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Homecare, emergency medical team and emergency department professionals´ perspectives on patient safety in health information exchange: A descriptive qualitative study of socio-technical factors

Piia Hyvämäki[1,2], Henna Härkönen[1,3], Maria Kääriäinen[1,3,4,5], Minna Pikkarainen[6], Miia Jansson[1,3,7]

[1] Research Unit of Health Sciences and Technology (HST), University of Oulu, Finland; [2] Oulu University of Applied Sciences, Oulu, Finland; [3] Medical Research Center Oulu, Oulu University Hospital and University of Oulu, Oulu, Finland; [4] North Ostrobothnia wellbeing services county, Oulu, Finland; [5] The Finnish Centre for Evidence-Based Health Care: A Joanna Briggs Institute Excellence Group, Helsinki, Finland; [6] Department for Rehabilitation Science and Health Technology & Department of Product Design Oslomet, Oslo Metropolitan University, Oslo, Norway; [7] RMIT University, Australia

Piia Hyvämäki, RN, PhD, Oulu University of Applied Sciences, P. O. Box 222, FI-90101 Oulu, FINLAND. Email: piia.hyvamaki@oamk.fi

Abstract

Health information exchange plays a critical role in modern healthcare delivery, especially in complex inter-organizational care pathways. This study describes healthcare professionals' perspectives on patient safety in health information exchange, with a focus on associated socio-technical factors. In 2023, semi-structured interviews were conducted with 21 healthcare professionals from home care, the emergency department, and an emergency medical team in one wellbeing services county in Finland, using a modified socio-technical model. Data were analyzed through content analysis, revealing 31 generic categories and 79 subcategories aligned with the model's eight dimensions.

Findings emphasize the crucial role of organizational factors, including insufficient information infrastructure, lack of unified systems, and poor integration. Additionally, user-centered design and support during health information exchange development and health information technology procurement are lacking. Inter-organizational collaboration is inconsistent, and safety monitoring remains inadequate.

Keywords: health information exchange, health informatics, patient safety

Introduction

Since the Institute of medicine´s *"To Err is Human"* [1] health care organizations have been focusing on the development of patient safety by identifying sources of error, reporting incidents, and developing risk and safety indicators [2–4]. A key area of interest has been the digitalization of healthcare services to enhance quality, efficiency, and safety [5]. In this context, efficient and accurate Health

Information Exchange (HIE) —defined as *"the electronic movement of health-related information among organizations according to nationally recognized standards"* [6]—plays a crucial role in improving patient safety by improving documentation, facilitating care coordination, and improving the quality of care across inter-organizational care pathways [7–10].

The safety of the inter-organizational care pathways is compromised by deficiencies in HIE processes and Health Information Technology (HIT) that captures, creates, transmits, stores, and manages individuals' health data [11–13]. Patient safety incidents related to HIE often occur due to inaccurate data entry, poorly designed user interfaces, inadequate system integration, and data output. These shortcomings can compound one another, adversely affecting the timeliness, quality, and overall safety of care delivered to multiple patients [14].

In digitalized healthcare organizations, it is crucial to consider the complexity of socio-technical (ST) factors, as adverse events frequently result from incidents related to HIE [15,16]. The ST-theory is based on general systems and open systems theory [17,18], considering technical, organizational, and human factors as components of the system [19]. In healthcare, ST- analysis has been used to evaluate and develop patient data management within health information systems [20], examine the relationship between information system adoption and patient safety [21–23], and develop a ST-model that examine HIT from both professional and patient perspectives [24,25]. However, previous research has not specifically applied the ST model to analyze factors affecting patient safety in the context of HIE. Therefore, the aim of the study was to describe healthcare professionals' perspectives of patient safety in HIE and related ST factors according to the Sittig and Singh's (2010) new ST-model [26]. The research question guiding the study was: *"What are the ST factors related to patient safety in HIE from homecare, emergency medical team and emergency department professionals´ perspective?"*

Material and methods

This study was conducted in three service provider organizations within one of Finland's wellbeing services counties focusing on homecare, emergency medical team and emergency department. Due to the healthcare reform implemented at the beginning of 2023, responsibility for organizing social and health services was transferred from municipalities to 21 autonomous wellbeing services counties to streamline operations and develop digital services [27]. As the wellbeing services counties were relatively new at the time of the study, the operational practices, including information systems, varied among the organizations studied. A qualitative descriptive design was used to describe healthcare professionals' perspectives through semi-structured interviews with open-ended questions [28].

