore, there are no administrators or supervisors present to ensure that rules are (or can be) followed. Instead, the organisation largely depends on self-reported measures and documentation. In other words, the degree to which organisational control is imposed is low. In this context, the responsibility for managing trade-offs between performance and risk lies with the practitioner (Pariès et al., 2018). Safety cannot be assured solely through standards, regulations, procedures (or guidelines); but demands robust adaptive skills from practitioners as a vital complement. Ironically, reducing variations of care, which has been described as a key advantage of guidelines and contributor to patient safety (Grimshaw & Russell, 1993) is also a factor that that has been linked to decreased safety (Wears, 2015). This paradox, where guidelines are both praised for reducing variations in care and simultaneously criticised for reducing safety (Grimshaw & Russell, 1993; Wears, 2015), sets the stage for exploring the practitioners' perspective and the function of guidelines at the hands of ambulance teams.

Research question

Clinical practice guidelines, serve as a bridge between scientific evidence and practical action, and are recognized for their potential to improve patient safety, standardise care, and provide a benchmark for quality control. Guidelines are seen as central for translating research into actionable steps, supporting consistency of care and ensuring that the quality of care meets standards. While some authors suggest that safety in healthcare could be improved through enhanced adherence, other authors contend that rigid adherence often introduces new vulnerabilities and limits the adaptive capacity in the complex systems.

The approach to guidelines varies between authors and different stakeholders in healthcare. For managers and administrators, guidelines are tools for monitoring and ensuring that medical practice aligns with established standards or norms. Guidelines are directives that should be followed, and deviations require justification or correction. This perspective emphasises the role of guidelines as maintaining a consistent and standardised method for patient care.

The perspective of ambulance teams themselves is less well explored. Studies, such as those by Maria (2021), indicate that clinical practice guidelines may serve functions beyond their intended purposes for prehospital practitioners. What perspective do ambulance teams themselves adopt to guidelines: How do they use them in their daily practice, and in what specific contexts and settings are guidelines consulted? What are their needs with regards to information?

To investigate the role and impact of clinical practice guidelines, it is essential to understand how, when, and why ambulance teams' access, read and use them. This understanding is not only important for adapting the content, design, and structure of guidelines to better suit the needs of practitioners, but also to understand the multiple functions that guidelines serve in prehospital emergency care. The research, therefore, focuses on investigating the use of clinical practice guidelines by ambulance teams, exploring their perspectives and practices. The research question is: How do ambulance teams use clinical practice guidelines?

Methods

A qualitative methodology using interviews and observations was used to collect data. Use refers to physically accessing and reading guidelines and not when guideline recommendations align with taken actions. Exploring how guidelines are used in context is not available to study through quantitative measurements, because they require an understanding of complex behaviours, interpretations, and contextual factors that are not easily captured through numerical data or statistical analysis. Quantitative studies typically quantify phenomena in terms of numbers and statistical operations, which can oversimplify or overlook the depth of understanding and the subtleties of human actions, behaviours, and interactions with the guidelines in real world situations.

Ontological and epistemological position: The researcher approaches the research through constructivism and interpretivism. Constructivism acknowledges that multiple, and subjective realities exist and are socially constructed. Interpretivism contends that knowledge that knowledge of humans and their social worlds cannot be understood in the same way as physical phenomena (Saunders et al., 2009), but rather depends on interpretation by individuals based on their experiences. Epistemologically a subjective and descriptive view was used, where the world of human experience is understood both through a lens of the researcher as well as the research subjects views, background and experiences (Walt, 2020).

Data collection resulted in a series of observations of ambulance crews using clinical practice guidelines in context, but also situations in which they were not used. Additionally, interviews were used to explore the tasks and actions that ambulance teams undertake, and what role guidelines play in mediating and performing these tasks. Interpretivism seeks to create new, richer understandings of social worlds and contexts (Saunders et al., 2009). This result in each ambulance team member having created their own work reality, grounded in their own experiences, training and the nature of the emergency they are attending, imagining, or remembering. The study aims to comprehend and analyse the formation and impact of these realities in work contexts. An interpretive method allows exploration of the context that motivates ambulance crews to access, read and use clinical practice guidelines in prehospital care situations.

Theoretical framework:

This section explores various theoretical frameworks to understand the role of clinical practice guidelines in prehospital emergency care, focusing on human action, social aspects, and context. Maxwell (2012) defines theoretical frameworks as models for understanding phenomena, and five theories were assessed: Sociotechnical Systems, Joint Cognitive Systems, Situated Action, Actor-Network Theory, and Activity Theory. Each theory has their own a unique perspective as well as some overlap:

Sociotechnical Systems Theory integrates human, technical, and organizational parts towards a shared goal, highlighting the need for joint optimization (Ruault et al., 2012). Joint Cognitive Systems/Cognitive Systems Engineering views humans, machines, and technologies as a unified system, emphasizing collaboration and joint cognition (Hollnagel & Woods, 1983). Actor-Network Theory (ANT) was developed from sociology of science, and sees humans and non-human elements, like technologies, forming networks with agency. Situated Action focuses on human behaviour in specific contexts, emphasizing the impulsive nature of activities and responsiveness to changing environments (Nardi, 1996).

While each of the examined theoretical frameworks provides insights into the interaction between human practitioners and artifacts within context, activity theory was selected as the model for this exploration because perhaps more than the others allows for distinction between general rules and norms that exist within prehospital care, rules and norms that are internalised by ambulance teams as well as rules or norms that are conveyed through artefacts such as clinical practice guidelines, but also because it is focused on action and how multiple goals or objects need to be negotiated in a complex system of interactions in an activity system.

Activity theory

Lew Vygotsky (1978), the Soviet psychologist, developed activity theory as a concept that explains how human agents engage in actions and how these actions are influenced or mediated by artefacts (Wiser et al., 2019). Leont'ev (1978) expanded upon the theory to include the effects of community. Engeström (2014/1987) introduced a systematic model - the activity system.

Research using activity theory looks at how activity systems work and the conflicts or tension that arise within them (Engeström & Pyörälä, 2021). An activity system includes the subjects, or human actors, what they aim to achieve - the object, the artefacts or tools they use, the rules or norms they follow, the community they are part of, and how work tasks are divided (Gormley et al., 2020).

An activity is a joint effort that directs action, and entire system is aimed at achieving a particular goal or fulfilling a motive (Hashim & Jones, 2014). Activity theory makes a distinction between actions that are short-term and aimed at operational goals, and activities that are long-term and involve a collective motive (Leont'ev, 1978). Activities can therefore be subdivided into actions and operations and described in a hierarchical system (Crawford & Hasan, 2007; Kuutti, 1999). Put differently, the activity system can work to achieve short term objectives, while simultaneously also aiming for broader, long-term objectives or motives.

Artefacts mediate actions in activity systems, and each artifact has its own culturally mediated history (Kuutti & Bannon, 2020). Knowledge starts as externalized and often mediated by artefacts or tools, but over time and through practice, knowledge is internalised as expertise (Wiser et al., 2019). In activity theory, context or the environment is not considered as an outer container in which activity happens, but instead what takes place in an activity system of actions, objects and operation makes up the context (Nardi, 1996).

Activity theory has been applied in healthcare (Engeström & Pyörälä, 2021; Engeström & Sannino, 2021),), education, fire emergencies (Wiser et al., 2019), and in prehospital care to understand decision making in emergencies (Mishra et al., 2015). It represents a set of fundamental principles, forming a conceptual framework rather than a predictive theory with rigid rules (Maier, 2005), and as such, there are degrees of freedom for researchers applying it, but also a risk of arbitrary decisions emerging (Honold, 2000).

Activity theory is valuable in contexts where tools or technologies are being designed for collaborative purposes, which makes it particularly interesting from the standpoint of clinical practice guidelines. It also practically attempts to reveal the motivations or reasons behind activities (Nardi, 1996). Critique towards activity theory has targeted a lack of standardised methods of data gathering, documentation and analysis, and for complex or ambiguous philosophical concepts (Wiser et al., 2019).

Sociotechnical systems, cognitive systems engineering/Joint cognitive systems, Actor-Network theory, situated action and activity theory all share some common principles and to overlap to a degree. All theories are concerned how human and technical components of systems mutually interact and influence one another, and those influences determine the outcome of system operations. Despite common features, each theoretical framework also has its own focus and characteristics.

For this research, activity theory was chosen as a theoretical framework. This is because activity theory describes actions in activity systems, which can help understand the role that clinical practice guidelines as mediating artefacts play in prehospital care. Activity theory helps distinguish between general rules and norms, and the artefacts that carry or convey these rules. Furthermore, activity theory focuses on action, and allows for hierarchies of objects, goals and motives that can help understand actions that only make sense when considering a higher motive. A thorough understanding of the role of clinical practice guidelines can potentially help create guidelines that are designer for the way that work is performed in prehospital emergency care.

Context: Healthcare in Skane

Skane is the southernmost region of Skane, with a population of 1 414 324 inhabitants and a land area of 10 965,30 km². The population density is 129 inhabitants per km² (Sweden, 2023). The Skane County or Region is responsible for healthcare services, which includes prehospital care. Emergency hospitals (4) provide more advanced medical care, with one university hospital located in two cities – Malmo and Lund. Community hospitals treat less serious disease in hospitals closer to patients' homes. Approximately 215 000 patients above the age of 19 were treated at emergency departments in Skane in 2022 according to the National board of health and welfare (2022)
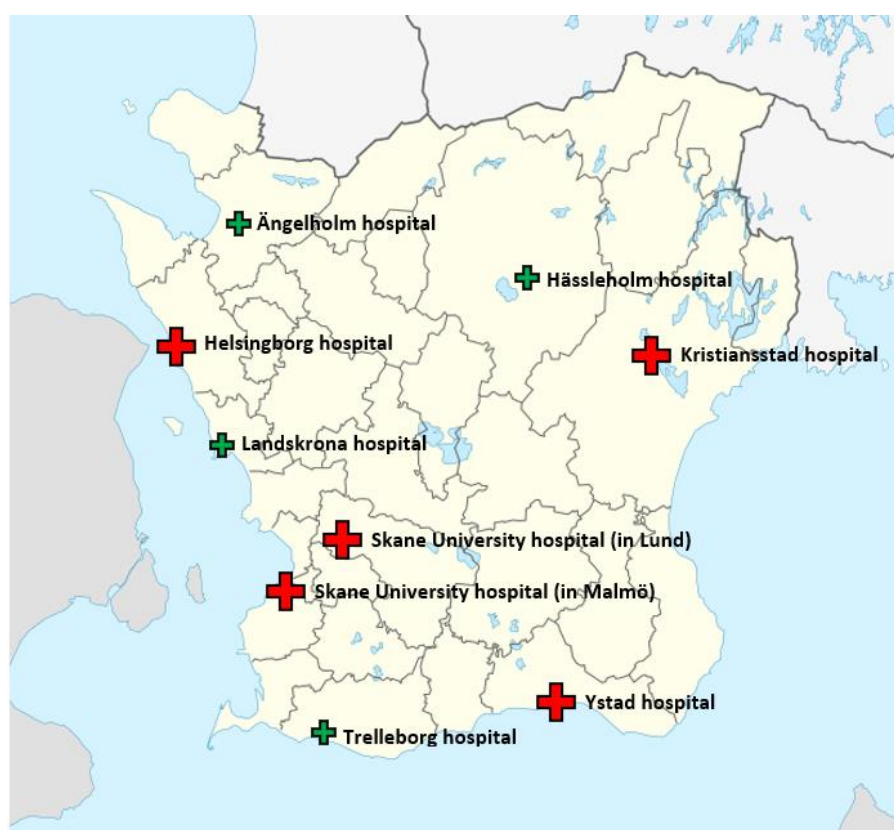
Figure 1.

Map of Skane with hospitals added. Original map by Frohne (2009)

Context: Prehospital care in Sweden

Prehospital care in Sweden is managed at the level of the County or Region. It is subject to the health and medical services act (Sweden, 2017) as well as the patient safety act (Sweden, 2010). The national board of health and welfare is the supervisory and regulatory authority for prehospital care (SOSFS 2009:10).

Prescription of medications in Sweden is limited to dentists and physicians. Nurses administer medications according to general prescriptions by a physician – for example, the medical director of ambulance care. These outline the medications, dosages, modes of administration and circumstances in which nurses can initiate treatment without a physician's order. Paramedics in Sweden are not allowed to administer medications in prehospital care.

Clinical practice guidelines therefore have the additional legal function of regulating medication treatments by nurses in ambulances in Sweden.

