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Utilisation and outcomes of patient safety incident reporting and learning in hospitals from a nursing perspective: a multi-method study

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Institute of Family Medicine and Public Health, Faculty of Medicine, University of Tartu, Estonia

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To all healthcare professionals

Knowing is not enough; we must apply.
Willing is not enough; we must do.

Johann Wolfgang von Goethe

CONTENTS

LIST OF ORIGINAL PUBLICATIONS

I. **Uibu**, **E**., Põlluste, K., Lember, M., Kangasniemi, M. (2020). Reporting and responding to patient safety incidents based on data from hospitals' reporting systems: A systematic review. Journal of Hospital Administration, 9(2): 22–32. https://doi.org/10.5430/jha.v9n2p22

II. **Uibu**, **E**., Põlluste, K., Lember, M., Toompere, K., Kangasniemi, M. (2023). Planned improvement actions based on patient safety incident reports in Estonian hospitals: a document analysis. BMJ Open Quality, 12:e002058. http://dx.doi.org/10.1136/bmjoq-2022-002058

III. **Uibu**, **E**, Binsol, K., Põlluste, K., Lember, M., Kangasniemi, M. (2025). Results of a qualitative semi-structured interview study with hospital nursing staff to improve incident reporting systems in Estonia. Journal of Healthcare Quality Research, 40(1): 39–47. https://doi.org/10.1016/j.jhqr.2024.10.003

The author of this dissertation, Ere Uibu holds primary responsibility for the entire study and the design of its sub-studies and is responsible for preparing all data collection tools and communicating with study environments and the ethics committee. Ere Uibu conducted all data collection and data analysis, interpreted the results, and drafted all manuscripts.

ABBREVIATIONS

ASR	Automatic Speech Recognition
CINAHL	Cumulative Index to Nursing and Allied Health Literature
ICPS	International Classification for Patient Safety
IRS	Incident Reporting System(s)
OECD	Organisation for Economic Co-operation and Development
PSIRLS	Patient Safety Incident Reporting and Learning System
REDCap	Research Electronic Data Capture
UT	University of Tartu
WHO	World Health Organization
WoS	Web of Science

1. INTRODUCTION

As a framework of organised activities, patient safety aims to ensure favourable health outcomes and safe care. It has a critical role in the functioning, evaluation and quality assurance of healthcare systems but achieving its goals remains a significant global challenge (Donaldson et al., 2021; WHO, 2021). Healthcare organisations and providers pursue patient safety by establishing cultures, behaviours, processes, technologies, and environments which reduce risks and occurrences of avoidable harm. When harm does occur, they are responsible for reducing its impact and any escalation (WHO, 2020a, 2021). However, the burden of harm continues to be alarming. Different bodies of evidence show that one in 10 (Jha et al., 2013; Slawomirski et al., 2017), one in 20 (Panagioti et al., 2019), and even one in four (Bates et al., 2023) patients are harmed while receiving healthcare. This suggests that current practices are inadequate and raises questions about the relevance and reach of the patient safety activities that have so far been implemented (Vincent & Amalberti, 2016; WHO, 2020a).

The World Health Organisation (WHO) has stated that awareness has grown and progress been made on safety over the past two decades, but these developments have not been as successful as desired (WHO, 2020a). Patient safety incident reporting and learning systems (PSIRLSs), also known as incident reporting systems (IRS) (WHO, 2016a), have mostly been implemented in hospital settings in high-income countries (Brunsveld-Reinders et al., 2016; Petschnig & Haslinger-Baumann, 2017; Slawomirski & Klazinga, 2022; Slawomirski et al., 2017). The implementation of IRS for detecting and fixing failures in healthcare remains highly variable across different countries and healthcare providers (Brunsveld-Reinders et al., 2016; Petschnig & Haslinger-Baumann, 2017). Moreover, there has been little investigation into what happens after incident reporting, including the improvements that have been planned and any incident-related safety outcomes that have been observed (Liukka et al., 2019; Stavropoulou et al., 2015).

Nurses and nursing managers are the professionals most actively involved in using IRS (de la Torre-Pérez et al., 2023; Goekcimen et al., 2023; Heuer et al., 2022). This can be explained by their high commitment to quality care (Wakefield et al., 2021) and the duty to deal with safety issues (Hafsteinsdóttir, 2019; Islam et al., 2018; Liukka et al., 2019; Wakefield et al., 2021). Across the continuum of care, nurses make up the largest proportion of healthcare professionals (WHO, 2020b) acting across the continuum of care (Wakefield et al., 2021), and are most active on the frontline and at patients' bedsides in hospital settings (Aiken et al., 2018; *The Future of Nursing*, 2011). Their work is intensive, and particularly during a long-term crisis such as COVID-19, this can lead to extended shifts, burnout, and ultimately nurse staffing shortages and poor outcomes for both nurses and patients (Wakefield et al., 2021). It has been noted that hospitals with a higher proportion of nurses with a higher level of education achieve significantly lower mortality and fewer adverse patient outcomes (Aiken

et al., 2017). These findings highlight the importance of strengthening the nursing workforce in terms of its working conditions and education (*The Future of Nursing*, 2011; Wakefield et al., 2021). Therefore, studies into nurses' experiences could inform our understanding of current practices and the future of IRS utilisation.

To date, the use of IRS has had limited impact on patient safety because of inadequacies in how incidents are responded to (Goekcimen et al., 2023; Liukka et al., 2019) and knowledge gaps concerning how learning from incidents is applied to improving patient safety (Goekcimen et al., 2023; Serou et al., 2021; Stavropoulou et al., 2015). Therefore, there is a need for further research into IRS utilisation and outcomes, particularly in Estonia where the knowledge in this field is scarce. Two hospitals in Estonia have been using electronic IRS for over five years, and most other hospitals, healthcare providers, and the national level database for reporting and learning are still in the early implementation process. Describing existing practices and comparing them with international experiences will contribute to a deeper understanding of the circumstances and outcomes of reporting and how learning from incidents can best be supported. Further, despite being the primary users of IRS, few studies focus specifically on nurses' experiences with them (Islam et al., 2018; Turner et al., 2014). This study therefore set out to investigate how incident reporting is used, what its outcomes are, and how these are learned from in order to improve patient safety in hospitals. Ultimately, the knowledge gained could enable development in the incident reporting process, organisational learning, and patient safety.

2. REVIEW OF THE LITERATURE

In this chapter I review the existing scientific literature and national and international policy documents on patient safety and its evolution and implementation. Systematic searches were conducted on patient safety incident reports' information handling and use for organisational learning and safety (Appendix 1, Table 1 and 2), and the results are described in sub-chapter 2.1.3.

2.1. Patient safety in healthcare

2.1.1. The nature and evolution of the contemporary concept of patient safety

The nature of patient safety

Patient safety as a framework of organised, multi-level activities is enabled by supportive legislation and just safety culture (Figure 1). These foster two-way learning and open attitudes during discussions about safety within the healthcare system and in all care environments. Safety culture encourages open and respectful communication, a balance between fairness and no-blame attitudes, and transparent information-sharing with staff and patients (WHO, 2021). Patient safety sits alongside other priorities for health care quality such as effectiveness, human-centredness, timeliness, equity, integration, and efficiency (WHO et al., 2018).

Patient safety both influences and depends on changes in healthcare systems more widely (Figure 1). Failures at any level can lead to consequences that severely reduce patient safety, the achievement of desired health outcomes, and the provision of quality health care to individuals and communities. Therefore, safety should be prioritised, harms acknowledged, and actions for improvement taken at all levels – i.e. at the healthcare system, the institution, and care of the individual patient.

The magnitude and societal impact of harm are currently underestimated (Slawomirski & Klazinga, 2022; Slawomirski et al., 2017). Safety is not a high enough priority, and the potential to learn from safety-related problems is diminished by a lack of appropriate leadership. It is evident, that healthcare leaders, managers, and administrators require education and training to understand and use their position to influence staff safety behaviour. Mattson et al., (2015) have argued that leaders' attitudes and behaviour towards employees must not be underestimated. Professionals need the knowledge and skills to detect, analyse, and deal with safety problems without blame or fear (WHO, 2021). They also require the knowledge and skills to involve patients, individuals, and communities in their care. Building such knowledge requires investment in their professional development, alongside effective strategies for patient education (WHO, 2016b).

