The Risk Factors Finnish Paramedics Recognize When Performing Emergency Response Driving

Authors: Anssi Koski, Master of Health Care*; Hilla Sumanen, PhD**.
* Project Manager at South-Eastern Finland University of Applied Sciences, Advanced level Paramedic at Kymsote - Kymenlaakso Social and Health services, Doctoral candidate at University of Helsinki, Faculty of Medicine.
**Principal Lecturer at South-Eastern Finland University of Applied Sciences, Adjunct Professor at University of Helsinki, Faculty of Medicine and Faculty of Social Sciences.

Correspondence to: anssi.koski@xamk.fi

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Abstract

Objective: Paramedics face several safety risks in their occupation, and crashes during emergency response driving (ERD) are quite common. However, there is a need for more research to develop educational and implementation suggestions to determine how these risks can be reduced and managed. In this study, we examined what risk factors Finnish paramedics recognize when performing ERD.

Methods: The study material consisted of 161 pages of material that had been written by experienced paramedics (n=44) who were master's degree students of South-Eastern Finland University of Applied Sciences in fall 2017. They wrote essays based solely on their own thoughts and experiences regarding the risk factors associated with ERD. The material was analyzed via inductive content analysis.

Results: Two main categories were found: Crew-related risk factors and environmental risk factors. These categories could be further divided into eight sub-categories. The crew-related risk factors consisted of lack of education and training for ERD, insufficient concentration on driving, irresponsibility and indifference, crew member's inability to take collective responsibility for safety as a team, and excessive load experienced by the driver. Environmental risk factors consisted of demanding handling of ambulance, poor visibility, and other road users.

Conclusions: Finnish paramedics recognized several risk factors in ERD. Some of the factors have been noted in previous literature regarding ambulance crashes and should be addressed as a matter of urgency to improve safety. Overall, better knowledge regarding these risks needs to be developed worldwide. The results led to several further study suggestions.

Keywords: safety, emergency medical services, ambulances, accidents, accident prevention,

risk factors

Highlights

- Finnish paramedics recognize various risk factors in emergency response driving.
- The risks can be divided to crew-related risk factors and environmental risk factors.
- Some of the risks are well-known and should be addressed as a matter of urgency to improve safety.
- The results of this study led to several further study suggestions.

Introduction

Paramedics have a high-risk occupation (Bentley and Levine, 2016; Blau et al, 2012; Brice et al, 2012; Maguire et al, 2002; Slattery and Silver, 2013), and emergency response driving (ERD) is a part of their daily work. The use of emergency lights and sirens implies that the ambulance is using, or requesting, privileges that may include driving above the speed limit, expecting traffic to yield, and assuming the right of way at intersections (Sanddal et al, 2008). Annually, multiple severe traffic accidents involving ambulances are observed throughout the world (Custalow and Graviz, 2004; De Graeve et al, 2003; Eksi et al, 2015; Kahn et al, 2001; LaDuke et al, 1999; Sanddal et al, 2010; Suserud and Jonsson, 2013; Yardley and Donaldson, 2016). These events represent remarkable risks to patients, workers, and members of the public. Not enough safety-related attention has been invested in understanding and addressing the risks associated with driving an ambulance that weighs approximately 3500 kg and has the ability to reach speeds of up to 160 kph.

In this study, we were interested in the ERD risks that Finnish paramedics recognize. According to a recent study (Johnston & Scialfa 2016) emergency medical services (EMS)

professionals are better on hazard perception compared to civilian drivers. Former studies have also found that professional driving experience and the ability to identify and respond to on road hazards are associated (Fisher et.al 2003; Fisher et.al 2006; Horswill et.al 2013; McKenna et.al 2006). However, previous studies among paramedics are lacking in this context. As the main focus on the paramedic profession is caring of the patient, it might be stated that paramedics are not professional drivers. Thus, the former knowledge on hazard perception can be drawn from the civilian context also. In the civilian context, hazard perception abilities correlate with driving experience, as novice drivers have less developed hazard perception skills than experienced drivers. Young inexperienced drivers have difficulties discerning potentially hazardous situations and have more traffic accidents. Experienced drivers are aware of more potential hazards and rely more on traffic-environment characteristics(Borowsky et.al. 2009; Ventsislavova 2016), respond faster on presented traffic conflict scenes (Scialfa et.al 2012), have better environmental prediction (Crundall 2016), spot hidden hazards such as obscured stop signs and pedestrians, and know what is relevant and important in hazard situations (Lee et.al 2008). However, a study by Underwood et.al 2012 did not find such differences.

In terms of driving risks, former research among paramedics is lacking. However, in the civilian context specific driving risks are often associated with age. Previous studies show that younger drivers, especially men, have riskier driving behaviors than older drivers (Laapotti & Keskinen 2004; Oltedal & Rundmo 2006; Turner & McClure 2003; Ivers 2009). These risky driving behaviors include for example speeding and enjoying the excess speed (Blows et.al 2005; Gonzales et.al 2005; Ryb et.al 2006; Harbeck & Glendon 2018), violating traffic rules (Vardaki & Yannis 2013), not using seatbelts (Vivoda et.al 2007) and texting

while driving (Cook et.al 2018; Cadzzulino 2014). These risky behaviors might be more prevalent in rural areas (Eiksund 2009).

In Finland, many of the recently graduated paramedics are inexperienced drivers as the paramedic education programs do not include nationally equal ERD studies with similar systematic approach and content. Finnish advanced level paramedic education (bachelor's degree) is provided in universities of applied sciences, while basic-level (emergency medical technician EMT) education is delivered in vocational schools. Some schools have noticed the importance of driving and ERD education in their curriculum, but the extent of the studies depend on a lot of available material and non-material resources (such as availability of an ambulance) and the appreciation of the subject. In Finland, driving an ambulance does not require a special license, and EMS employees do not attend comprehensive or nationwide instructional or educational courses for ERD.