In Sweden, ambulances must include at least one registered nurse or nurse specialist (Nilsson et al., 2020). In Skane, "Emergency" ambulances require a nurse specialist, whereas ambulances need a registered nurse. Dispatchers prioritise deploying emergency ambulances over ambulances ones for priority 1 cases whenever possible.

Context: Prehospital care in Skane

Skane is divided into four ambulance districts. The north-western district (District 3.), and Malmö (District 1) are managed by the county, while districts 2 and 4 are managed by private companies. This research was set in District 3 in North-Western Skane (Green), providing ambulance services to approximately 360 000 inhabitants.
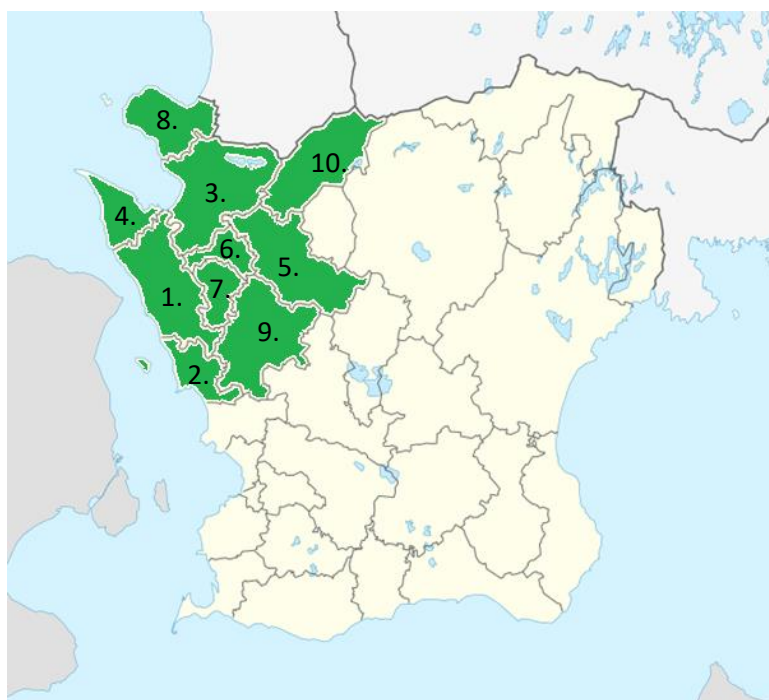
Figure 2.
Map of Skane with municipalities in district 3 added (Green). Original map by Frohne (2009)

District 3 consists of 10 municipalities with and has three major ambulance stations, Helsingborg, Ängelholm, and Landskrona. Ambulances based in the major stations, extend coverage to rural stations to provide service to those areas. In total, 58 679 ambulance assignments were received in 2022. Ambulance assignments involving patients above the age of 70 represent 43 % of all assignments. Of all assignments, 42 % are transported to a hospital, 23 % are not conveyed and 15 % are cancelled by dispatch before patient contact. For priority 1 patients, the highest medical priority level ambulances arrive after a mean time of 12 minutes and 50 seconds.

Table 1.

The municipalities in ambulance district 3, by number of inhabitants in 2023

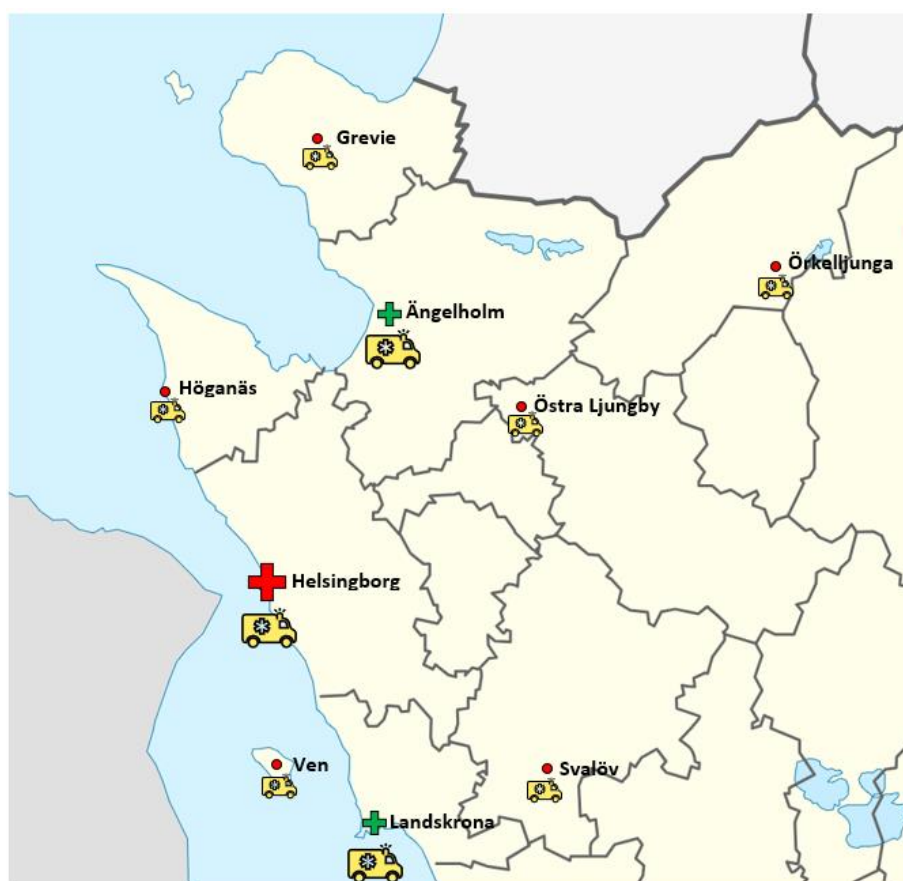| Municipality	Population
1. Helsingborg	150 975
2. Landskrona	47 004
3. Ängelholm	44 268
4. Höganäs	28 103
5. Klippan	17 865
6. Åstorp	16 341
7. Bjuv	16 062
8. Båstad	15 824
9. Svalöv	14 466
10. Örkelljunga	10 455
Total	**361 363**

Figure 3.

Map of Ambulance stations and hospitals in district 3 (North-Western Skane). Original map by Frohne (2009)

Participant Selection and Sampling:

Interviews: Ambulance nurses and paramedics were informed by their managers about the option to participate in the project. Managers asked for volunteers from the primary ambulance stations (Helsingborg, Ängelholm & Landskrona) based on their voluntary willingness to participate.

Observations: The researcher attended the morning briefing at the ambulance station in Helsingborg and informed teams about the research project. At first, ambulance teams were randomly approached and asked to participate. Following two days of observation, the researcher approached the team with the least experienced team member to include in the data the observations of a less experienced team.

Data Collection Methods:

Interviews:
Interviews were initially planned with ambulance teams of two subjects. However, the number of volunteers did not allow two subjects for each interview, and some interviews were conducted with the researcher and a single subject. The rationale behind interviewing an ambulance team is that it could mitigate the power imbalance between the researcher and the subjects (DeJonckheere & Vaughn, 2019). An interview guide was prepared (See appendix 1). Open ended questions were used (Smith, 1995) to ask subjects how they used clinical practice guidelines in their work. The researcher followed up these questions at his own discretion (Bryman, 2015). Subjects were asked what tasks and actions they perform in the different phases of an assignment, and how practice guideline are used in these contexts. The interviews were recorded with a computer, a microphone using Windows voice recorder. During the interviews, the researcher took notes on a sketch of a typical ambulance assignment.

Table 2.

6 interviews were performed with a total of 9 subjects from 3 different ambulance stations.

No	Pseudonyms	Gender	Experience (Years)	Role	Location	Length
1	**Jed**	Male	5	Specialist Nurse	Helsingborg	38:07
2	**Kyle**	Male	2	Nurse	Landskrona	24:45
3	**Ellen**	Female	13	Specialist Nurse	Landskrona	45:53
3	**Samantha**	Female	9	Specialist Nurse	Landskrona	45:54
4	**Bruce**	Male	17	Specialist Nurse	Ängelholm	35:42
4	**Stella**	Female	23	Paramedic	Ängelholm	35:42
5	**Kathleen**	Female	5	Specialist Nurse	Ängelholm	33:16
5	**Edgar**	Male	20	Specialist Nurse	Ängelholm	33:16
6	**Warren**	Male	1	Nurse	Helsingborg	32:00

The collective years of experience in ambulance care among all subjects was 95, resulting in an average of approximately 10.5 years. Among the participants, there were five males and four females. Interviews were conducted at the ambulance stations in Helsingborg, Ängelholm and Landskrona. To protect the anonymity of research subjects, pseudonyms were created using an online random name generator (www.behindthename.com/random/). Transcription was done in Microsoft word. Due to time constraints, transcription was not verbatim. Recorded audio was deleted after transcription to protect the anonymity of research subjects (See Ethical considerations). The interview guide, interviews and transcription were in all recorded in Swedish.

Observations:

Observations were conducted over 5 shifts. An ambulance team was followed for the entire shift. Data was recorded by hand in a notebook as was possible. The researcher had a participatory role in the ambulance team (Fangen, 2005), with interactions and conversations with ambulance teams were not avoided. When ambulance teams received an assignment, the researcher accompanied them to the ambulance and read the assignment together. Driving to the scene, the researcher sat in the back of the ambulance and made observations as to the actions of team during transport. This proved to be more difficult than expected, as there is only small window between the driver's area and the patient compartment in the back. Gathering data during transport was challenging. During the highest priority calls (Priority 1) the noise from the engine as well as the lights and sirens made hearing what was said nearly impossible. Furthermore, at high speeds, the ambulance often veered when turning which further complicated observations. Therefore, it was only partially possible to listen and observe the team during transport to scene.

At scene, the researcher took a passive role. The subjects were informed that they were allowed to interact with the researcher in any manner the wanted, which also led to some questions of medical nature being asked of the researcher. In general, I stood a few steps behind the ambulance crew and observed their actions. If notes were not appropriate to write on scene, documentation was postponed. If ambulance crews asked my opinion about a case or course of action, I interacted with them as I would have outside of the research setting and gave my advice or opinion to the best of my ability. The fact that they felt the need or want to ask a question or involve me would also be indicative and have meaning regarding the research question. Frequently, I found myself helping by carrying equipment or aiding a patient to the stretcher.

After the shift was over, notes were expanded to the best of my memory in a Word document. The main goal of the observation was to explore the way in which clinical practice guidelines were used, as well, to explore their role and function in prehospital care, I attempted to record as many tasks and actions as possible. At times, ambulance teams worked rapidly, with both team members performing a multiplicity of tasks almost simultaneously, which made detailed observations of who did what almost impossible. In total, 5 days of observation was performed with 10 different ambulance personnel.

Table 3.

5 days of observations were performed with a total of 10 different subjects.

No	Pseudonyms	Gender	Experience (Years)	Role	Location	Observation hours
1	**Russel**	Male	4	Specialist Nurse	Ambulance Helsingborg	8:00-18:00
1	**Joseph**	Male	4	Paramedic	Ambulance Helsingborg	8:00-18:00
2	**Edmond**	Male	4	Specialist Nurse	Ambulance Helsingborg	8:00-18:00
2	**Lindsey**	Female	7	Specialist Nurse	Ambulance Helsingborg	8:00-18:00
3	**Carla**	Female	1	Nurse	Ambulance Helsingborg	7:00-17:00
3	**Amos**	Male	20	Paramedic	Ambulance Helsingborg	7:00-17:00
4	**Fiona**	Female	4	Specialist Nurse	Ambulance Helsingborg	7:00-17:00
4	**Leanne**	Female	1	Paramedic	Ambulance Helsingborg	7:00-17:00
5	**Antony**	Male	14	Specialist Nurse	Ambulance Helsingborg	7:00-17:00
5	**Grant**	Male	1	Nurse	Ambulance Helsingborg	7:00-17:00

The observed ambulance teams had a sum of 60 years of experience with an average of 6 years per team member. 6 research subjects were male and 4 were female.

Ethical Considerations

Ambulance crews were informed about the purpose, design, and implications of participating in the study. Informed consent was obtained in writing from all research subjects. To protect the anonymity of research subjects, their names were changed to pseudonyms, and their experience rounded to the nearest year. The autonomy and privacy of research subjects was respected, care was taken to ensure that no pseudonym matched an actual employee at the ambulance service in district 3. To ensure confidentiality, audio recordings of interviews were deleted after transcription, and only pseudonyms were written in the transcripts.

Patients were not the subject of the research; however, some descriptions of patients and patient encounters were included in order to provide context. The researcher, and ambulance teams who make up the research subjects have signed confidentiality agreements that prohibit using any data than can be used to identify a patient. Patient characteristics have been altered to protect their confidentiality, and their ages are approximated to the nearest decade. No information regarding their names, detailed descriptions, addresses or the locations of the emergencies have been included. The research is not considered to have influenced the care provided to patients. While taking a passive and observant stance during patient care, I also helped to the best of my ability when ambulance teams asked for medical expertise or any other type of help, such as carrying equipment.