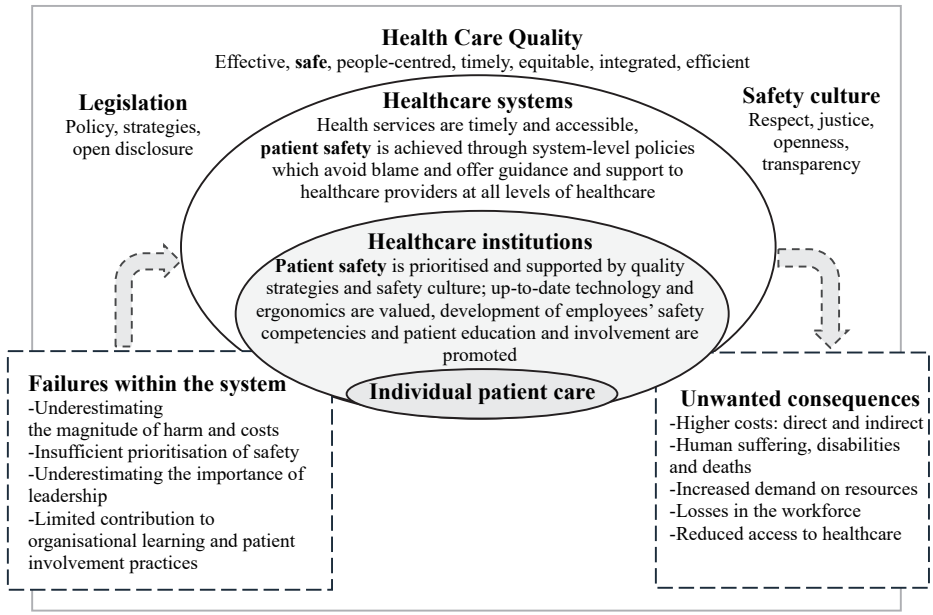

Figure 1. Multilevel patient safety compiled by the author based on the documents from WHO and OECD (Slawomirski & Klazinga, 2022; Slawomirski et al., 2017; WHO, 2021).

Failing to avoid harmful incidents is costly directly and indirectly. The direct costs include the financial cost to healthcare providers of ameliorating the consequences of harm and the broader resource implications of the additional testing, procedures, and staffing levels that would not have been required had the harm not occurred (Slawomirski & Klazinga, 2022).

Indirect costs to healthcare providers include resignations and decreased productivity among staff involved and negatively impacted by harmful safety incidents they witnessed or were involved in (Slawomirski & Klazinga, 2022). These staff members have been referred as 'second victims', as about half of them reportedly experience guilt and anxiety, tiredness, insomnia, and persistent feelings of insecurity after such incidents (Mira et al., 2015; Vanhaecht et al., 2022). At the same time, most of patient safety incidents can be traced back to flawed systemic or organisational conditions beyond the influence of individuals (Vanhaecht et al., 2022).

Indirect societal costs relate to patients whose care pathways became burdened or prolonged due to harm, causing financial problems for them and their families through lost wages or decreased productivity. Indirect costs also include human and workforce losses and the suffering of individuals and families (Slawomirski & Klazinga, 2022; WHO, 2021). Given that human and financial resources are finite, when a patient experiences harm and needs additional care, other patients

must inevitably wait longer for, or not receive, the care they need. Eventually, this reduces access to healthcare.

Evolution of the patient safety movement

While medical and healthcare professionals are steeped in the principle of 'first, do no harm', contemporary approaches to patient safety originated in studies into instances of harm, specifically those which had led to medical malpractice claims against healthcare providers (Brennan et al., 1991; Mills, 1978). Medical records were reviewed to identify patient safety incidents and analyse the circumstances that resulted in patient harm. Some form of patient harm, ranging from temporary harm to death, was identified in about 5% of cases (Mills, 1978). Studies revealed that many of the risks identified did not relate to health professionals' conduct but to institutional issues such as medical management (Brennan et al., 1991; Mills, 1978). Studies concluded that consistent incident reviewing is necessary to provide a basis for self-assessment and incident prevention in hospitals.

At the turn of the 21st century, the patient safety movement started with a critical quality concern highlighted by the Institute of Medicine, which also proposed an agenda for designing a safer health system (Institute of Medicine, 2001; Kohn et al., 2000). Following this report, numerous other publications supported the initiative to develop patient safety (Table 1).

The body of work captured a paradigm shift about why errors occur, based on the recognition that humans are fallible and therefore errors are inevitable (Department of Health, 2000; Kohn et al., 2000; WHO, 2021). The complexity of delivering care and the interaction of multiple factors in healthcare systems means that human errors cannot be eliminated, but they should be prevented and mitigated through the use of organised guidance, procedures, technologies, and behaviours which can detect and correct failures before they impact the patient (WHO, 2021). The WHO and the World Alliance for Patient Safety thus established vital initiatives to provoke international and national attention and stimulate commitment to patient safety among healthcare providers (Table 2).

A framework for patient safety was established in 2004 and is currently described in the Global Patient Safety Action Plan (WHO, 2021). Its guiding policies are integrated into a framework of strategic objectives which suggest activities for different key groups such as governments, healthcare institutions, and service providers along with healthcare professionals, patients, their organisations, and research and educational bodies. The main idea is to prompt interdisciplinary work and partnerships for patient safety and integrate Safety-I and Safety-II approaches (WHO, 2021). Safety-I focuses on detecting, analysing and fixing system failures and its management is by nature reactive responding with actions when something goes wrong or is categorised as an unacceptable risk. The Safety-II approach follows a proactive management principle of continuous attempts to anticipate events and avoid preventable harm. It closely monitors daily practices to find out how things are done and what solutions are successful. It also strives to discover and share knowledge about how things usually go well (Hollnagel et al., 2015; Mannion & Braithwaite, 2017).

Table 1. Documents published in support of patient safety initiatives.

Year	Institution(s)	The document	Seminal contribution
1999	Institute of Medicine	*To err is human: building a safer health system*	Revealed the magnitude of medical errors and their consequences
2000	Department of Health	*An organisation with a memory*	Highlighted patient safety as a new health priority and a new field of research
2005	World Alliance for Patient Safety, WHO	WHO draft guidelines for adverse event reporting and learning systems: from information to action	Introduced incident reporting and learning systems and highlighted the importance of the response to reporting
2009	WHO	Conceptual Framework for the International Classification for Patient Safety	Provided a conceptual framework for the International Classification for Patient Safety (ICPS)
2011	WHO	Patient Safety Curriculum Guide: Multi-professional Edition	Provided recommendations for building the knowledge and skills of health sciences for safe practice
2016	WHO	Minimal Information Model for Patient Safety Incident Reporting and Learning Systems	Provided a list of information categories that should be collected as a minimum when reporting an adverse event
2020	WHO	Patient Safety Incident Reporting and Learning Systems: technical report and guidance	Provided practical guidance on the effective use of patient safety incident reporting and learning systems and perspective on improving systems' use
2021	WHO	Global Patient Safety Action Plan 2021–2030	Presented a framework of strategic objectives and suggested actions
2024	WHO	Global Patient Safety Report	Presented the progress made and underscored the scope for further improvement by offering a strategy to promote patient safety

Table 2. Patient safety development initiatives.

Year(s)	Institution(s)	The initiative	Seminal contribution
2004	WHO	Establishment of the World Alliance for Patient Safety	Launched **initiatives to guide** and facilitate the development of **patient safety policies and practices** in WHO Member States
2005–2006	World Alliance for Patient Safety, WHO	1st Patient Safety Challenge *Clean Care is Safer Care*	Initiated worldwide commitment and **actions to reduce healthcare-associated infections**
2008	World Alliance for Patient Safety, WHO	2nd Patient Safety Challenge *Safe Surgery Saves Lives*,	Initiated worldwide commitment and **actions to reduce** the **risks** associated **with surgery**
Since 2009	WHO	*SAVE LIVES: Clean Your Hands* on the 5th of May	The annual campaign called to **highlight the importance of hand hygiene** in healthcare
2017	WHO	3rd Patient Safety Challenge *Medication Without Harm*	Initiated the process of change **to reduce** patient harm generated by **unsafe medication practices and medication errors**
Since 2019	WHO	World Patient Safety Day on the 17th of September	Started an annual campaign to **promote commitment to patient safety**

The Global Patient Safety Action Plan and leading researchers (Donaldson et al., 2021; WHO, 2021) emphasise a team-based approach, collaboration and commitment to safety across different healthcare fields, noting the need for relevant education and training for health professionals, healthcare educators, and administrators, and suggesting actions for improvement. Donaldson et al. (2021) emphasise the importance of integrating teamwork training into professional education for physicians, nurses, and other health professionals to overcome overly individualistic attitudes in their work.