Registered nurses, physicians, and paramedics (n=23) were recruited though purposive sampling with the assistance of nurse managers [29]. Participants were required to have a minimum of two years of work tenure in their current unit to ensure sufficient familiarity with the phenomenon under investigation. Two of the invited healthcare professionals did not respond to the interview invitation.

The data was collected by the corresponding author, a patient safety trainer and developer (RN, PhD), between August and October 2023 through semi-structured interviews. Interview themes were based on the modified Sittig´s and Singh´s ST model [26]. In this study, the ST model´s dimension "internal organizational features" was modified to "internal and inter-organizational factors" due to the

interorganizational perspective (Table 1). The themes were not modified after pretesting the interview with two healthcare professionals. The pretesting interviews were not included in the data.

The interviews were conducted individually using Microsoft Teams® software and lasted 45-70 minutes (mean 58 minutes). Data saturation was reached when approximately three-quarters of the interviews had been conducted [30]. The interviews were audio recorded with the consent of interviewees and transcribed by the corresponding author. Some field notes were made during the interview, mainly about the aspects on which the interviewee needed more understanding. No repeat interviews were conducted.

The qualitative data were analyzed using a combination of deductive and inductive content analysis approaches [31,32]. The corresponding author read through the raw data (152 pages, with arial 10 font and line spacing 1,5) and transferred it to NVivo qualitative data analysis software (QRR International Pty Ltd., Version 1.6.1). The analysis consisted of three phases: 1) creation of the analysis matrix based on the modified Sittig and Singh ST-model; 2) data reduction and coding; and 3) extraction of data into the matrix and creation of new categories [31,32]. Units of analysis (thought patterns) were condensed for clarity (n=802) and to facilitate code generation [33]. The coding was categorized into an analysis matrix and further analyzed into sub- and generic categories via inductive content analysis (Fig. 1).

Table 1. Interview themes modified from Sittig and Singh's (2010) new socio-technical model.

STS-model dimensions	Sociotechnical framework-based questions	Themes (used only if needed)
1. Hardware and software 2. Clinical content 3. Human–computer interface	What are the technical factors influencing patient safety in HIE?	Technology-related factors and the functionality and usability, e.g., • Structure • Content • Timeliness • Interoperability • Automatization level
4. Internal and Inter-organizational features 5. External rules and regulations 6. Measurement and monitoring	What are the organizational factors influencing patient safety in HIE?	Organization culture (variation in practices, education, attitude), e.g., • Safety culture • Workload • Resources • Interorganizational collaboration
7. People 8. Workflow and communication	What are the human-related factors influencing patient safety in HIE?	Human factors. e.g., • Competence • Cognitive factors • Psychological • and Physiological stressors