Paramedics face many risks for crashes and injury events (Custalow and Graviz, 2004; De Graeve et al, 2003; Eksi et al, 2015; Kahn et al, 2001; LaDuke et al, 1999; Sanddal et al, 2010; Suserud and Jonsson, 2013; Yardley and Donaldson, 2016). According to a previous register-based study using ambulance crash data by Jörgen (2007), the majority of the crashes involving an ambulance in northern Finland occur during daylight hours in urban areas under icy and snowy weather conditions. Most of the incidents involve collision with a passenger car, and occur in intersection areas (Jörgen, 2007). Other studies, mainly conducted in the USA, have shown that the risk of injury increases when paramedics are in the backspace of an ambulance during driving (Slattery and Silver, 2013; Kahn et al, 2001; Sanddal et al, 2010). In addition, the physical features of ambulance, such as chassis, external properties, and the technical configurations of backspaces, could be important in accident prevention (Brice et al,

2012; De Graeve et.al, 2003; Suserud and Jonsson, 2013; Levick and Swanson, 2005). Some evidence suggests that the improvement of technology and design, could reduce the risk of injury (Suserud and Jonsson, 2013). The placement of equipment should be easily reachable, so that crew members will not need to undo their safety belts. (Suserud and Jonsson, 2013.) In addition, other road users are unpredictable and are a source of external risks (Sanddal et al, 2010).

In summary, ERD is a part of paramedics' daily work.Thus, on a daily basis, they face many driving related risks, described in previous studies above. Still, they lack proper driving education for ERD. In order to make suggestions for educational and operational driving safety improvements, research is needed to identify the specific risks involved in ERD. In this study, we examined what risk factors Finnish paramedics recognize when performing emergency response driving.

Materials and Methods

Materials

The research material was collected in fall 2017 from the South-Eastern Finland University of Applied Sciences. The students of the Master of Development and Management of Emergency Medical Services (n=44) program were asked to write an essay based solely on their own thoughts and experiences regarding the risk factors of ERD. All of the informants held a Bachelor of Nursing or Emergency Care, and had at least three years of work experience as a paramedic. Men and women were equally represented. Cities and rural areas of Finland, with the exception of the northernmost Lapland, were all represented in the research material as the master's degree students were from different areas of the country.

The essays consisted of 161 pages of text in Finnish. The paramedics that participated in this research as informants were aware that their essays would be used as research material and had the option to withdraw their essay from the material used in this study. The names of the students and all mentions of places or employers' names were removed from the research material prior to the analysis stage in order to assure anonymity of the participants. The research material is stored in a safe location that could only be accessed by the two researchers involved in this study. The South-Eastern Finland University of Applied Sciences granted permission for this study.

Methods

To achieve a holistic understanding of the content that was presented in the research material, both the researchers read the material several times before commencing the analysis phase. Then, both the researchers coded meaningful sentences, paragraphs, and words from the material as a headings. The researchers completed this task independently to increase the quality and comprehensiveness of the analysis. Following the inductive content analysis process described in Elo and Kyngäs (2008), the researchers then compared headingsand grouped similar content together to form sub-categories. Then the sub-categories were grouped together to form generic categories. Generic categories formed two main categories (figure 1). (Elo and Kyngäs, 2008). Forming all the categories was achieved via a collaborative approach, and the results of the analysis were largely discussed as the analysis process progressed. Figures 1, 2 and 3, illustrate the formed main, generic and sub-categories. In addition, in the results section all the headings that forms sub-categories is presented and some of the original expressions illustrate the material. The original expressions have been translated from Finnish to English by AK, who has graduated from the Finnish National

Board of Education's approved general language degree in English Language and work experience from abroad, thus there was no outside source used in translations. All of the data fit in to categories that emerged from the data, and there was no unusable data or negative case analyses.

Results

Two main categories of risk factors were identified: Crew-related risk factors and environmental risk factors (Figure 1).

Crew-related Risk Factors

Lack of education and training for ERD

The main issues regarding lack of education and training were lack of driving experience, lack of knowledge, and lack of structured education. Lack of driving experience revealed that paramedics were worried about young, recently graduated colleagues who had little experience of driving a car, not to mention an ambulance.

> *"Shockingly, even today, you come across paramedics who inform you that it is their first time driving a larger vehicle when they head out to dispatch." (Paramedic number 5= P5)*

Those colleagues do not necessarily even own a car; as such, all of their driving experience had been gained during their work in the ambulance. Paramedics were also concerned about the frequency with which two inexperienced paramedics work alongside each other in the same ambulance.

> *"Often, your co-worker was an equally young summer help rookie with little experience. The more seasoned regulars worked together while rookies were partnered with each other." (P4)*

According to the paramedics, on some EMS events, the assignment in the unit is constructed such that a EMT and a paramedic work as a pair. In some cases with these assignments, the paramedic is mainly in the backspace of the ambulance, and the EMT is behind the wheel, especially on critical emergency calls, which necessitate ERD. The paramedics felt that this setup leads to a reduction in paramedics' ERD experience and, therefore, the decline in ERD skills. Paramedics pointed out that lack of knowledge included weakness on regional knowledge and insufficient awareness of the laws of physics (for example unawareness of the vechile's breaking distances)that affect driving.

> *"A few years ago, a person who had worked 10 years as a firefighter and 5 years as a paramedic rolled over an ambulance in an expressway ramp. The situational speed was too high and apparently the driver had not heard centrifugal force." (P9)*

Structured theoretical and practical teaching of ERD was considered inadequate. Paramedics also noted that the training of ambulance handling skills was missing from the educational programs. They felt that the ERD policy is currently strongly based on model learning at the work site, and the weakness of this arrangement is that bad habits also transmit to those who are learning.

> *"When learning about ERD is based largely on learning from coworkers, bad habits will also get passed on." (P13)*

Another point of development were issues on feedback in relation to ERD. Paramedics felt that lack of feedback hindered the development of ERD skills.

> *"In my opinion, you can't learn safe and good ERD if you are always under the impression that everything went well since nobody said anything about your driving." (P38)*

Insufficient concentration on driving

The internal distractions that occur in the ambulance and non-driving-related activities make it difficult for paramedics to concentrate on driving. Internal distractions include background noise inside the ambulance during the ERD, which makes communication between the cabin and the back space of the ambulance difficult.