2.1.2. Patient safety incident reporting and learning systems

The process of reporting and responding

The main purpose of the Patient Safety Incident Reporting and Learning System (PSIRLS), commonly known as the Incident Reporting System (IRS), is to facilitate learning and improve safety through a structured process. IRS consists of two main parts: the input part and the output part (Figure 2). The process of reporting and learning starts with detecting an incident and reacting to it by reporting what has happened. The goal is to know and learn about every patient safety incident that has caused harm to a patient or posed the threat of harm (WHO, 2016a, 2020a). In future, incident information will be analysed separately or in an

aggregated way to identify the underlying root causes and hidden risks (WHO, 2020a) and what needs to be changed to improve safety (WHO, 2016a).

The input part of the IRS (Figure 2) requires consistent staff education and awareness about detecting and reporting incidents, from near-miss events to never events, i.e. those such as wrong-site surgery that should never happen (WHO, 2020a). Staff must be able to notice incidents and failures at various stages of patient care, whether the patient was harmed or the harm was prevented on time through relevant interventions. Other prerequisites include a patient safety culture with a no-blame attitude (Mastroianni, 2018; NHS, 2019) and that the reporting system is technically quick and easy to use (Koskiniemi et al., 2024).

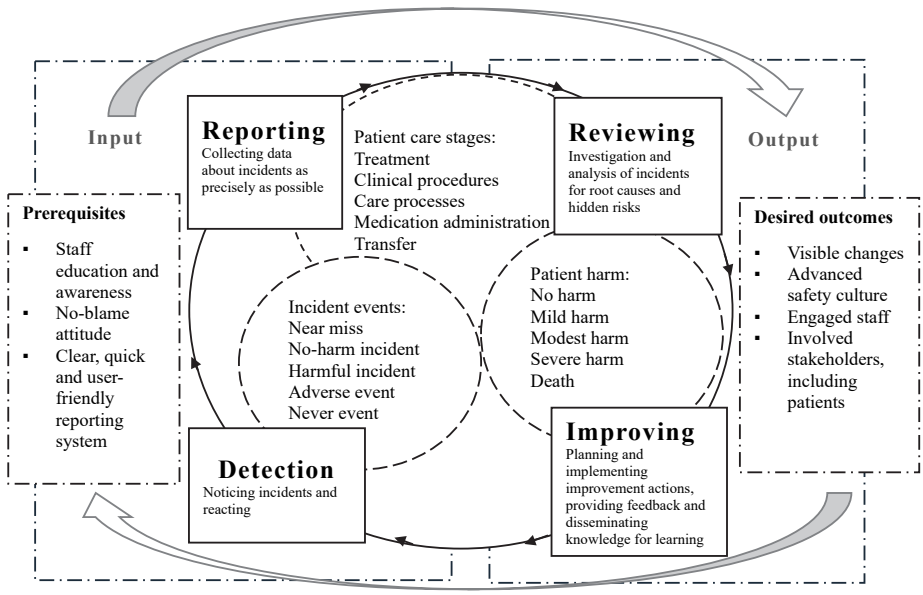

Figure 2. The incident reporting and learning process at the IRS, compiled by the author.

If the input part works well, it provides sufficient information for the output part to review, investigate, and analyse incidents properly, and eventually plan and implement improvements based on what has been learned (WHO, 2020a). Planning and implementing improvement actions must be supported by feedback and knowledge dissemination which prompts learning and builds trust in the IRS and its management (Hollnagel et al., 2015; WHO, 2020a, 2021). Therefore, the better that changes are communicated and made visible, the better the safety culture within the organisation and the staff readiness to be engaged (Sexton et al., 2018) and committed to reporting will be (Mattson et al., 2015).

Learning from incidents and sharing information about good practices depends on effective risk management within the IRS. WHO (2021) has therefore developed advice on policies and actions to improve this. Although the processes

and practices that support organisational learning are not always clear (Stavropoulou et al., 2015), evidence from high-risks industries suggests that joint reflections, acceptance of disagreement and transparency about how decisions are made and contextualised generally contribute to better safety governance and organisational learning (Rossignol & van Oudheusden, 2017). It has also been shown that multiple methods and strategies (Serou et al., 2021), including incident disclosure (Myren et al., 2022), can be combined so that they reinforce each other, promoting organisational learning and learning from specific incidents.

Using incident reporting systems' information for learning in hospitals

IRS are more common in high-income countries and at the hospital level than in poorer countries or other areas of healthcare such as primary care (WHO, 2020a). Whether national or specific to a hospital, they often focus on particular fields such as anaesthesiology or particular incident types such as medication (WHO, 2020a). The use of IRSs varies and is often limited to simply collecting data rather than serving as a resource for improving safety and learning (Brunsveld-Reinders et al., 2016; Petschnig & Haslinger-Baumann, 2017; Ramos & Abeldaño Zuñiga, 2018; Stavropoulou et al., 2015). Studies have revealed that none of such systems examined in intensive care field completely followed the WHO guidelines for IRS (Brunsveld-Reinders et al., 2016).

Reports in IRS show that incidents with immediate consequences and requiring immediate action, such as falls and medication errors, are more likely to be reported than near misses or incidents without immediate consequences (Evans et al., 2006; Ramos & Abeldaño Zuñiga, 2018). However, also near-misses, which are probably the most frequent incidents, can provide valuable information for improvements and learning (Department of Health, 2000; Kohn et al., 2000).

In terms of using IRS, nurses are more likely than doctors to report, as they have better knowledge about how to access the IRS and what to do with the completed report (Evans et al., 2006; Kaya et al., 2020). Meanwhile, doctors are more concerned than nurses about the consequences of reporting, including the risk of litigation and the confidentiality of the IRS (Jeffrey et al., 2021; Kaya et al., 2020). Poor patient safety cultures and a tendency to attribute blame, continue to shape the use of IRS and professionals' hesitance to report incidents leads to underreporting (Evans et al., 2006; Françolin et al., 2015; Kaya et al., 2020). Both nurses and doctors are dissatisfied with the technicalities of IRS which make reporting time-consuming and difficult to use in the context of their busy schedules (Carlfjord et al., 2018; Evans et al., 2006; Kaya et al., 2020; Koskiniemi et al., 2024). However, for all healthcare professionals, the main barrier to reporting is the lack of feedback on what action is implemented as an improvement (Evans et al., 2006; Kaya et al., 2020).

In general, healthcare professionals concur that IRS are useful for improving safety awareness among staff and services as new insights into risks and vulnerabilities stimulate change (Carlfjord et al., 2018; Tage et al., 2021). However, the

resulting actions and their outcomes are not sufficiently visible (Carlfjord et al., 2018). Another problem is that not all professional groups are actively engaged in patient safety improvement work (Jeffrey et al., 2021).

In conclusion, there is little evidence that much is learned from the information collected by IRS, and a lack of feedback about the actions subsequently taken fuels professionals' doubts that incidents have actually been investigated at all (Evans et al., 2006; Stavropoulou et al., 2015). Researchers have noted that, so far, more effort has gone into justifying the need for reporting than into determining what actions should be taken and sharing their outcomes (Carlfjord et al., 2018).

2.1.3. Patient safety and nursing

Among healthcare professionals, nurses are the most active in incident reporting and nursing managers are the most involved in investigating incident reports (Islam et al., 2018; Liukka et al., 2019). Within their teams, nurses tend to take a lead on developing and implementing management actions to identify risks and improve safety (Françolin et al., 2015; Vogus & Sutcliffe, 2011). Complementary safety management actions include the use of standardised protocols which structure interactions between people involved in care, facilitate shared understanding, and enable organisational learning (Vogus & Sutcliffe, 2011); clinical audits which monitor and improve the care that nurses provide; and assessment scales for detecting patients at high-risk of developing pressure ulcers (Françolin et al., 2015).