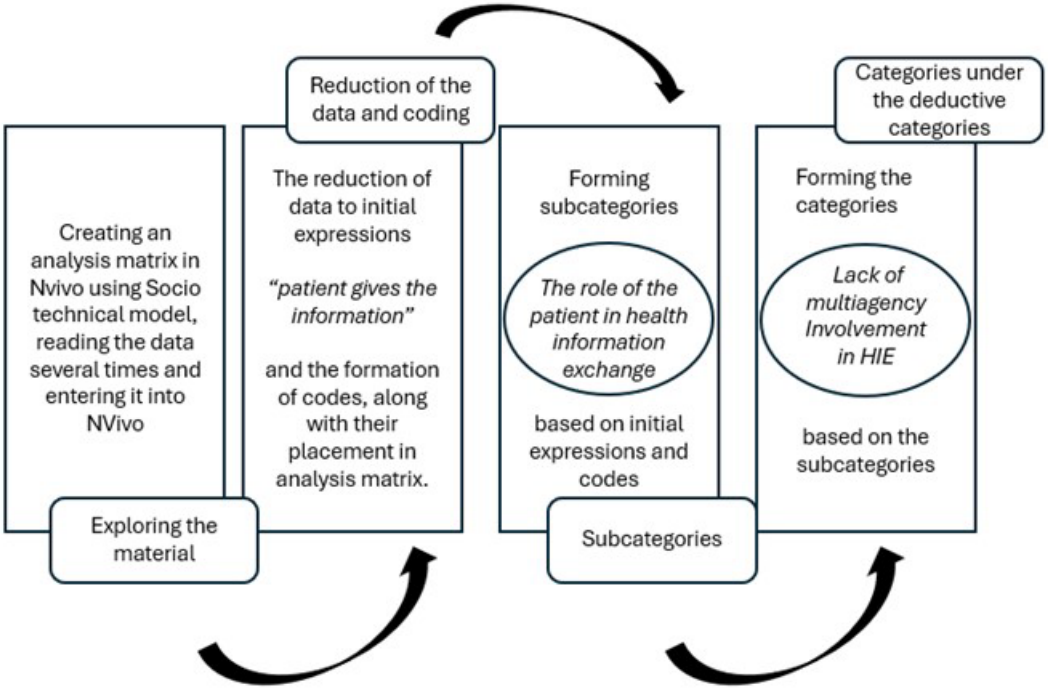

Figure 1. Process of analysis

The analysis was conducted by the corresponding author with validation of the process by the second (MHSc) and last (PhD) authors. In addition, the analysis was validated by a panel of six experts. Their members have expertise in nursing and in health science, both in acute and home care contexts. To ensure reliable reporting, the consolidated criteria for reporting qualitative research was used [34].

Ethical considerations

This study was conducted following good scientific practice and ethical research guidelines, considering carefully participant anonymity and maintaining the confidentiality and integrity of the data throughout the research process. All procedures were carefully considered and transparently reported by the authors. Written informed consent was obtained prior to participation via email. [35] The study was reviewed and approved by the relevant academic centers on December 5, 2022 (Decision no: 216/2022) and on September 6, 2023 (Decision no: 165/2023) The data was handled according to the EU's General Data Protection Regulation [36].

Results

A total of 21 healthcare professionals participated in the interviews (Table 2). A total of 31 generic categories and 79 subcategories of patient safety in HIE were identified in relation to the eight dimensions of the ST model used as an analysis matrix (Appendix 1).

Table 2. Characteristics of participants (n=21).

Characteristics	n (%)
Profession	
Nurse	10 (47.6)
Physician	3 (14.3)
Paramedic	8 (38.1)
Gender	
Female	17 (81)
Male	4 (19)
Organization	
Homecare	6 (28.6)
Emergency department	7 (33.3)
Emergency medical team	8 (38.1)

Hardware and software

Factors related to hardware and software were inductively grouped into three generic categories and related subcategories. An insufficient health information infrastructure was characterized by the absence of a unified patient information system and ongoing challenges with system integration: *The lack of communication between systems causes problems particularly in acute situations, because we don´t get information on time or at all* (Ern7).

Challenges related to information systems included variability in system performance (e.g., downtime and functionality problems of user IDs) as well as delays and real-time access to information: *Often there is an immediate need at that very moment, where you are just waiting for information so that you can see immediately how you should act. And then you must wait for that information* (HCn2). In addition, a lack of automation was noted, and the interoperability of mobile interfaces was perceived to be variable. While the KANTA system supported the timely output and exchange of patient information, difficulties were reported regarding data storage and the transfer of data from patient information systems to KANTA.