> *"The driver can attempt to warn the co-worker in the back about an incoming breaking, but this does not make much of a difference, because the co-worker most likely can't hear it due to the sirens that make so much noise". (P16)*

Unnecessary communication during ERD was also considered to be a risk factor.

> *"The importance of communication is emphasized as the driving speed increases. I'm mostly talking about avoiding unnecessary communication, because the driver has to be allowed to focus on the driving properly" (P17)*

Other crew members' involvement in traffic observation was also a source of distraction. Situational assumption of the other crew members may vary from the driver's assumption and was considered a risk factor.

> *"How a specific situation in traffic is interpreted, can depend on the person. In addition, a rushed vocalized reading of the situation can be very different from how the driver interprets what they're hearing." (P13)*

Paramedics noted various non-driving-related activities that disturb the driver's ability to concentrate on ERD. Use of the communication equipment during the driving task was considered a risk.

> *"However, the driver hears the radio communication which can become a partial distraction" (P12)*

Also, situations in which the driver needed to follow the screen of satellite navigation systems was seen as a distracting element in ERD. Other risk-elevating actions that paramedics identified were drivers using their own mobile phones during EDR tasks.

> *"It's not just one or two co-workers who use Snapchat, read Facebook or even type an update while driving" (P3)*

In addition, dressing up (for example boots) during the drive was considered to be a risk.

> *"Even minor tasks performed by the driver while driving have a major effect on safety of ERD, because ERD is a task that always increases stress levels and requires concentration." (P18)*

Irresponsibility and indifference

Irresponsibility and indifference consisted of factors such as excess situational speed, driver's overestimation of his or her driving skills, carefreeness, and carelessness towards other road users. According to paramedics, an excessive speed-related risk factor was speed blindness,

which occurs when driving from highway to b-roads or urban areas. Excess speed correlated to shortening of reaction time was also noted by the paramedics. Other points were favorable weather conditions and long straight roads, which tempt people to drive faster.

> *"Even good weather doesn't guarantee safe ERD, as the driving speed becomes unreasonably high, when the weather conditions are favorable." (P5)*

Driver's overestimation of him/herself constituted multiple risk factors. Inexperienced driver's eagerness and attitude towards ERD as it's the "cool" thing to do stood out from the material.

> *"Newcomers who put on the sirens experience rush of adrenaline and euphoria that increase trust in their driving and result in so-called 'rally driver feet and loose hands' situation. When you add tunnel vision and reduced hearing to the mix, disaster is ready to strike." (P27)*

Inability to balance risks and overestimation of own skills as a driver were also highlighted by the paramedics. Considering self as an immortal "superhuman" when performing ERD and being male were also pointed out as irresponsibility-related risk factors.

> *"You have to be able to acknowledge the risks that come with the job and your own mortality. In the past, it's often felt like you become immortal when you climb in to an ambulance and turn on the emergency sirens, which means you're more likely to take unnecessary risks." (P36)*

Overall carefreeness towards ERD included attitude, which can be described as the "It's never happened before, so it cannot happen now either" perspective. Carefreeness also emerged as excess trust in emergency lights and sirens. Another form of indifference was driver's

carelessness toward other road users. According to paramedics, this harmful phenomenon occurs as an arrogant attitude towards other road users, selfish driving style, and overall disregard:

> *"I'm aware that there's an unfortunately large crowd for whom there is a priority to drive fast as possible with no care for close calls, passenger comfort or patient safety." (P35)*

One form of selfishness that was also pointed out were indiscreet actions when the end of the shift was near, and the driver was in a hurry to go home:

> *"One particular issue I want to point out, although we are on our "dream job", sometimes employees own motivations goes ahead of the work. For example when you are hurry to get out of work, so you don't have to do overtime, own personal feelings, state of fatigue and experimentation. These issues are not commonly talked out loud, especially on public." (P15)*

Crew's inability to take collective responsibility for safety as a team

Crew's inability to take collective responsibility for safety as a team means that inoperative teamwork dynamics impair crew communication, not using proper safety equipment during ERD, and unpreparedness in sudden driving movements decrease the safety of ERD. Inoperative teamwork dynamics appears as inadequate communication and leads to situations in which the driver doesn't have knowledge of what happens in the back space of the ambulance during ERD when transporting a critical patient to the hospital. Vice versa, this also impacts the paramedic in the back if he or she doesn't get information about driving and can't prepare for bumps or such. Wearing the proper safety equipment is considered the responsibility of both crew members. However, paramedics face situations in which the

paramedic is without a seatbelt in the back space of the ambulance. A factor that affects the lack of seatbelt use in the back space is the unreachable placement of instruments and equipment for patient care.

> *"Often there are situations in back of the ambulance, where seatbelt use becomes impossible due procedures of examination of the patient" (P6)*

Paramedics also pointed out that patient attachment to the stretcher with appropriate safety equipment is also often lacking.

> *"These days, three-point belts have become the norm, which some choose to ignore because they are seen as "difficult", "time-consuming" or "impractical." (P9)*

Sudden driving movements were considered to have an effect on the actions performed in the back space of the ambulance. Sudden movements can lead to harmful mistakes with medication; for example, if the paramedic is performing iv-medication for the patient when the sudden driving movement occurs without notice.

> *"Medicating a patient during the drive is so risky that even slight bump in the road, or an abnormal maneuver causes significant difficulty to administering the drug." (P18)*

Vibration and noise of the car chassis when performing ERD were seen as factors that can potentially deteriorate the patient's condition. According to paramedics, unattached materials in the back space of the ambulance could move and fall as a result of the sudden driving movements performed by the driver.