Studies into managerial communication and organisation show positive relationships between nurses' safety behaviour, IRS use, and engagement in patient safety improvement (Mattson et al., 2015; Vogus & Sutcliffe, 2011). When managers communicate safety as a priority and provide subordinates with regular feedback on their safety performance, such as speaking up or capturing safety incidents, employees perceive safety work more positively and are more committed to safety developments (Mattson et al., 2015). Trust in their manager makes nurses more likely to be engaged in safety discussions because they feel it is safe (Vogus & Sutcliffe, 2011).

However, studies into nurses' experiences of using IRS have revealed problems with learning from incidents (Turner et al., 2014; Waring et al., 2013). Professional boundaries and power asymmetries contribute to fear and mistrust when discussing safety issues (Turner et al., 2014; Waring et al., 2013). Nurses may not dare to speak, even when they have valid input to offer (Turner et al., 2014). Professionals who have responsibility for safety but are not directly involved in everyday clinical practice, may remain formal and stand apart from clinical teams without engaging clinical communities in implementing learning (Waring et al., 2013).

Psychological safety influences nurses' courage to talk about safety issues, and has a positive influence on both incident reporting and ultimate improvements in incident reduction and patient outcomes (Ryan et al., 2009; Savage et al., 2017). Being the largest group of professionals in hospitals (WHO, 2020b),

nurses are involved in most clinical and managerial teams and must dare to speak up. Therefore, unit-based and organisational safety briefings have proven useful for improving risk recognition and promoting teamwork, contributing to better results in identifying and caring for 'high-risk' patients and supporting safety-oriented attitudes, situational awareness, and safety promotion (Ryan et al., 2009). Whole-team training interventions and interdisciplinary teamwork also improve participants' skills, recognition of safety issues, and capacity to speak out assertively when necessary, all of which foster psychological safety in the work environment (Savage et al., 2017).

IRS utilisation has repeatedly been shown to be compromised by the failure to translate incident reports into actions for improvement (Lea et al., 2023; Liukka et al., 2019), due to a lack of appropriate tools and consensus about effective methods (Carlfjord et al., 2018; Lea et al., 2023). Most actions focus on the behaviour of individuals rather than addressing deficiencies in the system, and their effectiveness is only measured against predefined action hierarchies or incident recurrence (Lea et al., 2023).

Inadequate IRS technologies and lack of training in their use are further significant concerns (Carlfjord et al., 2018; Islam et al., 2018; Koskiniemi et al., 2024). Reporting should be quick and easy, but too often, filling in the relevant forms requires an excessive amount of time (Carlfjord et al., 2018; Evans et al., 2006; Kaya et al., 2020; Koskiniemi et al., 2024). To ease access to the IRS and reporting, different reporting platforms should be available for staff (Koskiniemi et al., 2024). While nurses and nurse managers are the primary producers and handlers of incident data, they do not receive adequate training on how to write reports or analyse incidents, particularly at the aggregate data level, reducing their capacity to improve patient safety (Islam et al., 2018).

2.2. Patient safety in Estonia

Leading Estonian physicians first published their concerns about patient safety issues in the early 1990s, identifying that systems for medical care quality evaluation and assurance, were absent and noting the need for resources management (Ellamaa et al., 1994). Among other things, they highlighted the need to detect medical failures and treatment complications and called for collaboration in developing and implementing programmes to improve quality. The first legislation concerning patient safety in Estonia was established in the early 2000s (*Minister of Social Affairs. Regulation No. 128. Health Services Quality Assurance Requirements.*, 2004; *Riigikogu. Health Services Organisation Act, RT I 2001, 50, 284*, 2001). Following this, healthcare providers began to set up organised infection control services and began to document transfusion reactions, healthcare-associated infections (HAIs), post-operative wound infections, and adverse effects that occurred during the use of medical products. Nursing care providers started documenting pressure ulcers, serious patient injuries, fatal falls, and incidents of harm during intra-hospital transfer.

Tartu University Hospital was the first to implement a paper-based incident reporting system (IRS) in 2007, which transitioned to an electronic format in 2012. Various classifications of treatment and diagnostic complications were then agreed upon and these began to be recorded electronically in parallel with use of the IRS (Freimann, 2021). In 2013, another regional hospital, Tallinn, Children's Hospital, implemented an IRS, again initially in paper-based form and later, in 2017, in electronic form. For many years, hospitals used and developed IRS separately, based on their individual institutional needs. More recently, other publicly funded hospitals have started implementing IRS.

In 2014, the legislation was updated to include a requirement to establish guidelines for ensuring patient safety (*Minister of Social Affairs. Regulation No. 128. Health Services Quality Assurance Requirements.*, 2004). In November 2024, when the Compulsory Liability Insurance of Health Care Providers Act came into force, the national-level IRS was made available to all health providers (*Compulsory Liability Insurance of Health Care Providers Act. RT I, 29.04.2022, 1.*, 2022).

The concept of patient safety first appeared in national level strategy in the National Health Plan 2020–2030 which describes the importance of building a patient safety culture, involving and educating patients to actively participate in their own care, and investing in patient safety education and research (The National Health Plan 2020–2030, 2020). The first strategy to focus on patient safety advancements and development needs was the Patient Safety Research and Development Strategy 2022–2026 which was published in 2021 (Freimann et al., 2021, 2022). It aims to enhance the skills of academic staff, young researchers, and students in patient safety and patient safety research. Another of its objectives is to foster collaboration between healthcare providers, funding organisations, professional associations, and patient organisations to develop a model in which the expectations and needs of all parties are identified, allowing them to agree on the selection of research topics, research methodologies, and the implementation of results.

2.3. Summary of the literature review and study rationale

The current scientific evidence shows that the information from IRS is under-utilised for improving patient safety and that there is a knowledge gap regarding how well and whether at all learning from incidents happens. Studies to date show that IRS is generally used as a data collection tool rather than a resource for learning and improvement.

Most previous studies have investigated incident reporting trends and practices, barriers to reporting, and the overall value of IRS implementation for clinical risk management. The evidence suggests that incidents with immediate consequences are more likely reported, and persistent cultures of blame hinder improvements in patient safety in hospitals. It also reveals differences between recommended and actual practices for using IRS. WHO's guidelines for IRSs are

not followed thoroughly in terms of incident reviewing, immediate feedback to reporters, and follow-up to monitor the changes afterwards. Further, not all professional groups are equally engaged in or even aware of IRS and their purpose. Few studies describe the content of incidents and the actions for improving patient safety that followed from them. Many studies focus on specific aspects of care or clinical contexts, and there remains a need for more systematic and comprehensive evidence about reported incidents and improvement actions.

There is little evidence about how specific improvement actions have been planned to prevent future incidents, and how they are associated with incidents' background. Moreover, little is known about IRS information-sharing practices, particularly from the perspective of IRS users and their experiences, and it is not clear how learning from incidents takes place. Building such knowledge could deepen both learning and practice for patient safety. This involves gathering both international and national data about what information IRS contain and how this is used to improve safety in hospitals, and the experiences of IRS's main users, nurses and nursing managers, in terms of learning from such information and improving patient safety outcomes.

3. AIMS OF THE STUDY

This study aimed to investigate the utilisation and outcomes of incident reporting and learning for patient safety improvement in hospitals. The provided knowledge enables understanding and development of incident reporting process for organisational learning and safety improvement. The specific aims were:

1. To identify and describe reported incidents and improvement actions (Papers I, II, III).
2. To analyse the associations between the improvement actions described and incident characteristics (Paper II).
3. To examine nurses' and nursing managers' experiences of incident reporting system (IRS) information sharing and use and their perceptions concerning patient safety developments (Paper III).

4. MATERIALS AND METHODS

4.1. Study design

To gain an understanding of the use of incident reporting systems (IRS) in hospitals, a multi-method research design drawing on different data sources was used (Anguera et al., 2018; Vivek et al., 2023) (Figure 3). Firstly, a systematic review method (Liberati et al., 2009) was conducted to summarise the latest scientific knowledge about responses to incidents documented in hospital incident reporting systems (IRS). This provided a framework for the following sub-studies, a document analysis and an interview study. A retrospective document analysis (Bowen, 2009) of incident reports from Estonian hospitals' IRS described and examined the associations between incidents and their improvement actions. A semi-structured interview study (Pope & Mays, 2006) was conducted with nurses and nursing managers, individually and as groups, to describe their experiences and perceptions of sharing and using IRS information.