Clinical content

Factors related to clinical content were inductively grouped into three generic categories and related subcategories. Patient background information (e.g., contact details and the patient's current ward) and clinical data (e.g., medication information, treatment instructions) were often incomplete, compromising care safety. The lack of reliable information made it difficult to accurately assess treatment needs, as documentation of underlying medical conditions was frequently unavailable and unreliable: *Almost everyone has acute deterioration as a diagnosis. That's why that diagnosis could be thrown in the trash and shouldn't be used* (Ern6). Additionally, professionals expressed concerns

about the transfer of data from patient examination devices to information systems. Both technical issues (e.g., uncertainty in transferring EKG data) and poor data output quality (e.g., lack of clarity in printouts) posed challenges to the care process.

Human–computer interface

Factors related to the human-computer-interface-related were inductively grouped into five generic categories and related subcategories. Overall, the usability of the interfaces was perceived as satisfactory; however, notable challenges remained, particularly in documentation. For instance, the current interface view lacked sufficient guidance and structure to ensure the adequacy of information content.

Manual documentation was widely used, and greater automation was strongly desired. As one participant noted, *"When you must rely on your memory, mistakes happen. The information should be transferred automatically"* (ERp16). The duplication of systems resulted in overlapping documentation, making data output cumbersome and time-consuming: *The patient's vital signs are written manually to ensure they are transferred correctly to other organizations' information systems, and this increases the risk of errors* (ERn14).

Some integrated AI solutions were already in use to support decision-making, for example, *"It automatically calculates the NEWS score and alerts you if it is too low"* (ERn17). Speech recognition technology has also become more widely adopted, and was perceived to facilitate documentation and accelerate HIE. The variability in user-centered design during development partly explains both the usability strengths and the challenges noted. Although feedback provided through the user interface did not always lead to improvements, the involvement of healthcare professionals in the development process was seen as a significant advantage. As one participant remarked, *"One nurse works now in in that company and was attending to the development of this user interface … and it shows"* (Ern9).

People

People-related factors were inductively grouped into five generic categories and related subcategories. Professional competence was found to be a significant determinant in the patient safety of HIE. When professionals valued HIE, they placed strong emphasis on its accuracy and security. As one participant noted, *"Safety issues are not thought through, because the HIE and documentation may be too familiar"* (P12).

Professional competence was related to professional training, work tenure, and age: *Experienced professionals have tacit knowledge of how an overall understanding is formed and what information is needed* (P20). Individual characteristics also influenced documentation styles. Additionally, cognitive features were highlighted as important for ensuring the accuracy and thoroughness of documentation. As one participant emphasized, *"You must remember to update the patient information and be more thorough"* (ERn6).

Working conditions (Incl. work pace, workload, and environmental factors) were closely linked to the safety of HIE. Key concerns included resource limitations, multiple competing tasks, and challenges during rush and peak periods. The lack of a calm environment was identified as a significant barrier to effective documentation and familiarization with patient information: *Sometimes we don't have time to read the care instructions properly and things get left undone....* (HC2).

Interoperability and usability challenges in HIT negatively impacted work performance and

contributed to increased stress. As a result, there was reluctance to adopt new HIT features: One participant explained, *"People are not used to using ready-made phrase bases and do not have the time to learn them"* (ERp8).

Workflow and communication

Workflow- and communication-related factors were inductively grouped into five generic categories and related subcategories. The variable effectiveness of HIE within the care pathway was linked to the presence of overlapping information systems and challenges in data exchange among some organizations. Overlapping systems caused delays and interruptions in HIE due to the need for multiple logins and navigating several interfaces, which disrupted workflow. While HIE between the emergency department and emergency medical team (EMT) was perceived as improving, significant issues remained with HIE involving home care (HC). As one participant noted, *"In the emergency department, the patient data from the EMT is visible, but we can´t see the HC patient records"* (EDn14).