> *"There can't be any sudden brakings because you risk injuring the paramedic or even the patient. EMS gear backpacks and other equipment can also be loose during the*

drive and they can hit the paramedic or the patient with sudden use of brakes or during a collision." (P16)

Excessive load experienced by the driver

Paramedics felt that the driver can be under psychological pressure, suffer from a reduction in alertness, or be uncertain, and these may cause excessive load. Psychological pressure can be social pressure to drive fast or feeling under pressure from the other crew member to drive faster.

"You should never tell anyone to drive faster, because reaching the driver's skill limit increases the risk of getting into an accident." (P38)

Being in a rush affects the ability to judge, and the situation in the target destination creates additional pressure.

"When a person is in a hurry and under a lot of stress, their field of vision narrows down and they're unable to make thoughtful decisions." (P16)

According to paramedics, this occurs especially if the patient is a child. This pressure increases if the delay on reaching the target destination is long:

"Take, for example, a dark, winter night with heavy snowfall and zero visibility. You have worked for 10 hours, and you have resuscitation of a child waiting at the destination. The paramedic on the care shift is talking to the authority's radio network, cellphone and is verifying care instructions. The driver navigates to the destination totally leaning on the map. Even the basis for a situation like this is challenging and feels overwhelming, but you still have to pull through. Factors like these have an effect on ERD and safety." (P43)

Paramedics pointed out that the driver may have an urgent desire to reach the patient as quickly as possible and this leads to excessive risk-taking. They felt that emergency dispatchers may sometimes overestimate urgency of the mission and, thus, place the driver under additional stress. Planning the crew's work during driving also creates a load for the driver. The paramedics also pointed out that, in some areas, EMS supervisors operate their unit alone and are forced to navigate, use communication equipment, and lead the situation while performing ERD. This multi-tasking was considered to represent a mental load.

> *"During a drive to, for example, a multiple unit, multi-authority dispatch, the EMS supervisor has to use the communication equipment to communicate with several operatives, consider the sufficiency of resources, work assignments, work safety, navigation and several other matters and still performing ERD." (P13)*

Another risk factor that occurs when driving an ambulance with the patient aboard concerns the driver being forced to make all the driving decisions by him/herself. Long distance highway travels appeared to numb the senses. The driver may also have outside stress in his/her life that affects driving ability.

> *"During the morning greetings, one might reveal that they've been up all night with a sick child, while their co-corker has been struggling with insomnia because their shifts has disrupted their regular sleep pattern. In a case like this, which one of these two should drive, for example, class A high risk emergency transportation dispatch?" (P39)*

Driver vulnerability to these factors decreases his/her alertness status. Long driving distances to missions were considered tiring. Another alertness-related risk factor was the driver's

tiredness due to type of his/her work shifts. Paramedics pointed out that long shifts that last up to 24h affect alertness.

> *"A well-rested paramedic is undoubtedly a more reliable driver than one who's been awake for the last 26 hours." (P13)*

How hectic the shift is also has an effect on the driver's state of fatigue and alertness. Paramedics also felt that drivers might experience uncertainty to admit something in terms of driving ability or fear of driving fast. They also described how the drivers' colleagues may avoid giving real-time feedback on their driving because of the fear of insulting or angering them.

> *"Many things can be a habit or a personal mannerism for a driver, but co-worker doesn't always intervene or point them out for fear of offending colleague." (P4)*

Environmental Risk Factors

Demanding handling of ambulance

Paramedics described how the unique handling characteristics of the ambulance, poor technical conditions, and weather conditions are risk factors related to ERD safety. According to paramedics, ambulances' heavy weight and weight distribution vary from normal passenger cars and acceleration in overtaking situations is slower.

> *"Ambulances are often relatively large vans and they can almost feel like passenger cars while driving in the city, but once you reach higher speeds, the larger mass and higher center of gravity reduces drivability." (P20)*

They noted that most ambulances have rear-wheel drive, which varies significantly from the majority of front- or four-wheel drive passenger cars and affects the handling. Paramedics felt

that some EMS producers do not invest enough in the fleet and cars are simply too worn out with excessive high mileage. Neglecting technical routine service was also considered to represent a risk factor in ERD.

> *"Condition of the vehicle is relevant. It's obvious that a vehicle that's out of repair and neglected service history increases the risk of an accident." (P7)*

Furthermore, slippery roads, bumpy surfaces, and strong side winds were also described to affect the handling of large ambulances and, as such, to represent risk factors. Paramedics pointed out that weather conditions can change suddenly during the work shift and changes in the way the vehicle handles in response to the varied conditions can surprise the driver. Poor maintenance of the road network was also perceived to represent a risk-increasing element.

Poor visibility

Paramedics described how poor visibility includes limited view from the cabin, weather that limits view, and various moving elements in the ambulances surroundings. Elements that affect visibility from the windshield were positioning of navigation and communication equipment on the dashboard and the poor condition of the windshield.

> *"The GPS navigation system is situated on the driver's left side in such a way that the paramedic in the front seat can't see it properly. The screen is so small that the driver has to focus their gaze on the device to be able to see where they're supposed to go, but it's still large enough to block part of the lower half of the windscreen." (P23)*

Paramedics pointed out that visibility from the mirrors can be limited, and there are "dead angles" on the side of the car. Sometimes, the drivers can't see their surroundings because of the weather conditions. Rain, fog, darkness, and sun reflection from the surface of the road

were described as factors that disturbed the driver's vision. Nighttime driving overall was considered as a poor visibility-related risk factor. According to paramedics, there are several various moving elements in the surroundings of the ambulance that demand drivers' attention. When performing ERD in urban areas, there is a lot to observe. The amount of other road users is greater in cities, and full vision can be blocked by the traffic at crossroads. Outside of population centers, wild animals that jump on the road form a potential risk.

> *"In the rural areas especially, there is a risk to hit wild animals that don't always know to watch out for the blue emergency lights." (P16)*

Other road users

According to paramedics, other road users form an ERD safety risk. Other road users may not be able to detect the ambulance, may be reckless, and may misjudge the actions of the ambulance driver because ambulances deviate from normal traffic rules. Paramedics felt that, especially during bright daylight, emergency lights are poorly visible. Modern cars were described to have good soundproofing and, as such, the emergency sirens cannot be heard properly from their interior.

