Department of Emergency Medicine and Services, University of Helsinki and Helsinki University Hospital Helsinki, Finland

PATIENT SAFETY CULTURE IN THE EMERGENCY MEDICAL SERVICES: THE PATIENTS, STUDENTS, AND PROFESSIONALS' PERSPECTIVES

Anu Venesoja

DOCTORAL DISSERTATION

To be presented for public discussion with the permission of the Faculty of Medicine of the University of Helsinki, at Athena, Room 302, Siltavuorenpenger 3 A on the 14th of April 2023, at 12 o'clock.

Helsinki 2023

Supervisors

Professor Veronica Lindström Department of Nursing, Umeå University Department of Ambulance Service, Region Västerbotten Umeå, Sweden

Professor Maaret Castrén Department of Emergency Medicine and Services The University of Helsinki and Helsinki University Hospital Helsinki, Finland

Dr Susanna Tella Faculty of Health Care and Social Services LAB University of Applied Sciences Lappeenranta, Finland

Reviewers

Professor Jouni Kurola Centre for Prehospital Emergency Medicine Kuopio University Hospital and the University of Eastern Finland Kuopio, Finland

Professor Hanna Kuusisto Department of Health and Social Management University of Eastern Finland Kuopio, Finland

Opponent

Docent Lasse Raatiniemi Docent in Prehospital Emergency Medicine University of Oulu Consultant Anaesthesiologist Department of Air Ambulance and Department of Anaesthesia and Operative Care University Hospital North Norway Tromsoe, Norway

Dissertationes Scholae Doctoralis Ad Sanitatem Investigandam Universitatis Helsinkiensis No. 14/2023. ISSN 2342-3161 (print) and ISSN 2342-317X (online)

The Faculty of Medicine uses the Urkund system (plagiarism recognition) to examine all doctoral dissertations.

ISBN 978-951-51-8991-2 (pbk.) ISBN 978-951-51-8992-9 (PDF)

Cover page layout by Anita Tienhaara

Unigrafia Helsinki 2023

ABSTRACT

Background

Patient safety culture (PSC) is a complex phenomenon, and it is important to understand, especially in prehospital settings where the working conditions are more unpredictable than in other healthcare settings. Knowledge and understanding of PSC can help enhance and develop patient safety in emergency medical services (EMS) at the organisational, team, and even individual levels. Therefore, this study aims to describe how PSC manifests in Finnish EMS from the patient, prehospital nursing students, EMS personnel, and EMS management perspective.

Materials and methods

The study consisted of four sub studies. All the data used in this study was collected between 2018 and 2021. EMS patients in study I were encountered and transported by the EMS after calling to the emergency medical communication centre (EMCC). EMS professionals in study II were recruited via social media aiming to achieve EMS personnel working full- or part-time in the EMS from different areas in Finland. Final year prehospital nursing students in study III were recruited from three different University of Applied Sciences. EMS managers and medical directors in study IV were recruited from five healthcare districts to participate the study. Participants job descriptions should include managerial/supervisor responsibilities.

Results of this thesis were analysed using qualitative (I, III and IV) and statistical analysis methods (II). Interviews were analysed using inductive content analysis in study I while (reflexive) thematic analysis was used in studies III and IV. In study II, confirmatory factor analysis (CFA) was conducted to validate the EMS safety attitudes questionnaire (EMS-SAQ) in a Finnish setting. Connections between individual and organisation-based characteristics and six safety culture domains (safety climate, job satisfaction, perceptions of management, teamwork climate, working conditions, and stress recognition) were explored by using appropriate non-parametric tests.

Results

Altogether, 384 persons participated in the four studies conducted. Of those participants, 21 were patients (I), 327 were EMS professionals (II), 17 were prehospital nursing students (III), and were 19 EMS managers and medical directors (IV).

According to the findings of qualitative studies (studies I, III, IV), PSC in EMS forms the operational environment, behaviour, attitudes, and feelings. The changing working and operational environment was highlighted when patients, prehospital nursing students, EMS managers, and medical directors described their experiences or views of patient safety issues in EMS. EMS

managers and medical directors considered patient safety an organisational responsibility, but according to the students, there was lack of reporting patient safety events. The EMS personnel and EMS managers' and medical directors' interaction skills and behaviour were highlighted when EMS professionals and students described PSC in EMS. Also, patients highlighted the meaning of EMS personnel behaviour when patients described their experiences regarding safety in the EMS. Feelings and assumptions also have connection to experienced PSC in the EMS.

According to the CFA results, the EMS-SAQ model fit was not totally optimal, and the correlations between five out of the six factors were high. The total mean scores for each safety culture domain were identified as nonpositive. Within the individual characteristics, only education level was linked with significant variation in safety culture scores. All organisation-based characteristics were connected in significant variation in at least one safety culture domain scores.

Conclusions

Changing working and operational environment in the EMS clearly manifests circumstances where EMS operates and is linked to the PSC in EMS. However, the nature of the EMS missions could affect the patient participation to develop patient safety in EMS. Attitudes and behaviour are seemingly in connection to PSC in EMS from the patients, students, and EMS professionals' perspective. EMS does not always seem to be a psychologically safe environment for EMS patients, prehospital nursing students and EMS professionals. Overall, it looks like PSC in Finnish EMS is not optimal and needs development.

TIIVISTELMÄ

Tausta

Potilasturvallisuuskulttuuri on monimutkainen ilmiö. On tärkeää tiedostaa, että erityisesti ensihoidon toimintaympäristössä olosuhteet eivät ole niin vakioidut kuin muissa terveydenhuollon toimintaympäristöissä. Tietoisuus ja ymmärrys potilasturvallisuuskulttuurista voi auttaa parantamaan ja kehittämään potilasturvallisuutta ensihoidossa organisaatio- työyhteisö- ja yksilötasolla. Siksi tämän väitöskirjan tarkoituksena on kuvata sitä, miten potilasturvallisuuskulttuuri ilmenee suomalaisessa ensihoidossa potilaan, ensihoitajaopiskelijan, ensihoitohenkilöstön ja ensihoidon johdon näkökulmista.

Aineisto ja menetelmät

Väitöskirja koostuu neljästä osatutkimuksesta. Väitöskirjassa käytetty aineisto kerättiin vuosina 2018-2021. Osatutkimuksessa haastateltiin T hätäkeskukseen soittaneita ensihoidon hoitamia ja kuljettamia potilaita. Osatutkimukseen II rekrytoitiin sosiaalisen median kautta koko- tai osaaikaisesti ensihoidossa työskenteleviä ammattilaisia eri puolilta Suomea. Osatutkimukseen III rekrytoitiin viimeisen vuoden ensihoidon opiskelijoita kolmesta suomalaisesta ammattikorkeakoulusta. Osatutkimuksen IV ensihoidon esihenkilöt vastuulääkärit rekrvtoitiin ja viiden eri sairaanhoitopiirin alueelta. Edellytyksenä oli, että työnkuvan tuli sisältää johtamiseen ja esihenkilötyöhön liittyviä velvoitteita.

Väitöstutkimuksen tulokset analysoitiin käyttämällä laadullisia (I, III ja IV) ja tilastollisia menetelmiä (II). Osatutkimuksen I haastattelut analysoitiin aineistolähtöisellä sisällönanalyysillä. Osatutkimuksien III ja IV aineistojen analysoinnissa käytettiin (refleksiivistä) teema-analyysia. Osatutkimuksen II ensihoidon turvallisuusasennekyselyn validiteettia arvioitiin faktorianalyysilla (CFA). Turvallisuuskulttuurin osa-alueiden (turvallisuusilmapiiri, tvötvvtvväisvvs, käsitykset johtamisesta, työskentelyolosuhteet, tiimityöilmapiiri ja stressin tunnistaminen) yhteyksiä yksilö- ja organisaatiolähtöisiin tekijöihin tutkittiin käyttämällä soveltuvia epäparametrisia testejä.

Tulokset

Väitöstutkimukseen osallistui yhteensä 384 henkilöä. Näistä 21 oli potilaita (I), ensihoidon ammattilaisia 327 (II), ensihoitajaopiskelijoita 17 (III) ja ensihoidon esihenkilöitä ja vastuulääkäreitä 19 (IV).

Laadullisista tutkimusten (I, III, IV) tulosten perusteella ensihoidon potilasturvallisuuskulttuuri muodostuu ensihoidon työskentelyolosuhteista, käyttäytymisestä, asenteista ja tunteista. Potilaiden, ensihoitajaopiskeiljoiden ja esihenkilöiden sekä vastuulääkäreiden kuvailemissa näkemyksissä korostui ensihoidon muuttuva työskentely- ja toimintaympäristö. Ensihoidon esihenkilöiden ja vastuulääkäreiden näkemysten mukaan potilasturvallisuus Opiskelijoiden on organisaation vastuulla. havaintojen perusteella potilasturvallisuustapahtumien raportoinnissa oli puutteita. esihenkilöiden vastuulääkäreiden Ensihoitohenkilöstön ia sekä vuorovaikutustaitoja ja käyttäytymisen merkitystä korostettiin, kun ensihoidon ammattilaiset ja opiskelijat kuvailivat potilasturvallisuuskulttuuria ensihoidossa. Myös potilaat korostivat ensihoitohenkilöstön käyttäytymistä, kun he kuvailivat kokemuksiaan turvallisuudesta ensihoidossa. Kuvausten ja kokemusten perusteella myös tunteilla ja olettamuksilla oli yhteys koettuun potilasturvallisuuskulttuuriin.

Faktorianalyysin (CFA) tulokset osoittivat, että tällä aineistolla ensihoidon turvallisuusasennekyselyn malli ei ollut täysin optimaalinen ja korrelaatiot viiden turvallisuuskulttuurin osa-alueen välillä kuudesta olivat korkeat. Kokonaisuudessaan kaikki turvallisuuskulttuurin osa-alueet arvioitiin heikoiksi. Yksilölähtöisistä tekijöistä ainoastaan koulutustasolla oli yhteys merkittävään vaihteluun turvallisuuskulttuurin arvioinnissa. Kaikki organisaatiolähtöiset tekijät aiheuttivat tilastollisesti merkitsevää vaihtelua vähintään yhdellä turvallisuuskulttuurin osa-alueella.

Johtopäätökset

Ensihoidon jatkuvasti muuttuva työskentely- ja toimintaympäristö on selkeä ilmentymä olosuhteista, jossa ensihoito joutuu toimimaan. Vaikuttaa siltä, että muuttuvalla työskentely- ja toimintaympäristöllä on myös yhteys ensihoidon potilasturvallisuuskulttuuriin. Ensihoitotehtävien luonne saattaa kuitenkin vaikuttaa potilaiden osallistumiseen potilasturvallisuuden kehittämiseen ensihoidossa. Ensihoidon ammattilaisten, opiskelijoiden sekä potilaiden näkemysten mukaan näyttää siltä, että asenteilla ja käytöksellä on vhtevs ensihoidon potilasturvallisuuskulttuuriin. Vaikuttaa siltä, että ensihoito ei ole psykologisesti turvallinen ympäristö potilaille, opiskelijoille ja ensihoidon ammattilaisille. Tulosten perusteella näyttää siltä, että potilasturvallisuuskulttuuri suomalaisessa ensihoidossa ei ole optimaalinen ja se vaatii kehittämistä.

ACKNOWLEDGEMENTS

This thesis was conducted at the wellbeing services county of South Karelia from 2018 to 2023. Thank you to the wellbeing services county of South Karelia, the Department of Emergency Medicine and Services of Helsinki University Hospital and the University of Helsinki for the financial support, which helped make this thesis possible.

The initial idea for applying doctoral studies arose during my master's studies when Professor Maaret Castrén and Docent Jouni Nurmi highlighted that in Finland, there is a need for more doctoral level research conducted by prehospital nurses. I could not have guessed what an interesting journey to the research world those words would lead me.

I express my deepest gratitude to my supervisors Professor Veronica Lindström, Professor Maaret Castrén, and Dr Susanna Tella. Thank you, Maaret, for believing in me and my ideas at the beginning and introducing me to Veronica. Veronica, thank you for your excellent guidance and support during this research journey. Without your help, enthusiasm, and supervision, this would have been impossible. Susanna, thank you for leading me to collaborate with the international patient safety researchers. Overall, after this journey, I feel I can call you my dear friends.

I warmly thank the reviewers of this thesis, Professor Jouni Kurola and Professor Hanna Kuusisto, for dedicating time and expertise and providing excellent comments for helping me improve my thesis manuscript. Also, thank you to the members of my thesis committee, Docent Tuomo Nieminen, Dr Pirjo Vaittinen, and Dr Minna-Maria Behm, for their support and excellent discussions during this thesis project.

Thank you to my supervisors Jan-Erik Palviainen, Kati Saarikivi, and Timo Tanninen, at the wellbeing services county of South Karelia who made this thesis and research project possible by enabling working arrangements and partial working hours during this project.

Thank you to Pasi Aronen for your guidance, support, and enthusiasm concerning the statistical analysis process in sub study II. Tia, thank you for being my 'language police' and Niina, thank you for accouraging me to apply for doctoral studies. I owe my warmest thanks to the nurses in the emergency department of wellbeing services county of South Karelia for being active and helpful in recruiting patients for the study.

Combining the research work and clinical work was not always easy. Therefore, I thank my colleagues in South Karelia wellbeing county who helped me keep my feet on the ground and close to clinical work in the EMS. I feel blessed having you as my colleagues. I warmly thank you all – Elina, Heini, Miika, Anna, Laura, Mika, Matti, Kimmo, Jarno, Juha, Sussu, Teemu, Eetu, Fatih, Arttu, and other dear colleagues in South Karelia wellbeing county EMS. Special thanks to Dimitri, for helping me with many practical ways during this journey. Milla and Ilmar, thank you for your practical support and 'peer support' discussions during this journey. Katri, thank you for your help in visualising my research to the poster format.

Most importantly, warmest thanks to my family, Pekka and Sisu, my sister Tuuli and her husband Bernie, and my parents Airi and Jaakko for their love and support during this journey. At the end of this project, it was nice hearing my son describing that 'mom is a famous person, it does not bother her, and that she is a good teacher'.

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LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

- I Venesoja A., Castrén M., Tella S., Lindström V. Patients' perceptions of safety in emergency medical services an interview study. *BMJ Open* 2020;10:e037488.
- II Venesoja A., Lindström V., Aronen P., Castrén M., Tella S. Exploring safety culture in the Finnish ambulance service with Emergency Medical Services Safety Attitudes Questionnaire. *Scand J Trauma Resusc Emerg Med* 29, 148 (2021).
- III Venesoja A., Lindström V., Castrén M., Tella S. Prehospital nursing students' experiences of patient safety culture in emergency medical services – a qualitative study. *Journal of Clinical Nursing*, 00, 1–12.
- IV Venesoja A., Tella S., Castrén M., Lindström V. Collaborating with patients concerning patient safety issues in the emergency medical services: an interview study with managers and medical directors. (submitted)

The publications are referred to in the text by their Roman numerals. All articles are reprinted with the publishers' permission.