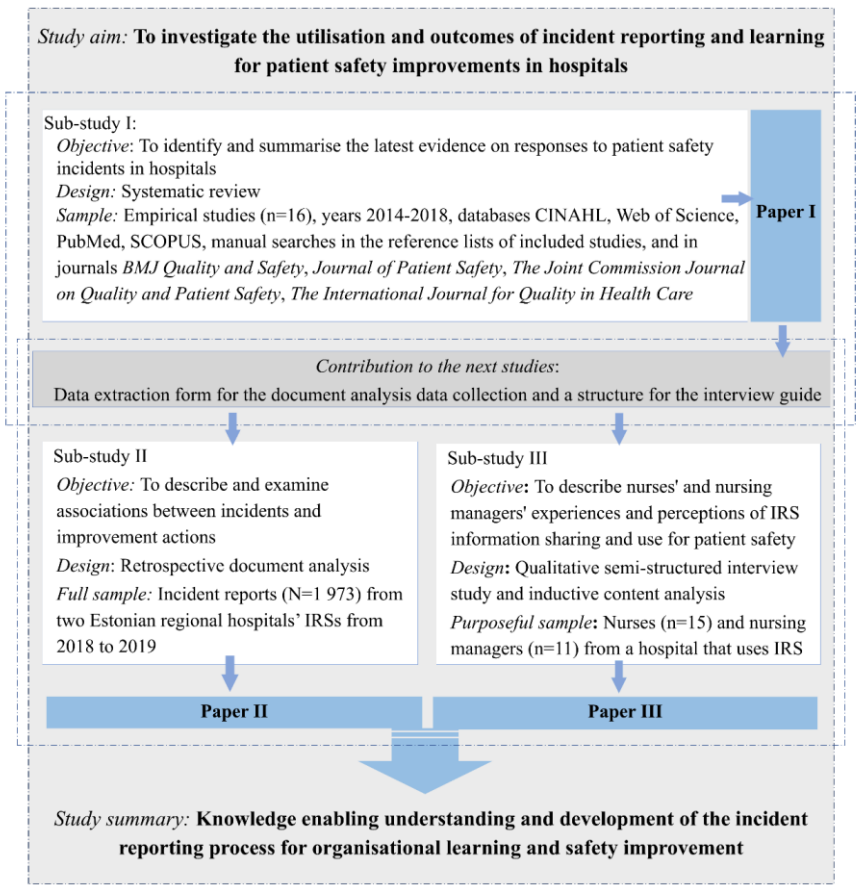

Figure 3. Study design and papers I–III.

4.2. A systematic review of reporting and responding to safety incidents in hospitals (Paper I)

4.2.1. Databases and search strategy

To summarise the latest scientific knowledge, a systematic review of the literature (Liberati et al., 2009) was conducted. Literature searches were made twice, first covering the years 2014–2018 (Paper I) and then updated covering the years 2019–2024.

Electronic searches were performed in four databases, CINAHL, Web of Science (WoS), PubMed and Scopus, followed by manual searches of the selected papers' reference lists and of four patient safety and healthcare quality-focused scientific peer-reviewed journals: *BMJ Quality and Safety*, *Journal of Patient Safety*, *The Joint Commission Journal on Quality and Patient Safety*, and *The International Journal for Quality in Health Care*. The search terms were based on previous research (Brunsveld-Reinders et al., 2016; Petschnig & Haslinger-Baumann, 2017) and the framework for patient safety (WHO, 2009), and included various combinations of keywords relating to incident reporting systems and MeSH words for patient safety and hospital. All searches were limited to peer-reviewed research papers published in English. The second, updated literature searches were conducted electronically, in a similar manner to the systematic review (Paper I), using the same databases and search term combinations (Table 3).

Table 3. Search strategy and screening in the systematic review (Paper I).

	Search terms	**Limitations**	**Inclusion criteria**	**Exclusion criteria**
Boolean operators OR, AND	"reporting system*", "electronic* system*", "incident system*", "critical incident system*", "incident* reporting system*", "learning system*", "event* system*", "sentinel event* system*", "monitoring system*", "quality system*", "deviation reporting system*", "error* reporting", reporting "patient safety" [MeSH] (in PubMed), hospital* [MeSH] (in PubMed and WoS), "hospital setting*"	English Years 2014–2018 Peer-reviewed Research article Field tags: [TI], [AB], [TX] in CINAHL [Topic], [TI] in WoS [TI], [AB] in PubMed and Scopus	Incident reporting system in relation to hospital data Reports on, responses to, or processing of incidents described Reporting systems' content and use of the content to improve patient safety Reported incidents and follow-up actions described	Patient-reported incident system National or regional-level or non-hospital system Training, consultation interventions or competencies development Incident reporting or responding information is missing or cannot be identified

4.2.2. Screening and selecting of data

In total, 2 628 papers were identified. These papers were screened using established inclusion and exclusion criteria (Table 3), phase by phase examining papers based on titles, abstracts, and full texts (Table 4). Finally, duplicates were removed. Selection of papers for the systematic review (Paper I) was independently made by three researchers, and for the literature update by one researcher. Manual searches were conducted for the systematic review only and this yielded four additional papers: one from the reference lists and three from the selected journals. For the final analysis, 16 papers from the systematic review and two from the updated literature searches were included, giving a total of 18 papers. As required for a systematic review (Cooper et al., 2009; Liberati et al., 2009) (Paper I, Table 2), quality appraisal of selected papers was conducted independently by two researchers and for the updated literature by one. All selected papers were included in the synthesis.

Table 4. Selection of literature for the systematic review and updated literature searches (2014–2024).

Years	**2014–2018 (Paper I)**	**2019–2024 (Updates)**
Electronic searches	**666**	**1962**
CINAHL	175	190
Web of Science	249	986
PubMed	141	596
Scopus	101	190
Included based on titles	**222**	**99**
CINAHL	40	22
Web of Science	123	11
PubMed	27	21
Scopus	32	45
Included based on abstracts	**75**	**19**
CINAHL	21	7
Web of Science	38	2
PubMed	9	0
Scopus	7	10
Included based on full texts	**12**	**2**
CINAHL	2	2
Web of Science	7	0
PubMed	2	0
Scopus	1	0
Manual searches	4	–
Selected papers	**16**	**2**

4.2.3. Data analysis

The data from all included papers were analysed using content analysis (Finfgeld-Connett, 2014; Hsieh & Shannon, 2005) to detect and summarise knowledge relevant to the study aim. First, data about the studies' authors, countries, study aims, and methods were extracted and tabulated for the systematic review (Paper I). Next, the data of interest, i.e., the actions taken in response to incidents, were distinguished from broader descriptions of activities. Such actions included information-sharing and dissemination about changes following the reported incident, and discussions held with staff to identify the causes and consequences of an incident. The results presented in Chapter 5 are a synthesis of findings from both the systematic review (Paper I) and the updated literature searches (Table 4).

4.3. Document analysis of incident-related improvement actions (Paper II)

4.3.1. Study settings

A retrospective document analysis method was used to describe and analyse the associations between incidents and subsequent improvement actions (Bowen, 2009; Moilanen et al., 2022). The study was conducted for two Estonian regional-level hospitals which have used IRS for long enough to yield sufficient data.

In Estonia, two of the 19 publicly-funded hospitals, Tartu University Hospital and Tallinn Children's Hospital, have been using IRS for over a decade and have collected data electronically for at least five years. Both hospitals provide outpatient and inpatient healthcare services in all specialities, including acute psychiatric care for children. Tartu University Hospital primarily provides health services for adults and children in Estonia's eastern and southern regions. Tallinn Children's Hospital provides healthcare services for children up to 18 years of age and is situated in the capital of Estonia, Tallinn. Together, the two hospitals represent about 20% of the average annual hospital beds available in Estonian Hospital Masterplan hospitals (National Institute for Health Development, 2022).

In both hospitals, the IRS is based on the Finnish HaiPro system (Palojoki et al., 2017) and consists of two main parts: the input part, and the output part. The IRS was initially used in paper format with electronic platforms being developed in 2012 in Tartu University Hospital and 2017 in Tallinn Children's Hospital. Use of the system is anonymous and voluntary for all staff members. The input part can be completed by a staff member who has witnessed or experienced an incident, and the output part is completed by a manager, usually the unit-level nursing or clinical manager, responsible for handling the report, i.e., for reviewing it, organising an investigation, and documenting the decisions made about improvement actions based on analysis of its findings (Freimann, 2021).