> *"It can be presumed that those driving in front of an approaching ambulance aren't necessarily aware of it, because the sound of the siren doesn't always reach the driver even in close proximity." (P12)*

Paramedics pointed out that pedestrians may have difficulties detected an ambulance that is performing ERD. Some ambulance drivers use emergency devices only partially; e.g., just the blue lights. This makes it more difficult to detect the ambulance. Other road users do not

necessarily observe the traffic as much as needed and ambulance drivers do not always give them sufficient time to react.

> *"It is also important to acknowledge pedestrians as more and more people walk with their noses stuck on their phones while they take selfies or listen to music (I say this as someone who occasionally does it too)." (P5)*

Some participants described how other road users' reactions to ambulances that were performing ERD maneuvers surprised the ambulance driver:

> *"It is impossible to predict the actions and reactions of the drivers in the cars that are in front of you or in the cars that you have to overtake." (P18)*

Sudden braking and inability to give way correctly form risk factors. According to paramedics, some road users may even start to race with the ambulance.

> *"A few times during ERD on the highway a car driven by civilian has distracted the driving by trying to race with the ambulance. The speeds have become notably high, approximately 150kph. The civilian has driven right behind the ambulance with high speeds and overtaken it several times. This kind of interference has distracted the driver from focusing on their driving." (P17)*

Drunk drivers were also seen as a potential risk factor. Pedestrian movements can also be difficult to predict. Overtaking with poor visibility or in the face of oncoming traffic are risk factors regarding the violation of traffic regulations when performing ERD. Traffic-light controlled crossroads that have restricted passage and insufficient safety distance also form potential risks.

> *"I think the risk of an accident is at its highest when you're driving towards a relatively recent red light and the light is about to turn green for the intersecting traffic. Often, when the lights turn green, the driver doesn't pay attention to the rest of the intersection." (P33)*

Discussion

The aim of this research was to find out what ERD-related risk factors paramedics recognize. Similar research has not been done before in Finland or elsewhere. The main results reveal that the paramedics pointed out various risk factors related to ERD. The risk factors were divided into two main categories: Crew-related, and environment-related risk factors.

The significance of education stood out from the material. Lack of education was experienced through insufficient experience, lack of knowledge and absence of structured education. The situation could be improved by creating congruent nationwide best practices on ERD; material shows that they are needed. Kahn et al. (2001) pointed out that it is reasonable to require a higher level of competence in driving and knowledge of laws among paramedics than among general members of the public. The need for additional ambulance driving training was also noted in a review by Sanddal et al. (2008). Conventions for education from other high-risk fields of work, such as aviation, could improve risk management on threat-rich ERD. The practices employed in the aviation industry such as crew resource management (CRM) can improve skills, especially nontechnical skills such as communication and teamwork (Bennett, 2017). The use of high-fidelity simulation could provide effective opportunity to implement these practices. (Eddy et al, 2016).

Insufficient concentration on driving has issues considering non-driving-related secondary tasks and internal distractions inside the ambulance such as background noise, which disturbs the communication between the cabin and the back space of the ambulance. Communication in a noisy environment could be improved by using short-wave radio transmission with headsets (Suserud and Jonsson, 2013). The use of navigation systems and communications devices, such as mobile phones or radio communication equipment, while performing ERD also stood out from the material as a recognized risk factor. Secondary tasks that take the drivers' eyes off the road reduce visual scan, increase cognitive load, and may cause potential danger. According to Simons-Morton (2014), the total duration of glancing away from the forward roadway is associated with crash risk; for example, taking eyes off from the road for two seconds or longer doubles the risk of near crashes or crashes. Talking on the phone has an effect on detection time, notification of hazards on the road, and similar activities, and also increases mental workload and information processing demands (Smahel et al, 2008). Handheld mobile phone tasks that require the driver to take their eyes off the road increase the risk of misjudging safety-critical events, degrade the driver's performance, and contribute to traffic deaths (Simmons et al, 2016). The risks can be reduced with education and policy that discourages the driver from performing these secondary tasks (Simons-Morton et al, 2014). The problems associated with communication between the cabin and the back space of the ambulance has not been under study from the safety viewpoint. In visioning, future needs for ambulances in terms of such communication issues have been poorly stood out (Hignett et al, 2009), but the safety aspect should be more closely monitored to make future suggestions for improvements.

In our data, poor communication was seen as a risk in ERD, and such situations were related to inoperative teamwork dynamics and also to the excessive background noise inside the

ambulance due to sirens and road noise. In a survey with 2537 EMS personnel respondents, the necessity of good verbal communication was recognized, as there is often a need to inform other passengers of impending driver actions (Lee et al, 2013). In addition, the clarity of the communicated messages was noted to be impacted because of the noise (Lee et al, 2013). Hohenstein et al. (2016) suggested in their study on communication failures in prehospital emergency medicine that closed-loop communication, especially under loud situations, could improve patient safety (Hohenstein et al, 2016). Implementing closed-loop communication to ERD protocol in the pre-hospital emergency care setting might reduce the impact of team member dynamics on safety issues, as the directions for communication would be the same, regardless of the crewmembers on shift. Also, such communication strategies could reduce the safety risks related to bad hearing, as the reception of the message would be ensured. The usability and feasibility of closed-loop communication in ERD should be studied.

Previous evidence shows that the lack of using seatbelts while ERD is a common problem worldwide (Sanddal et al, 2008; Lee et al, 2013). This is a safety risk, especially in the backspace of an ambulance, as the seatbelts are more often used in the cabin (Kahn et al 2001). According to Lee et al. (2013), many paramedics exhibit the wrong attitude towards safety in the ambulance work environment. Our material showed that delivering care is often impossible with seatbelts, as the belts hinder paramedics from reaching the patient and necessary equipment. Similar findings, and the need for better designs, were noted a long time ago (Sanddal et al, 2008; Hignett et al, 2009; Becker et al, 2003; Petzäll et al, 2011). Also the safety risk due to unattached objects was recognized in our study, and was also noted previously (Kahn et al, 2001; Hignett et al, 2009; Lee et al, 2013; Petzäll et al, 2011).