ABBREVIATIONS

AE = Adverse eEvent CFA = Confirmatory Factor aAnalysis CFI = Comparative Fit iIndex COVID-19 = Coronavirus disease ED = Emergency Department EMCC = Emergency Medical Communication Centre EMS = Emergency Medical Services EMS manager = work includes administrative responsibilities EMS medical director = physician who leads and is responsible for EMS as described in EMS service level decisions EMS officer = operational supervisor of the shift EMS personnel = prehospital nurses, emergency medical technicians (EMT), firefighters, or nurses with or without special training in prehospital care EMS-SAQ = Emergency Medical Services Safety Attitudes Questionnaire EMS-SI = Emergency Medical Services Safety Inventory EMT = Emergency Medical Technician HEMS = Helicopter Emergency Medical Services ICU-SAQ = Intensive Care Unit Safety Attitude Questionnaire INSAG = International Nuclear Safety Advisory Group NNFI = Non-Normed Fit Index OECD = Organisation for Economic Co-operation and Development Prehospital nurse = a nursing degree for the prehospital setting, conducted at the University of Applied Sciences PSC = Patient Safety Culture PSI = Patient Safety Incident RMSEA = Root-Mean-Square Error of Approximation RN = Registered Nurse SLERT = Sharing learning from practice to improve patient safety Learning **Event Recording Tool** SLIPPS = Sharing LearnIng from Practice to Improve Patient Safety SPSS = Statistical Package for the Social Sciences TLI = Tucker-Lewis Index UAS = University of Applied Sciences WHO = World Health Organization

1 INTRODUCTION

Over 12% of healthcare expenditures are consumed by managing unsafe care and other indirect costs evaluated by the Organisation for Economic Cooperation and Development (OECD)(1). Costs to the emergency medical services (EMS) organisations are unclear, but assuming patient safety issues cost the EMS organisations is reasonable. In EMS, approximately 1 in 10 patients experience a patient safety incident (PSI); a median of 15.6% of PSIs harms the patient(2).

From a patient safety perspective in EMS, researchers has stated that key patient safety issues are technical skill, competence, and factors related to EMS working environments(3). Therefore, patient safety studies in EMS mainly focus on clinical judgment, adverse events (AEs) and error reporting, communications, ground vehicle safety, aircraft safety, interfacility transport, field intubation(4), and non-conveyed patients(5, 6). Conversely, the most common reason for AEs in EMS is actions or inactions by the crew(7). Despite knowledge about patient safety issues in the EMS, barriers to reporting patient safety events in EMS exist(8), such as lower PSI counts (0.3/100) when the incident reporting system was utilised, while in studies using record review, the PSI count was 9.9/100(2).

Although patient safety is linked to healthcare expenditures and single measures or working practices, there are other dimensions to consider when discussing patient safety. The World Health Organisation (WHO) highlighted that human factors and patients are critical for designing safe, resilient, and patient safety systems in health care(9). The Finnish client and patient safety strategy and its implementation plan 2022–2026 align with WHO's views by highlighting four strategic priorities: together with clients and patients, thriving and competent professionals, safety first in all organisations, and enhanced best practices(10). Therefore, the WHO can presume the international and national visions of client and patient safety aims to develop PSC rather than single patient safety processes.

However, PSC is a complex phenomenon. Despite PSC including organisational policies and practices and professionals' technical skills, it includes social processes and a psychological dimension(11). Some can presume that behind, for example, actions and inactions of the EMS crew(7) or barriers to reporting patient safety events(8) is PSC in EMS. However, we do not know how and what kind of social processes and psychological aspects affect PSC and patient safety in EMS. Therefore, there is a need for additional knowledge about PSC in EMS as a phenomenon.

Although there is knowledge about patient safety issues in EMS, there is a lack of knowledge concerning PSC in EMS. Therefore, this thesis describes how PSC manifests in the Finnish EMS from the patient, prehospital nursing

student, EMS personnel, and EMS management's viewpoints. This thesis focuses on raising awareness about the good and bad manifestations of PSC in Finnish EMS. This knowledge about PSC's manifestations in EMS can help enhance and develop patient safety at the organisational, team, and even individual levels.

2 REVIEW OF THE LITERATURE

2.1 EMERGENCY MEDICAL SERVICES

EMS as a working environment differs from other healthcare settings; in general, EMS working conditions are less constant than in hospitals. For example, EMS personnel must work outside in different conditions, in patients' homes, and in moving ambulances(12, 13). Another difference from the hospital working environment is that EMS personnel usually work in pairs, and physicians are rarely physically available on-site. EMS missions can be complex by challenging the EMS personnel's decision-making skills(14, 15). EMS personnel need knowledge about the specific contexts in EMS, the patients' medical assessment and care – from assisting in childbirth to resuscitation – and holistic aspects of a patient's situation (16). EMS missions include time-critical emergencies, such as stroke(17), cardiac arrest(18), or trauma(19); commonly, the patient encounters are relatively short compared to the length of stay in emergency departments (EDs)(20), although most EMS missions are non-urgent(6, 21, 22).

EMS principles are similar globally. However, the competencies and educational demands needed to work in the EMS differ around the world(23, 24). Although similarities exist, Finnish educational demands are not totally comparable to those in the other Nordic countries, Belgium, or the UK. For example, in Sweden, Belgium, and Finland, ambulances can be staffed with registered nurses (RNs), while other countries use emergency medical technicians (EMTs) and paramedics(23, 24, 25). The term 'prehospital nurse' is used in this thesis for the Finnish EMS personnel who has earned a degree at the University of Applied Sciences (UAS). 'Prehospital' describes the setting and core competencies the education aims for, and 'nurse' describes the education level that fulfils the nurses' educational demands.

2.1.1 FINNISH EMERGENCY MEDICAL SERVICES

At the beginning of 2023, Finnish healthcare and rescue services combined under the same administration in 21 wellbeing counties. The HUS hospital district and the rescue and healthcare services in Helsinki are excluded from the wellbeing counties; the administration of healthcare and rescue services did not merge in Helsinki(26).

During the study period, Finland had 21 hospital districts, five of which included the university hospital (tertiary care). University hospitals provide all highly specialised medical care services required within their specific catchment areas, meaning every hospital district (secondary care) in Finland belongs to one particular specific catchment area. Every specific catchment area includes a centre for prehospital emergency care. This centre's responsibilities are coordinating the EMS performance regarding the local special features, developing EMS nationally with the other specific catchment areas, and promoting scientific research in their specific catchment area. Centres for prehospital emergency care should follow the EMS effectiveness and performance indicators in their specific catchment area(27).

Hospital districts (secondary care) oversaw organising the EMS in their area. Table 1 presents Finland's geographical information and annual EMS missions. The hospital district could produce the EMS alone, contract with the rescue departments or other hospital districts, or purchase the EMS from the third party, such as private companies(28). Every hospital district and specific catchment area should have a medical director in EMS. The medical director is the physician who leads and oversees EMS as described in hospital districts' EMS service level decisions. The EMS medical director should have a specialist degree in medicine, be versed in emergency medicine, and have EMS experience(27).

Geographical size (km²)*		3	90 909 km²		
People live in Finland (31.12.2021) **	5 548 241				
EMS calls (2021) **	778 337				
Specific catchment area	$\mathbf{H}\mathbf{U}\mathbf{H}^{\dagger}$	TYKS ⁺⁺	TAYS	KUH ⁺⁺⁺⁺	OYS
Areas' geographical size (km ²) *	36 642 km²	62 800 km²	37 073 km²	78 268 km²	176 126 km²
People living in the area (31.12.2021) **	2 207 363	900 422	906 499	796 248	737 709
EMS calls (2021) **	261 224	111 311	127 770	144 781	133 251
 [†] Helsinki University Hospital ^{††} Turku University Hospital ^{†††} Tampere University Hospital ^{††††} Kuopio University Hospital ^{††††} Oulu University Hospital * NLS National land survey of Finland ** Sotkanet.fi Statistical information on welfare and health in Finland 					

Table 1.	Finland's geography and count of annual EMS calls
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In Finland, every hospital district should have an EMS officer who is an operational supervisor of the shift participating in challenging tasks and mass casualty situations as a situation leader. The EMS officer should at least be at the advanced level, meaning he/she should have earned a bachelor's degree to become a prehospital nurse or be a nurse with 30 credits of prehospital emergency care studies. The EMS officer works closely with the prehospital emergency physician. The legal requirement is that all the specific catchment areas should arrange for the prehospital emergency physician in charge 24/7to be stationed in at least one location in their area. A prehospital emergency physician's responsibility is to lead the EMS operational situations in their area with the EMS officers; their duty is to give guidance and medical support to the EMS officers and other EMS personnel(27). Finland has seven Helicopter Emergency Medical Services (HEMS) units; prehospital emergency physicians staff six of them. Prehospital emergency physicians are on-call and move with ground vehicles in six additional areas. Prehospital emergency physicians give guidance by phone or physically participate in high-risk EMS missions in which the patient is estimated to benefit from the prehospital emergency physicians' special competence(29).

The decree of the Ministry of Social Affairs and Health defines the criteria for EMS personnel. One can work in Finnish EMS if he/she is a prehospital nurse, EMT, firefighter, or nurse with or without special training in prehospital care(27). In Finland, education is given to prehospital nurses and nurses at the University of Applied Sciences (UAS); both are bachelor-level educations(30). Prehospital nursing studies include RN qualification, but the education mainly focuses on prehospital nursing. EMTs (practical nurses) can be taught at vocational colleges, while firefighters learn in an emergency services academy. In this thesis, the term 'EMS personnel' covers all these professional titles.

Finland has two levels in the EMS: basic and advanced. At the basic level, an ambulance must have at least one healthcare professional with prehospital emergency care studies (e.g. RN or EMT). The other person can be a healthcare professional or a professionally educated firefighter. In the advanced-level ambulance, at least one person should have a bachelor's degree to become a prehospital nurse or a nurse with 30 credits of prehospital emergency care studies. The other person in the advanced-level ambulance should at least be a healthcare professional or a professionally educated firefighter(27). However, there are no regulations concerning the education levels of administrative EMS supervisors or managers, although the Union of Health and Social Care Professionals in Finland recommends that higher healthcare managers should have a master's degree and education and experience in leading and management(31).

2.2 PATIENT SAFETY

Patient safety is a global issue. Over 12% of healthcare expenditures have been estimated to be consumed by managing unsafe care and other indirect costs(1). The WHO defined patient safety as '*A framework of organized activities that creates cultures, processes, procedures, behaviours, technologies and environments in health care that consistently and sustainably lower risks, reduce the occurrence of avoidable harm, make errors less likely and reduce the impact of harm when it does occur(9)*.' This means reducing the risk of unnecessary harm associated with healthcare to an acceptable minimum. An acceptable minimum refers to the collective notions of current knowledge, available resources, and how care was delivered weighed against the risk of non-treatment or other treatment(32).

Patient safety errors are usually described as caused by faulty systems, processes, or conditions in the organisation rather than individual healthcare workers(33). The role of healthcare organisations and systems emphasises the safety of all clinical procedures, as the WHO patient safety framework's seven strategic objectives show. However, the current WHO patient safety action plan highlights human factors and the patient's role when designing safe, resilient, and patient safety systems in health care (Figure 1)(9).



Figure 1 WHO's patient safety framework's seven strategic objectives. (Figure modified from the source: WHO Global Patient Safety Action Plan 2021–2030: Towards eliminating avoidable harm in health care, p. 13.(9))

The current Finnish client and patient safety strategy and its implementation plan 2022–2026 follow the WHO's patient safety action plan. Finnish client and patient safety strategy and its implementation plan 2022–2026 has four strategic priorities: facilitating clients and patients working together, hiring thriving and competent professionals, putting safety first in all organisations, and enhancing best practices. Each priority has three objectives concretely fostering the realisation of a client and patient safety strategy(10). Figure 2 presents four strategic priorities and their objectives.



Figure 2 Finnish client and patient safety strategic priorities and objectives (Figure source: Finnish client and patient safety strategy and implementation plan 2022–2026(10)).

2.2.1 PATIENTS' ROLE WHEN DEVELOPING SAFER HEALTH CARE

The WHO has raised the patient at the centre of improvement strategies for safer health care (9, 34). The patients' role in developing patient safety has been raised as one of the key issues in the WHO's current patient safety strategy(9). Finnish current client and patient safety strategy highlight the roles of patients and their relatives regarding patient safety development. After all, patients go through the whole healthcare system. Therefore, patients and their relatives could recognise different kinds of threats to patient safety linked to, for example, transitions and information flow, which may be invisible to healthcare personnel(10).

Patient safety from the patients' viewpoint has mainly been studied in hospital settings, showing that patients give valuable insights into improving or assessing patient safety, but previous studies highlight that patients are an underused resource(35, 36, 37, 38). Researchers have concluded there is a need to ensure error management is open, timely, and transparent to patients. Also, error management should promote developing a strong safety culture affording the patient a role in promoting safety in their care(39). A patient's role in promoting patient safety is considered important among patient safety experts(40). However, there are recognised facilitators and barriers to patient engagement and safety(41, 42). For example, in EMS settings, patients' perceptions of safety differ regarding receiving safe care(43). Conversely, there is a lack of research on how a patient could participate in developing patient safety in EMS.

2.2.2 PATIENT SAFETY IN EMERGENCY MEDICAL SERVICES

As a working environment, EMS is challenging and constantly changing compared with other hospital emergency care settings. The hospital environment changes less, and the facilities are planned and built for patient care. In EMS, only the ambulance is built for patient care; otherwise, EMS personnel must operate where the patient is(12, 13, 44). The dynamic and constantly changing environment in EMS could compromise EMS personnel and patients' safety. For example, transporting a patient to the hospital by ambulance could be hazardous, and if an ambulance is moving with blue lights and sirens, the risks of traffic accidents increase(44, 45, 46).



Figure 3 Patient care facilities and treatment equipment inside the ambulance. (Picture by Dimitri Lisitsyn)

One study suggested there are 4.3 AEs per 100 ambulance missions(7); another study suggests that approximately 1 in 10 patients in EMS experience a PSI; of PSIs, a median of 15.6% harms the patient(2). In Finland, between 2017 and 2018, 25 patients got compensation from PSIs in EMS. The most common (52%) reason was PSI during patient transport, such as falling off the

stretchers or the patient being dropped while being moved. Conversely, different kinds of diagnostic delays caused 40% of compensated PSIs in EMS. Some of the compensated PSIs may have been recorded as occurring in the ED, although the actual incident happened in EMS(47).

Patient safety studies within the EMS setting have investigated AEs, mishaps, near-misses, occupational hazards, and patient safety or quality of care(44, 48, 49, 50), as well as clinical judgment, AEs and error reporting, communications, ground vehicle safety, aircraft safety, interfacility transport, and field intubation(4). A recent study has highlighted outcomes and risk factors concerning non-conveyed patients(5), while other studies identified the rate and predictors of adverse outcomes after non-conveyed patients(6). However, recent study summarised that most of the methods for measuring and monitoring patient safety in prehospital care mainly concentrated on past harm (73.1 %) rather than integration and learning (5.8 %)(51).