Challenging working conditions (e.g., on-call times, overlapping tasks, and rush) compromised the safety of HIE. System downtimes and updates frequently occurred at inconvenient times and were often poorly coordinated. Limited access rights to information systems further disrupted workflow, particularly during on-call times: *During on-call time, there may be no one on call who has access to another system* (ERp8).

The use of paper patient records was associated with several security risks, including potential loss, compromised confidentiality, and illegibility due to manual entries. Additionally, challenges in accessing and processing records were frequently reported. Consequently, there is a clear need to evaluate the use and reliability of paper medical records. As one participant noted, "*Paper is just paper, so it would be good to use electronic records and to be able to trust it"* (ERp16).

There was a need to support HIE though additional measures such as verbal and written communication (e.g., emails and phone calls), the creation of new roles focused on HIE (e.g., discharge coordinator), and the implementation of procedures and guidelines (e.g., providing medication to patients upon discharge if information does not reach home care in time). Interprofessional cooperation, including active patient involvement, was also emphasized: *You call the patient and ask them where they are currently being cared for* (HCn2).

Internal and inter-organizational factors

Internal- and inter-organizational-related factors were inductively grouped into six generic categories and related subcategories. The acquisition of multiple overlapping information systems led to lack of interoperability, and professionals reported limited opportunities to influence the procurement process. While they anticipated that the new information system would enhance HIE, there was uncertainty regarding its implementation timeline. Additionally, professionals expressed a desire for more through assessments of HIT readiness and usability prior to deployment: *The new system has been developed by the authorities, and the development of usability from a paramedic perspective is ongoing* (P13).

The level of organizational support for professional competence development varied across settings. Both the amount and type of deployment training was inconsistent. Professionals were largely responsible for maintaining their own skills and expressed a need for more systematic training, particularly in the use of existing systems. As one participant stated, *"Systematic training in the use of*

systems is not provided for new or senior staff" (HCp4). In contrast, training in information safety was consistently provided. Notably, a positive organizational culture around patient safety was reported, encouraging open discussion and learning from errors: *The atmosphere is such that you dare to share your mistakes* (P14).

The lack of support for inter-professional cooperation was related to uncertainty about roles, responsibilities, and guidelines followed by other organizations and professionals. One of the main challenges was the variation in access rights to information systems across the care pathway. Participants expressed a clear need for a shared strategy to manage and grant access rights. Additionally, professionals' knowledge of inter-organizational cooperation was limited, and collaboration was perceived as inconsistent. Development projects were mentioned as a common form of cooperation between organizations, though engagement and awareness varied: *Development projects are ongoing, but I don´t have more knowledge about them* (P13).

External rules and regulations

External rules- and regulations-related factors were grouped formed into two generic categories and related subcategories. The impact of health and social services reform, as well as legislation, on HIE was evident. Externally driven organizational changes caused ambiguities and challenges, particularly in quality management and inter-organizational cooperation, due to inconsistencies in available information. Legislative issues also raised questions, such as the right to access patient records before direct contact: *Do we have the right to check the data before seeing the patient* (P15)? Additionally, concerns were expressed about the availability of healthcare resources, linked to budget constraints and the departure of staff from the healthcare sector.

Measurement and monitoring

Measurement- and monitoring-related factors were inductively categorized into two generic categories and related subcategories. The Patient safety reporting system, HaiPro, was the primary tool used to monitor incidents related to HIE. However, the handling of the HaiPro reports was inconsistent. Despite this, HaiPro was considered a valuable tool for raising safety awareness. Nurses and paramedics typically reported HIE-related issues through HaiPro, whereas physicians more often reported problems directly to their supervisors.