Irresponsibility and indifference stood out from the material as excess situational speed, driver's overestimation of him/herself, carefreeness, and carelessness towards other road users. Time is an important element in prehospital emergency care; however, only a limited number of patients benefit from high-speed and aggressive ERD (Sanddal et al, 2010; Petzäll et al, 2011; Ray and Kupas, 2005). Petzäll et al. (2011) pointed out that the risks increase with speed, and it's not reasonable to take those high risks in every situation; the time should be saved elsewhere (Petzäll et al 2011). Sanddal et al. (2010) noted that paramedics may make assumptions that the use of lights and sirens give them license to disregard certain rules of the road (Sanddal et al, 2010). However, irresponsibility and indifference among paramedics needs to be more closely studied, especially the ways that could reduce or prevent this kind of behavior at an early stage in professionals' careers.

Previous studies show that the risky behavior of EMS drivers could be modified by an external "black box" recorder device that monitors acceleration, speed, and harsh braking (De Graeve et al, 2003; Sanddal et al, 2008; Sanddal et al, 2010). Implementation of the device should be combined with well-defined guidelines (De Graeve et al, 2003). In the study by Levick and Swanson (2005), the use of recording devices had a dramatic effect on seatbelt violations, speed violations, and force violations. The recorder also delivered 20% savings in vehicle maintenance costs (Levick and Swanson, 2005). Our material revealed that paramedics had experience of colleagues who irresponsibly used social media on smartphones during driving tasks. Research evidence accumulates that distraction is an important cause of any type of crash. Policies for restricting the use of electronic devices while driving, especially for young drivers, is supported in the research findings. Text messaging and Internet use while driving are associated with crash or near-crash risk (Simons-Morton et al,

2014). Evidence suggests that cell phone prohibition is appropriate for all drivers, not just novice ones (Smahel et al, 2008).

The paramedic profession is physically and psychologically demanding. In the USA, the rate of fatalities per 100,000 EMS workers was 12.7 while the national average was 5.0 during the same time period (Maguire et al, 2002). In Finland, the risk of work disability for the paramedics was 2.4%, while the national average was 1.7%. According to statistics, the profession of paramedic has the 25th highest risk for work disability across all professions in Finland (Finnish Centre for Pensions, 2017), and even higher in other countries, such as Australia and United States (Maguire et al, 2014; Maquire et al, 2013). Paramedics are exposed to various stress factors that may contribute to stress reactions. Special critical event stress can be caused by death of a child, taking care of a friend, a family member or someone known to the responder, and treating seriously injured or acutely ill patients. Injury or death from vehicle-related crashes causes additional work-related stress. (Donnelly et al, 2016.) Our material showed that high psychological pressure has an effect on performance during ERD tasks. Additional stress was experienced especially on occasions when the patient at the target destination was a child. Stressful driving situations in EMS result in more unsafe vehicle operation, particularly among inexperienced drivers (Kahn et al, 2001). In some areas, EMS supervisors work alone in a unit and have to concentrate on excess radio network traffic, navigation, and giving instructions for the other units on the mission. The act of performing secondary tasks while driving increases mental workload and information processing demands (Smahel et al, 2008). This risk could be reduced by using additional personnel on EMS supervisor units to handle the driving task.

The handling characteristics of an ambulance are demanding and cannot be compared to normal passenger cars. However, in Finland, it is possible to perform ambulance driving for a profession with only the passenger car driving license. This situation could be improved by demanding special license qualifications for ambulance driving, also noted by Kahn et al. (2001). At least truck license (C/C1) should be insisted by the employers when recruiting new staff. It stood out in the material that some EMS producers do not invest enough in the maintenance and renewal of the fleet. This could be improved by tightening supervision of the service subscriber organizations, such as joint municipal authorities, and outlining clear requirements in the contracts with the service producers.

Paramedics experienced poor visibility as an environmental risk factor. Nothing can be done about the weather conditions that cause poor visibility. Paramedics have to perform in all weather conditions, at all times of day, and in every season, varying from bright sunlight to snow blizzards. The paramedics considered visibility-blocking equipment to represent a risk factor. Visibility outside of the cabin can be improved by positioning radio and navigation equipment on the dashboard so that it doesn't block the view. Urban area ERD is especially demanding for the driver because of the number of observed elements. Drucker et al. (2013) noted that urban roads present more clutter and, thus, the other road users have a harder time detecting the ambulance, especially at intersections when looking only forward towards green lights (Drucker et al, 2013). Over a half of the crashes in the USA occur at intersections, and most of the fatal crashes occur during emergency use (Kahn et al, 2001). Four-way intersections that have traffic lights but not stop signs are particularly risky (Sanddal et al, 2010; Ray and Kupas, 2005). Traffic light control systems can represent one solution by which it is possible to reduce the number of observed objects in the urban area. When the

ambulance has the wave of green lights, the number of moving objects on the crossroads is reduced. Some cities in Finland have these systems already.

Other road users cause remarkable risk regarding ERD, and there is very little that can be done in this regard. Paramedics felt that the actions of other road users are unpredictable and cause remarkable risk for ERD. A study by Sanddal et al. (2010) also supported this finding. Additional education in driving schools regarding the encounter with ambulances could improve the situation (Sanddal et al, 2010). Also some kind of enlightenment campaigns should be promoted worldwide. However, a study by Drucker et al. (2013) pointed out that many drivers are inattentive. This undermines their ability to visually detect oncoming ambulances and results in inappropriate driving maneuvers (Drucker et al, 2013). It stood out from the material that some paramedics use only the blue lights when performing ERD. This makes detection of the ambulance more difficult. However, the audibility of the sirens may also differ substantially, also affecting detectability (Catchpole and McKeown, 2007). In Finland, according to law, both should be used when ERD includes using or requesting privileges on the roads.