It has been stated that most AEs in EMS are avoidable. Deviations from standard care and documentation were the most common factors contributing to AEs in EMS. EMS personnel's actions or inactions were the most common cause of AEs (7). Conversely, there are still barriers to reporting patient safety events in EMS. The main reasons behind experienced barriers are primarily caused by a fear of consequences, such as fears of being punished, suspended, terminated, investigated by national authorities, or decertified(8). Deviations from standard care and documentation and experienced barriers to reporting patient safety events could be considered one manifestation of safety culture in EMS.

2.3 SAFETY CULTURE AND SAFETY CLIMATE

The term 'safety culture' was initially defined in 1991 when the International Nuclear Safety Advisory Group (INSAG) published a report on Chornobyl's nuclear accident. INSAG stated that a 'strong safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance'(52). After INSAG's definition, researchers studied safety culture. However, researchers have not determined what definition safety culture includes or consists of(53). Differences in the theoretical background rather than researchers' total disagreement concerning characteristics essential to safety may explain the variations in safety culture (54, 55).

Safety culture is a series of dynamic and multi-layered constructs(54, 55). Researchers show that safety culture includes three interrelated dimensions or levels. The 'Organizational dimension' illustrates how management aims to ensure workplace safety. The 'Social process' or 'group level' represents members' actions and interactions with others, and the 'psychological

dimension' or 'individual level' involves one's subjective experience and understanding of safety(54, 55). Cultural phenomena, attitudes, values, and assumptions form a safety culture. Safety culture is the ability and will to understand what safety performance in organisations means, what hazards it includes, and how preventing hazards is possible, as well as its ability and determination to prevent dangers and advance safety. In a good safety culture, employees have the conditions to do their jobs well(54, 56). Measuring safety culture with only one method or instrument is impossible(55).

Defining safety culture based on accident analysis is probably useful when recognising how an accident could have been prevented. Can safety culture assessment prevent another accident(57)? Guldenmund stated there is no special need to define safety culture. Rather, safety culture should be perceived as an organisational culture impacting attitudes and actions that impair or reduce risks(55).

'Safety culture' and 'safety climate' are usually used synonymously; even researchers have discussed the terms' differences and similarities. In literature, safety culture has been described as less flexible and more complex than safety climate. According to some, safety culture and safety climate should be defined based on research methods. 'Safety climate' is appropriate if data is collected via a questionnaire. Safety climate can measure several attitude levels, such as individual, team, unit, organisation, and environment. Safety climate studies are more like attitude studies.(55, 58, 59)

Conversely, some have argued that safety climate is appropriately analysable only at the team and organisational levels. Those levels repeatedly highlight supervisors' and managers' impact on safety(55, 59). Research shows that organisational climate predicts team-level climate, which impacts behaviour, and demonstrated that when safety and productivity compete, supervisors' actions influence perceived perceptions of the safety climate(60, 61). Some have stated that employees' commitment to the job impacts the safety climate. The most critical factors impacting this commitment are the supervisor's ability to recognize the growing climate and how they allow the climate to be shaped by safety culture(58, 60, 61, 62). Despite the differences between safety culture and safety climate, this thesis uses the term safety culture for clarity and includes safety climate in safety culture.

2.3.1 SAFETY CULTURE IN HEALTH CARE

Evidence shows that safety culture in health care affects patient safety. Occupational safety and patient safety are combined for well-being at work and employee output. The links between employees' well-being, occupational safety, and patient safety should be noticed because of the organisation's endeavours. In health care, enhancing safety culture can positively impact patient safety(56, 59).

Safety culture formulates situation awareness, communality, and cooperation among organisations, supervisors/managers, and employees.

Decision-making strongly affects safety culture in health care. Therefore, the organisations and supervisors/managers are crucial when developing a safety culture in health care. Despite affecting patient safety, safety culture has been suggested to affect healthcare personnel safety(59). Although leaders have been recognised as critical when discussing safety culture in health care, nurse leaders have described barriers to leading and developing a safety culture(63). It has been suggested that as a part of patient safety and quality, developing a safety culture should be measured annually(64). Safety culture has been also explored in EMS settings.

2.3.2 SAFETY CULTURE IN EMERGENCY MEDICAL SERVICES

Safety culture in EMS has been studied with the EMS-Safety Attitudes Questionnaire (EMS-SAQ)(65, 66, 67). The EMS-SAQ was developed by modifying the Intensive Care Unit Safety Attitude Questionnaire (ICU-SAQ)(68) suitable for prehospital settings, measuring variations in safety culture between EMS organisations; results showed wide variations in safety culture scores across EMS agencies. HEMS agencies scored higher across all safety culture domains. Safety culture scores were higher in organisations where the annual patient contacts were lower and in organisations with fewer employees(66).

The same EMS organisations have measured safety culture in EMS for two consecutive years. The researchers found significant differences between the first and second years. In some services, the scores increased; in others, they decreased. Only one service showed only minor changes between the years. However, researchers could not identify the reasons for those differences(67).

Safety culture in EMS has been studied with other methods; some have suggested the perceptions of the EMS personnel, social environment, organisational endorsement and guidance, and paramedics' role in the working community have affected the safety culture. The same study stated that national guidance, organisation management, and leadership have the most significant role in the safety culture in EMS(69). Occupational callings have been depicted as affecting the relationship between safety culture and safety behaviour. If the occupational callings were high, the relationship between safety culture and safety behaviour was stronger; if the occupational callings were low, the relationship was weakened(70). In the EMS setting, burnout is associated with safety outcomes(71), which could be seen as one manifestation of safety culture in EMS. Safety culture is part of the organisation's culture; thus, understanding the organisational culture theory is essential(54, 55).

2.3.3 ORGANISATIONAL CULTURE

Organisational culture in health care is connected to healthcare quality and patient safety(11, 72). Therefore, understanding what organisation culture is, what it covers, and how to assess it is crucial. Avoiding the oversimplification of organisational culture is important because doing so could complicate generating understanding among the culture members, inhibiting attaining desired goals(73).

Organisational culture has three levels, artefacts, or visible manifestations, espoused values, or shared ways of thinking, including beliefs, values, underlying assumptions, or deeper shared assumptions(11, 72, 73, 74). Artefacts are visible and noticeable organisational structures and processes. Espoused values regard an organisation's strategies, goals, and philosophies that are invisible but concluded, such as those based on conversations. Underlying assumptions are unconscious and describe perceptions, thoughts, feelings, and beliefs. These underlying assumptions are unnoticeable; however, the answer to 'why' can be found in these assumptions (11, 72, 73, 74).

Regarding the EMS context, artefacts or visible manifestations include, for example, working conditions, communication styles, and the EMS guidelines. In turn, espoused values or shared ways of thinking are, for instance, beliefs and values typical for EMS personnel. Underlying assumptions or deeper shared assumptions determine, for example, perceptions, thought processes, feelings, and behaviours manifesting in EMS assignments(75).

Overall, culture is learned(74). Understanding that part of people's learning is 'constructing knowledge and meaning from real-life experience' is crucial in this context(76). For example, in workplaces, learning occurs in two ways: students or new graduates (novices) learn from experienced professionals and vice versa(77). Changing and affecting the culture is a slow process, and culture changes rarely succeed if the changes are forced from the top down. From the EMS perspective, taking care of working conditions, including vehicles, equipment, stations, and career development, is the easiest way to affect the culture(78).

2.4 PATIENT SAFETY CULTURE

When researchers say patient safety culture (PSC), they define sections of safety culture impacting patient safety(11, 79, 80). Based on previous publications(81, 82), WHO defined safety culture as '*The product of individual* and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management'. WHO also defines safety culture as 'an integrated pattern of individual and organizational behaviour based upon shared beliefs and values, that continuously seeks to

minimize patient harm that may result from the processes of care delivery'(32).

PSC has been suggested to include three interrelated dimensions, the 'organisational dimension', the 'social process', and the 'psychological dimension'. The organisational dimension describes an organisation's actions that aim to ensure patient safety. Social process describes how meaning is created, how things are interpreted, and how practices develop within the organisations. Conversely, the psychological dimension describes one's subjective experiences and perceptions concerning their work(11). Safety culture studies have used this same classification(54, 55).

However, the other researchers found seven different PSC properties in their studies: leadership, teamwork, evidence-based, communication, learning, 'just', and patient-centred. Leadership describes leaders' ability to acknowledge that health care is a high-risk environment and their skills to recognize, for example, staff competency, human resources, and ability to align the vision/mission. Teamwork describes the spirit of collegiality, collaboration, and cooperation among different healthcare actors. Evidencebased means patient care is based on evidence, processes are standardised, and a process's goal is high reliability. Communication describes the environment where one has the right and responsibility to speak up for the patient regardless of their job. *Learning* aims for a healthcare organisation to learn from mistakes and seeks opportunities to develop its actions and processes. Just means a culture where errors are recognised as system failures rather than individual failures. A culture is where individuals do not get punished or blamed for failures. Patient-centred means patient care is patient and family-centred, and the patient actively participates in his/her care and acts as a liaison between different actors(79, 83). Leadership could be said to play the most important role in PSC because some have said that a manager's behaviour can influence the quality of care and AEs(84).

Effective leadership and a supportive culture are essential for improving PSC. The environment should encourage professionals, students, and patients to speak freely without fear and retribution. In that environment, people want to report risks and safety incidents to learn from them. Creating an environment where people understand that incidents are largely caused by system failures rather than individuals is important(85). If the environment is experienced as psychologically safe, then everyone can speak up without fear of being belittled or dealing with other negative consequences(79, 86).

The prevailing PSC positively impacts organisational support. Organisational support reduces unwanted consequences such as second victim-related distress(87). The term 'second victim' has been used to describe healthcare personnel who have been affected psychologically or physically after they have (potentially) harmed their patients(88, 89). Despite different dimensions of PSC, research on that topic in EMS settings is mainly conducted with questionnaires(90, 91, 92, 93).

2.4.1 PATIENT SAFETY CULTURE IN EMERGENCY MEDICAL SERVICES

PSC in EMS has been mainly measured with questionnaires. However, those studies include the perspectives of the EMS personnel's safety(90, 91, 92, 93). For example, one study suggests the safety culture experienced by EMS personnel and patients and EMS personnel safety outcomes are interrelated(90). That study combined EMS-SAQ results and EMS safety inventory (EMS-SI) results. EMS-SI is a tool to capture EMS personnel's self-reported safety outcomes. In that study, respondents who reported injury gave lower scores on five of the six safety culture domains. Also, respondents who reported an error or AE gave lower scores on four of the six safety culture domains. When respondents reported safety-compromising behaviour, they had lower safety culture scores for five of the six domains(90). Otherwise, PSC studies in EMS have mainly concentrated on evaluating PSC questionnaires' psychometric properties in the EMS setting(91, 92, 93).

2.5 PATIENT SAFETY EDUCATION IN FINLAND

In Finland, eight Universities of Applied Sciences (UASs) educate prehospital nurses (bachelor's level education). The overall extent of the prehospital nurse studies is the 240 European Credit Transfer and Accumulation System (ETCS), which includes RN qualification. These 240 ETCS include 80–90 ETCS internships; approximately 30 ETCS include internships in ambulance service. Therefore, prehospital nursing education follows the Finnish national and European higher education qualification framework(30). In Finland, the UASs have the autonomy to determine the course contents; therefore, the course content can vary. For example, in some UASs, patient safety education is part of all the prehospital nursing studies, whereas some UASs organise specific patient safety courses(94, 95), and some of the learning concerning patient safety occurs during internships(96, 97, 98).

According to Finland's largest healthcare organisation's annual patient safety and quality report, organisations can offer and require patient safety education for their personnel(99). Some patient safety courses are nationally coherent and available online(100). For instance, the Finnish Centre for Client and Patient Safety organise online and face-to-face meetings and seminars for patient safety(101). Although Finnish legislation pays attention to patient safety(28, 102, 103), the legislation does not take a stand on healthcare professional patient safety education. However, a recently published Finnish Client and Patient Safety strategy suggests that different professional groups in health care should have nationally coherent competence criteria for client and patient safety(10).

3 AIMS OF THE STUDY

This thesis aimed to describe the manifestations of patient safety culture in Finnish EMS from the patient, prehospital nursing student, EMS personnel, and EMS management perspective.

This thesis aimed to specifically:

- 1. Describe the patients' perceptions of safety in the EMS. (I)
- Test the psychometric properties of EMS-SAQ in a Finnish EMS setting. (II)
- 3. Explore the connections between individual- and organisation-based characteristics and safety attitudes in the Finnish EMS setting. (II)
- 4. Describe prehospital nursing students' experiences of patient safety culture in EMS during their internship. (III)
- Describe EMS managers' and medical directors' perceptions of collaborating with patients concerning patient safety issues in the EMS. (IV)

4 MATERIALS AND METHODS

4.1 STUDY DESIGN

The design of this thesis is descriptive and includes studies with qualitative and quantitative approaches. Table 2 presents the overview of study characteristics.

Table 2.Overview of the study characteristics

	STUDY I	STUDY II	STUDY III	STUDY IV
AIM	Describe the	Test the	Describe	Describe EMS
	patients'	psychometric	prehospital	managers' and
	perceptions of	properties of EMS-	nursing	medical directors'
	safety in the	SAQ in a Finnish	students'	perceptions of
	EMS.	EMS setting and	experiences of	collaborating with
		explore the	patient safety	patients
		connections	culture in EMS	concerning
		between	during their	patient safety
		individual- and	internship.	issues in the EMS.
		organisation-based		
		characteristics and		
		safety attitudes in		
		the Finnish EMS		
		setting.		
PARTICIPANTS	EMS patients	EMS personnel	Graduating	EMS medical
	aged 44–91,	(nurses,	prehospital	directors (n=5),
	n=21	prehospital nurses,	nursing	EMS managers
		EMTs,	students, n=17	(n=14), n=19
		firefighters), n=327		
SETTING	EMS patients	EMS personnel in	Three UASs in	Five EMS
	from urban and	Finland,	Southern	organisations in
	rural areas in	participants	Finland	one specific
	Southeast	recruited via social		catchment area in
	Finland	media		Finland
DATA	Individual	EMS-SAQ (survey)	SLERT-tool	Five group
COLLECTION	interviews		(written	interviews, two
			description and	individual
			reflection of an	interviews
			important	
			patient safety	
			learning event)	

ANALYSIS	Qualitative content analysis (inductive)	CFA (psychometric properties); nonparametric tests (the connection between individual- and organisation-based	Thematic analysis (inductive)	Reflexive thematic analysis (inductive)
		organisation-based characteristics and safety attitudes)		

EMS = emergency medical services, EMS-SAQ = emergency medical services safety attitudes questionnaire, EMT = emergency medical technician, SLERT= Sharing Learning from Practice to Improve Patient Safety Learning Event Recording Tool

4.2 STUDY SETTING

All the interviews in study I were conducted in one hospital district in southern Finland; in that area, one service provider is responsible for EMS. Participants in study II were from all five specific catchment areas and were recruited via social media. Study III recruited participants from three UASs in southern Finland. All the participating organisations in study IV were from one specific catchment area in Finland.

4.3 STUDY PARTICIPANTS

Purposive sampling was used to recruit the participants for the studies(104) to achieve depth and variation in the collected data. Purposive sampling means the researcher selects information-rich cases for in-depth study to illustrate the questions under study(105).