Discussion

This study is the first to apply the ST model to analyze factors influencing patient safety in the context of HIE. A total of 31 generic categories and 79 subcategories were identified, offering a comprehensive understanding of the complex interplay between technological systems and human factors that impact patient safety in HIE. (Appendix 1)

HIE adverse events occur in digitalized healthcare organizations and are often associated with complex sociotechnical factors [24,25]. In this study, the safety of HIE was perceived as satisfactory in certain areas, yet notable challenges remained. During the data collection, the well-being services lacked a unified information system and effective system integration, which were seen as barriers to improving patient safety. Participants also expressed concern over the limited opportunities to influence system procurement and reported insufficient support during system implementation. Organizations should carefully evaluate whether to integrate separate systems or to purchase pre-integrated, multi-modular solutions. Such decisions should be guided by a

thorough careful assessment of the comparative advantages and disadvantages, considering both technical functionality and clinical usability [37].

There remains a clear need for further development in both the hardware and software components of HIE. Challenges such as frequent system updates, downtimes, delays in real-time data access, and usability issues—alongside deficiencies in clinical content—were prevalent. Problems with system interfaces and data exchange across multiple platforms is reported to cause errors that may impact numerous patients simultaneously [38,39]. Moreover, the national KANTA system was not yet able to fully address these issues, as also highlighted by Saranto et al. (2020) [40]. These shortcomings often disrupt clinical workflows and contribute to the continued reliance on paper-based patient records [41]. This finding was echoed in the present study, where the use of paper records remained widespread.

The role of healthcare professionals in ensuring patient safety of HIE was clear in this study. Variability in the use of information systems contributed to delays in HIE, while inadequate documentation led to incomplete medication lists and missing basic patient information. Time constraints were identified as a key barrier to utilizing available patient data, and patient transfer information was not always communicated to the receiving organization. These findings align with previous research [42–44]. Barriers to effective documentation are multifaceted, encompassing technological, organizational, social, and individual factors [45,46]. While the organizational culture appeared supportive of patient safety development, the availability of resources and opportunities to maintain and enhance professional competence varied. As supported by both this study and prior literature, competence in using health information systems is influenced by age and educational background [46,47]. Consequently, targeted organizational support is essential—tailored to users' age, prior experience with HIT, and educational level [41,48,49]. Providing consistent, structured content and comprehensive training in system use has been shown to improve documentation practices among professionals [50–53].

Healthcare professionals demonstrated limited knowledge of inter-organizational collaboration, and deficiencies were noted in interprofessional and multi-agency cooperation. Establishing strong inter-professional relationships is perceived as beneficial, highlighting the need to prioritize and strengthen regional strategic collaboration between healthcare organizations [39,54,55].

This study was conducted amid ongoing healthcare reform, which may have influenced the findings, as changes related to HIE had not yet been fully implemented across all organizations. Nevertheless, this timing provided valuable insights into the current needs and preferences of healthcare professionals. Some participants demonstrated limited understanding of certain interview topics (e.g., internal and inter-organizational factors), prompting the researcher to clarify these areas during interviews to ensure alignment with the study's objectives, which may have influenced the data. Transcript review by participants for comments or corrections was not undertaken, as ambiguities were addressed in real time during the interviews. Additionally, member checking of the findings was not performed due to the limited availability of the interviewees.

Conclusion

Our findings highlight that organizational factors play a particularly crucial role among the ST elements influencing patient safety in HIE. These factors contribute to an insufficient information

infrastructure, characterized by the absence of a unified information system and challenges in successful system integration. Moreover, there is a notable lack of user-centered design and adequate support throughout the HIE development and HIT procurement processes. Inter-organizational and interprofessional collaboration related to HIE remains inconsistent. Additionally, current measurements and monitoring of HIE safety are inadequate, underscoring the need for more comprehensive oversight mechanisms. Adopting a ST approach could significantly enhance the development and safety of HIE within regional healthcare systems.

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Conflict of interests

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Ethical approval and informed consent statements

This study was conducted following good scientific practice and ethical research guidelines. This study was reviewed and approved by the relevant academic centers on December 5, 2022 (research permit 216/2022), and on September 6, 2023 (research permit 165/2023). Written informed consent was obtained prior to participation via email.