Strengths and limitations

All the informants were well-experienced paramedics, and they represented different parts and urban/rural places of the country. All the individual essays were more than two pages long. Most of texts presented deep analysis related to the subject, meaning that the informants gave explanations and examples for the observations they made. Only a minority of texts were superficial and concentrated on the more obvious aspects.

Analysis was carried out by two researchers with comprehensive discussion during the process, which increases the trustworthiness of the results. The analysis was first done in Finnish and then translated to English. The author who made the translations has extensiveEnglish language education. However, there is a possibility for some bias especially in the quotes, as some of the paramedics use colloquial language.

The informants may be more thoughtful than others to some extent as they are studying master's degrees. However, if so, this is beneficial in terms of the reliability of this study. All the risk factors presented in this study came across several times in the texts. However, considering that the informants were group of providers engaged in education to advance their careers in the field could be considered also as a limitation to generalizability. It is also a limitation that the more detailed information on informants' work history, experiences as a driver or additional education was not available.

The written material approach made it possible to include many informants, but there was a lack of opportunity to clarify the information. Some of the risk factors highlighted—for example, attitudes—should be explored more deeply via an interview approach in the future.

Conclusions

Finnish paramedics recognize several risk factors in emergency response driving. Those risks can be divided into crew-related and environment-related factors. The lack of proper education for ERD and the lack of using seatbelts were particularly noted to represent substantial risks. However, these are still waiting for improvements in 2018. Systems and protocols that support good communication during ERD should be more closely monitored and implemented. The negative attitudes toward ERD should be studied more in order to find

ways to prevent the development of such attitudes, especially in the case of young paramedics who are at the beginning of their careers. Preventing the excessive mental load experienced by paramedics is essential for safety; thus, methods of calming down the ERD situations should be monitored. Overall, the ambulances should be designed from the viewpoints of those working in them. Encounters between ambulances and civil cars and pedestrians have also been noted to be of risk in previous studies; thus, knowledge spreading campaigns are needed worldwide to address these issues.

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Conflicts of Interest

The authors report no conflict of interest.

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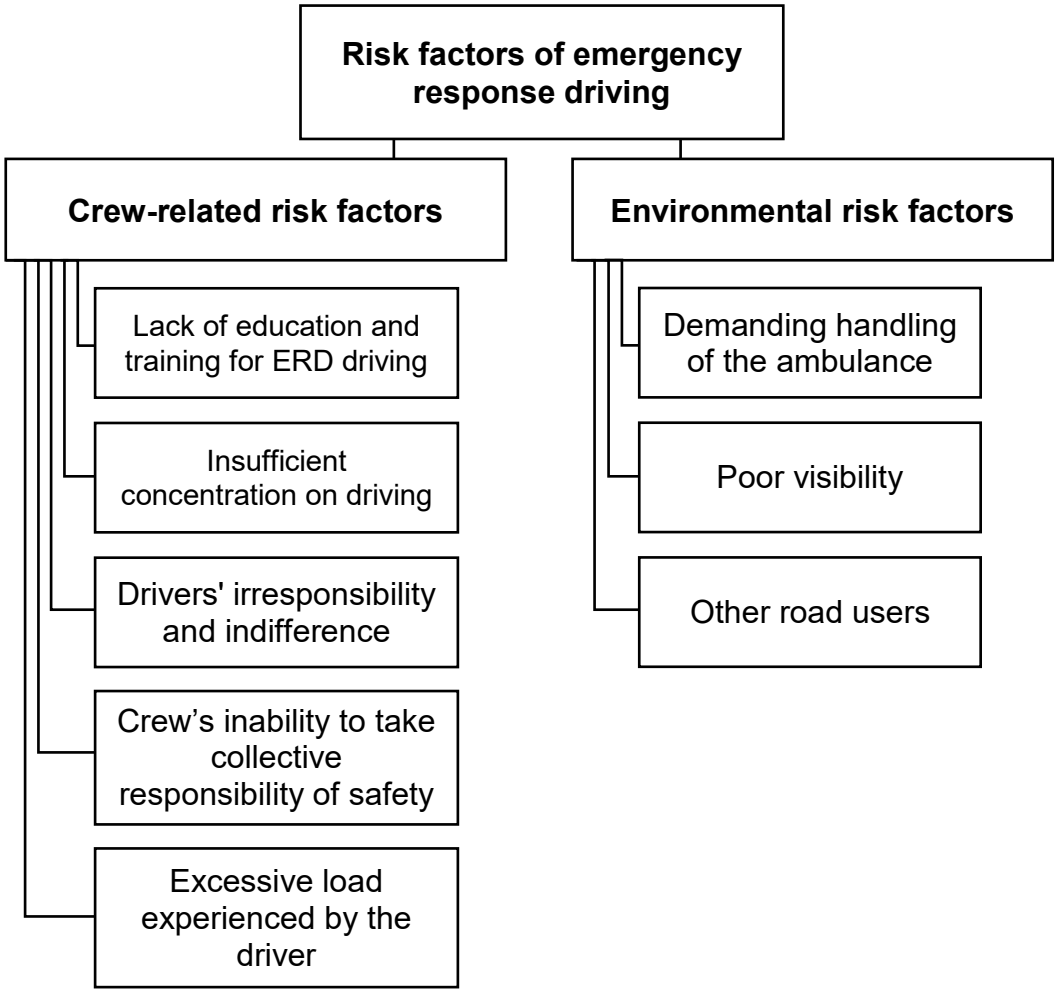