4.3.1 EMERGENCY MEDICAL SERVICES PATIENTS AS PARTICIPANTS IN INTERVIEW STUDY (I)

Recruited participants in study I were patients who were transported by the EMS after calling the emergency medical communication centre (EMCC). Participants were recruited from one healthcare district in southern Finland. Participants should have been appraised as low-priority in the ED or after treatment there. Interhospital-transported patients; patients under the influence of alcohol or drugs (as evaluated by an ED nurse); patients who needed urgent treatment in the ED; patients under 18; patients unable to

communicate in Finnish; and patients with a memory disorder or terminal disease were excluded.

4.3.2 EMERGENCY MEDICAL SERVICES PROFESSIONALS AS PARTICIPANTS IN QUESTIONNAIRE STUDY (II)

Study II's participants were recruited via social media to obtain EMS personnel working full- or part-time in the EMS from different areas in Finland. Social media was selected to attain many EMS personnel from different areas in Finland because social media is an effective way to collect data in health, medical, and social research(106, 107).

4.3.3 PREHOSPITAL NURSING STUDENTS AS PARTICIPANTS IN SURVEY STUDY (III)

Study III's participants were recruited from three UASs. Participants should be final-year prehospital nursing students, meaning they should have completed all internships in the EMS or were doing their last internship in the EMS.

4.3.4 EMERGENCY MEDICAL SERVICES MANAGERS AND MEDICAL DIRECTORS' AS PARTICIPANTS IN INTERVIEW STUDY (IV)

EMS organisations' managers and medical directors from five healthcare districts were recruited to participate in study IV. Achieving three to five participants from every EMS organisation was the goal. EMS organisations were guided: all the participants' job descriptions should include managerial/supervisor responsibilities; one of the participants should be the EMS organisation medical director, and another should be the manager overseeing the EMS. Otherwise, EMS organisations could decide who from the organisation should participate in the study.

4.4 DATA COLLECTION

Data sets were collected between 2018 and 2021. Studies I and IV were interview studies. Study II was a survey of the EMS providers. Study III collected the data with written descriptions using the Sharing Learning from Practice to improve Patient Safety Learning Event Recording Tool (SLERT).

4.4.1 DATA COLLECTION IN INTERVIEW STUDY FOR EMERGENCY MEDICAL SERVICES PATIENTS (STUDY I)

Study I's interviews were conducted in the spring of 2018. Interviews were conducted in March 2018 on weekdays between the 8th and 16th. However, some of the patients could have arrived at the ED at night. The researcher received a list of eligible participants from the ED nurse. All interviews were conducted in the ED shortly after the patients had arrived, where the ED personnel assessed and gave them the initial treatment. Interviews were recorded with the patient's consent. Short memos were made concerning the patient's age and reason for calling an EMCC.

Interview questions were created with the supervisors to describe patients' perceptions of safety in the EMS (Appendix 1). All the interviews started with an open-ended question: 'Can you tell me about your experience of the EMS encounter?' Interviews continued via semi-structured questions, where patients were encouraged to share their experiences of different parts of the EMS encounter and what in those EMS encounters made them feel safe or insecure. The interviews lasted approximately 10 to 20 minutes.

4.4.2 DATA COLLECTION IN QUESTIONNAIRE STUDY FOR EMERGENCY MEDICAL SERVICES PROFESSIONALS (STUDY II)

Study II of the EMS providers was conducted between December 2019 to January 2020. Data was collected via social media using the Webropol® survey tool. The link to the questionnaire was shared on Facebook® and Instagram®, targeting workers in the EMS or the EMS stakeholders. The social media page followers were informed that the questionnaire was only for those working full- or part-time in the EMS.

4.4.2.1 Emergency medical services safety attitudes questionnaire

The EMS Safety Attitude Questionnaire (EMS-SAQ)(65, 66) was developed by modifying the Intensive Care Unit Safety Attitude Questionnaire (ICU-SAQ)(68) suitable for the prehospital setting. ICU-SAQ and other SAQ versions were based on the Flight Management Attitudes Questionnaire, which assesses airline cockpit safety culture(108).

The EMS-SAQ measures six different safety culture domains: safety climate, teamwork climate, perceptions of management, stress recognition, working conditions, and job satisfaction(65). The SAQ has been used and validated in several other healthcare settings (109, 110, 111, 112); measuring and comparing safety attitudes is suitable among different settings and services(113).

The EMS-SAQ includes 50 statements concerning the safety culture in the EMS (Appendix 2). Based on the ICU-SAQ, the EMS-SAQ contains 30 core

questions characterising six safety domains: safety climate, job satisfaction, perceptions of management, teamwork climate, working conditions, and stress recognition. Every domain includes four to seven core questions. Study II had nine demographic questions, four concerning individual characteristics (age, gender, education level, working experience), and five concerning organisation-based characteristics (position type, employment status, shift length, employer status, and which specific catchment area the participant works).

4.4.3 DATA COLLECTION IN SURVEY STUDY FOR PREHOSPITAL NURSING STUDENTS (STUDY III)

In study III, prehospital nursing students documented experiences of patient safety events they had encountered while interning in EMS; these experiences were collected in the spring and autumn of 2020. Data collections were conducted in two periods because the number of responses was small after the first round. Data was collected via Webropol® survey tool (first and second period) and face-to-face data (second period) in the autumn of 2020, as one UAS offered to meet some of the targeted students in person. Practical arrangements for sharing the invitation to participate and the survey link with the students were arranged with the course leaders/teachers.

4.4.3.1 Sharing learning from practice to improve patient safety learning event recording tool

SLERT was used for data collection. SLERT utilises the critical incident technique (CIT) methodology, where participants are guided to memorise and describe their observations concerning critical incidents (positive or negative) (114). SLERT was chosen for data collection because it can help collect information-rich student descriptions of patient safety events. The Sharing Learning from Practice to improve Patient Safety (SLIPPS) research team developed SLERT, which is publicly available in various languages.

SLERT includes three parts. In the first, respondents were asked to describe a positive or negative patient safety event as precisely as possible, supported by supplementary questions: what happened, who was involved and what they did, when and where it happened, what the outcome/result was, and if it was discussed with the persons involved. In the second part, the respondents were asked to describe their feelings afterwards, what they learned from the event, and what they thought others should learn. The third part included structured background questions where the respondent selects the most appropriate option(s) from those given. The background questions were as follows: age, gender, year in the programme, what the event broadly related to (communication; checking/verification; teamwork; leadership, guidance, and education; handover/information transfer; procedure and/or

treatment; moving and handling; decision-making; using technology or equipment; medications; confidentiality; violence; food and nutrition; infection prevention and control; invasive procedures; and others), the type of event (good practice, near miss, hazard, AE) and whether it was reported through the reporting system and documented on the patient's medical record. Two background questions were excluded (profession and the type of clinical/work placement in which the event happened) because study III aimed to research only patient safety events experienced by prehospital nursing students during their ambulance service internship (Appendix 3).

4.4.4 DATA COLLECTION IN INTERVIEW STUDY FOR EMERGENCY MEDICAL SERVICES MANAGERS AND MEDICAL DIRECTORS (STUDY IV)

Data was collected between May and September 2021 by interviewing EMS managers (n=14) and medical directors (n=5). Interviews were recorded and conducted remotely (On-Premise Zoom) with the participants' consent. Data was collected in five group interviews and two individual interviews. Because of timing, two interviews were conducted individually with two medical directors, achieving the equivalent of the information that would have been obtained had all the medical directors from all the participating healthcare areas been interviewed. Interviews lasted from 30 minutes to a little over an hour.

Interview questions were devised with the supervisors to explore EMS managers' and medical directors' perceptions when collaborating with patients concerning patient safety issues in the EMS (Appendix 4). The participants were asked for examples to describe their views on what constitutes patient safety in EMS, how patients can communicate their safety concerns, excellence and development ideas, and how participants could include patients to develop patient safety in the EMS. Short memos and final checks were made concerning participants' background information.

4.5 STUDY METHODS

This study combines qualitative (studies I, III, and IV) and statistical analysis methods (study II).

4.5.1 QUALITATIVE ANALYSIS

Studies I, III, and IV utilised qualitative methods in data analysis. In study I, no supporting program was used, while Atlas.ti® software supported the analysis in studies III and IV. Study I used inductive content analysis(115), while studies III and IV used (reflexive) thematic analysis(116, 117).
Study I used inductive qualitative content analysis to analyse the data(115). The analysis started with preparation, meaning the text was read several times to obtain a sense of the whole, selecting the unit of analysis and deciding on the analysis of manifest content. In study I, the unit of analysis was patients' expressions about their safety experiences in the EMS. The experiences were single words or short sentences. The supervisor read the transcriptions to increase the process's reliability and verify the preparation phase. After that, the organising phase commenced, which included open coding and creating categories, grouping codes under higher-order headings, and generating categories and subcategories. During the analysis, there was a recurrent movement between the whole and its parts. By being close and moving backwards and forwards in the text during the analysis, the researchers strove to be as reflective and open to the data as possible. Also, there were discussions concerning the balance between pre-understanding and openness to the content during the analysis. In every phase, the analysis continued after the researchers reached a consensus. The last phase of the analysis was conceptualising the results and producing the report.

Six phases of (reflexive) thematic analysis(116, 117) guided studies III and IV. The analysis started with familiarising the data. In study III, this meant reading the prehospital nursing students' written narratives and making notes. In study IV, the analysis started by listening and transcribing the interviews verbatim and noting the initial analytic ideas. In the second phase, studies III and IV's initial codes were generated, and data relevant to each code was collated. In the third phase, searching for themes commenced. In the fourth phase, preliminary themes were reviewed by reading the coded data extracts to deduce whether these themes appeared to form a coherent pattern and examining the relationship of the preliminary themes to the whole dataset. In this phase, to enhance the credibility and clarity of the analysis, preliminary themes were presented in study III to the prehospital nursing students not participating in the study; in study IV, preliminary results were presented to the study participants. These results revealed the need for minor changes to codes and themes in both studies. Changes were made before continuing the analysis. In the fifth phase, clear definitions and names for each theme were created, and all the supervisors did a member check of the analysis. The sixth phase was finalising the study reports.

4.5.2 STATISTICAL ANALYSIS

For study II, a statistical analysis was performed using Statistical Package for the Social Sciences Amos (SPSS Amos) version 25.0 and Statistical Package for the Social Sciences (SPSS) version 25.0.

CFA was conducted to validate the questionnaire (EMS-SAQ) in a Finnish setting. The sample size for multiple factors analysis research is recommended to be at least ten times the number of items(118, 119). Therefore, the minimum acceptable sample size was 300, which was achieved. Before the CFA, missing

values were imputed with the median. This method is acceptable when only a few values are missing(120). Missingness was between 0% (22 questions) to 0.9% (one question). Normality was screened using skewness or kurtosis values and the normality plots of a histogram(121). Eighteen variables show indications of nonnormality (kurtosis or skewness values larger than \pm 1). Because of nonnormality, the maximum likelihood (ML) with 1000 bootstrapped replications was used(118). Following the previous studies EMS-SAQ conducted, the comparative fit index (CFI); Tucker-Lewis index (TLI); non-normed fit index (NNFI); and the root-mean-square error of approximation (RMSEA) were used to assess fit. Following Hair's recommendation(122), the criteria were set to evaluate the model's adequacy: CFI 0.90, NNFI 0.90, and RMSEA < 0.07. The modification indices (MI) were examined to identify any additional supplements. Cronbach's alpha was used to explore the reliability level, set at \geq 0.7(123).

Appropriate non-parametric tests were used to explore the connections between individual- and organisation-based characteristics and safety attitudes. The significance level was set at 0.05. The Bonferroni correction adjusted significance values for multiple tests. Before exploring the connections between individual and organisation-based characteristics and safety attitudes, the 5-point Likert scale was converted to a 100-point scale: 0 = Disagree strongly, 25 = Disagree slightly, 50 = Neutral, 75 = Agree slightly, 100 = Agree strongly. Two questions ('*In this EMS agency, it is difficult to discuss errors*' and '*At this EMS agency, it is difficult to speak up if I perceive a problem with patient care*') were reverse-coded in the analysis to match the other questions. Prior studies dichotomized the safety culture domain scores as 'positive' (\geq 75) and 'non-positive' (< 75). Study II used the same dichotomising, meaning the respondents' answers with an average of 'agree slightly' or higher were considered positive.

4.6 ETHICAL CONSIDERATIONS

The guidelines of the Declaration of Helsinki (124) and other international and national ethics guidelines(125, 126, 127) were followed. The Ethics Committee of Helsinki University Hospital (HUS/3529/2017) approved Study I. After consultation, the Helsinki University Hospital ethics committee stated that according to Finnish law(128), designs of the other studies (II, III, IV) need no formal ethics approval. However, in studies III and IV, we obtained research permits from all the participating organisations; the University of Applied Sciences in study III (LAB University of Applied Sciences; date14.2.2020; Metropolia University of Applied Sciences in study IV. Research permit numbers in study IV could expose the study participants.

Therefore, for the participants' privacy, research permit numbers and the information of the participating organisations are confidential.

Participation was voluntary in all four studies, and the participants received written information about the study's purpose with contact information for the responsible researcher. In study I, the patients completed a form affirming their voluntary participation; during the interviews, they were observed, and there was preparation to discontinue the interviews if any changes occurred in their physical or mental condition. Patients were informed that participating, withdrawing, or anything they might say would not influence their treatment in the hospital or EMS. The participants had the right and possibility to withdraw from the study by suspending their interviews (I and IV) or selecting not to send the answers (II and III).

The study's purpose and information about the research were discussed with the participants when the interviews commenced (studies I and IV). In studies II and III, sending the responses (II) or writing and sharing about the experience (III) was considered consent to participate. Because of the study design, the need for written informed consent was waived in studies II and III. Accurate identifying information (e.g. name, birthdate, address, IP address, employer/internship location, or hospital district) was not collected from the respondents. In study III, direct contact lists/email addresses, including all potential participants, were unavailable due to restrictions in the research's permissions.

In study IV, a data protection statement and information about the study's purpose were shared with the organisations' contact persons while the interview time was agreed upon. Before the interviews, all participants in study IV provided verbal consent to indicate voluntary participation. On-Premise Zoom provided by NORDUnet was used to conduct the interviews remotely. This service was securely implemented following EU regulations.

5 RESULTS

5.1 PARTICIPANT CHARACTERISTICS

Altogether, 384 adults participated in studies I, II, III, and IV. Of those 384, 194 were male; information about gender was missing for four participants.

5.1.1 PATIENTS' CHARACTERISTICS IN STUDY I

In study I, all participants (n=21) were patients who were transported by the EMS after calling the EMCC. Nine were male between 41 and 86 (mean age 68.1), and 12 were female between 44 and 91 (mean age 74.5). Twelve were transported from urban areas; the rest came from rural regions. The most common reason for seeking EMS care was breathing difficulties (n=5) or cardiac-related symptoms (n=5). Other reasons were gastrointestinal problems (n=3), lower body pain (n=2), minor injury (n=2), or neurological symptoms (n=2). Two participants did not share why they requested help from EMS.