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Appendix 1. Patient safety in HIE and related ST factors.

Socio-technical dimension	General categories	Subcategories
Hardware and software	Insufficient healthcare information infrastructure	Absence of a unified patient information system. Challenges in system integration
	Performance challenges of information systems	Variability in system performance Delays and time access challenges Functionality of mobile connections
	KANTA in information management	KANTA supports data output KANTA supports timely HIE Difficulties with data transfer to KANTA Variations in successful data storing in KANTA
Clinical content	Inadequate background information	Ambiguities in location information Ambiguities in background information
	Inadequate clinical data for patient care	Ambiguities in medical information Delays in physician documentation Absence of treatment instructions Insufficient information to assess the need for treatment
	Variability in data transfer from the patient examination devices	Uncertainty in the transfer of vital-signs measurements from medical devices Uncertainty in the transfer of ECG data
Human-computer interface	Usable functions in data entry	User interface and content structure to support browsing and documentation of data Predefined phrase bases in the interface
	Challenges in data entry	Manual documentation Overlapping documentation Need for automation
	Laborious data output process	Duplication of systems in the data output Time-consuming data output
	AI-based solutions to support professionals	Interfaces support decision making Speech recognition to support dictation
	User-centeredness in all stages of interface usage	Variable user involvement in development User consultation during use and updates
People	Professional competence	Professionals' attitudes towards health information exchange Professionals' work motivation Clinical competence Skills to use the systems along the care pathway
	Factors affecting professional competence	Professional training Work tenure Professional´s age
	Individual characteristics of professionals	Individual documentation style Cognitive features

	Working conditions affecting professional performance	The impact of workload and rush Impact of work environment
	Changes and reliability of information systems affecting professional performance	Pressures caused by technical inefficiencies and lack of availability Pressures caused by changes in information systems The use of new functions
Workflow and communication	Variable effectiveness of HIE in the care pathway	Use of overlapping information system along the patient pathway Problems in information transfer in homecare Challenges in HIE between homecare and emergency medical team Challenges in HIE between homecare and emergency department Developing HIE between emergency department and emergency medical team
	Challenging working conditions for HIE	Overlapping tasks Variable readiness for updates and down times On-call times
	Use and risks of paper patient records	Extensive use and risks of paper patient records The challenges of handling paper patient records
	Additional measures to support HIE	Additional verbal and written reporting to support health information exchange Creation of new job roles to support health information exchange Existing measures and guidelines to support health information exchange
	Lack of multi-agency involvement in HIE	Interprofessional cooperation in health information exchange The role of the patient in health information exchange
Internal and inter-organizational factors	Acquisition and renewal of multiple information systems	Acquisition of overlapping information systems between organizations New systems to support the health information exchange
	Preparatory work of the organization in the system implementation process	Assessment of system readiness and usability prior to implementation Variable deployment training
	Systematic support for competence	Variability of systematic training and support Professional´s responsibility for ensuring competence Data security training is provided
	A positive organizational culture to ensure patient safety	A positive atmosphere for improving patient safety Organizational support for the use of systems

	Deficiencies in supporting interprofessional collaboration	Uncertainty of the work of other organizations and professionals Variable access rights to systems
	Characteristics of interorganizational cooperation	Limited information on collaboration Varying cooperation Development projects as a tool for cooperation
External rules and regulations	National health and welfare reform and legislation	Externally driven organizational changes Considering data security and patient work on the procurement process
	Healthcare resources	National healthcare budget The departure of the staff from the healthcare sector
Measurement and monitoring	HaiPro for identifying patient safety challenges	HaiPro as a safety awareness provider HaiPro in the development of health information exchange
	Variations in the use of HaiPro	Variable HaiPro reporting Variable processing of HaiPro reports

Abbreviations: HaiPro = The National patient safety reporting system in Finland; KANTA = Finland's national data archive service