This project was conducted as part of higher-level education, specifically a master's program in Human factors and Systems Safety at Lund university. As such an ethical approval is not required according to the 2 §; The Swedish Law on Ethical Review of Research Involving Humans (2003:460). The observational study was approved by the director of the ambulance services in Skane.

Researcher reflexivity and characteristics.

The author of this master's thesis is a physician, has been employed as a medical director part time for the ambulance service in north-western Skane since 2019. I also work part time at the emergency department at Helsingborg hospital.

As an emergency medicine physician, I currently work every other week at the Emergency department in Helsingborg hospital, and every other week for the ambulance service in north-western Skane. At the emergency department, I work clinically, which includes receiving patients from the ambulance service at the emergency department or resuscitation room. Ambulance staff are open to seek me out to discuss cases or chat, because I believe an atmosphere of openness and trust will benefit patient care.

Every other week I work for the ambulance service. My first contact with the ambulance service was during training to become an emergency physician. This involved participating in the ambulance services introductory course followed by 6 weeks of clinical work in an ambulance. Currently, my assignments for the ambulance service include supporing managers in medical questions, a shared responsibility for the medical content of guidelines and training, performing medical assessments in incident investigations and to further medical care in a prehospital context. The ambulance district provides care to both urban and rural areas, with three major ambulance stations located in the cities of Ängelholm, Helsingborg and Landskrona, and smaller stations in some rural communities. Working with the ambulance staff, I know most of them by name and all of them interact with me regularly either at the ambulance stations or during patient handoffs at the emergency department.

Going into this research I want to discuss some preconceptions about how ambulance services use clinical practice guidelines that could influence the research, and therefore warrant disclosure. Prehospital emergency care is complex, unpredictable, and often performed under time pressures (Pruchnicki & Dekker, 2017). There is the ever-present risk of being dispatched to a critical case, or a patient can rapidly and unpredictably deteriorate, requiring rapid, aggressive, and appropriate interventions. Although critical cases do not make up most assignments, they must nevertheless be prepared for when entering a scene. This preparation primarily takes place during transport to the scene. Here ambulance crews have received some information from the dispatcher and can make some preliminary assumptions about the nature of the illness or injury that the patient has suffered. Clinical practice guidelines are used to refresh the memory and to provide certainty as to prioritised tasks and medication dosages, particularly if the nature of the assignment is somewhat uncommon or involves a paediatric patient where doses have to be individually calculated. For novice staff, clinical practice guidelines are more often read and treated as educational or learning material. For both novice and more experienced staff, clinical practice guidelines are accessed at scene only when uncertainty with regards to key information is present. There are numerous tasks and actions to be performed, among them an initial assessment, evaluation of ABCDE, taking history, performing secondary evaluations, diagnostic or therapeutic interventions, determining a triage level and planning and executing egress. Referencing written instructions competes with these tasks and I therefore believe is only performed when staff are sufficiently uncertain about how to proceed without double-checking guideline recommendations.

Data Analysis:

Interview transcripts and expanded observational data were compiled in a MS Word document. Both transcripts and observation notes were in Swedish when analysed. The document was 94 pages long and contained 50 999 words. The analysis started with converting the file into a pdf document and reading the document to familiarise myself with the contents. NVIVO was used for coding.

Initial coding was performed according to the elements of the activity system (Engeström & Pyörälä, 2021), as subjects, artefacts/tools, objects, rules and norms, community, and division of labour as well as identifying the different phases of prehospital care, before an assignment, during transport to scene, during patient care, during transport to hospital and after an assignment. Secondary coding was performed where instances of guideline became its own code, as well as Subject – Hazards or risks, Subject – Uncertainty, and Tensions-conflicts. The author performed all coding, and when uncertainty was encountered during coding the researcher's judgment decided which code or codes were used.

As the elements in the activity system change in different phases of prehospital care, each phase was treated as an own activity system, with the assignment being a chain of activity systems. Interview data helped depict the objects in the different activity systems. The objects were organised in a hierarchy (Kuutti, 1999; Leont'ev, 1981) in order to explore how multiple goals at different levels are pursued simultaneously or in succession. Observational data provided insights into when guidelines were read and what object that works towards. Interview transcripts, notes, and expanded field-notes were used to describe five activity systems representing the different phases of prehospital care, and what role guidelines as mediating artefacts play in actions performed or anticipated. An analysis of the tensions and conflicts related to the role of clinical practice guidelines within the different activity systems was conducted.

Identifying the elements of the activity system:

An activity system consists of actors, tools/artefacts, objects, rules and norms, community and division of labour (Engeström & Pyörälä, 2021). The subjects are the actors within the activity system. Tools or artefacts work by mediating the actions performed by subjects, while the object represents goal-directed actions or what they are trying to achieve. Organisational rules and norms, community interactions and division of labour can also affect how the actions are performed and how an outcome is achieved. The activity system depicts these elements as interacting and influencing each other. Engeström (2021) depicts the activity system as a triangle with each element of the activity system exerting mutual influence, pictured as bidirectional arrows that connect the elements with each other.

Below the elements of the activity system are further explained:

Subjects: The ambulance team consisting of a specialist nurse/registered nurse, joined by either another nurse or a paramedic. The subjects are the actors, performing actions in the activity system.

Tools/Artefacts: The focus of the research is to explore the way clinical practice guidelines as an artefact or tool mediates actions in ambulance team. Ambulance teams access clinical practice guidelines through a smartphone app. A range of other tools are used by ambulance teams, such as medical equipment, transportation tools, communication devices and a touchscreen computer that is used for documentation and triage according to RETTS.

Object: The object of the activity system is a goal, aim or intended outcome that the team is trying to achieve through their actions. Goals or purposes exist on multiple different levels in an activity system and shift throughout the course of an ambulance assignment.

Rules/norms: Organisational rules and norms are the standards or norms that govern behaviour in the activity system. There is a multiplicity of rules and norms that regulate how medical care is provided, and what interventions are appropriate. Certain rules are written down and codified in clinical practice guidelines and become tools or artefacts.

Community: In prehospital emergency care, the term community refers to the way actions are influenced by collaborating groups. This involves interactions with patients, their families, other healthcare professionals like home care nurses or hospital staff, as well as partners such as law enforcement or firefighters. These interactions influence the delivery of emergency medical care.

Division of labour: Division of labour in an activity system involves distributing tasks and responsibilities among the individuals or team in the activity system.

Phases of an ambulance assignment

Prehospital emergency care involves a variety of settings, goals, contexts, and actions that change based on the ambulance's activities. To illustrate the evolving nature of these activities, assignments are divided into five phases. The division into phases is arbitrary and no strictly defined boundaries between phases exist. Not all ambulance assignments follow his pattern, particularly in cases of non-conveyance. In these cases, certain tasks like transporting to the hospital do not apply. Some actions span across many phases, and some goals, tasks or actions can be postponed to later stages. However, visualising an assignment in this way can help to understand how an ambulance assignment evolves through different objects, and how clinical practice guidelines can mediate actions differently depending on context and circumstances. In this way, a typical ambulance assignment can be described as a chain of activity systems with various objects and goals.

	Phases of an ambulance assignment:
	Before an assignment: Before an assignment is received, ambulance teams often spend time at the ambulance station.
	En route to scene After the ambulance team receives an assignment until they have gained access to the patient.
	During patient care, on scene From first contact with patient, during assessments and treatments on scene until transportation is initiated
	During transport to hospital During transportation from scene to a hospital.
	After an assignment After a patient has been handed off at the hospital

Figure 4.

An ambulance assignment divided into phases according to objectives and context

Trustworthiness, Rigor, and Limitations

To increase the trustworthiness of findings two methods for data collection were used. Combining data from multiple sources may also increase reliability (Carter et al., 2014). A description of data collection and analysis methods are detailed in the corresponding section. Coding procedures were consistent with both the elements of the activity system and the various phases of assignments, ensuring a systematic approach to data interpretation. The researcher's reflexivity and acknowledgment of biases are discussed in a dedicated section, in an effort to address and mitigate potential biases in the research process.

Interviews and observations were performed with a total of 19 different ambulance nurses and paramedics, which represents a limited selection of all personnel. All ambulance personnel work in the same district and can therefore have a historical and cultural influences on how they use clinical practice guidelines. The participants volunteered to participate, and as such, sampling was not random. Ambulance teams that are interested in research on clinical practice guidelines could use them in ways that could bias results. The interview subjects had on average much more experience compared to subjects observed. As the sample size was small, differences in experience could potentially have a significant impact in how the role of guidelines is perceived. Furthermore, while interviews included personnel from all stations, observations were only conducted in an urban environment (Helsingborg). Stations located at a distance from a hospital have longer transportation times and may therefore use clinical practice guidelines differently. This finding is also described in the results section.

Observing ambulance teams working was on occasion difficult. Two particularly demanding situations that made observation challenging was when the ambulance was in transport to a patient. The highest priority calls, priority 1 made observations during transport often difficult, as the engine noise and sirens overpowered the conversation that the team had in the front of the ambulance. Therefore, this phase could only be partially observed. Another demanding situation was when ambulance team members performed a series of actions and tasks in rapid succession. It was challenging to detail what each team member had done in contexts like these. As a team, one team member would perform certain actions while the other interacted with patients or relatives. Therefore, the level of detail in observations is varying and context dependent.

The interviews and observations focused on typical ambulance assignments, and therefore, conclusions about the role of clinical practice guidelines in other, more extreme circumstances remains unclear. Furthermore, the division of ambulance assignments into phases, before an assignment, en route to patient and so on is an arbitrary division made by the researcher in order to simplify depictions. There are no clear boundaries where activity systems shift, rather, some actions and objects are transferred to the next phase while others are deemphasised. Not all ambulance assignments follow this pattern in the same way.

Internationally, prehospital care systems are designed and function in many ways. Some prehospital care systems employ physicians, while others depend on nurses or paramedics (Al-Shaqsi, 2010) which could limit the generalisability of findings. The design and content of clinical practice guidelines also varies across different regions and prehospital care systems. The content and design of guidelines could influence the way in which they are used.

Results

Summary of Observations:

Five different ambulance crews were observed for one shift each. The number of assignments received per shift varied from 3 to 7. In total 25 assignments were received during the 5 days of observation.

10 assignments or 40 % were dispatched as the highest priority calls (1A or 1B) with the ambulance responding with lights and sirens. 15 assignments or 60 % were priority 2 (2A or 2B). In total, 15 patients (60 %) were transported to the hospital, out of which 4 (27 %) were priority 1 (lights and sirens) and 11 (73 %) as priority 2 (Emergent but not life threatening). Six patients were non-conveyed, dispatch cancelled 2 assignments before patient contact. Additionally, one assignment was providing assistance to another ambulance, and 1 inter-hospital transfer.

Patients were not the subject of observations, and their characteristics were not detailed. Patients age was approximated to the nearest decade in order to protect their anonymity. The average age of patients was approximately 62, 10 were male and 15 were female. Clinical practice guidelines were accessed on five occasions (20 %). On one occasion, guidelines were searched for information, but no article relevant to the case exists. On one occasion, the ambulance team accessed an online pharmacological reference (Pharmaceutical Specialties in Sweden) and the poison control website.

Clinical practice guidelines were mostly used before patient contact (5 occasions), during transport to hospital on one occasion, and the pharmacological reference and poison control websites were used during patient care on one occasion. In all cases where guidelines were accessed, patients were transported to the hospital.

Summary of assignments where CPGs were used.

Case 1. Priority 1B – Chest pain

A 50-year-old man complained of chest pain and difficulty breathing. An assessment and ECG showed no major pathologies, but it was decided to take him to the emergency room suspecting acute coronary syndrome. The patient, who had diabetes, mentioned high blood sugar levels, and that he had taken extra insulin twice. His first glucose level was first measured at 6.1 mmol/L. After being loaded into the ambulance his CGM device showed 4.9 mmol/L. Because the levels were decreasing a third glucose was measured using the ambulances device, showing 4.1 mmol/L. The ambulance nurse accessed guideline CPG 6.4 – Hypoglycaemia; concerned about the dropping glucose levels.

Case 2. Priority 1A – Intoxication

~20-year-old female who had a self-harm incident with a mixed intoxication involving an opiate. The team had members with 4 and 7 years of experience in prehospital care. En route to scene ambulance, the medically responsible nurse accessed CPG 9.0 - Naloxone and read the dose and administration routes of naloxone aloud. Later, the team explained that on missions involving intoxications, the scene can be disorderly and messy, and checking dosages may be difficult in that setting. Reinforcing knowledge of dosages and administration routes beforehand creates security despite the team reporting that they know already the dose and administration route of naloxone.