5.1.2 EMERGENCY MEDICAL SERVICES PROFESSIONALS' CHARACTERISTICS IN STUDY II

Study II's total sample size was 333 EMS providers. In the Finnish EMS setting, personnel usually work 24-hour or double shifts. Therefore, six responses were omitted because of divergent shift lengths (three-shift, day shift). Therefore, the final admitted sample size was 327, which was acceptable for CFA. Of the respondents, 50.31% (n=163) were male, and most (63%, n=172) were 35 or younger and had a decade or less of working experience in EMS (68.2%, n=223). Most of the respondents (81.23%, n=264) worked on an advanced level, and 85.2% (n=282) worked in the public sector (hospital district or fire department). Respondents were from all five specific catchment areas, and 34.25% (n=112) were from the Helsinki University Hospital districts area. Tables 4 and 5 present more detailed participant characteristics with the safety culture domain scores.

5.1.3 PREHOSPITAL NURSING STUDENTS' CHARACTERISTICS IN STUDY III

Participants (n=17) were final-year prehospital nursing students. They had all completed their internship in the EMS or were doing their last internship in the EMS. Eight of the participants were male; information was missing for one

participant. All the participants were under 40; most (n=14) were 30 or younger.

5.1.4 EMERGENCY MEDICAL SERVICES MANAGERS AND MEDICAL DIRECTORS' CHARACTERISTICS IN STUDY IV

Study IV's participants (n=19) were EMS managers (n=14) and medical directors (n=5). Most were male (n=14); all were over 30 and had 6–36 years (mean 22,1) of working experience in EMS. Working experience in managerial positions varied from under one year to 30 (mean 9,0). All the participants had received patient safety education.

5.2 PATIENTS' PERCEPTIONS OF SAFETY IN EMERGENCY MEDICAL SERVICES

Study I's results comprised one main category: *patients' confidence in the EMS*. Looking at two generic categories under the main category, patients' confidence in EMS relies on *EMS personnel's social skills and professional competence* and *circumstantial factors affecting care* (Figure 4).



Figure 4 Patients' perceptions of safety in the EMS. Figure modified from study I.

Based on the results, EMS personnel's social skills and professional competence affected patients' sense of safety in EMS. EMS personnel social skills and professional competence formulated four subcategories: *equal treatment, information, involvement in care decisions,* and *EMS personnel professional competence.*

Equal treatment describes the meaning of dedicated patient-EMS personnel regarding the patients. Patients' descriptions of a trustworthy, patient-EMS personnel relationship include the EMS personnel's calm, natural, and friendly behaviour. According to the patients, these aspects generated a sense of safety in the EMS.

Patients' descriptions concerning the information they received were contradictory. Patients stated having received enough information as well as a lack of information. However, this lack did not automatically reduce patients' confidence in the EMS personnel and their professionalism because they felt they received help from EMS personnel.

Patients described their involvement in care decisions as varied. Sometimes, EMS personnel asked about their needs, such as for pain medication, while in other situations, EMS personnel neglected patients' wishes concerning, for example, transport position without explaining why. The possibility of one's transport position being affected was important to those patients' sense of safety who suffered breathing problems. Sometimes, if the patients experienced something threatening their safety, they could take an active role.

According to the patients, EMS personnel's professional competence made them feel safe. The EMS asking questions about their health problems, getting background information, taking numerous assessments, and giving medication when needed showed competence to the patients. Conversely, patients' experience of a lack of EMS personnel's professional competence made the patient feel uncertain and unsafe, such as if the EMS personnel were uncertain what had caused the patients's health problem or when the patient became aware that the EMS personnel had a lack of knowledge or competence.

According to the results, circumstantial factors affecting patients' care affected patients' experiences of safety in the EMS. This generic category is formulated from two subcategories: *environmental factors* and *EMS personnel driving skills*. Based on patients' experiences, environmental factors, such as road and weather conditions, ambulance features, and conditions inside the ambulance during transport, as well as EMS personnel's driving skills, created the circumstances affecting the patients' safety experiences in the EMS.

Environmental factors affected patients' feelings of safety in EMS. The patients stated that EMS is an essential public safety function, and experiences of quick response times affected their perceptions of safety. Conversely, some environmental issues, such as bad bumpy roads or poor suspension in the ambulance, made patients feel unsafe or otherwise uncomfortable. Overall, patients described feeling relieved and secure when the EMS personnel arrived with help and good equipment.

EMS personnel's driving skills and style affect patients' perceptions of safety in EMS. Patients described feeling unsafe and insecure if the ambulance was too fast, especially on uneven roads or in bad weather conditions. According to the patients, EMS personnel's good and safe driving skills were reflected in "smooth and fast transportation," not driving too fast, and taking notice of the weather and road conditions by adjusting their driving style.

5.3 SAFETY CULTURE IN FINNISH EMERGENCY MEDICAL SERVICES

5.3.1 FINNISH EMERGENCY MEDICAL SERVICES SAFETY ATTITUDES QUESTIONNAIRE VALIDITY AND RELIABILITY RESULTS

Factor loadings ranged from 0.86 (Job Satisfaction Q3: *This EMS agency is a good place to work* and Job Satisfaction Q4: *I am proud to work at this EMS agency*) to 0.42 (Working Conditions Q4: *All the necessary information for treating patients is routinely available*). According to the chi-square test, the fit was significant ($\chi 2 = 828.471$, degrees of freedom [df]* = 390, p = 0.000), and RMSEA was 0.059, also suggestive of a good fit. However, according to the results from CFI (0.896) and TLI (NNFI) (0.884), there was a slight lack of model fit. The correlations between five of the six factors were high, and stress recognition has a negative correlation among the other factors (Table 3). The total model, Cronbach's alpha, was 0.871. The single domains, Cronbach's alpha, ranged between 0.851 (Job Satisfaction) to 0.660 (Working Conditions) (Tables 4 and 5).

Factor		Factor	Correlation estimate
Safety climate	<>	Teamwork climate	0.976
Job satisfaction	<>	Teamwork climate	0.935
Teamwork climate	<>	Perceptions of management	0.908
Teamwork climate	<>	Working conditions	0.882
Job satisfaction	<>	Perceptions of management	0.870
Safety climate	<>	Working conditions	0.862
Perceptions of management	<>	Working conditions	0.851
Safety climate	<>	Perceptions of management	0.843
Job satisfaction	<>	Safety climate	0.840
Job satisfaction	<>	Working conditions	0.834
Stress recognition	<>	Working conditions	-0.159

Table 3. EMS-SAQ (Fin) correlations between the factors

Stress recognition	<>	Perceptions of management	-0.170
Job satisfaction	<>	Stress recognition	-0.198
Teamwork climate	<>	Stress recognition	-0.212
Safety climate	<>	Stress recognition	-0.221

5.3.2 CONNECTIONS BETWEEN INDIVIDUAL AND ORGANISATION-BASED CHARACTERISTICS AND SAFETY ATTITUDES

The total mean scores for each safety culture domain (safety climate, teamwork climate, perceptions of management, stress recognition, working conditions and job satisfaction) were identified as non-positive (< 75). Also, a percentage of positive (\geq 75) responses was calculated (Figure 5).



EMS-SAQ n=327

Figure 5 Total mean scores and percentage of positive responses for each safety culture domains based on EMS professionals' perceptions.

Means and standard deviations were calculated for age, gender, education, working level, working experience (Table 4), employment status, shift length, employer status, and specific catchment area (Table 5) for all study dimensions.

	Safety climate α = 0.810	Teamwork climate α = 0.821	Perceptions of management $\alpha = 0.726$	Stress recognition α = 0.689	Working conditions α = 0.660	Job satisfaction α = 0.851
,		M	ean (standard d	eviation)	•	•
Total (n=327)	60.04 (18.40)	60.95 (18.40)	56.19 (22.10)	64.62 (18.40)	53.40 (20.30)	70.26 (19.42)
Gender (n=324)	NS	NS	NS	NS	NS	NS
Female (n=161)	59.23 (18.11)	60.43 (17.37)	58.15 (20.86)	66.61 (17.86)	53.42 (21.37)	70.99 (18.18)
Male (n=163)	60.71 (18.79)	61.17 (19.31)	54.33 (23.11)	62.85 (20.69)	54.33 (23.11)	69.45 (20.65)
Age (n=273)	NS	NS	NS	NS	NS	NS
\leq 25 years (n=23)	64.60 (13.79)	62.32 (14.18)	54.62 (19.24)	69.57 (14.99)	52.67 (17.64)	71.52 (15.11)
26–30 years (n=78)	57.69 (17.90)	60.04 (17.59)	58.57 (20.42)	62.58 (19.88)	51.84 (19.92)	71.03 (16.74)
31–35 years (n=71)	57.75 (19.22)	59.27 (17.27)	53.87 (20.13)	65.05 (17.60)	52.11 (20.15)	67.75 (19.49)
36–40 years (n=53)	58.76 (18.30)	61.40 (19.87)	52.59 (22.41)	67.57 (22.44)	52.48 (23.04)	68.21 (22.41)
41–45 years (n=30)	62.86 (18.68)	62.64 (17.80)	53.54 (25.93)	66.04 (17.96)	55.63 (18.01)	70.50 (17.63)
\geq 46 years (n=18)	63.29 (22.25)	56.25 (21.87)	59.72 (24.65)	61.11 (24.96)	56.25 (22.38)	70.83 (21.09)
Education level (n=327)	NS	p = 0.009	NS	NS	NS	p = 0.021
Master's (n=50)	56.92 (19.70)	53.75 (20.40)	51.13 (22.75)	66.00 (20.95)	52.13 (20.07)	63.80 (20.57)
Bachelor's (n=225)	59.92 (18.33)	61.69 (17.88)	56.67 (22.30)	65.75 (18.65)	52.69 (20.01)	70.80 (19.33)
Vocational (n=46)	64.83 (16.72)	66.49 (16.03)	60.46 (20.16)	58.29 (20.84)	57.74 (22.25)	75.76 (16.05)
Other (n=6)	53.57 (18.49)	50.69 (20.31)	47.92 (17.97)	59.37 (19.26)	57.29 (16.96)	61.67 (24.63)
Working experience (n=327)	NS	NS	NS	NS	NS	NS
\leq 5 years (n=110)	62.18 (16.59)	62.84 (15.76)	59.89 (21.07)	66.48 (18.66)	51.88 (19.07)	73.95 (14.89)
6–10 years (n=113)	57.78 (19.50)	61.69 (19.29)	56.14 (20.85)	62.50 (20.20)	55.59 (20.16)	69.25 (21.44)
11–15 years (n=53)	59.30 (17.33)	55.82 (19.05)	49.88 (22.38)	64.74 (20.59)	50.35 (19.59)	64.62 (20.96)
> 15 years (n=51)	61.20 (20.47)	60.54 (20.44)	54.90 (25.47)	65.19 (18.21)	55.02 (23.59)	70.39 (20.61)

 Table 4.
 Variations in safety culture domain scores among the respondent's individual characteristics. Table modified from study II.

All p-values counted with non-parametric tests (Mann–Whitney U and Kruskal–Wallis). P-values adjusted by the Bonferroni correction for multiple tests. A 100-point scale: $0 = Disagree strongly, 25 = Disagree slightly, 50 = Neutral, 75 = Agree slightly, 100 = Agree strongly (<math>\geq 75 = positive$).

Within the individual characteristics (gender, age, education level, working experience), education level was linked to significant variation in safety culture scores. Higher education was connected to a lower teamwork climate and job satisfaction; in pairwise comparisons, master's educated EMS personnel had a lower score in teamwork climate (p = 0.012) and job satisfaction (p = 0.022) than vocationally educated personnel. Other individual characteristics did not affect variations in safety culture scores.

 Table 5.
 Variations in safety culture domain scores among the respondent's organisation characteristics. Table modified from study II.

	Safety climate α = 0.810	Teamwork climate α = 0.821	Perceptions of management α = 0.726	Stress recognition α = 0.689	Working conditions α = 0.660	Job satisfaction α = 0.851
	-	M	ean (standard d	eviation)		
Total (n=327)	60.04 (18.40)	60.95 (18.40)	56.19 (22.10)	64.62 (18.40)	53.40 (20.30)	70.26 (19.42)
Position type (n=325)	NS	NS	NS	NS	p = 0.032	NS
Advanced level (n=264)	59.02 (18.96)	60.21 (18.66)	55.75 (22.14)	65.63 (19.22)	52.18 (20.45)	69.45 (20.11)
Basic level (n=61)	64.29 (15.50)	63.93 (17.31)	57.79 (22.35)	60.25 (20.19)	58.50 (19.20)	73.61 (16.10)
Employment status (n=327)	p = 0.020	NS	p = 0.037	NS	NS	NS
Full-time (n=295)	59.23 (18.47)	60.52 (18.52)	55.36 (22.06)	64.96 (19.32)	52.82 (20.42)	69.68 (19.72)
Part-time (n=32)	67.52 (16.08)	64.84 (16.96)	63.87 (21.34)	61.52 (20.58)	58.79 (18.57)	75.63 (15.75)
Shift type (n=327)	NS	p = 0.011	p = 0.001	NS	NS	p = 0.008
24-hour shifts (n=131)	61.64 (18.89)	64.53 (19.24)	61.50 (23.59)	64.27 (19.24)	54.91 (21.41)	73.74 (20.01)
Two-shift (n=181)	59.18 (18.21)	58.63 (17.80)	52.45 (20.11)	63.16 (19.72)	52.52 (19.96)	67.98 (18.91)
Mix (24h+12h and/or 8h) (n=15)	56.43 (16.04)	57.50 (15.12)	55.00 (23.76)	73.33 (16.61)	50.83 (13.34)	67.33 (16.78)
Affiliation (n=327)	NS	NS	p = 0.008	NS	p = 0.002	NS
Health care district (n=161)	59.58 (18.01)	59.16 (18.12)	52.68 (22.13)	65.92 (17.51)	49.57 (20.01)	68.11 (19.46)

Rescue department (n=119)	59.54 (18.84)	63.06 (18.31)	58.25 (21.40)	64.34 (21.77)	58.66 (19.88)	72.90 (18.67)
Private (n=47)	62.84 (18.73)	61.70 (19.32)	63.03 (21.96)	60.90 (19.35)	53.19 (19.76)	70.96 (20.68)
Specific catchment area (n=327)	p = 0.023	p = 0.006	p = 0.000	NS	p = 0.012	p = 0.002
Helsinki University Hospital (n=112)	62.56 (18.06)	59.44 (19.07)	53.07 (23.22)	65.85 (19.39)	52.79 (19.97)	69.06 (20.41)
Turku University Hospital (n=41)	59.58 (20.87)	64.23 (17.20)	59.76 (21.65)	66.62 (19.04)	52.74 (24.61)	74.51 (19.33)
Tampere University Hospital (n=50)	57.71 (18.17)	59.33 (18.63)	61.38 (20.31)	66.00 (21.32)	50.50 (18.07)	69.70 (21.01)
Kuopio University Hospital (n=63)	54.54 (16.18)	56.75 (14.73)	45.44 (17.93)	59.62 (18.23)	50.10 (17.19)	64.84 (15.63)
Oulu University Hospital (n=61)	63.29 (18.59)	67.14 (19.75)	66.39 (19.97)	65.06 (19.17)	60.76 (21.23)	75.65 (18.49)

All p-values counted with non-parametric tests (Mann–Whitney U and Kruskal–Wallis). P-values adjusted by the Bonferroni correction for multiple tests. A 100-point scale: $0 = Disagree strongly, 25 = Disagree slightly, 50 = Neutral, 75 = Agree slightly, 100 = Agree strongly (<math>\geq 75 = positive$).