Figure 1. Risk factors of emergency response driving

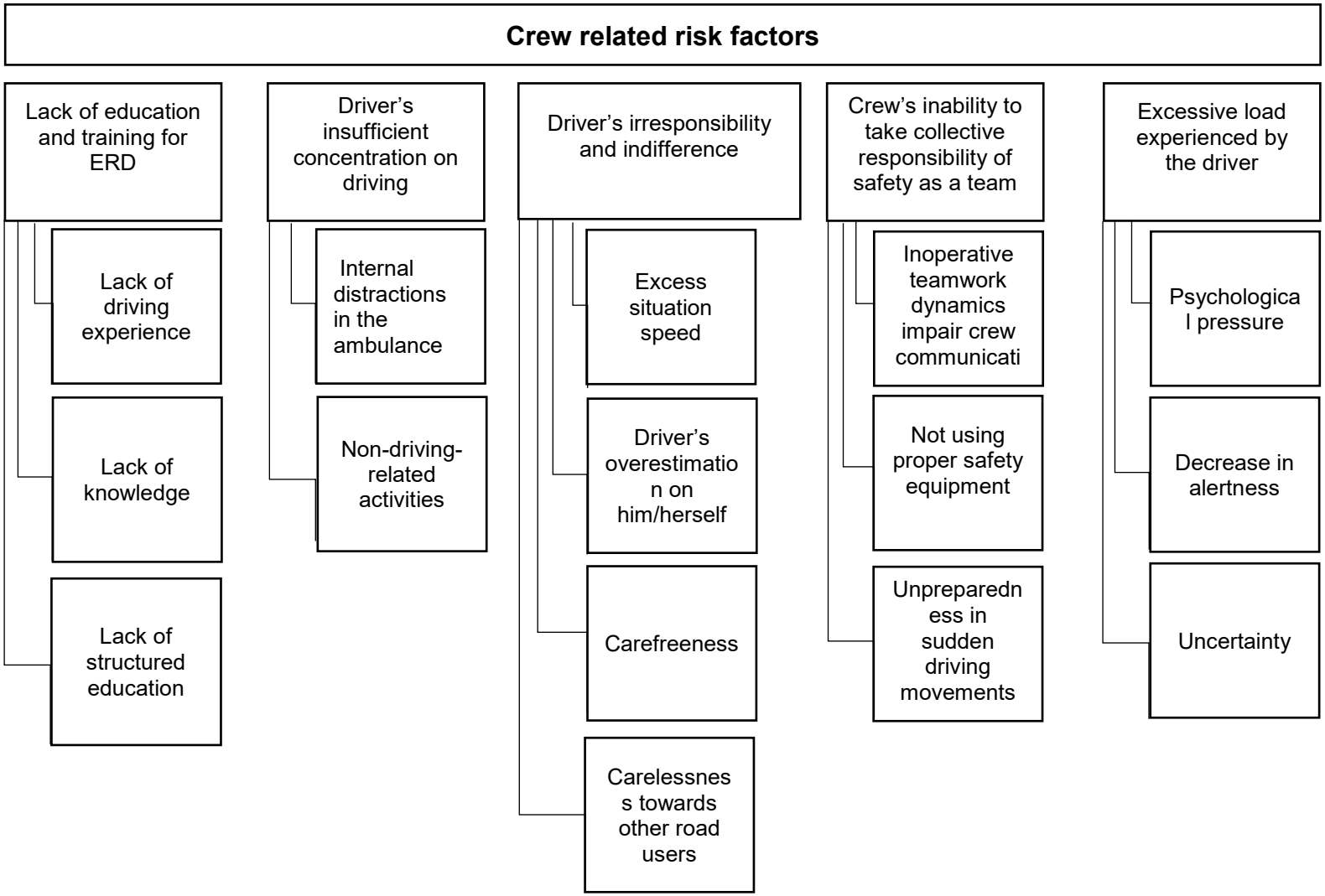

Figure 2. Crew-related risk factors

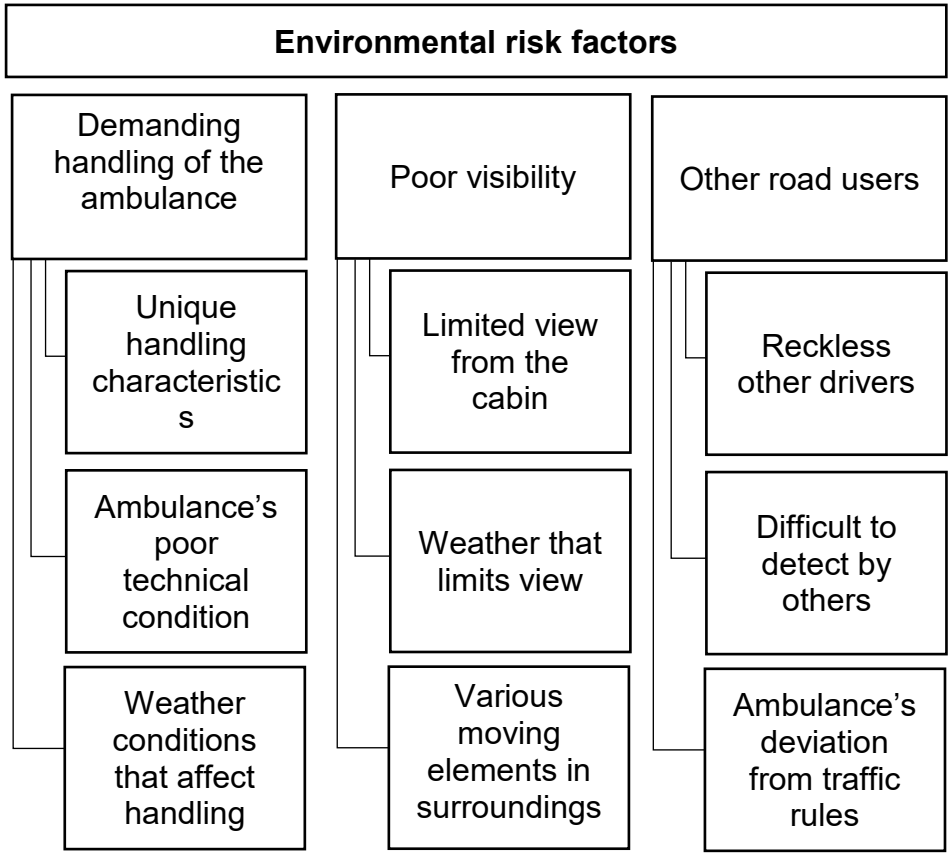

Figure 3. Environmental risk factors