Case 3. Priority 2A -Stroke/TIA

An 80-year-old woman on anticoagulation experiences a suspected cerebrovascular incident (CVI). The team had members with 4 and 7 years of experience in prehospital care. While driving to the scene, a member of the ambulance team refers to CPG 6.7 - Stroke, to review stroke-alert timeframes applicable to patients on anticoagulation. She reads the timeframes to the colleague driving. Later, explaining that she was uncertain if the time limits for stroke alerts with anticoagulated patients was 72 hours or 7 days.

Case 4. Priority 1B – Extremity pain

An approximately 80-year-old man complains of foot pain. The ambulance team had a registered nurse with 1 year experience, and a paramedic with 20 years of experience in ambulance care. The dispatch note mentions redness and prolonged pain over several days. He has been undergoing antibiotic treatment for two days without any improvement. Driving to the scene, a member of the ambulance team searched clinical practice guidelines for "Extremity," but no relevant guidelines was found.

Case 5. Priority 1B – Stroke/TIA

An approximately 80-year-old woman suspected of having a stroke. The ambulance team consisted of a registered nurse with 1 year experience, and a paramedic with 20 years of experience in ambulance care. While en route to the scene, the nurse reads CPG 6.7 – Stroke aloud. The actions described in the guideline were conducted, such as measuring a glucose level, recording vital signs, and placing an I.V. line.

Case 6. Priority 2B – Sepsis

A woman around 60 years old with symptoms of infection, including fever. The ambulance team consisted of a registered nurse with 1 year experience, and a paramedic with 20 years of experience in prehospital care. After arriving on scene, the nurse reports that she read CPG 7.10 – Sepsis during transportation to scene.

Case 7. Priority 2A – Intoxication

The ambulance responds to a self-harm incident involving and intoxication with over-the-counter pain medication. After an initial assessment, the ambulance nurse in charge, with 14 years of experience accessed an online pharmacological reference website and the poison control website to determine if the reported dose ingested high enough to be toxic. These were accessed in the ambulance shortly after measuring vital signs and obtaining a medical history.

Table 4.

Summary of observations

Assignment no	Nature of emergency	Patient Age	Gender	Dispatch priority	Ambulance Team	Guideline accessed	Phase of mission	Comment	Result	Ambulance priority	Suspected condition
1	Abdominal pain	80	Female	1B	Russel & Joseph	-		-	Transported to hospital	2	Constipation
2	Loss of concioussness	30	Male	1B	Russel & Joseph	-			Non-conveyed	-	Vasovagal syncope
3	Chest pain	50	Male	1B	Russel & Joseph	6.4 Hypoglycemia	During transport to hospital	Patient had administered extra insulin, provider searched guideline for information about insulin use	Transported to hospital	2	Acute coronary syndrome
4	Psychiatric symtoms	30	Male	2B	Russel & Joseph	-	-	-	Assisting another ambulance	-	Psychiatric symtoms
5	Headache	80	Female	2B	Russel & Joseph	-	-	-	Non-conveyed	-	Otitis
6	Minor trauma/fall	80	Male	2A	Edmond & Lindsey	-	-	-	Transported to hospital	2	Peritonitis
7	Palpitations	40	Female	2A	Edmond & Lindsey	-	-	-	Cancelled by dispatcher	-	-
8	Chest pain	80	Female	1B	Edmond & Lindsey	-	-	-	Non-conveyed	-	Musculoskeletal shoulder
9	Self-harm incident, intoxication	20	Female	1A	Edmond & Lindsey	9.0 Naloxon	Before patient contact	Read dosages and administration routes	Transported to hospital	1	Self-harm incident, intoxication
10	Stroke/TIA	80	Female	2A	Edmond & Lindsey	6.7 Stroke	Before patient contact	Read time criteria for Stroke alert when anticoagulated	Transported to hospital	1 (Stroke alert)	Stroke/CVI
11	Minor trauma/fall	80	Female	2A	Edmond & Lindsey	-	-	-	Transported to hospital	2	Fracture of humerus, hematoma on hip
12	Extremity pain	80	Male	1B	Amos & Carla	Searched for "Extremity" in CPGs	Before patient contact	Searched clinical practice guideline for extremity symtoms, no relevant guideline found	Transported to hospital	2	Diabetic foot - infection
13	Stroke/TIA	80	Female	1B	Amos & Carla	6.7 Stroke	Before patient contact	Read actions from guideline en route to patient	Transported to hospital	1 (Stroke alert)	Neurological symtoms
14	Postoperative pain	60	Female	2A	Amos & Carla	-	-	-	Cancelled by dispatcher	-	-
15	Chest pain	50	Female	1B	Amos & Carla	-	-	-	Transported to hospital	2	Acute coronary syndrome
16	Headache	80	Male	2A	Amos & Carla	-	-	-	Non-conveyed	-	Vasovagal syncope
17	Fever	60	Female	2B	Amos & Carla	7.10 Sepsis	Before patient contact	Read guideline en route to patient	Transported to hospital	2	Upper respiratory tract
18	Chest pain	80	Female	2B	Amos & Carla		.	-	Transported to hospital	2	Upper respiratory tract
19	Inter-hospital transfer	60	Male	2A	Leanne & Fiona	-	.	-	Inter-Hospital transfer	-	Low platelets
20	Minor trauma/fall	80	Female	2A	Leanne & Fiona	-	.	-	Non-conveyed	-	Minor head trauma
21	Minor trauma/fall	70	Female	2A	Leanne & Fiona	-	.	-	Transported to hospital	2	Trauma to knee
22	Stroke/TIA	80	Male	1B	Grant & Antony	-	.	-	Transported to hospital	2	Peritonitis
23	Abdominal pain	80	Male	1B	Grant & Antony	-	.	-	Transported to hospital	1	Gastrointestinal bleeding
24	Self-harm incident, intoxication	20	Female	2A	Grant & Antony	FASS/ Poison control centre	During patient care	-	Transported to hospital	2	Self-harm incident, intoxication
25	Psychiatric symtoms	30	Male	2A	Grant & Antony	-	.	-	Non-conveyed	-	Psychiatric symtoms

Organisation of Activity Systems:

Activity system: Before an assignment

Subject: Ambulance teams

Object*:*   Equipment readiness and maintenance, continuous learning, and professional development, managing recovery, building and maintain team cohesion and relationships.

Tools/Artefacts: Clinical practice guidelines, the ambulance and equipment.

Rules or Norms: Sharing experiences through informal knowledge exchange.

Community: Social interactions with other teams. Maintaining team cohesion.

Division of labour: Shared responsibility for knowledge exchange and team support

Tasks and Actions:

1. **Equipment Readiness and Maintenance:**
   - Checking ambulance and refilling equipment.
   - Performing station duties.

2. **Continuous Learning and Professional Development:**
   - Informal knowledge exchange among teams.
   - Tracking information (E-mail, morning briefing).
   - Familiarising or reinforcing knowledge using Clinical Practice Guidelines (CPGs).
   - Reinforcing knowledge through other means or resources.
   - Providing instruction and supervision to junior team members.

3. **Recovery Management:**
   - Managing meals, nutrition, and hydration needs.
   - Time for exercise or rest.
   - Addressing personal needs.

4. **Team Cohesion and Support of Relationships:**
   - Social interaction among team members.

Activity system: Before an assignment

The mediating role of clinical practice guidelines

Before assignments, ambulance teams normally operate from the ambulance station. Prehospital emergency care is unpredictable. Anticipating what calls or medical emergencies that will present themselves during the shift is not possible, which also makes preparing for specific cases a challenge. While less experienced team members may read clinical practice guidelines as educational material or to familiarise themselves with their content, more experienced team members describe relying on each other for cues when reading guidelines outside of ambulance assignments. Teams engage and discuss challenging or uncommon cases and learn from each other's experiences. Edgar, a nurse specialist with 20 years of experience in prehospital care when speaking about reading clinical practice guidelines before an assignment explained how teams rely on each other.

> -There are discussions, I am involved with the CPR. This morning, some people came and asked about [a situation], how they should have thought [about it] and if they solved correctly. It leads to discussions, just as you said, in the kitchen. If someone has experienced something or been in a traffic accident, on a bit larger scale. When something more specific has happened, it's going to be discussed. Edgar, a nurse specialist in interview 5.

Uncommon or challenging cases

Learning from other teams can serve as a cues and reminders of the character and nature of various emergencies that one could encounter in prehospital care. This obtains particularly for uncommon or challenging cases. Infrequently encountered emergencies have less firmly reinforced rules or norms that govern action. The uncertainty this creates can be addressed by referencing written rules in clinical practice guidelines. Thus, one use of guidelines is to relieve uncertainty and reinforce rules and norms that mediate action, particularly in rare or challenging cases. Bruce, a nurse specialist with extensive prehospital experience speaks about how other teams' experiences can prompt the reading of clinical practice guidelines:

> - If you've heard colleagues talk about or been out on something, then I can get a bit like, 'It's been a long time since I had that.' And then you can pick up the phone and check, or if something [in you] is growing, well, they were out on it, and it's a pregnancy, then I can go in and check on that. And then… what can happen? You're dealing with two patients potentially; it's a childbirth. It's the mother and the child. Bruce, interview 4.

Other cues may also influence the team to reference clinical practice guidelines. Some medical emergencies occur during certain parts of the year, for example, allergic reactions due to bees, wasps and other stinging insects are more common in the summer. Stella, a paramedic with 23 years of experience in prehospital care related how she reminds colleagues that certain types of emergencies may become more frequent when seasons change, which can prompt teams to prepare by reinforcing the content of clinical practice guidelines.

> -Something I usually do, or listen to my colleague, yes, how did you do that then [Manage a case or problem]? Learning from others' experiences, trying to listen to them. Then something that I usually give a heads-up for, is when we approach summer, I usually tell my colleague, how was it with drowning, and now there are wasps out, then we usually go in, which I and I also have done, practiced, and studied it. Winter is coming, now we have to go in and read about hypothermia. Stella, interview 4.

Sharing experiences informally appears important when teams prepare for challenging cases. In this context, clinical practice guidelines function as a mediator of rules and norms and are used to reinforce actions, goals, objectives for future scenarios. Although professional learning and development is important, it is not the only concern when working at the station. Ambulances might be dispatched at any moment, and it could be a long time to return to the station. Teams must balance preparing for future cases with rest, recovery, maintaining social relationships and supporting team cohesion.

Knowing the rules and the role of experience

There were occasions when guidelines were read by experienced team members without the need for a cue or trigger. On day 4, the team and I were resting in the recreational area conversing about matters unrelated to healthcare. Fiona, a nurse specialist with 4 years of experience sat reading up on childbirths. I asked what prompted her to read that specific guideline and she answered - "It feels like we might have a prehospital delivery today." Observation from day 4. She also read up on paediatric CPR and reviewed paediatric medication doses. –.

These cases are infrequently encountered, and their complexity, the surrounding context and requirements for prompt action may make it difficult to retrieve and read guidelines in the moment. Not being prepared enough, or not acting effectively towards objectives is a cause for concern for ambulance teams. They worry about being unprepared, and not being able to retrieve and follow the rules necessary to manage a tough case. When speaking to Ellen, a nurse specialist about preparing for cases, she expressed this fear, and how important being prepared was. The conversation was about paediatric emergencies:

> …So that everything is ready beforehand because it's about taking up the doses when you're with the patient. If it's a critical patient. I don't want to end up there, because then I know that you could be staring at the screen, and seeing numbers but not really being able to.... I think. So everything ready beforehand. Ellen, interview 3.

Preparing for a case assigned is of course different from preparing for a hypothetical case that you one day might encounter. But the nature of the emergencies that ambulance teams prepare for reveals something about the role of clinical practice guidelines in prehospital emergency care. Ambulance teams are aware that exceptionally demanding cases may require precise and well-timed actions and can unpredictably call on them to perform at their best. Because these cases can be infrequent, the rules must be regularly reviewed and reinforced.

Less experienced crews conveyed reading guidelines differently. Here guidelines were more distinctly used as learning material. Before having internalised the actions, rules or norms that govern the actions of caring for common medical emergencies, guidelines are read as a textbook. Warren, a registered nurse who had worked in prehospital care for about a year jokingly responded - "Evening reading, no but when you were new, they became a quite good bedtime story" when asked about how used guidelines in interview 6.

Activity system: En route to scene

Subject: Ambulance team

Object: Navigating to the scene, preparation for patient contact

Tools/Artifacts: Ambulance, GPS navigation map, radio communication devices, smartphone with clinical practice guideline app.