4.3.2. Data collection

Once organisational and ethical approval was obtained, data specialists in the hospitals were contacted. Complete datasets with a full sample of reports from the period January 1st 2018 to December 31st 2019 were received in compliance with the Estonian legislation (*Personal Data Protection Act*, 2018).

The data extraction form (hereafter referred to as the form) was developed (Moilanen et al., 2022) on the basis of the WHO conceptual framework (WHO, 2009), previous literature (Brunsveld-Reinders et al., 2016; Petschnig & Haslinger-Baumann, 2017) and the systematic review conducted for Paper I. The initial version of the form (Table 5) consisted of 10 main items with subdivisions as proposed by the World Health Organization (WHO, 2009). The specific details included were based on previous research (Brunsveld-Reinders et al., 2016) to identify relevant content during the testing phase.

The data from both hospitals were received in Excel spreadsheets, and the form testing was conducted by extracting 5% of the data, i.e. 50 reports from each hospital's dataset. Following the testing (Moilanen et al., 2022), four items were removed from the form because corresponding information was either unavailable, difficult to distinguish, or considered sensitive and not provided by the hospital.

Table 5. Development of structure and content for the data extraction form.

No	Main items	Item subdivisions and specific details based on previous research	Items found in hospitals' IRS	Final items after testing
	Part I – Incident details			
1.	**Incident type**	• Incident types relating to the content	Drop-down menu	1. Incident main type
2.	**Patient outcomes**	• Patient outcome i.e. patient harm	Drop-down menu	2. Patient harm
3.	**Patient characteristics**	• Patient characteristics such as sex, age, and other	Free text	3. Patient age
4.	**Incident characteristics**	• Description of when exactly (the date and time) the incident happened • Department/unit	Free text, fixed date Not provided	4. Incident time
5.	**Contributing factors/hazards**	• Descriptions of contributing factors/hazards • Reporter's recommendations for improvements	Free text Free text	5. Contributing factors and related recommendations
6.	**Organisational outcomes**	• Descriptions of outcomes for organisation, staff, inventory, etc.	Free text	6. Consequences for the organisation

Continues

No	Main items	Item subdivisions and specific details based on previous research	Items found in hospitals' IRS	Final items after testing
7.	**Detection**	• Descriptions of the circumstances of detecting the incident by people or machines or others, i.e. lab results, or other	Free text	7. Incident detection
		• Information on whether the reporter was involved, witnessed the incident, or other	Unavailable	
	Part II – Immediate actions taken by staff			
8.	**Mitigating factors**	• Descriptions of activities taken by staff to prevent or moderate the progression of an incident towards harming a patient	Free text	8. Mitigating factors
		• Descriptions of activities taken to prevent the escalation of the incident and avoid an emergency	Free text	
		• Date of reporting	Fixed date	9. Reporting date
		• Reporter's profession	Not provided	
	Part III – Responding at a managerial level			
9.	**Ameliorating actions**	• Actions taken to make better or compensate for any harm after an incident	Free text	10. Ameliorating actions
		• Informing staff, patients, relatives, etc.	Free text	
		• Information about the disclosure of what happened	Unavailable	
10.	**Actions taken to reduce risk**	• Descriptions of actions planned to respond to the incident reported	Free text	11. Improvement actions
		• Descriptions of the dissemination of knowledge about and from incidents	Free text	
		• Descriptions of follow-up monitoring	Free text	
		• The date of the decision documented	Fixed date	12. The date of the decision 13. Days taken to decision

After the testing (Moilanen et al., 2022), the final form consisted of three parts, incident details, immediate actions taken by staff, and response at the managerial level – comprising altogether 13 items (Table 5). Seven items in the first part focused on the incident details and outcomes, including contributing factors and recommendations for avoiding a recurrence of such situations. The second part of the form contained information about mitigating factors preventing the escalation of an incident, and the date the report was made. The third part covered ameliorating actions and improvement actions documented, the date of noting the decision in the IRS and the time taken from reporting the incident to responding at the managerial level.

The finalised form was uploaded onto the web-based platform REDCap (Research Electronic Data Capture) (Harris et al., 2009). All study data was inserted and saved as a single dataset on this platform.

4.3.3. Data analysis

The data were organised, quantified, and analysed using descriptive statistics (Trochim, 2007). First, the differences in incident typology, level of patient harm, and planned improvements categorisations were harmonised following the WHO framework for reporting and learning systems (WHO, 2009). This process resulted in 14 distinct main incident types, five levels of patient harm, and 14 types of improvement action. Patient harm was evaluated according to the relevant hospital's scale for harm assessment (Appendix 3). At a later stage, incident types were condensed into six nominal variables, patient harm into four by summarizing severe harm and death, and improvement actions into four, allowing statistical analysis across different groups.

New nominal variables were created for the characteristics distinguished from the free text, and a numerical variable for number of days before noting a decision was created, based on the date an incident was reported and the date of a decision being documented in the IRS (Table 5). A single incident could be linked to several contributing factors, recommendations, mitigating factors, ameliorating actions performed and improvement actions planned. All new variables got grouped values (Table 6).

R version 4.1.2 was used for the statistical analysis (The R Foundation for Statistical Computing, R Core Team). Descriptive statistics were conducted to summarise the distribution of incident types, patient harm, age, and the time at which incidents took place. Differences between groups were identified using binary variables based on whether planned improvement actions were documented or not. Associations between improvement actions being documented and the background characteristics of incidents were calculated using Pearson's $\chi 2$ test or Fisher's exact test, whenever applicable. ORs with corresponding 95% CIs and p values were calculated using logistic regression models to explore the odds for improvement actions being documented or not in regarding incident types, age of the patient involved, and patient harm. A value of $p<0.05$ was selected as the cut-off for significance.

Table 6. Nominal variables created based on free texts, derived groups, and their content.

Variable name	Grouping	Description of the groups		
Patient age	Newborn/infant (1 day to 1 year) Child/adolescent (1<+20) Adult (20<+65) Elderly (65<)	Distinguished roughly according to phase of life		
Incident time	Morning (6–12) Afternoon (12–18) Evening (18–00) Night (00–6)	Distinguished according to the description of the shift or daytime		
		Contributing factors		***Recommendations***
Contributing factors and related recommendations	Patient-related	Behaviour, imposed restrictions, illness	→	Better monitoring, relevant care
	Staff related	Behaviour, performance, communication	→	Training, supervising, guiding
	Work environment related	Environment, technology, equipment	→	Safer rooms, adequate equipment
	Organisational factors related	Services, systems, external factors	→	Need for root-cause analysis, system-level improvements
Consequences for the organisation	Additional resources needed	Extra resources in terms of staff, materials, patient treatment		
	Staff injury/assault	Staff injuries, inability to work, extra treatment		
	Property damage	Broken furniture, doors, technical equipment		
	Reputational damage	Accusations against each other in front of patients, legal complaints		
Incident detection	Patient (or another patient) Relative or other Staff Lab Device Audit (internal or external)	Distinguished by source		
Mitigating factors	Patient-based Staff-oriented Team-oriented	Factors preventing or neutralising escalation of the incident		
Ameliorating actions		Actions carried out after the incident to compensate for or alleviate the consequences of the incident		
Improvement actions	Staff-focused Patient care focused Environmental or organisational issues Equipment or general protocols related	Actions described to reduce risks and prevent similar incidents happen in the future		

4.4. Interview study with nursing staff about reporting for patient safety (Paper III)

4.4.1. Study environment and the target group

Semi-structured interviews (Kallio et al., 2016) were conducted to explore nurses' and nursing managers' experiences of using information from incident reporting systems (IRS) to improve patient safety. Both, individual and group interviews were conducted to encourage sharing of both individual and shared experiences and provide participants with multiple ways of participating.

Two publicly-funded hospitals in Estonia have over five years' experience of using electronic incident reporting systems (IRS) (Freimann, 2021), and both were considered potentially suitable environments for this study. Annually, about 200 patient safety reports have been documented in one hospital, and between 700–900 in the other. The IRS used by hospitals is based on the HaiPro system (Freimann, 2021; Palojoki et al., 2017) and is recommended for voluntary use by all staff. Training in IRS is available in hospitals for existing and new staff members.