The organisation-based characteristics (position type, employment status, shift length, employer status, and specific catchment area) were all connected in significant variations in at least one safety culture domain score. In pairwise comparison, EMS personnel working in the 24h shifts had a significantly higher score in teamwork climate (p = 0.012), perceptions of management (p = 0.001), and job satisfaction (p = 0.008) than those working in a two-shift system.

In pairwise comparison, perceptions of management scores were significantly higher (p = 0.015) for EMS personnel working in private companies than for those in the healthcare districts. EMS personnel working in rescue departments scored their working conditions higher (p = 0.001) than for those in the healthcare districts.

The most significant variation between the safety culture domain scores (all except stress recognition) was linked to the working area. In pairwise comparison, significance varied between the perceptions of management scores p = 0.000 (between the Kuopio and Oulu University Hospital Districts areas) to working conditions' domain scores and the safety climate domain scores p = 0.046 (working conditions between the Tampere and Oulu University Hospital Districts areas, and the safety climate between the Kuopio

University Hospital Districts area and Oulu University Hospital Districts areas).

5.4 PREHOSPITAL NURSING STUDENTS' EXPERIENCES OF PATIENT SAFETY CULTURE IN EMERGENCY MEDICAL SERVICES

Altogether, 18 descriptions of patient safety events were received, and 17 were included in the analysis. One description was excluded because it had not happened in the ambulance service. From the experienced patient safety event types, most (n=8) were near misses. One student mentioned that event was reported via the healthcare reporting system. None of the students saw the event documented in the patient files. Students have the opportunity to tick the box beside their preferred options. According to the students', the patient safety events were complex and included more than one factor associated with one patient safety event (presented in the table 6).

Table 6.	The patient safety events students' experienced and what these events pertained
to. Table mo	dified from study III.

Students' choice	n
Experienced event type	N=17 (100%)
Good practice	n=5 (29.4%)
Near miss	n=8 (47.1%)
Hazard	n=4 (23.5%)
AE	n=0 (0%)
Reported through a healthcare reporting system	
Yes	n=1 (6%)
No	n=6 (35.2%)
I don't know	n=8 (47.1%)
N/A	n=2 (11,7%)
Incident documented in the patient files	
Yes	n=0 (0%)
No	n=7 (41.2%)
I don't know	n=8 (47.1%)
N/A	n=2 (11.7%)
What the event related to	
Communication	n=11 (64.7%)

Checking/verification	n=8 (47.1%)
Teamwork	n=6 (35.2%)
Leadership, guidance, and education	n=5 (29.4%)
Handover/information transfer	n=5 (29.4%)
Procedure and/or treatment	n=5 (29.4%)
Moving and handling	n=5 (29.4%)
Other	n=4 (23.5%)
Decision-making	n=3 (17.6%)
Using technology or equipment	n=3 (17.6%)
Medications	n=3 (17.6%)
Confidentiality	n=2 (11.7%)
Violence	n=2 (11.7%)
Food and nutrition	n=0 (0%)
Infection prevention and control	n=0 (0%)
Invasive procedures	n=0 (0%)

Based on students' descriptions in study III, four main themes were generated during the analysis: *environmental and other unexpected factors, working practices and professionalism in EMS, teamwork in EMS, and feelings related to patient safety events in EMS* (Figure 6).



Figure 6 Prehospital nursing students' experiences of patient safety events encountered in an EMS internship. Figure modified from study III.

Based on prehospital nursing students' descriptions, a complex working environment, and other unexpected factors were part of the work in EMS. Descriptions included experiences of how changing working conditions affected patient and occupational safety.

In written descriptions, students reflected on the experiences of patient safety working practices and professionalism they encountered. According to the students, behaviour and attitudes affected patient safety when students saw their supervisor or other healthcare personnel jeopardise patient safety in their actions. The students said the willingness to use professional skills in patient assessment affected the situation. After these situations, students reflected on their own professionalism and how this kind of experience affected their views regarding their own professionalism going forward.

According to the students, discussions afterwards and appreciation of others – including other professionals and patients – were identified as experiences conducive to teamwork. However, students said they did not experience a teamwork climate so strong that they dared to speak up in a situation alone. Negative teamwork experiences arose from situations where the student experienced being solely responsible for a potentially hazardous situation and where students noticed that supervisors had recognised potential risks but did not intervene. Students stated that teamwork in the EMS is more than teamwork with an ambulance crew. Based on students descriptions, a lack of teamwork with others present could jeopardise patient safety.

Patient safety events evoked feelings in prehospital nursing students during the event, after the event or both. Feelings were positive or negative and were part of students' experiences. Some students experienced postincident defusing sessions. However, there were no descriptions of the discussions concerning students' feelings held by students' own initiatives. Unexpected situations caused fear concerning students' safety while fearing for a patient's safety was linked to the actions of others. If the students felt involved in the patient safety event or 'near miss' situation, the feelings manifested as self-blame.

5.5 EMERGENCY MEDICAL SERVICES MANAGERS AND MEDICAL DIRECTORS' PERCEPTIONS OF PATIENT PARTICIPATION TO DEVELOP PATIENT SAFETY

After thematic analysis of the EMS managers' and medical directors' interviews, the data generated two main themes: '*Patient safety considered an organisational responsibility*' and '*EMS patients' opportunities and obstacles to speak up.*' Patient safety was considered an organisational responsibility

and included three subthemes; the other central theme was EMS patients' opportunities and obstacles to speak up had four subthemes (Figure 7).



Figure 7 EMS management's perceptions of patient participation and a patient's role in developing patient safety in EMS. Figure modified from study IV.

Based on the participants' views, EMS organisations could not transfer patient safety responsibility to the patients. Therefore, the main theme '*Patient safety is considered an organisational responsibility*' describes that phenomenon. Participants stated that system-level models helped them handle and observe patient safety in EMS. However, in some cases, legislation could construct a barrier to collaborating with patients. According to the participants, patient safety is considered part of the quality of EMS. However, participants stated that in the EMS context, the challenge is that patients are unfamiliar with EMS policies and practices, and patient contacts are relatively short. Conversely, participants stated that finding a balance to utilise patients' feedback on patient safety development was difficult. Patient feedback was experienced more like customer feedback, and participants were somewhat afraid that enhancing patient participation could overburden the management if the increased workload was not considered.

According to the participants, patient participation in developing patient safety in EMS includes *EMS patients' opportunities and obstacles to speaking up.* Participants stated that the social and feedback skills of EMS personnel and management are essential when communicating with patients. Participants stated that their role in exemplifying patient communication is vital. However, participants highlighted that patient participation is already critical in patient encounters, although participants had assumptions about patients' reasons for not speaking up. Results

Participants mentioned EMS organisations' different but unsystematic ways of collecting feedback, stating that patient participation depends on patients' activity; participants were concerned about how to reach the right patients, especially vulnerable patient groups, to develop patient safety in EMS. Conversely, EMS managers and medical directors mentioned that patient feedback allows them to develop patient safety and other processes in EMS, and management's openness to developing patient participation was apparent. However, participants raised concerns about possible patient safety consequences if no patient feedback is received.

6 **DISCUSSION**

6.1 SUMMARY OF MAIN FINDINGS

The main findings of studies I, III, and IV show the complexity of PSC in EMS and how it manifests to the patients (I), EMS professionals (II), prehospital nursing students (III), and the EMS managers (IV). There are differences yet similarities in how safety in EMS is experienced or perceived by the patients (I), EMS professionals (II), prehospital nursing students (III), or from the EMS management's perspectives (IV). Conversely, results show that safety culture in Finnish EMS is not optimal, and organisation-phased characteristics caused more variation in safety culture scores than individual characteristics (II). However, the model fit did not seem optimal when testing the EMS-SAQ psychometric properties in a Finnish EMS setting. As a summary of the main findings, the PSC in EMS is transformative, and PSC in EMS is under the influence of the *EMS operational environment*, *organisational aspects in EMS, EMS personnel interaction and behaviour*, and *feelings and assumptions*, as Figure 8 displays.

V EMS	Feelings and assumptions - Second victim phenomenon associated with other caregivers' actions (III) - Second victim phenomenon associated with students' own actions (III) - Feelings related to students' or patients' safety (III) - Management ability to find a balance to utilise patient feedback at patient safety development (IV) - Management's assumptions of why patients don't speak up (IV)	2 60.04 (18.40), 26 (19.42)
F SAFETY CULTURE IN	EMS personnel interaction and behaviour Information (I) Involvement in care decisions (I) Equal treatment (I) Patient assessment in EMS (III) Ignoring/belittling findings (III) Communication and information flow (III) Communication and information (III) Discussions after the EMS tasks with supervisors/others present (III) Discussions after the EMS tasks with supervisors/others present (III) Appreciation of others (III) Experiences preventing patient active veents (not speaking up) in EMS (III) Social and feedback skills of EMS personnel and management (IV)	ean (standard deviation): tagement 56.19 (22.10), Safety climate on 64.62 (18.40), Job satisfaction 70.
SFORMATIVE PATIENT	Organisational aspects in EMS EMS EMS EMS personnel's professional competence (I) EMS personnel's driving skills (II) Students' own technical skills (III) System-level models to handle and observe patient safety (IV) Patient safety is considered part of the quality in EMS (IV) EMS organisations have different but unsystematic ways to collect feedback (IV) Management openness to developing patient participation (IV)	Safety culture scores (II) M ons 53.40 (20.30), Perceptions of man climate 60.95 (18.40), Stress recogniti
TRAN	EMS operational environment • Environmental factors (I) • Changing working environment (III) • Weather conditions (III) • Expect the unexpected (III)	Working conditi Teamwork

Figure 8 Transformative patient safety culture in EMS; summary of the main findings

Questions in the EMS-SAQ reflect all sections in Figure 8. Questions linked to *working conditions* and *perceptions of management* have reflections of organisational aspects, EMS personnel and management's behaviour, and social skills; *safety climate* and *job satisfaction* have reflections of organisational aspects, EMS personnel and management's behaviour, social skills, and feelings and assumptions. *Teamwork climate* seemingly reflects only EMS personnel and management's behaviour and social skill. *Stress recognition* reflects EMS personnel's feelings and assumptions and the EMS operational environment (II).

Rather than being a part of a PSC, the EMS operational environment is a contextual framework describing conditions that could affect the shaping of PSC in EMS. Working outside in different conditions, in patients' homes, and in a moving ambulance was part of the external framework in the EMS personnel's working environment. Patients could recognise potential risks to their safety in the EMS, causing, for example, environmental factors (I). Conversely, the prehospital nursing students realise the working environment in EMS differs from other healthcare settings, meaning experiences of changing the working environment and unexpectedness helped the students place the patient safety events they experienced explicitly in the EMS context (III).

From the organisational aspects of EMS, patient safety is considered part of the quality of EMS (IV), including a system-level approach to patient safety and ways to collect patient feedback (IV). It is an organisation's – EMS and educational – responsibility to ensure EMS personnel (I) and students are competent (III), and that possibilities to develop professional competence, including driving skills, are offered (I). EMS management stated that patient participation is vital when developing patient safety and processes in EMS (IV).

However, the interactions and behaviour of EMS personnel, EMS managers, and medical directors are seemingly paramount, impacting PSC in EMS and patients' experiences of safety in EMS. Patients stated that EMS personnel behaviour relates to how they experienced safety (I); prehospital nursing students had experienced patient safety events where the EMS personnel's behaviour positively or negatively impacted patient safety (III). Also, EMS managers and medical directors mentioned that behaviour – theirs or EMS personnel's during the patient encounter – could influence how EMS patients experience the possibilities and willingness to raise their concerns or give feedback on patient safety (IV).

Feelings and assumptions also have a role in EMS PSC. Feelings were critical when students described the patient safety events they encountered in EMS internships (III). Adding patient participation to improve patient safety in EMS evoked feelings and assumptions among EMS managers (IV).

6.2 RELATION OF RESULTS TO OTHER STUDIES

As stated, PSC includes more than just organisations' policies and healthcare professionals' technical skills (11, 72, 79). This thesis describes the PSC in EMS and highlights the gap between what safety means to the prehospital nursing students, EMS personnel, or EMS organisation and what kind of safety perceptions patients had in the EMS encounter. Patients' perceptions of safety in the EMS are not synonymous with receiving safe care(43). Therefore, EMS organisations and EMS personnel must continue developing the other elements affecting the safety and feelings of safety in the EMS. Otherwise, important sections of patient safety risk being deprived of the attention they deserve.

The results of this thesis can fall under the three dimensions presented in other organisational culture, safety culture, and PSC theories(11, 54, 55, 72, 73, 74, 129). In the summary of the findings in this thesis, organisational aspects in EMS could be said to reflect the 'organisational dimension', interaction, and behaviour reflecting the 'social processes' when feelings and assumptions reflect the 'psychological dimension'. Conversely, the EMS operational environment does not reflect the previously presented cultural dimensions(11, 54, 55, 72, 73, 74, 129). However, the EMS operational environment creates circumstances that must be considered at the organisational and behavioural levels and could provoke feelings and assumptions among EMS patients, EMS personnel, and EMS managers. As other studies(11, 43, 79, 129) and the result of this thesis shows, patient safety and PSC are more than just organisation policies and practices.

The relation of results to other studies is discussed in more detail below and divided into separate headings based on a summary of the main findings: *EMS operational environment, organisational aspects in EMS, EMS personnel interaction and behaviour, and feelings and assumptions.*

6.2.1 EMERGENCY MEDICAL SERVICES OPERATIONAL ENVIRONMENT

According to the results of this thesis, changing the working and operational environment in the EMS manifests circumstances where EMS operates and impacts the PSC in EMS. These results showed that patients stated that environmental factors affected their sense of safety (I); prehospital nursing students said patient safety events were linked to environmental factors or weather conditions (III). Some have said environmental factors affect patients and EMS personnel's safety during response and transport(44). One study showed that traffic, weather, and the place of incident (home, commercial, road) significantly affected ambulance response times(19). Other studies reveal that EMS users value a short waiting time (130), and study I highlights that time influences patients' perceptions of their safety. However, in study I, a short waiting time, according to patients, ranged from a few to 30 minutes. The results regarding the EMS operational environment align with previous international studies(19, 44, 130) and add the patient's perspective to that area. Therefore, the results of this thesis can be considered transferrable in other countries' EMS settings.

6.2.2 ORGANISATIONAL ASPECTS IN EMERGENCY MEDICAL SERVICES

According to the findings of this thesis, organisational aspects are one dimension of PSC in EMS, showing EMS managers' and medical directors' views on how they appear to experience an organisational responsibility for patient safety so strongly that no room exists for patients' views on patient safety (IV). However, patients could recognise potential risks to their safety in the EMS, such as those concerning EMS professionals' driving skills (I).