Community: Communication with dispatch, radio communication with other units and emergency services

Rules/Norms: Perform actions recommended by CPGs, make sure actions are not overlooked.

Division of Labour: Team member in passenger seat typically becomes in charge of patient care at scene. If needed, review of guidelines and reinforcement of rules or anticipated actions. Clarifying roles and tasks within team

Tasks and Actions:

1. **Navigation to Scene:**

   - Route planning, reviewing the map and GPS.

   - Navigating traffic, adapting to situational changes.

   - Parking and placement of vehicle.

2. **Preparation for Patient Contact**

   - Assessing dispatch information.

   - Formulating early hypotheses, developing initial action plans.

   - Aligning early hypotheses and initial action plan within team.

   - Calculating or reinforcing relevant information on medication dosages.

   - Reinforcing anticipated actions and other relevant rules or norms or expected exceptions to rules or norms.

   - Planning and preparation to use medical equipment.

   - Clarifying roles and assigning tasks among team members.

   - Establishing common goals, understanding, and task prioritization.

3. **Equipment and Safety Measures:**

   - Assessing possible threats or hazards at scene.

   - Deciding the need for safety precautions or personal protective equipment.

4. **Access to Patient:**

   - Gaining access to the patient's location

Activity system: En route to scene

Clinical practice guidelines as preparation for action

The ambulance teams receive assignments on their handheld radio terminals. The message displays the priority, nature of the emergency, as well as patient information, and location. More detailed dispatch information and a GPS route is displayed on the ambulance's front computer screen. The distance to the call's location gives an indication about the time available to prepare before patient contact. In this phase, the ambulance crew prepares for patient interaction while navigating to the scene. The team member in the passenger seat typically assumes medical responsibility for managing the call. Both interviews and observations indicated that guidelines are most often accessed and read at this stage of the assignment in preparation for patient care. The dispatch information provides initial medical details, allowing the team to make preliminary assumptions about the expected condition and relevant actions. The team forms initial expectations about the upcoming scene by analysing both available information as well as information not yet on hand. A brief dispatch report could suggest that the dispatcher had limited time to gather details before dispatching an ambulance, which could be due to a patient's critical condition. These preparations were described in interview 4 by Stella and Bruce, both experienced in prehospital care. They respond a question about what actions are performed when a call is received:

> Bruce: -As soon as we enter the vehicle, sometimes, if it's an unusual address, we check the map, Okay, it's located, but that road is closed off; we'll have to take another route, good check on that
> Stella – Threats or hazards
> Bruce – Threats or hazards, and if we're more than one vehicle, we check that we've switched to the right channels on our radios
> Stella – Yes
> Bruce – And we announce ourselves [On the radio], So it's when we've done that and when we'll started moving.
> Stella – Yes, that's when I think of the bags. Then we go through which equipment bags to take [with us]
> Bruce – Which bags to take, and then, if there's a more time, or if it's a paediatric assignment, it's quite handy to look up and check doses, and write them on the glove.

Teams emphasised medication dosages and administration routes as frequently read or sought after information. Temporary artefacts are occasionally crafted for future reference, for example when doses are written on a latex glove. Doubt regarding medication dosages can potentially impede or delay critical actions when caring for a patient. Teams use clinical practice guidelines to reinforce information on dosages, at times despite being familiar with them. In this way, clinical practice guidelines can help mitigate this uncertainty and reinforce rules, allowing the team to be prepared for action.

> … You receive an assignment, and even if it might not be a very detailed one [the dispatch report], you still get a hint about what it could be. Then, you can go in and double-check doses, and I do that even if I'm actually 99.9% certain about what to give. Samantha, interview 3.

This function of clinical practice guidelines was also observed when Edmond and Lindsey were en route to a self-harm incident involving an intoxication. Edmond was in the passenger seat when they received the call. The precise location of the patient was initially uncertain. Both are nurse specialists with Edmond having 4 years of experience and Lindsey 7. Edmond first reads an online pharmacological reference, and then the CPGs. He reads the dose and route of administration for Naloxone aloud to Lindsey who is driving towards the emergency. -"1 ml, 0.5 ml in each nostril, you can give it IV, IM, IN ." Observations day 2.

Later, I ask Edmond and Lindsey about reading on the Naloxone dose. After all, it's not an uncommon medication to use in prehospital care. Edmond explained that some calls are more likely to be disorderly or chaotic. There may be a need to provide the treatment rapidly.

> -It usually happens [when responding to] seizures or intoxications, when Naloxone needs to be given. I already know the [medication] dose, but I still want to double-check it to be sure.

A disorderly or chaotic scene may make double-checking medication dosages on scene challenging. "It's not the right time to check it on-site when it's chaotic, with bystanders present. [Checking the dose] creates a sense of safety." Lindsey adds that it does not feel good to be unprepared. "It's really tough when you're unprepared. Unpredictable dangers, that is really tough", observation day 2. Here, clinical practice guidelines prepare for and mediate expected actions, particularly if the team expects a scene to be disorderly or chaotic.

Reliance on internalised rules and norms in routine cases.

During this phase of the ambulance assignment, the situation often remains unpredictable. This unpredictability requires the ambulance team to be able to adapt and be flexible when achieving their goals. Reinforcing dosages not only provides the team certainty in critical situations but also reinforces the established rules and norms of appropriate actions. In cases that are routine and anticipated, the reliance on guidelines becomes less critical, as the rules and norms are already deeply ingrained through frequent encounters. Practitioners rely on guidelines to reinforce rules and norms if they have not been encountered recently. Kathleen and Edgar discuss how this perception of uncertainty correlates with the level of exposure they experience.

> Kathleen – When we read the...[CPGs]? I usually do it on the way to an assignment. If I'm uncertain about the expected [medical] condition, we might encounter. Or sometimes just to refresh my memory.
>
> RESEARCHER – So, on the way to a patient or to refresh your memory."
>
> Edgar – I have to agree with Kathleen there. If you're have a patient with chest pain, for example, maybe you don't have to read [them]. But if have with a seizure and you haven't encountered [that] in a while, you might check [the dosage] of Midazolam. You know it's 10 mg. But, I mean, to safeguard medication treatment. And the same goes for children. There, you always need to check. Kathleen and Edgar from interview 5.

Paediatric emergencies

Paediatric emergencies can present a unique and complex challenge that almost always demands the adaptation of norms and rules governing actions. Because dosages need to be weight adjusted, individualised adjustments to rules are necessary. This results in rules and norms that vary across patients, which often produces uncertainties in appropriate action. Further uncertainties relate to hazards or risks when caring for paediatric patients. There exists concern regarding the potential inability or inappropriateness to read and use guidelines on scene when urgent objectives require immediate action. Consequently, in both interviews and observations, paediatric emergencies were highlighted as situations where the mediating action of clinical practice guidelines was emphasised.

Jed, a nurse specialist with 5 years' experience spoke about not having the time or opportunity to use guidelines in emergencies. He responds to a question about having time to read guidelines during patient treatment on scene.

> No, and that's why I am well-prepared beforehand… or how should I say, on the way to the patient. It's rare in an emergency that you have the opportunity to quickly grab [CPGs] and use [them] super-actively. We usually say this: if, for example, a child is choking, you won't have time to pick up your treatment guidelines. Because it's time-consuming. So, that's basically what we trained for and what we prepare for, Jed from interview 1.

Because the activity system on scene will have a multiplicity of prioritised objects and goals, both time and contextual constraints may thwart the reading and use of clinical practice guidelines. Again, this emphasises the role of guidelines as reinforcing rules and norms in advance.

Medication dosages are precise rules, without a margin for error. Here clinical practice guidelines can be used to create temporary artefacts, like writing information on a latex glove that is worn to the emergency. Future referencing of CPGs is at times facilitated by leaving the anticipated relevant CPG displayed on the appropriate page. Warren explains his approach to paediatric emergencies in interview 6. He speaks about a specific shift where many paediatric emergencies were encountered.

> Warren - It was just paediatric emergencies. And there it is, you know… Then we go in, we read everything. It's doses, it's treatments. What actions to perform first. You write it on the glove so I have the most essential…If it's on the glove, then I can quickly...
> Researcher: -What do you write on the glove?
> Warren – Mainly doses. Depending on what we might encounter out there. So that it's prepared, you know. Then we... I always have the app open on the page I had. Then I just have to open the phone... If something happens. From interview 6, Warren, a nurse with about 1 year of experience in ambulance care.

Paediatric emergencies in ambulance care require the adaptation of rules and norms, especially regarding medication dosages, due to complexity and the need for individualised treatments. Ambulance teams prepare in advance by familiarizing themselves with clinical practice guidelines or by creating quick-reference tools, such as writing information on gloves, to efficiently manage these emergencies. Clinical practice guidelines aid in preparation by providing access to some rules and norms.

Experience and exceptions to rules as preparation.

The fundamental rules and norms of prehospital care are internalised by both clinical practice guidelines and practical experience. Standard objects and goals are in place for initial assessment, medical history, and various other actions at the scene. Although objects may be pursued in different order, the prioritisation among elements within the activity system and the corresponding actions become established for average scenarios. However, certain situations demand variations from standard actions. Cases where ordinary treatments and actions should be avoided, or where caution is required due to specific risks inherent to the treated condition. Novice teams often lack internalised rules and norms, relying more on clinical practice guidelines or an experienced colleague to guide action. Carla, a registered nurse with a year of experience in prehospital care prepared for a call to a patient with suspected stroke. She prepared by reading the recommended actions of the clinical practice guideline aloud en route to scene. "[Measure] Glucose… the patient needs an I.V. line… Ringer's Acetate…" When finished, she put her phone away and said, "I feel quite confident [about the case]."

In contrast, experienced teams tend to rely on guidelines when responding to unusual or extraordinary cases, where standard rules and norms do not apply or when objects need to be prioritised and organised in unique ways in order to achieve goals.

When asked about what information is usually searched for in CPGs Kathleen, a nurse specialist responded:

> But I'm thinking a bit like this. Physical exam. If there's something in this patient category that should be examined a bit more... And then I also think it's good to have some contraindications in the [CPGs]. I mean, which patient groups should I not treat in that manner? So, some kind of risk or what should I say? You need to be particularly watchful for this. In general, this applies but with this category of patients, you should take extra care because of... Kathleen from interview 5.

The role of clinical practice guidelines as mediating exceptions to general rules was also described by Jed, a nurse specialist with 5 years of experience when talking about what he looked for when reading guidelines. "…what one

looks for is dosages, among other things, and conditions when one need be careful and when don't need to be [as] careful," interview 1 Jed.

Exceptions to rules internalised can also appear in a different form. Healthcare is rapidly progressing, which produces changes in established norms and rules. This dynamic nature can introduce uncertainty among experienced ambulance teams when internalised rules become obsolete. Guidelines can assist in resolving uncertainty regarding the rules and norms that presently apply. The view on oxygen treatment and spinal immobilisation have for example undergone significant changes in over the last years. Previously, universal application of rigid backboards and cervical collars for spinal protection was employed. Today, an individualised approach where restriction of spinal movement is adapted to each patient is instructed. The change in rules, from backboard on all patients to an individual approach that requires decision making triggered Edgar, a nurse specialist with 20 years of experience to refer to guidelines for decision making.

> Now, since we have changed to spinal movement restriction. I go in sometimes. It's not so often, I haven't had them so frequently, the NEXUS [criteria] there. Before, everyone in accidents or falls ended up on the board without really thinking about why. And now when it has changed, I have actually gone in and checked a few times", Edgar, interview 5.

Ellen, a nurse specialist with 13 years of experience, also described a similar reason to access guidelines, where internalized rules and norms have become obsolete.

> Sometimes, I feel it's to confirm what one is thinking. That happens when you've worked for many years and followed many guidelines that have changed repeatedly. Some things actually stick deeper in your mind. And then there may have been a change. When you've been doing something a certain way for 7 years and then it's changed in the last year, then I think it's good to double-check. I remember, we had a hip patient, for instance. What were the guidelines regarding that, as that has also been changed a bit. Ellen, from interview 3.

Experienced ambulance teams rely on internalised rules and norms in standard situations and use clinical practice guidelines for exceptions to rules or to reinforce current rules and norms if these have changed. Novice team members that have do not yet have strong internalised rules and norms depend more on clinical practice guidelines to mediate action.

Activity system: During patient care, on scene

Subject:	Ambulance team.
Object:	Perform assessments, provide treatments to the patient, commence documentation.
Tools/Artifacts:	Medical equipment, assessment protocols (X-ABCDE, SAMPLE/OPQRST), touchscreen computer, personal protective equipment, CPGs.
Rules/Norms	Primary and secondary assessment according to X-ABCDE. Patient medical history according to SAMPLE/OPQRST. Rules and norms described in CPGs.
Community:	Interactions with patient, relatives, home care and other healthcare personnel.
Division of Labour:	Actions are divided between ambulance team members.