The population targeted for interviews (Hamilton & Finley, 2019) were registered nurses and nursing managers (at any level of management), i.e., nursing staff, who are the most frequent IRS users (Freimann, 2021; Heuer et al., 2022) and have relevant experience to share (Hammarberg et al., 2016). Relevant staff were informed about the study through meetings held at both hospitals and information letters distributed afterwards. The information letter outlined the study objective, the voluntary nature of participation, how and where data would be collected, reassurance about data protection, and information about who to contact in order to participate. Information letters were shared with hospitals' contact persons who were responsible for forwarding them to nursing managers and nurses. Follow-up invitations were shared three further times. Lastly, the final invitation was sent directly to nursing managers and nurses using their organisational email addresses, to avoid possible information barriers or losses. After each interview, participants were asked to share information about the ongoing interview study with their colleagues (Heckathorn, 2011). The inclusion criteria for participating in the study were working as a nurse or nursing manager in the relevant hospital for at least two years and having at least one experience of reporting in the IRS.

4.4.2. Interview guide

An interview guide (Kallio et al., 2016) was developed based on the existing literature (Brunsveld-Reinders et al., 2016; Petschnig & Haslinger-Baumann, 2017), the systematic review (Paper I), and guidelines for implementing incident reporting systems (WHO, 2020a). An introductory question invited free sharing of experiences relating to patient safety in the hospital. Four themes, with sub-questions, were then discussed, and participants invited to add anything else

relevant before concluding the interview (Table 7). The interview guide was agreed to be appropriate after the first interview, which served as a pilot interview. As no changes were required, data from this interview was included in the final dataset.

Table 7. The interview guide.

Topics	***Sub questions****
Introductory question: Please tell us about patient safety and incident reporting in your hospital	
• Please tell us about the reporting process	*... what does the process foresee?* *... in what cases is a report made?* *... who does what?* *... who is responsible for what?* *... please give some examples.*
• Please tell us about your personal reporting experience	*... what happened after the report was made?* *...what kind of feedback did you receive?* *... what changes were made to prevent this incident in the future?* *... how was the knowledge gained from incident analysis disseminated?*
• Please tell us about incident information sharing	*... in the unit?* *... within the organisation?* *... with patients?* *... with the public?*
• Please tell us how the incident reporting should be developed	*... what information does this require?* *... what skills does this require?* *... who should do what?* *... with what regularity?* *... you said that…. What do you mean by that?*
Closing statement: Please feel free to share if anything important needs highlighting and was missed during the discussion	

* *These were used only if answers did not provide sufficient information*

4.4.3. Recruitment of study participants and data collection

Using purposeful sampling, altogether 26 participants enrolled in the study. Individual interviews were held with seven nursing managers and eight nurses. Group interviews were conducted with four nursing managers and seven nurses, with 2–4 participants in each group. Two of the groups were mixed, included both nurses and nursing managers; one involved only nurses; and one included only nurse managers.

The interviews were conducted virtually, on Zoom, between March and September 2022. Interviews were organised once participants had registered their wish to participate, and the interview groups were formed by participants themselves, as offered in the information letter. The interviewers followed the interview guide. After each interview, the participant(s) filled out a background information questionnaire about their education, position, field of work, general work experience, and patient safety training. Responses to the background questions

were collected directly on REDCap (Harris et al., 2009) and used to describe study participants in general terms.

4.4.4. Data analysis

Inductive content analysis was used to analyse the interview data (Graneheim & Lundman, 2004). The interviews were audio-recorded and then transcribed verbatim using an automatic speech recognition (ASR) system (Olev & Alumäe, 2022). All data provided by nurses and nursing managers were analysed as one data set. Firstly, the material was read several times to form overview. Then, clauses, sentences, or paragraphs that responded to the aim of the study were identified as units of analysis and reduced to codes. Codes were firstly grouped into sub-categories according to their similarities and differences and then, after abstraction, into categories. Coding and categorisation were carried out inductively (Graneheim & Lundman, 2004) and with the assistance of the qualitative data analysis software Nvivo (QSR International Pty Ltd., 2020).

4.5. Ethics of the study

Research ethics were observed throughout the study (*Estonian Code of Conduct for Research Integrity*, 2017; ALLEA, 2023). In planning the systematic review, previous literature and similar systematic reviews were carefully checked. For the document analysis and interview study, the data collection was endorsed by the involved hospitals involved and by the Research Ethics Committee of the University of Tartu (No 319/T-5) and data protection requirements under Estonian legislation were met (*Personal Data Protection Act*, 2018). All materials collected for the document analysis were handled discreetly and confidentially, as they initially contained potentially sensitive information relating to individuals involved in incidents, including staff members.

Participants in the interview study were introduced to its aims and data collection methods, and assured their right to withdraw consent until the end of the interview (ALLEA, 2023). Consent forms were sent to the participants for familiarisation a day before their interview. All consents were electronically signed by both the study participant and the interviewer, and stored in a cloud storage space protected by user account credentials at the University of Tartu. No specific names or places were revealed in study reports, and the results from both empirical studies were presented anonymously.

4.6. Trustworthiness and rigour of the study

Trustworthiness in multi-method research is built on gathering information from multiple sources and methods, each contributing to what has been learned from the previous components of the study (Anguera et al., 2018; Vivek & Nanthagopan, 2021). Different types of data were collected using different methods to

provide comprehensive answers to research questions. The data were collected sequentially and the results then combined to form complete conclusions (Esteves & Pastor, 2003). To ensure the rigour of the study, method-specific criteria for each research method were followed.

For the systematic review, the searches were limited to the years 2014–2018 (Paper I), and complementary literature searches were performed for 2019–2024. Relevant research questions and inclusion and exclusion criteria were specified and followed throughout the searches and selections. Inclusions and exclusions were decided upon independently by three researchers and final selections were confirmed through discussions within the research group for the systematic review (Paper I). The results were reported based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (Liberati et al., 2009) and the limitations of the review were openly discussed.

The documents analysed in Paper II were originally written for purposes other than research, and this limitation was taken into account in drawing final conclusions (Bowen, 2009; Moilanen et al., 2022). To strengthen the trustworthiness of the study, a specific data extraction form was created following the WHO conceptual framework (WHO, 2009) and previous systematic reviews. Then, 5% of the dataset was initially tested to confirm the applicability of the form before the rest of the material was included. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were followed to ensure the quality of the study (Vandenbroucke et al., 2007).

To ensure the credibility and comprehensiveness of the interview study (Paper III), a semi-structured, literature-based, and pre-tested interview guide was followed (Kallio et al., 2016), and the data analysis process was accomplished with three researchers. The interview themes were sent to participant(s) a day before each interview to enable them to prepare (Lincoln et al., 1985). Finally, to ensure the quality of the study results, the Consolidated Criteria for Reporting Qualitative Studies (COREQ) were followed in presenting the results (Tong et al., 2007).

5. RESULTS

This chapter presents the results of the study, organised by sub-aims. Firstly, I describe the characteristics of IRS and related activities in hospitals according to the existing literature (Paper I and updated literature review), document analysis (Paper II), and interview study (Paper III). Secondly, I present the results of the retrospective document analysis (Paper II) into the associations between the characteristics of incidents and the actions for improvement that have been planned or implemented to respond to them. Finally, I outline nurses' and nursing managers' experiences of using information from IRS and their perspectives on safety developments (Paper III).

5.1. Incident reporting and learning in hospitals (Papers I–III)

Based on the systematic review (Paper I) and updated literature, most of the IRS that have been implemented are electronic (Feeser et al., 2020; Kuosmanen et al., 2022, Table 8) and only a few are paper-based (Table 8). Most of the studies included specify who can use the IRS in question, and that its use is anonymous (Kuosmanen et al., 2022, Table 8). The IRS vary in terms of documenting follow-up activities, which can be presented as improvement actions, recommended or already implemented, or described as feedback and/or dissemination of knowledge (Table 8). Fewer than half of the IRS reports are managed by special teams or patient safety departments (Feeser et al., 2020, Table 8), the others being managed by individual specialists or managers of the units in which the incident occurred (Kuosmanen et al., 2022).

Table 8. Summary of IRS' characteristics described in systematic review and updated literature searches (n=18).