EMS managers and medical directors stated that professionally treating EMS personnel is an organisational responsibility (IV). EMS tasks can be very complex concerning the EMS personnel's decision-making(14). However, in other healthcare settings, researchers establish positive associations among patient experiences, patient safety, and clinical effectiveness(131). Based on patients' experiences, the EMS personnel's medical knowledge and driving skills directly relate to a positive sense of safety for the patient (I); EMS personnel's professional competence was highlighted when older patients described their feelings of safety in EMS(132). However, none of the students described any events that driving caused (III), although driving the ambulance has a major role prehospital care and impacts not just safety (133) but a patient's experience of safety (I).

Fortunately, EMS managers and medical directors recognise that patient safety and EMS quality development are incomplete without patient experiences of EMS processes (IV). As a study conducted in a hospital setting suggested, error management should promote developing a strong safety culture affording the patient a role in promoting safety in their care(39). Furthermore, based on study I and a former study(134), EMS personnel, EMS organisations, and vocational training providers need more knowledge about factors affecting patients' sense of safety in the EMS. Otherwise, patients' view of safety in EMS is lacking, possibly limiting patient safety development in EMS, which could come at a cost.

OECD has evaluated that over 12% of healthcare expenditures are consumed by managing unsafe care and other indirect costs(1). We do not know how much those costs are in EMS organisations, but patient safety issues cost EMS organisations. Overall, many PSIs in prehospital care(2) give reasons to EMS organisations to use every opportunity to reduce PSIs, which come at a cost. There are ways to use every opportunity to develop patient safety in EMS, including adding patient participation in patient safety development work and structured handling methods to manage reports of patient safety events (IV).

Reporting patient safety events is crucial for organisations to receive information concerning patient safety events(135). However, based on the result of this thesis, PSC in EMS organisations seems not so strong that it supports reporting patient safety events. Only one prehospital nursing student stated that a PSI was reported via the healthcare reporting system; none of the students saw the incident reported in the patient's files (III). Many EMS personnel had witnessed a PSI, but fewer had reported it (136). The same phenomenon is recognised in other healthcare settings (97, 98). There are barriers to reporting patient safety events in EMS(8). Therefore, the lack of reporting patient safety events seems to be a global phenomenon and needs attention.

From the patient participation perspective, EMS managers and medical directors described several feedback systems, most of which are based on electronic systems. However, EMS organisations recognise that not all patients have the possibilities, skills, or willingness to use electronic systems (IV). For example, age, language, mental health, and a patient's overall experience affect their comfort and courage in speaking up(137). Overall, userfriendly and appropriately implemented electronic systems can be good; age does not always have to be an obstacle to using electronic systems(138, 139, 140). However, EMS managers and medical directors stated that patient feedback is more like customer feedback. However, this feedback could cause problems for organisations when they try to develop patient safety and PSC in EMS. From the organisational aspect, enhancing patient participation in patient safetv needs organisational support. patient-professional collaboration, a proactive approach, and user-friendly feedback systems(42), which all need employee resources. After all, adding patient participation requires cultural changes in the organisation, where leadership is crucial(79, 141).

6.2.3 EMERGENCY MEDICAL SERVICES PERSONNEL'S INTERACTION AND BEHAVIOUR

In this thesis, EMS personnel interaction and behaviour highlight the importance of the meaning of psychological safety within the team and its effect on patient safety and PSC. Behaviour and interaction are part of psychologically safe teamwork(86). In study III, students expressed feeling they had been a part of a team. However, their experience of being part of the team was limited because they lacked the courage to speak up when they recognised patient safety threats. Other studies have shown this reticence among medical- and nursing students(142, 143, 144). Reasons could be fear of retribution or punishment or based on the team's culture(142, 143). Lack of teamwork, unsupportive behaviour, and loneliness in decision-making were

everyday experiences when nurses were new in the ambulance service(145, 146). EMS professionals described challenges in teamwork when they discussed perceived human factors from the perspective of EMS professionals(147). Therefore, it was good to notice that EMS managers and medical directors highlighted the meaning of their own behaviour to show an example (IV). From the patient safety perspective, managers' behaviour could influence the quality of care and AEs(84).

EMS managers and medical directors mentioned that EMS personnel behaviour could affect patients' willingness to speak up about his/her safety concerns (IV). One study showed that sharing information and being treated in a friendly and respectful manner is important when involving patients in patient safety(148). However, some recognise that enhancing patient involvement is not necessarily easy and depends on patients' willingness to participate(141). Also, some EMS missions can be challenging and timesensitive(17, 18), possibly affecting EMS personnel behaviour and patients' possibilities to communicate their safety concerns (IV). Conversely, most EMS missions are non-urgent(6, 21, 22), giving patients more opportunities to participate in their care and voice their safety concerns. Research has shown that harmful errors (preventable AEs) and unpreventable AEs can decrease by developing patient/family-centred care without affecting time use(149).

From the patient's perspective, EMS personnel's behaviour is vital in creating a safe environment for the patient. In this thesis, the perception of equality, the possibility to get information, and the involvement in care decisions affected the patient's sense of safety in the EMS. (I). If the patient feels objectified by the EMS personnel, this may cause a feeling of 'suffering from care', leading to a sense of unsafety and patient deviations(150). Patient experiences of safety in hospital settings highlight that being treated equally is important to patients (35, 36, 38); this is true in the EMS context based on the findings of this thesis (I, III). If the EMS personnel are more willing to see a patient as a team member, they can create a psychologically safe environment for the patients(36, 86). Still, students described poor attitudes or bad behaviour towards patients, patients' relatives, other healthcare professionals, and, in some cases, themselves (III). Other studies recognised this same phenomenon (142, 146, 151, 152, 153). Fortunately, not all students' experiences concerning behaviour or attitudes were negative. Some described experiences on how observing colleagues' careful assessment helped them recognise those patients needing urgent treatment or another kind of attention from the EMS personnel (III). Results from other studies support this finding(153, 154).

Furthermore, this thesis shows that students want to absorb good practices and patterns of behaviour. Students recognise bad practices and behaviour and clearly do not want to adopt those models as part of their future professionalism (III). Results from another study supported this phenomenon(98); new graduate RNs also recognise this phenomenon(155). These are important issues to notice, especially when patients stated that the EMS personnel's professional competence and good driving skills are meaningless in maintaining the patients' confidence if the EMS personnel does not treat the patient equally and humanely (I). Despite the healthcare context or setting, behaviour and interaction seem crucial when discussing PSC and behaviour, and interaction needs more attention when developing PSC.

6.2.4 FEELINGS AND ASSUMPTIONS

Findings in this thesis show that feelings and assumptions are part of PSC in EMS. Feelings are reported as a part of perceived human factors from the perspective of EMS professionals(147). In this study, the patient safety events prehospital nursing students experienced evoked feelings (III). Feelings are one part of learning (156). However, as a learning environment, EMS does not support the tools to handle those feelings, even though students' feelings were crucial to their patient safety learning experience (III).

Conversely, EMS encounters evoked feelings in the patients. EMS managers' and medical directors' assumptions for patients' reasons not to speak up (IV) somewhat aligned with descriptions of EMS patients' feelings when patients stated feeling uncertain and insecure because of EMS personnel's behaviour or if they felt EMS personnel's professional competence was lacking (I). Still, patients felt relief when they experienced that help was near (I). These same feelings among patients were described in patients' non-conveyed situations(157). It is good to notice that discussing the EMS encounter is important for patients and their relatives to cope(157).

A barrier to handling and understanding the feelings among students and patients could be that the EMS environment did not feel psychologically safe (I and III), which might be because the students may not have spent enough time in their internships to familiarise themselves with their supervisors or with EMS as a working environment. A lack of a psychologically safe environment has been recognised among new graduate RNs(159). Feelings improperly handled could cause second victim phenomenon(88, 89) for the prehospital nursing students (III) and EMS personnel. Healthcare workers must discuss the patient safety event experience if they suffer second victim phenomenon(87, 160). Managerial and peer support are vital when healthcare workers cope with an event(87, 160). However, coping is difficult if there is a lack of support. In a worst-case scenario, the impact of the patient safety event could have long-lasting consequences(160). Where and how experienced feelings occur can vary depending on the situation. EMS managers and medical directors' fears and concerns raised their own coping difficulties (IV). Possible reasons for coping-related fears and concerns could be a heavy workload or inadequate support for management(158).

There is seemingly some knowledge concerning feelings associated with PSC; this study adds knowledge about the feelings related to PSC in EMS. Still, how emotions can be considered when developing PSC in EMS is unclear.

6.2.5 SAFETY CULTURE SCORES

Organisation-based characteristics caused most of the significant variations in safety culture domain scores (II); some have stated that safety culture has clear connections to management's actions and perceived perceptions of safety culture(60, 161). Thinking safety culture should be evaluated by measuring safety culture annually (64), and developing a safety culture at the organisational level is reasonable. Organisations must evaluate not only direct measures (errors and AEs) of patient safety but other sub-areas of patient safety(85).

Strong correlations in CFA results among five of the six safety culture domains raise a question: Is keeping strong correlations by improving only one domain with intervention possible? This means if organisations can develop one safety culture domain, can it impact other safety culture domains? For instance, if organisations develop working conditions for the professionals, will the teamwork climate or perceptions of management improve simultaneously?

Hospital settings have shown that management's commitment to safety positively correlated with teamwork(162). A previous study showed improved safety climate and teamwork climate scores after intervention. The same study reported that serious safety events and severity-adjusted hospital mortality decreased(163). Therefore, rather than trying to change the whole patient safety culture simultaneously, looking at safety culture domains and/or students' responses to the question 'What was the event related to?' could help EMS and educational organisations pay attention to and develop smaller areas of patient safety culture.

6.3 METHODOLOGICAL CONSIDERATIONS AND LIMITATIONS

Rather than offering an empirical generalisation of PSC in EMS, this study yields insights and adds an understanding of PSC in Finnish EMS. Still, we do not know all the underlying assumptions affecting the PSC in EMS. Therefore, more than discussing the generalisability of the results, perhaps discussing information power is better(164). Information power considers a study's aim, sample specificity, established theory, interview dialogue/content of written narratives, and analysis strategies(164). When considering those along the lines of this thesis, this thesis could be seen as having achieved sufficient information power.

Discussion

In qualitative studies, trustworthiness is usually evaluated with the markers of credibility, dependability, and transferability(115, 165). The credibility and dependability of this thesis are discussed below. The suggestions concerning the transferability of findings are in a separate section: 'Transferability'. Regardless, the final decision on the transferability of the results to another clinical context and settings are at the readers' discretion(115, 165).

6.3.1 CREDIBILITY AND DEPENDABILITY

This thesis has researched patient perceptions of safety in EMS (I), prehospital nurses' experiences of patient safety events (III), EMS management's views of patient participation to develop patient safety in EMS (IV), and EMS personnel attitudes concerning safety culture in EMS. Qualitative study designs were selected because qualitative methods are suitable when researching meanings and experiences from the participant's perspective. However, qualitative data is not usually amendable to numbers or measures(166). Conversely, study II uses quantitative methods to measure EMS personnel attitudes toward safety culture in Finnish EMS. However, the results were based on respondents' views rather than objective measures. Therefore, saying study II was qualitative is reasonable.

The qualitative data this thesis used was rich; the overall data captured the participants' views and experiences regarding this topic. However, in qualitative studies, there could be a risk of researcher-driven biases, meaning the researcher is not open to the data and insufficiently considers participants' experiences and views(167). Therefore, the researcher harbouring a deep preunderstanding of the research topic could be considered a strength or limitation. Theoretical and clinical experience helps place collected data and the results into a clinical context. However, the theoretical and clinical experience could cause bias via a lack of openness to the research topic. Multiple discussions were held with the supervisors during the research project to reduce potential bias due to pre-understanding. Also, one of the supervisors had no experience with EMS but had research knowledge of patient safety, which may have reduced the risk of bias that preconceptions cause.

The first three studies had gender diversity among the participants. However, it seems that same-gender diversity has not reached the managerial level in Finnish EMS, as most of study IV's participants were male. This could be considered a limitation because this homogeneity could limit the data's diversity. Conversely, the managers' gender may reflect the present uniformity among EMS managers, raising the question of the need to develop gender diversity among EMS managers.

Content analysis(115) and thematic analysis(116) was chosen because those are commonly used methods in health and nursing sciences when analysing

qualitative data. Both methods are acknowledged for clarity and userfriendliness(168). At the beginning of the analysis, content and thematic analysis include the same elements. The difference between these methods is that in thematic analysis, the researcher should consider latent (developing themes) and manifest content (developing categories), while in content analysis, the researcher can choose between manifest and latent content(168). In study I, the manifest content was considered. In studies III and IV, the manifest content was considered when developing codes for the categories; those studies' latent content was considered when subthemes and themes were developed. Braun and Clarke stated their thematic analysis method paper(116) is often cited without reading the methodological guidelines(169). Therefore, in studies III and IV (which uses [reflexive] thematic analysis) and study I (which uses content analysis), the description of how the analysis process was conducted was adjusted based on what had been done rather than just listing the phases of the analysis processes.

As mentioned, the qualitative data this thesis used was rich; overall, the data captured the views and experiences the participants had of this topic that was researched for this thesis. However, although the interviews were conducted alone with the patient (I) or together with the colleagues (IV), participants may have hesitated to openly share all their views. For example, in study I, patients could have experienced barriers to disclosing their concerns caused by, for instance, "I do not want to be a troublemaker", "I don't know how to raise my concern", or "I do not want to harm my relationship with members of the medical team"(140), even though the interviewer was dressed casually, and patients were informed that interviews were not connected to patients' ongoing or future care in the hospital or the EMS (I). In study IV, all the participants held a managerial or supervisor status in their organisation. However, they were still at different hierarchical levels among each other, which could have caused some limits for some participants in influencing the discussion, even though the interview tried to strike a casual chord(170).

Facebook[®] is considered a good tool for recruiting participants from hardto-reach groups(107). Study II used Facebook because there are no mailing lists with a similar service to reach EMS personnel all over Finland. However, data collection and sharing of the survey link via social media in study II could be considered a limitation concerning a possible risk of responses from participants outside the target group because not everyone who saw the invitation to participate worked in the EMS. Reducing the risk of receiving responses from participants outside the target group meant no incentives were shared with the participants while highlighting that the survey was targeted to those who work in EMS. Despite possible risks of getting responses from participants outside the target group, social media, more specifically Facebook^{®,} has several advantages, such as cost, time, and the snowball effect when collecting data(106, 107).

Using social media and a web-based survey as data collection methods in study II could constitute a risk for selection biases, which could limit the results' generalisability (171). Selection biases in study II may have occurred as a potentially non-representative of the social media population and created possible self-selection bias. However, researchers have evaluated that samples recruited through Facebook[®] were similarly representative to samples recruited via more traditional methods(107). Self-selection bias in study II means respondents could be those interested in or concerned with this topic. Overall, results from study II highlight those safety culture domains which need attention in Finnish EMS. However, study II does not explain why the safety culture was perceived as weak in Finnish EMS. The reason for those results is unclear because this survey did not include any open-ended questions where the respondents could have had the opportunity to describe their concerns or positive experiences of safety culture in Finnish EMS more briefly.