Tasks and Actions:

1. During Patient Care:

- Perform initial assessment of criticality.

- Assess safety for ambulance team.

- Perform Primary assessment according to ABCDE.

- Make decision if patient is critical or non-critical.

- Gather patient history (SAMPLE – OPRQRST)

- Perform Secondary assessment ABCDE.

- Measure and record vital signs.

- Make clinical decisions on treatments.

- Initiate treatments.

- Document findings

- Collaborate with other medical personnel or emergency services.

- Interactions with patient and relatives

2. Preparing transport of the Patient:

- Prepare equipment.

- Ensure safety when transporting patient to the ambulance.

Activity system: During patient care on scene

A multiplicity of pending actions

Arriving at scene, the activity system is characterized by abundant pending actions and tasks. Ambulance teams prioritise assessing the criticality of injury or illness quickly, as this provides valuable information regarding the pace of actions. During observations, experienced teams would introduce themselves and quickly proceed to check the patient's radial pulse. While airway and breathing problems may be easier to assess at a glance, assessing circulation can be more difficult by observation alone. A quick initial assessment of the pulse and its quality can assure teams that they have sufficient time to proceed without immediate concern for a rapid worsening of the patient's condition.

Particularly fascinating however, is how differently teams perform actions when they encounter or suspect critical illness. During a call involving an elderly woman complaining of abdominal pain, Russel, a nurse specialist with five years of experience, and Joseph, a paramedic with an equivalent level of experience, entered the room where the patient and her son were. After introducing themselves, Joseph moved to the bedside and felt the patient's radial pulse, reporting -"Strong radial pulse." Meanwhile, Russel started gathering the patient's medical, and Joseph then began preparing the equipment for measuring vital signs. From observations on day 1.

Later during the same shift, Russel and Joseph responded to a priority one emergency call. It was a man in his fifties who had been experiencing chest pain for a few days. Upon arrival at the scene, they found the man sitting on a couch in a reception area of a manufacturing plant. From a distance he looked pale and diaphoretic. Russel approached the man and checked his radial pulse, - "No radial pulse." This prompted immediate action from both Russel and Joseph who quickly moved in, laying the man down on the couch and removing a back cushion to create space. They performed a series of actions in quick succession, which made it challenging to observe each in detail. However, they prioritised connecting the patient to their monitoring equipment, using a pulse oximeter, blood pressure, and ECG monitoring. The measured vital signs were normal, and the patient's appearance improved as they worked. Russel inserted an I.V. line and measured a finger-stick glucose (6,1 mmol/L). No clinical practice guidelines or other written artefacts mediated actions in this initial encounter. Actions were based on learned rules and norms but as the assignment progressed, clinical practice guidelines were to come into play later.

Detecting critical illness and division of tasks

When detecting signs of critical illness, the objects of the activity system are often rearranged and reprioritised. Obtaining more information is replaced by obtaining information that is critical. Kyle, an ambulance nurse with 2 years of experience describes the way in which the patient's condition can determine objects and generate time constraints in the activity system.

> … Then, of course, you need vital signs. Sometimes you may need IV access, EKG. There is a lot happening around the patient. Here, the patient's condition determines how much time you have to do everything. How time-critical it is. Interview 2, Kyle, a registered nurse with 2 years of experience.

The multiplicity of ongoing actions competes with accessing and reading of clinical practice guidelines. Many of the actions are routine and are carried out in virtually every patient encounter. Consequently, experienced teams are inclined to depend on internalised rules and norms rather than mediated guidance. When asked about using guidelines during obtaining a medical history, both Stella and Bruce who have significant experience in prehospital care, described it as almost being almost on autopilot.

Clinical practice guidelines were not observed to be read during the primary or secondary surveys. Instead, these assessments unfolded in a synchronized manner, like a choreographed dance. Actions were executed sequentially, with each team member seamlessly taking over from the other. Findings were verbally communicated in the team, but with little observable verbal coordination.

Fiona and Leanne's dialogue during assessment of an elderly patient with minor head injuries serves as an example of this approach.

-Airway is clear
-No tenderness in the neck.
-Have you checked the radial pulse? If not, I'll do it now.
-Full and regular,
-Pupils are normal.

When are CPGs read during patient care?

En route to this patient encounter, Leanne, Fiona, and I discussed reading clinical practice guidelines. We had read the dispatch note that described a fall due to stumbling. The patient was awake but had superficial facial injuries from her eyeglasses. While en route to the scene, Leanne turns to me saying: - "These cases, like this one, we don't really need to read the treatment guidelines, because when you've seen many of them you know… ." She says that she prepares for a case by reading guidelines in unusual and exceptional calls, or paediatric emergencies. But adds that I will not see anyone picking up guidelines in a true emergency, "You usually do it before you arrive." Fiona added – "I've seen people check medication dosages and things like that." Leona and Fiona, observation day 4.

Clinical practice guidelines are only occasionally read and have a role in and during patient care. In cases where uncertainty about action has arisen, when rules and norms are not well established or when objects unexpectedly change. Samantha, a specialist nurse speaks about responding to a paediatric emergency were preparing adequately was not possible. She responds to a question on how often guidelines are read during patient contact.

> It was when, for example we got an allergic reaction, and upon arrival, the child had seizures. I had read allergic reaction and said, no! Wait!" … I was thinking upper airway obstruction, allergic reaction, how much adrenaline should I give, and then suddenly, no! Now it's a seizure, and I have to read [about] seizures, Midazolam instead.

This experience was experienced as distressing:

> First we got it as a cardiac arrest, then we got it like an allergic reaction and when we arrived it was a seizure. So that was like… and no age or anything, between 7-15 years. She was approximately 7. Samantha from interview 3.

This describes an activity system were immediate and precise action is required, and preparation was not possible due to the unreliableness of how the case evolved. The dispatch information is typically not completely reliable. When actions are necessary despite doubts, clinical practice guidelines can be used as a mediating tool to resolve uncertainty. Some actions, such as administering anticonvulsant drugs cannot be postponed and any reservations must be resolved promptly. In these contexts, clinical practice guidelines serve a vital mediating function and enable action.

Another context in which guidelines were described to be used during patient care was when a brief pause in the sequence of actions was created, for example following the initiation of treatments. During these moments, teams sometimes would double-check that no crucial actions had been overlooked with the help of guidelines. Furthermore, when teams had applied all the rules they recall, but uncertainty about if additional actions are necessary or possible, clinical practice guidelines would be used to resolve this uncertainty.

Bruce described an example of when clinical practice guidelines were accessed during patient care at the scene. He spoke about managing a paediatric emergency with an infection and a partial airway obstruction.

> We're constantly talking and communicating with the parents, explaining what we're going to do and why. And then, while administering the inhalation treatment, we're thinking, okay, we've gone through ABCDE, we've started this and that. What else can we do? That's then it's easy to check the clinical practice guidelines, is there anything more we can do? Alright, we've given the first dose of Ventolin, what else can I do? Bruce, interview 4.

In summary, the activity system during patient treatment contains many pending actions and tasks, some which require immediate and precise action. Experienced teams describe often depending on internalised rules and norms

in cases where this was possible. During observations, clinical practice guidelines were not observed to be accessed or read during the shifts observed. However, when doubt or uncertainty about rules or norms arise, and actions that cannot be postponed or delayed are required, clinical practice guidelines are used as a mediating tool to resolve uncertainties and enable action to be taken.

Activity system: During transport to hospital

Activity System: During Transport to Hospital and Transfer of Care

Subject: Ambulance Team.

Object: Safely transport the patient to the receiving facility, monitor patient during transport. Complete pending or postponed actions. Provide necessary treatments. Document patient encounter.

Artifacts: Ambulance, medical equipment, touchscreen computer for documentation, mobile phone/radio for advance notice.

Community Interactions and conversation with the patient or patients' relatives. Interactions with receiving facility or dispatcher.

Rules/Norms Completion of documentation for handover. Patient monitoring throughout transport. Adherence to triage protocol (RETTS).

Division of Labour: One team member manages patient care while the other drives.

Tasks and Actions:

1. **Ensure Safe Transportation:**

   - Transporting the patient safely to the receiving facility.

2. **Re-evaluation and Evaluation:**

   - Re-evaluating the patient according to ABCDE.

   - Evaluating the effect of initiated treatments.

   - Measuring and monitoring vital signs

3. **Documentation and Addressing Pending Tasks:**

   - Documenting the patient's status and treatments provided.

   - Addressing incomplete or pending tasks from earlier stages of the call.

4. **Patient History and Collaboration:**

   - Obtaining an in-depth patient history if previously incomplete.

   - Collaborating with the receiving medical team or hospital staff.

5. **Triage and Preparation:**

   - Triaging according to RETTS (Rapid Emergency Triage and Treatment System).

6. **Confirm that no important actions are overlooked.**

   - Ensure nothing important is forgotten or omitted.

Activity system: During transport to hospital
The mediating role of Clinical Practice guidelines

Transportation of the patient to a receiving hospital is a continuation of the previous phase of the encounter, but with some noteworthy differences. There is the additional objective of moving the patient to the ambulance and continuing to provide care during transport. In cases where the patient is unable to ambulate, equipment or tools are necessary to enable transportation. Once in the ambulance, the team regroups and addresses any pending actions necessary before transport jointly. To assist in determining acuity, the ambulance service employs a triage system referred to as the Rapid Emergency Triage and Treatment System (RETTS). RETTS depends on both vital signs, as well as physical findings and medical history. Once a priority is determined and all necessary actions have been completed, the team splits, with one continuing to provide care while the other drives the ambulance. This results in only one ambulance team member caring for the patient, performing actions and being the subject in the activity system.

Actions in the activity system are variable. Frequently vital signs are rechecked and evaluated for any changes. The patient may be connected to monitoring equipment and medications, or other treatments may be administered. Actions that have previously been postponed or delayed because of contextual constraints are now performed. Samantha, a nurse specialist explains how pending actions can be addressed during transport to hospital, for example a thorough abdominal exam.

> If you skipped some part of the exam… If the patient was sitting on a chair, then maybe I can't [Examine the patient effectively] ... In that case, we do an abdominal examination in the vehicle. So, I think that one finishes what was not initially done.", Samantha, from interview 3.

Constant juggling of actions, centred around monitoring and treating the patient, documentation, and communication with the receiving hospital are present in this phase of care. This challenge becomes particularly visible during short transports, where the ambulance nurse must swiftly shift between multiple objects and actions in order to complete goals before reaching the hospital. Considerable time is dedicated to documentation in this phase. Documentation is conducted on a touchscreen computer equipped with a fold-out keyboard. Certain information is inputted using the touchscreen interface, while medical history and physical exam findings are entered as text using the keyboard. The process of documentation also involves reviewing and summarising the details of the case. Additional information may surface as the medical history is revisited. In addition to documentation, the ambulance nurse also engages in communication with the receiving hospital via mobile phone or radio. Simultaneously, they are tasked with monitoring the patient's condition and interacting with them. The way in which ambulance nurses negotiate multiple objects was observed when Lindsey and Edmond were caring for a patient with a possible peritonitis related to peritoneal dialysis. They had loaded the patient into the ambulance and performed a short secondary survey without any critical findings.

> Lindsey nods towards Edmond and says – Alright, lets head in. – Priority 2? Edmond asks. – Yes, priority 2. Edmond leaves the back of the ambulance for the driver's seat and soon the ambulance starts rolling. Lindsey unfolds the keyboard and alternates between tapping the touchscreen and typing on the keyboard. She pauses, picks up her phone and wedges it between her shoulder and cheek before continuing to type. She pauses again and speaks in the phone –Yes, this is ambulance 64-91XX, we're coming in with a patient who has … After the phone call to the receiving hospital has ended, she turns to the patient and asks – Are you doing okay?. Observation from day 2.

Temporary artefacts created during patient care, such as writings on gloves must be either discarded or transferred as documentation into the computer. Carla, an ambulance nurse with one year of experience was observed checking her latex gloves for any written information before removing them when caring for a 50-year-old woman complaining of chest pain. She had a few minutes earlier treated the woman with nitro-glycerine, and the patient was connected to pulse oximetry, NIBP and cardiac monitoring. Carla had just finished phoning the charge nurse at the receiving hospital and was typing on the fold-out keyboard. She turned to the patient and asks – "How do

you feel right now?" – "Better", the patient answered. She resumes writing, pauses, then looks at both hands wearing latex gloves while turning them over before removing them and continuing to write.

Clinical practice guidelines as a cure for uncertainty

On one occasion, clinical practice guidelines were observed to be read during transport to hospital. Remember the 60-year-old man complaining of chest pain, that Joseph and Russel treated. The patient who initially was pale and did not have a palpable radial pulse. After an initial ECG that was normal, vital signs had normalised and improvement in his general condition was observed when he was loaded into the ambulance for transport to hospital. He suffered from diabetes, and when the medical history was reviewed, he reminded Russel that he had administered extra doses of insulin, because his blood glucose values had been high. Russel suggested they recheck in the ambulance, and the patient asked for his phone to use his own CGM device.

> Russel – We can check it again. The patient requests his mobile phone, which he retrieves from his backpack. He holds the phone against his upper arm. - 4,9 he says. - It was 6,1 a moment ago, we will check it again with our device. He takes a fingerstick glucose measurement. Russel – It's 4,1, so it's falling. Russel takes out his mobile phone and opens the clinical practice guideline 6.4, hypoglycaemia. After glancing through the guideline, he says, – We will give you some Dextrosol [Glucose tablets]. The patient was transported to the emergency department, and the rest of the transport was uneventful.

When Russel returns to the ambulance after handing the patient over, I ask him about reading the treatment guideline. -"What were you looking for?" He says that the blood sugar was falling, and he had taken extra insulin. - "I wanted to see if there was anything written about it ." Russel, observations day 1.

Clinical practice guidelines mediate actions in situations that demand urgent action or potential danger is present. Rapidly falling blood sugar levels is one scenario that may require urgent intervention. While ambulance nurses are typically proficient in managing hypoglycaemia, managing it in the context of a specific patient can sometimes introduce uncertainties that clinical practice guidelines help alleviate. In this case, the rules regarding hypoglycaemia were reaffirmed, and a course of action with oral administration of glucose tablets was chosen.

Much like in the previous activity system, the prioritisation of actions is dependent on the objects in the case. Providing reassurance and interactions with the patient, monitoring their condition, or administering treatments, documenting, and communicating with the receiving hospital all demand the nurse's attention. Actions shift swiftly from one task to another, and there is limited time for consulting clinical practice guidelines during short transports. Actions are mostly grounded in learned rules and norms, but clinical practice guidelines see use when enough uncertainty arises or in preparation for an anticipated hazard.

Clinical practice guidelines to affirm actions.

Ambulance crews working in areas with longer transportation times reported a different way of reading guidelines. Because transportation times are longer, crews are less pressed for time and there may be available room in the activity system to consult guidelines. An action that guidelines can mediate is double checking that no actions have been omitted. Kyle, an ambulance nurse with 2 years of experience described using guidelines in this way:

> Now I work in Landskrona where it's often a bit further to the hospital, and you actually have time to check. And it happens quite often, in my opinion, that you consult treatment guidelines, from interview 2.

Using clinical practice guidelines to mediate certainty when reviewing a case was also described by more experienced ambulance personnel. Ellen, a nurse specialist with 13 years of prehospital experience in interview 3 described using clinical practice guidelines in the transport phase during relaxed transportations. When pending actions, reassessment and documentation have been performed and there is additional available time, clinical practice guidelines can mediate certainty.

I asked what kind of information was retrieved from the guidelines, and Ellen responded: "-It could be that you check to make sure you haven't forgotten anything. Or it's something that you think about when you click into [the guidelines] ." Using guideline to ensure all recommended actions have been exhausted, and that nothing has been forgotten was also described by Stella and Bruce in interview 4.

Activity system: After an assignment

Subject: Ambulance Team.

Object: Review and improve future ambulance operations, support continuous learning, reflect on experiences, ensure readiness by cleaning and restocking equipment.

Tools/Artifacts: Ambulance, medical equipment, CPGs.

Community   Reflection and review between team members, feedback from receiving hospital staff.

Rules/Norms   Uncommon, challenging cases are reviewed and shared with other teams.

Division of Labour: Teams distribute the tasks of cleaning and restocking the ambulance in the team.

Tasks and Actions:

1. **Continuous Improvement:**

   - Reflecting on experiences and the care process.

   - Learning and evaluating challenging tasks and treatments.

2. **Restoring Ambulance and Equipment Readiness:**

   - Restoring and cleaning the ambulance after the assignment.

   - Restocking equipment for readiness.

3. **Informal knowledge exchange:**

   - The sharing of uncommon, challenging cases and experiences with other teams.

4. **Recovery Management:**

   - Managing meals, nutrition, and hydration needs.

   - Time for exercise or rest.

   - Addressing personal needs.

5. **Team Cohesion and Support of Relationships:**

   - Social interaction among team members.

Activity system: After an assignment

Following the transfer of the patient to the emergency department, the object changes to tasks such as equipment cleaning, restocking for the next assignment, and managing recovery. In routine cases, where established rules and norms are followed, there may not be a need to reaffirm these rules according to guidelines. Situations that have presented challenges or where alternative approaches could have been considered are used for reflection and discussion. Ambulance teams often rely on each other for evaluation, feedback, and learning. Edgar and Kathleen discuss this aspect of prehospital work in interview 5. They respond to a question about whether guidelines are read after a case:

> Edgar - No, what I usually do is maybe discuss it with my colleague [that] I've been working with. That's not something you do when you've had a regular chest pain or abdominal pain. It's more in specific cases. A challenging extrication of a patient with a hip fracture. Maybe there could be another way to manage that situation.
>
> Kathleen – Exactly.
>
> Edgar – Or if you have had a cardiac arrest, should we have hurried more? Should we have left earlier? Or should we have stayed, maybe? Well, I think when it's something specific, that's when you discuss it.
>
> Kathleen - There's a lot of learning by doing in this job. You build upon your knowledge base. There might be a treatment guideline saying this is what we should do. But circumstances around the patient sometimes make it impossible. If it's in a hard-to-reach high place... on the way down... a narrow staircase. Sure, there are certain things we should do. But sometimes it's not possible. You must constantly reassess your work in some way.

Ambulance teams depend on one another for feedback and continuous learning after a case has concluded, especially if the case is challenging or if some guideline recommendations cannot be adhered to for any reason.

Did I do everything right?

Once a case has concluded, ambulance teams can reflect on the actions and decisions made. While routine cases do not necessarily bring about reflection in experienced teams, a review of decisions is brought about by instances where guidelines were not strictly adhered to or if alternative choices for action were possible. Feedback from team members and colleagues is valued because guidelines solely are unable to account for contextual factors or constraints. Reviewing a case using guidelines might demonstrate suggested actions that were impossible to carry out. Technically, this means not adhering to the guidelines, potentially leading to criticism from those who lack a full understanding of the context. Support and reassurance from team members are valuable for managing emotions and fostering learning in such situations.

Feelings of doubt, uncertainty, or possible wrongdoing about actions can develop after a case has concluded. Samantha, a nurse specialist reported using a variety of online sources for learning after encountering an unusual or challenging case. But also describes reading clinical practice guidelines to resolve suspicions about errors. After all, the clinical practice guidelines will be the standard used when their actions and performance is evaluated.

> Samantha - If I have someone with a strange diagnosis, that I read about, then I read on Internet-Medicine [an online medical reference website], or FASS if it's in regard to medications. That's often where I look up things unless I have a feeling that I've done something wrong ."
> RESEARCHER -–And if there's a feeling that one has done something wrong?
> Samantha – No, but you know, one still feels like, oh god, how was it again? or Should I have treated it in this way or how was it? – Samantha, interview 3.

What-if?

Not only occasions of doubt or possible error are reflected on by ambulance teams. Perceptions of risks, and what could have happened are also reviewed and re-evaluated after a case. Here as well, ambulance teams depend on their team members for feedback and reassurance.

Edmond and Lindsey responded to a call involving an elderly woman who had fallen in observation day 2. The patient had some months prior suffered a stroke with some residual symptoms. She was unable to explain why she fell, stating that – "It just happened ." Neither the patient or present family members described any new symptoms, and the physical exam was unremarkable aside from residual symptoms that reportedly were present since the previous stroke. Lindsey decided to consult a physician by telephone, and while on hold in the phone queue for a consultation, the patient suddenly developed signs of stroke. This prompted immediate transport to the hospital as a priority 1 stroke alert. Later, Lindsey expressed concern for what could have happened if the patient would not have developed the stroke symptoms at that moment. There was a possibility that she would not have been transported to the hospital. "If we had left that stroke case [at home]… then it would have resulted in a new call… but we can only rely on what we had at that moment ." Lindsey and Edmond, observation day 2.

Confronting what-if scenarios and cases where perceived risks were high is a source of doubts and uncertainty. Team members can share their perspectives, experiences, and offer reassurance that the actions taken were reasonable given the information available at the time.

Activity system: Tensions and conflicts

Competing objects and priorities and resource constraints

In each phase of an ambulance assignment, a multiplicity of different goals and objects must be negotiated by the team. Each object can demand action and compete for the teams' resources, time, and attention. Teams quickly shift between different goals and actions. Accessing and reading clinical practice guidelines reroutes resources and time from other pending actions. Frequently, guidelines were reported and observed to be read as preparation for a patient encounter, en route to scene by the team member in the passenger seat. Arriving at the patient location, numerous pending actions compete for available resources. Limitations become apparent when the workload is at its peak. This frequently occurs during the initial encounter, where gathering information, multiple interactions, assessments, treatments, and documentation is balanced. A continual conflict of resource allocation within activity systems involves balancing action with documentation. If details of the patient's history, physical exam, treatments, or vital signs are not documented, they may not be visible after handover. However, each action also requires time and attention to be completed. During short transports, ambulance nurses manage limited resources, juggling tasks like documenting, advance calling, and monitoring and interacting with the patient during transportation. Documentation often continues as the patient is unloaded in the emergency department.

Reading guidelines to mediate action as opposed to rules or norms will require resources that may be needed elsewhere. The level of uncertainty or perceived hazard must be sufficiently high to warrant resource allocation to reading guidelines during high-pressure situations.

Adaptation and external factors:

In virtually all assignments, some degree of unexpected action was required, or an unanticipated goal or object appeared. In some instances, bystanders assisted ambulance teams gain access to buildings, facilitating the goal of reaching the patient's location. But more often, unforeseen elements resulted in an increased number of tasks and actions, and an increase in workload.

Challenges surfaced when it unexpectedly became hard to locate a patient's location or gain access. There were instances where planned routes had to be altered because of construction work or other unexpected reasons. Some patients had difficulties responding to questions, requiring ambulance teams to explore alternative methods of gathering the required information. There were also instances of medical equipment malfunctions, such as the blood pressure monitor failing to produce readings. This necessitated multiple attempts to measure blood pressure. In one case, following the handover of a stroke alert, the touchscreen computer, which contained all recorded documentation, unexpectedly shut down, resulting in the need to re-enter the information upon restart.

Many of these unforeseen events created new objects that required attention and action. These unexpected circumstances added complexity to the overall activity system, generating tensions when new objects appeared and had to be negotiated.

Clinical practice guidelines and adapting to context.

In prehospital emergency care, clinical practice guidelines are used to mediate action and prioritise between competing goals and objectives. For novice personnel, guidelines are regularly read, reread, and used until the rules and norms of prehospital care have become internalised. Clinical practice guidelines represent a selection of some rules and norms that are in effect in prehospital care. Guideline recommendations remain constant regardless of the contextual factors influencing the activity system. While certain actions are mediated by general rules and norms, others are mediated by written recommendations in practice guidelines, and others yet, by specific goals and objects. Circumstances may render adhering to guideline recommendations impossible. The existence of prescribed rules or norms that should be followed but cannot, often introduces tensions within activity systems. Resolving this tension involves navigating conflicting priorities as well as respecting contextual constraints. Pragmatic considerations may outweigh strict adherence to guidelines, and may prompt improvisation, adaptation or deviation from prescribed rules or norms.

Being able to adapt has been described as an essential skill for safety in complex and unpredictable work systems (Amalberti et al., 2005; Pariès et al., 2019; Woods, 2018), but this can result in conflicts between different actions, goals and objects. Guidelines are generally not effective in negotiating these conflicts because they require situational and contextual adaptation. Instead, they are resolved by relying on experience or colleague input. However, such actions are also commonly evaluated against the recommendations of clinical practice guidelines.

Finding the right rule and knowing which rule applies

Clinical practice guidelines cover a range of different medical conditions. Some guidelines describe specific conditions or diseases, while others describe situations with unspecific symptoms. A frequent problem faced by ambulance teams is finding the right rule or rules that applies when action is required. Patients frequently complain of multiple symptoms or have several signs that can overlap. Ellen, an experienced nurse specialist describes the difficulties of finding the right rules and knowing which to apply in interview 3.