The EMS-SAQ model fit was not entirely optimal. CFA results were not as good as in previous EMS-SAQ studies(65, 66). However, the model fit was better with only minor adjustments(122). Conversely, reliability scores were close to or above the acceptable level (0.7), demonstrating good internal consistency of the total model and individual domains; correlations between the safety culture domains (II) were in the same direction as in Sexton et al.'s original SAQ version(68). There seems to be some variation in SAQ's CFA results in other healthcare settings and different countries (109, 110, 111, 112). Therefore, in safety culture studies, cultural differences could affect the CFA results(172, 173, 174).

The SLERT was used to collect study III's data. The collected data was rich and informative; clearly, SLERT guided the students in writing about the patient safety experience. SLERT utilises CIT – widely used as a learning tool in nursing and healthcare professional education and personal reflection(175). Because in CIT, observations are reported from memory, it is suggested that the event reported should be fairly recent(114). However, the actual time between the event and writing its description in study III could have been relatively long, possibly affecting the data. Conversely, SLERT's validity and reliability were demonstrated in previous studies when researchers collected patient safety learning experiences from nursing students in five countries and healthcare settings, including EMS(98, 176, 177).

The coronavirus (COVID-19) outbreak (178) caused some challenges and advantages when conducting studies – specifically, studies III and IV– included in this thesis. The small number of responses in study III might have been caused by the COVID-19 disruption and students changing to distance learning, meaning the COVID-19 disruption and students changing to distance learning forced them to use remote options to collect the data. Data collection in study III might have been more successful had there been an opportunity to meet more prehospital nursing students face-to-face. This conclusion can be made because one UAS met 12 prehospital nursing students in person, seven of whom agreed to participate in the study. Conversely, remote options offered the prehospital nursing students a chance to choose the best time for them to write and share their experiences. In study IV, collecting the data remotely was decided because of the resource manner and because participants had become accustomed to using remote tools during the COVID-19 pandemic, which could be considered an advantage.

6.3.2 TRANSFERABILITY

The interviews for studies I and IV were done in a single area in Finland (study I in one healthcare district and study IV in one specific catchment area), possibly limiting the transferability of the results. Study III's participants were recruited from three UASs in southern Finland. However, they may have interned in ambulances in other areas of Finland.

In study I, patients' characteristics cover common EMS patient groups according to the EMCC official statistics; thus, thinking the results can be transferred to a similar context is reasonable. According to study I's exclusion criteria, no interviews were conducted among high-priority patients with multiple traumas, other life-threatening conditions, or inter-hospital transfers. These patients could have given valuable information on their perceptions of safety when EMS personnel must use, for example, different kinds of support equipment and transfer methods.

All the data were collected in Finland, which could limit the transferability of the results of this thesis. However, basic EMS principles are similar globally: emergencies and relatively short patient encounters. Therefore, the results and findings in this thesis can be interpreted as transferrable to similar settings.

6.4 CLINICAL IMPLICATIONS FOR ENHANCING PATIENT SAFETY

- There is a need to develop teamwork and collaboration skills in EMS within the EMS organisations, among students and other healthcare professionals.
- Patients should be considered a team member rather than an object of an action. EMS needs patient-centredness, EMS management, and EMS personnel to hear what patients have to say when trying to increase patient safety in EMS.
- Personnel working in EMS should create a psychologically safe, blame-free, and supportive environment where patients, prehospital nursing students, and EMS personnel has the courage to speak up.
- EMS organisations and managers should utilise students' observations to develop PSC and patient safety in EMS by developing a low-threshold patient safety feedback channel for the students or allow students to use existing reporting channels during their internships in the EMS.

- EMS-SAQ could be used as one tool for EMS supervisors to evaluate PSC in their organisations, such as before and after the organisational interventions.
- Rather than separating PSC and safety culture, using only the term 'safety culture' in the EMS context could be valuable, as the same situations could compromise the safety of patients and EMS personnel safety.
- EMS organisations and educational organisations should offer students and EMS professionals the possibility to discuss their feelings and concerns.
- EMS organisations should develop a coherent way to collect patient safety concerns with sufficient resources.

6.5 FUTURE RESEARCH

- Explore how to invite patients to participate in the patient safety work in the EMS.
- Explore patients' perspectives on participating as a part of the team in the EMS to develop patient safety.
- Explore the EMS personnel's perspectives on patients as a team member in developing patient safety.
- Explore how psychological safety is experienced in EMS settings and what factors can increase or decrease psychological safety in EMS.
- Explore what kind of support (emotional or practical) prehospital nursing students need and whether their needs are like EMS professionals.
- Explore the reasons that could enhance or reduce possibilities to add patient-centredness in the EMS.

7 CONCLUSIONS

Based on the results of the thesis, the following conclusions can be made:

- PSC in Finnish EMS seems suboptimal and in need of development.
- Patient safety in EMS is not only a safe performance of technical tasks; it also seems that patient safety in EMS is connected to EMS operational environment, organisational aspects in EMS, EMS personnel interaction and behaviour, and feelings and assumptions.
- EMS personnel behaviour relates to how patients experience safety in EMS. The attitudes of EMS personnel may be linked to the level of safety in the care patients get in the EMS. It is reasonable to think that attitudes and behaviour are linked to how the patients can participate in their own care and patient safety development in the EMS.
- EMS is seemingly not always a psychologically safe environment for EMS patients, prehospital nursing students, and EMS professionals.
- Prehospital nursing students could offer valuable views on patient safety and PSC in EMS.
- The nature of the EMS missions could affect patient participation in developing patient safety in EMS, although EMS managers and medical directors are receptive to collaborating with patients concerning patient safety issues.
- Measuring EMS personnel's safety attitudes and identifying the strengths and weaknesses in the safety culture in EMS is possible.

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APPENDICES

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Appendix 1: EMS patients' interviews: an interview guide

- Can you tell me about your experience of the EMS encounter?
 Additional questions:
 - Can you tell me more about the waiting time?
 - Can you tell me more about the assessment?
 - Can you tell me more about the treatment?
 - Can you tell me more about the transportation?
 - Can you tell me more about the handover at the ED?
- 2. What made you feel safe during the EMS encounter?
 - Follow up question if needed:
 - Can you tell me more about that?
- 3. Was there anything that made you feel insecure during the EMS encounter?
 - Follow up question if needed:
 - Can you tell me more about that?
- 4. Is there something else you want to tell me about the care in the EMS?

EMS-SAQ (65	EMS-SAQ (65, 66)		
Question	Domai		
1. I like my job	JS1		
2. EMS Personnel input is well-received in t	his EMS agency TWC1		
3. I would feel safe being treated by this EM patient	S agency as a SC1		
4. Medical errors are handled appropriately	at this EMS agency SC2		
5. This EMS agency does a good job of training	ing new personnel WC1		
6. Working at this EMS agency is like being family	a part of a large JS2		
7. The management of this EMS agency sup efforts	ports my daily POM1		
8. I receive appropriate feedback about my p	performance SC3		
9. In this EMS agency, it is difficult to discus	ss errors SC4 *		
10. Staff turnover at this agency is high			
11. This EMS agency is a good place to work	JS3		
12. Management does not knowingly compro patients	pmise the safety of POM2		
13. The levels of staffing at this EMS agency a handle the number of calls	are sufficient to POM3		
14. I am encouraged by my colleagues to repo safety concerns I may have	ort any patient SC5		
15. The culture at this EMS agency makes it e the errors of others	easy to learn from SC6		
16. This EMS agency deals constructively wit personnel	h problem WC2		
17. At this EMS agency, it is difficult to speak problem with patient care	t up if I perceive a TWC2 *		
18. When my workload becomes excessive, minpaired	ny performance is SR1		
19. I am provided with adequate, timely infor events that might affect my work	rmation about POM4		
20. Many EMS personnel at this agency have part-time job	other full-time or		
21. I have seen others make errors that had the harm patients	he potential to		
22. I know the proper channels to direct ques patient safety	stions regarding SC7		
23. I am proud to work at this EMS agency	JS4		

Appendix 2. EMS-SAQ and questions/ domain

24. Disagreements at this EMS agency are resolved appropriately (i.e., not who is right, but what is best for the patient)	TWC3
25. I am less effective at work when fatigued	SR2
26. I am more likely to make errors in tense or hostile situations	SR3
27. I have the support I need from other personnel to care for patients	TWC4
28. It is easy for personnel at this EMS agency to ask questions when there is something that they don't understand	TWC5
29. Personnel here work together as a well-coordinated team	TWC6
30. I have the co-workers who are actively looking for additional full-time or part-time work	
31. Morale at this EMS agency is high	JS_5
32. Trainees in my discipline are adequately supervised	WC3
33. I have made errors that had the potential to harm patients	
34. Fatigue impairs my performance during emergency situations	SR4
35. During emergency situations (e.g. cardiac arrests, traumas etc.) my performance is not affected by working with inexperienced or less capable personnel	
36. Personnel frequently disregard rules or guidelines (e.g. treatment protocols, standard operating procedures, etc.) that are established for this EMS agency	
37. A confidential reporting system is helpful for improving patient safety	
38. I may hesitate to use a reporting system because I am concerned about being identified	
39. This agency provides me with the training to prevent ambulance driving accidents	
40. I have co-workers who are actively looking to leave this agency for other employment	
41. This agency could do more to improve emergency vehicle driver safety	
42. When moving a patient, I have the training to prevent injury to the patient	
43. When moving a patient, I have the right equipment to prevent injury to the patient	
44. All the necessary information for treating patients is routinely available to me	WC4
45. Patient safety is constantly reinforced as the priority in this EMS agency	
46. Emergency vehicle or aircraft accidents occurs at this EMS agency	

47. Emergency vehicle or aircraft accident close-calls (near- misses) occur at this EMS agency	
48. Patient handling mishaps (e.g. stretcher collapse, patient drop or fall, etc.) occur at this EMS agency	
49. Medical adverse events (incidents where a patient was harmed from medical care or medical equipment malfunction) occur at this EMS agency	
50. Medical adverse event close-calls (near-misses) occur at this EMS agency	
SC = Safety climate	

TWC = Teamwork climate

POM = Perceptions of management

SR = Stress Recognition

WC = Working conditions

JS = Job satisfaction

 \ast = Reverse coded in the analysis to match the other questions

Appendix 3. Important Patient Safety learning event recording form to the prehospital nursing students

In the following pages you will be asked to complete these sections: In section A: You are asked to describe the event

In section B: You are asked to think about and reflect on the event, and the learning you took from it

In section C: You are asked to answer some demographic questions

Analysis of the learning event records will summarise and amalgamate the records so that no individuals or clinical areas can be identified.

You can complete the patient safety learning event record more than once.

Section A

Please tell us about an event that was important for you when learning about patient safety. Important learning events can be described as significant events in a learners' life: something meaningful for you, it does not need to be a major event (e.g., does not need to have caused serious consequences) something you feel strongly influenced your learning.

Please recall such learning events related to patient safety that took place during your internship in ambulance. Whether or not the event was resolved successfully does not matter.

The learning event can be:

1. A **positive**, satisfactory event

2. A negative, unsatisfactory event

Please note: Although the learning event may be negative in nature, the learning can be experienced as positive.

Describe ONE event and tell us as much as you can about:

- What happened (e.g. the event and what led up to it, if you were involved or only witnessed the event, if you had experienced this type of event before)
- Who was involved and what they did (e.g. Patient, relative, mentor, clinical supervisor, nurses, doctors, health care assistant, midwife, social care worker, or other staff or students and their job title or roles). Please note: do not use any names of people or health care organisations
- When it happened (e.g. which semester, which shift: day time or night time)
- Where it happened (e.g.in a patient's home, a room, operating theatre)
- What did the person or people do, or not do, that had an effect
- What was the outcome or result (at the time or later if you know)
- Was it discussed with the person(s) involved (your mentor/clinical supervisor/clinical educator or any other staff, another student, or your teachers)

Section B

Thinking of the event described in Section A, please say why that event was an important patient safety learning event for you. Tell us what you learnt and how you felt about the event afterwards:

Please also describe the feelings before, during and after the event, and/or anything you noticed about emotions expressed by others

- What in your opinion preceded and contributed to the event?
- If you discussed it with someone afterwards, did this discussion help you to learn from this event?
- Why it seemed important and memorable for your learning? What you felt you learned or took from the experience? Why was the experience significant for you?
- What do you think others could learn from this event?

Please note: do not use any names of people or healthcare organisations

Section C

Your age: 16-20 21-25 26-30 31-35 36-40 41-45 46-50 51 or over

Gender

Male Female Other Prefer not to answer

Year in program

1st 2nd 3rd 4th or over

Was the important learning event broadly related to (you can tick multiple boxes):

Communication Checking/verification Teamwork Leadership, guidance, and education Handover/information transfer Procedure and/or treatment Moving and handling Other Decision making Using technology or equipment Medications Confidentiality Violence Food and nutrition Infection prevention and control Invasive procedures

What type of learning event do you feel it was: (e.g. a near miss, etc.)

- Good practice = It is a successful experience, which you feel deserves to be shared. It may be 'effective caring practice' in which a health/social care professional seems to go further than usual or provide extra special care (SLIPPS)
- Near miss = an incident that did not reach the patient (WHO)
- Hazard = a circumstance, agent or action with the potential to cause harm (WHO)
- Adverse event (Harmful incident) = an incident that resulted in harm to a patient (WHO)

What type of learning event do you feel it was?

Good practice Near Miss Hazard Adverse event

If the event was a patient safety incident, was it reported through a healthcare reporting system?

Yes No I don't know If you answered no, why not?

If the event was a patient safety incident, was it documented in the patient's files?

Yes No I don't know If you answered no, why not?

Please note:

If the event you describe makes you worried or concerned about patient or staff safety we recommend you talk to someone in your practice placement and/or education institution, and that you follow guidance from them. If there may be immediate danger to patients, students or staff (e.g. nurses, doctors, physiotherapists or other members of staff in healthcare organisations), then YOU MUST TAKE ACTION to make sure everyone is safe and it may be that project team members in specific countries may also need to take action in accordance to their own rules and regulations.

Appendix 4. EMS managers and medical directors' interviews: an interview guide

You can reflect all your answers to your own organizations' policies. We do not report any organization information in the article.

- 1. Tell me what patient safety is and how it appears in the EMS?
- 2. In your point of view, what things/ factors makes patients feel safe in the EMS?
- 3. What could cause fears/ feelings of insecurity to the patients?
- 4. In your own work, how could you include patients to develop patient safety in the EMS?
- 5. How can patients communicate about their safety concerns, excellence, and development ideas?
- 6. How are patients supported in case of adverse events?
- 7. How do you want to or how could you develop patient safety in the EMS so that it promotes the patients' sense of safety / reduces the patients' fears?
- 8. What else do you want to say about patient safety in the EMS?

Supporting questions if necessary:

- Can you describe more?
- Can you give me an example?
- Tell me more?

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