> It's a lot of documents. Which would be okay if they were easy to navigate. Sometimes, I feel like they [CPGs] overlap. It can be challenging because a patient's condition is often not clear-cut. A seizure is a seizure, but there can also be many other factors involved. They could also have chest pain or shortness of breath or other underlying issues. So, you have to dig into different aspects. I think it's difficult to strictly follow a guideline and check off boxes because then you might miss other important things.

Tension can be created when other sources present competing rules. Kyle how other sources may introduce competing rules, which may be a source of uncertainty. "Sometimes there is too little information [On a medication treatment] when I check, but then I find more contraindications than what is provided in the treatment guidelines ." Although guidelines are the primary determinant of appropriate treatments in local contexts, rules from competing sources must be resolved by the team. This can involve asking someone higher up in the medical hierarchy, such as a physician to clarify why certain rules are omitted from local guidelines.

Discussion

In many ways, this research can be described as stating the obvious. That ambulance teams' access and read clinical practice guidelines when faced with uncertainty is no ground-breaking revelation. Using guidelines to prepare for emergencies that are unfamiliar or to resolve uncertainties when prompt actions are required is supported by my own experiences when working clinically in prehospital care. Starting out, guidelines were read and reread until content was familiar. However, as time went by, I found myself more often searching for specific information in response to planning courses of action, especially when dispatched to an uncommon or unfamiliar type of emergency. No longer working clinically in prehospital care, I now approach guidelines from a different point of view, and with a different question. How should clinical practice guidelines be designed to align with the needs of the prehospital care practitioners, considering the context and complexity of prehospital emergency care? In order to answer this question, clinical practice guidelines from Sweden as well as English speaking countries were reviewed and found to be remarkably different in both content and design. The literature on guidelines in a prehospital context favours adherence to or appraisal of guidelines, with fewer articles exploring their use or function (Maria, 2021). This is surprising since exploring the function and use of guidelines in context is a prerequisite for developing useful guidelines, as their usefulness is related to how well they fulfil their purpose. Furthermore, guidelines are a common target for safety interventions, especially following adverse events. The effectiveness of these interventions is determined by the role and function of guidelines. Therefore, the research question became to investigate how ambulance teams use clinical practice guidelines.

Collecting data was limited by a constrained time frame, however, neither interviews nor observations alone would suffice to answer the research question. While observation could help discover when clinical practice guidelines were read during day-to-day operations, they would be unlikely to be observed in uncommon cases, because uncommon cases are unsurprisingly, uncommon. Conversely, interviews provided insight into use in uncommon cases, but would primarily reveal how practitioners imagine or think about guideline use. Combining both observational and interview data provides a more comprehensive understanding of how guidelines are actually used in prehospital care. Although interviews discussed guideline use in various situations, the majority of cases observed did not see guidelines being used. This indicates that observation did not necessarily lead to guidelines being read more often. This finding underscores the internalisation of rules and norms among experienced practitioners, particularly in routine cases where guidelines become less needed to reference. Guidelines are more frequently read in situations with limited room for error, such as when providing medication treatments, or when rules need to be tailored to specific cases, like in paediatric emergencies. Similarly, there is a tendency to refer to guidelines in less common emergencies, when the perceived risks are high, the scene is expected to be chaotic or disorderly, or when there are exceptions to standard rules and norms for a particular condition.

Approaching the role and function of clinical practice guidelines using activity theory as a lens reveals that the rules and norms that mediate action in prehospital care, and those conveyed through written language or images in clinical practice guidelines are not necessarily the same thing. Rules and norms exist on several levels, and new rules and norms can emerge from various sources, for instance, by reflecting on or analysing a case, insights from other ambulance teams' experiences, or from changes in the prehospital care system. It also highlights how action is not only mediated by artefacts, but how it is influenced by multiple interactions, the shifting objects, and goals at various phases of the emergency and the division of tasks among the team. Inspired by activity theory, an ambulance assignment can be explained as a chain of interconnected activity systems. Clinical practice guidelines serve as artefacts that mediate action in in the different systems. However, the activity systems themselves create preconditions for their mediating function. Activity systems with highly prioritised or multiple pending actions, accessing and reading guidelines carries a cost of time and attention. To the degree that it is possible, ambulance teams try to prepay this cost by preparing action beforehand. But they must also be ready to adapt, as the initial dispatch information may be unreliable, and the unpredictability in prehospital emergency care can lead to sudden and unexpected developments in a case. At times, it becomes necessary to allocate the time and resources to verify a medication dose, identify a contraindication or reaffirm an exception to a general rule or to ensure that all crucial tasks and actions are completed, and none are missed.

While clinical practice guidelines have a significant role in mediating action, they only represent one element in a complex web of rules and norms that guides prehospital emergency care. Their effectiveness is not only contingent on their content and design but also on how they fit within the broader system of experience and informal knowledge exchange among practitioners.

The scope of this study is constrained due to its limited size and local context, as it was conducted in one north-western part of Skane in southern Sweden. Prehospital care practices vary among countries and regions which may decrease the generalisability of findings. Each set of clinical practice guidelines have been created in a context, and variation exists in guideline content and design. These differences could lead to distinct ways in which clinical practice guidelines are applied in different countries and regions.

Implications for safety

Safety is often portrayed as related to guideline adherence (Ebben et al., 2013; Hagiwara et al., 2019). The underlying assumption is that if rules governing work are in writing and accessible to workers through artefacts, they will be complied with. Therefore, guidelines, protocols or procedures are common targets for safety interventions, particularly following patient safety incidents (Dixon-Woods, 2010). However, practitioners appear to keep making mistakes, despite being told not to, and despite having clearly written instructions that explain how not to err. Human error is reported to be the root cause of roughly 80 % of errors in healthcare (Khaleghi et al., 2022). As it is implied that many errors can be prevented by compliance to guidelines, the solution becomes ever increasing measurement and management (Wears & Hunte, 2014), aimed at increasing compliance. This tactic approaches guidelines as rules or laws that need to be enforced, and human practitioners as a weak link between scientifically proven best practices of prehospital care and vulnerable patients.

However, treating guidelines as definitive solutions, or as enforceable laws can have some unexpected and undesirable side-effects. Overemphasising compliance can lead to practitioners becoming rigid at work: compliance with rules becomes an aim and not a mean to reach a goal (Merton 1957, according to Fuchs 2013). Practitioners' ability to adapt and manage situations not covered by rules may decline (Fuchs, 2013), as may the skills of negotiating competing rules, abilities that are key for safety in complex work environments (Woods, 2018). Too many rules can make it difficult to distinguish between mandatory core principles from a vast amount of other rules or arbitrary policies that may exist (Vincent & Amalberti, 2016b, p. 33). And one must be mindful to not fall in the trap of managing documents instead of managing safety (Hutchinson et al., 2022). Furthermore, strictly adhering to rules is generally not doable, due to structural incompleteness of rules, variability of persons and processes, undefined conditions of use where rules are based on an implicit model of users, undefined application conditions, organisational variability and referencing ideal situations (Bourrier 1999 according to Fuchs 2013).

In other words, while there are some rules that need be followed, other rules cannot (Koenig et al., 2016). Prescribing rules for work requires a thorough understanding of how work is done and not just how it is thought of or imagined to be done (Hollnagel et al., 2015). Put another way, the presence of clinical practice guidelines does not in and of itself ensure that they will be used to mediate actions, or that actions will be completely aligned with recommendations. Pariès et al. (2019) and Amalberti et al. (2005) explain how that the effectiveness of written instructions such as guidelines depends upon the system's characteristics and the adaptability required to accomplish objectives in the system. Observing ambulance teams revealed numerous unpredictable problems and obstacles requiring adaptation of initial plans, additional actions, or a redirection of goals or objectives. Prehospital emergency care requires a great deal of adaptability from practitioners to achieve success.

Two fundamentally different perspectives on clinical practice guidelines as written instructions for work emerge. In the first one, guidelines are seen as rules or restrictions that can create an oversimplified way of evaluating prehospital care practices. Fuchs (2013) describes this oversimplified way of evaluating performance as: you are right if you stay within the set rules and wrong if you do not. This can create a tendency among practitioners to shy away from autonomous or independent action or asking management for written instructions to situations previously managed locally (Fuchs, 2013).

Contrastingly, the other view sees guidelines as an aid, or support rather than a set of rules that demand strict adherence. This recognises the users' skills and judgement and allows for flexibility and responsibility on the part of the practitioner (Fuchs, 2013), aiming for a goal rather than enforcing each rule. Making this distinction and approaching guidelines from the perspective of practitioners establishes a different set of questions. Instead of asking how ambulance teams can be made to adhere to guidelines, asking what their needs are, what functions and roles guidelines serve in their daily practice and how these functions can be prioritised to meet those needs.

Fundamentally, safety in prehospital care depends on finding the balance between the two perspectives. Guidelines ought to clearly distinguish between essential principles and prioritised goals, and less important rules (Vincent & Amalberti, 2016a). This prevents overwhelming practitioners with unnecessary compliance, allowing them to concentrate on key aspects of safety. Furthermore, safety management should encourage an environment that tolerates and supports informed risk-taking and builds trust, enabling practitioners to make informed decisions rather than excessive reliance on compliance. This approach should prioritise practicality, flexibility, and alignment with real-world contexts and constraints. Studying guideline use and function in context can help calibrate and manage expectations of safety interventions targeting guidelines or other written instructions for work in prehospital care. It also informs guideline creators and helps prioritise design and content according to actual practice and the needs of prehospital care practitioners.

Conclusion

Many ambulance assignments are routine and the rules and norms that mediate action are internalised and familiar to experienced ambulance teams, and do not require the referencing of guidelines to mediate action. Experienced ambulance teams use guidelines principally in preparation for patient contact, especially if the initial dispatch information suggests an uncommon or unfamiliar condition, a critical condition necessitating prompt action or when rules and norms must be individually adapted such as when responding to a paediatric emergency. Further use is seen when encountering uncertainty during treatment or to reinforce medication dosages or other vital information in medical emergencies. Interviews and observations revealed various ways in which guidelines serve as mediators of action.

However, their primary function, as prioritised by ambulance teams, is to assist in preparing for patient contact or accessing vital information quickly during time-sensitive medical emergencies. This role of guidelines places limits on content, design, and prioritisation of information to accommodate the urgent contexts and settings in which they are used. Typically, preparation for patient interaction occurs while en route to the scene, limiting the time available for consulting guidelines. Developers of guidelines need to consider content, design, and prioritisation of information to facilitate their use in the context of prehospital emergency care. Experienced ambulance teams use guidelines to address uncertainties in actions and medication dosages, especially in paediatric emergencies. They also rely on guidelines to navigate uncommon or particularly difficult cases and to become aware of risks, hazards, or exceptions to the usual rules or norms.

Additional roles of clinical practice guidelines are serving as educational material, ensuring no critical actions are missed, acting as a reference for additional steps when ideas are exhausted, and verifying current rules following updates. Less experienced teams described relying on clinical practice guidelines to learn the rules and norms of prehospital care and use them as learning material more often than experienced staff. A guideline that works well as a learning or teaching material, comprehensively detailing standard procedures for treating an illness, might not be as useful in an unexpected medical emergency or when preparing for potentially life-threatening cases that require flexibility and prompt action. Consequently, guidelines creators should thoroughly understand prehospital care practices to make informed choices when prioritising guideline functions, content, and design and prioritisation of information.

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Appendix 1. Abbreviations

ANT	Actor-network theory
CGM	Continuous glucose monitoring
CPG	Clinical practice guidelines
CSE	Cognitive systems engineering
FASS	Farmaceutiska specialiteter I Sverige [Pharmaceutical Specialties in Sweden]
GPS	Global Positioning System
HFMEA	Healthcare Failure Mode and Effect Analysis
IV	Intravenous
JCS	Joint cognitive systems
NIBP	Non-Invasive Blood pressure
OPQRST	Onset, palliation/provocation, quality, radiation, severity, time.
RCA	Root cause analysis
SA	Situated action.
SAMPLE	Signs/symptoms, allergies, medications, past medical history, last meal, events leading up to illness.
STS	Socio-technical systems
RETTS	Rapid Emergency Triage and Treatment system

Appendix 2. Interview questions:

1.) Tell me about how you use clinical practice guidelines in your daily work.

2.) The ambulance assignment can be divided into different phases, tell me about the tasks and actions you perform in:
   - Before an assignment
   - En route to scene
   - During patient care
   - During transport to hospital
   - After an assignment

3.) What is the role of CPGs in relation to the other tasks you perform?

4.) What is the biggest problem with using CPGs?

5.) In what way would you want to organisation to work with CPGs in the future?