Reporting	Form	Electronic	n=11
		Paper-based	n=3
		Both electronic and paper-based	n=1
	Anonymity	Anonymous	n=10
		Non-anonymous	n=4
		Both, anonymous and non-anonymous	n=1*
	Users	All staff	n=16
	Incidents	Different types	n=15
		Only medication-related	n=3
Reports management	Follow-up activities	Improvements	n=16
		Feedback and/or dissemination of knowledge	n=5
	Reviewers	Special teams or department	n=8
		Consultant specialists in the field or department managers	n=10

* Variations reported (over 130 hospitals involved in the study)

5.1.1. Reported incidents

Based on the systematic review (Paper I) and updated literature searches (Feeser et al., 2020; Kuosmanen et al., 2022), studies into IRS use have either focused on specific clinical areas or on clinical practice in general without distinguishing between fields. Some studies have specifically investigated medication-related incidents, intra-hospital transportation, or incidents relating to older patients.

The results show that the most frequently-reported incidents relate to medications (Kuosmanen et al., 2022, Table 9). Next are organisation-related incidents (Table 9), including problems related to non-compliance between training and tasks (Feeser et al., 2020, Table 9), patient injuries related to violent behaviour, and patient accidents, most of which are falls (Kuosmanen et al., 2022). The remainder of incidents are communication- or technology-related incidents (Feeser et al., 2020).

Table 9. Reported incidents based on Paper I and updated literature searches (n=18)*.

Study focus	Reported incidents			
	Medication-related	**Work-organisation related**	**Communication-related**	**Technology-related**
Specific clinical field				
Anaesthesiology (n=3)	Wrong medication	Failure to check	Hasty behaviour Staff fatigue	Faulty or malfunctioning equipment
	Wrong dose Wrong speed Side effects or interaction	Non-compliance between the training and task	Documentation failure Information not passed on No informed consent	Wrong use of equipment Equipment or accessories not available Manual unclear
Operating room (n=2)	–	Failure to check Failure to manage the situation	Hasty behaviour staff fatigue Documentation failure information not passed on Faulty monitoring, treatment or procedure No informed consent	Wrong use of the equipment Equipment or accessories not available
Intensive care (n=1)	Wrong route for administration	Patient fall Non-compliance between the training and the task	Patient identification No informed consent	Faulty or malfunctioning equipment
Emergency care (n=1)*	–	Sharps left at the bedside after a procedure Delayed consultation	Documentation failure	Equipment or accessories not available

Continues

Study focus	Reported incidents			
	Medication-related	**Work-organisation related**	**Communication-related**	**Technology-related**
Forensic psychiatry (n=1)*	Wrong medication	Patient injury or fall Patient violence towards another patient Patient self-harm	–	–
Specific activity or patient-group				
Medications (n=3)	Wrong medication Wrong patient Wrong dose Wrong route Wrong speed Medication not administered	–	–	–
Intra-hospital transportation (n=1)	–	–	Faulty monitoring, treatment or procedure	Equipment or accessories not available Facility malfunctioning
Older patients (n=2)	Wrong medication Wrong patient Wrong dose Wrong time Medication not administered	Non-compliance between the training and task Failure to manage the situation Inadequate care Patient fall Patient injury Patient death	Hasty behaviour Staff fatigue Documentation failure Information not passed on Faulty monitoring, treatment or procedure Patient identification	equipment (bed rails) not properly placed
General				
Clinical fields not distinguished (n=4)	Wrong dose Medication not administered Side effects or interactions	Failure to check Non-compliance between the training and task Lack of coordination Inadequate care Patient fall Food aspiration	Hasty behaviour Staff fatigue documentation failure Information not passed on Faulty monitoring, treatment or procedure Patient identification no informed consent	Faulty or malfunctioning equipment Wrong use of equipment

The document analysis of data from Estonia (Paper II) showed that most of the incidents reported (N=1973) related to patients' violent behaviour (n=587) towards themselves, others, or staff. The second most frequently reported were patient accidents (n=379) such as falls, followed by problems with performing procedures (n=297), documentation (n=165), and managing the organisation's resources (n=152).

Patient harm was assessed for all of the reports (N=1973) analysed in Paper II: based on this assessment, 60% (n=1191) of incidents harmed patients. Patient harm was mild in 585 incidents, moderate in 561, and severe in 45 incidents. 346 reports (18%) provided the patient's age, and 72% (n=249) of these described incidents that happened to children or adolescents (1<+20 years). 323 reports (16%) noted the exact time of the incident and about 29% of these concerned incidents that occurred in the morning (6.00–12.00 a.m.).

5.1.2. Improvement actions

The systematic review (Paper 1) and updated literature searches found 18 studies which documented specific actions for improvement which were either planned or already implemented. Four categories of improvement action were identified (Table 10), of which developing guidelines and protocols was the most frequently reported. These guidelines mostly followed medication-related incidents and communication failures that had complicated procedures and patient care. The second most frequent type of improvement action was staff training, specifically for medication management skills, critical situations management, communication, general work orientation, and adhering to guidelines. Next came general safety-related actions, followed by technical improvements in patient care.

Five of the 18 studies described methods for providing feedback to reporters or specific staff, as well as ways of sharing information by reviewing and discussing incidents that had occurred or disseminating the lessons learned in written or visual form (Table 10).

Table 10. Summary of follow-up actions identified in the systematic review and updated literature searches* (n=18).

Follow-up activities		
Improvement actions by category (n=18)	**Feedback and knowledge dissemination (n=5)**	
Guidelines (n=13)	**Recipients (n=5)**	
• medications: storing, prescribing, dispensing, administering, outcome monitoring • establishing communication and documentation principles • reorganising workflow • safety principles, coordination of care	• individuals • unit staff members • whole organisation	
	Time and frequencies (n=3)	
	• instantly • quarterly • annually	
Staff training (n=13)	**Forms and content (n=5)**	
	Meetings (n=4)	**Content (n=2)**
• general medication management processes • specific skills training: managing airway-related problems, cardiopulmonary resuscitation, other critical situations • communication skills • teamwork skills • general safety behaviour • incident reporting skills • quality of care • orientation training for new staff members • adhering to guidelines • direct instructions about systems or equipment use*	• meetings • forums • public fair events	• feedback about the recommended improvements or corrective actions implemented • reviewing and discussing incidents • establishing quality improvement projects • developing action plans or strategies
General safety improvements (n=12)	**Written support (n=4)**	**Content (n=3)**
• patient monitoring for general safety • accessories such as transparent drapes (paediatric anaesthesia) • facilities such as follow-up rooms • special solutions for monitoring confused older patients • increased staff resources • regular audits to examine safety behaviour in departments • discussions of safety incidents in multi-professional settings • higher level investigations, root cause analyses*	• electronic letters • shared meeting memos • alerts • newsletter publications	• summaries of key findings from in-depth analysis • alerts about safety problems • agreed-upon rules about policies or changes made • lessons learned and findings from analysis of reported incidents and improved practices
Technical improvements (n=8)	**Visual support (n=2)**	**Content (n=2)**
• enhanced patient identification bracelets • advanced infusion pumps • bar-code scan systems • computerised medication order entry system • electronic prescribing system • patient glycaemic monitoring system • technology to monitor high-risk patients for anaesthesia • equipment or accessories available (sevoflurane vaporisers, saturation probes, tube holders) • withdrawing and replacing problematic, faulty, or unsuitable equipment	• plenary session • video	• overview of progressive steps in safety development • real-life story of an incident presented by a healthcare professional • story about how the safety issue was noticed, investigated and improvement actions developed

In the document analysis of data from Estonia, 83% (n=1643) of incidents reported in IRS described planned or implemented improvement actions (Paper II, Table 1). These focused on staff (n=932), patient care (n=822), environmental or organisational issues (n=520), and equipment or general protocols (n=260) (Paper II, Table 2). The date when the incident happened was documented for 21% (n=416) of incidents. The response time from reporting, meaning the time until a decision to respond was noted in the system, was documented for 99% of reports (n=1956) and ranged from the same day to 723 days (median=9).

In the interview study (Paper III), nurses and nurse managers described improvement actions such as sharing lessons learned at staff meetings and other events, receiving and gaining competencies through training, and rearranging day-to-day work using new or updated protocols, additional staff, and additional equipment (Figure 4).

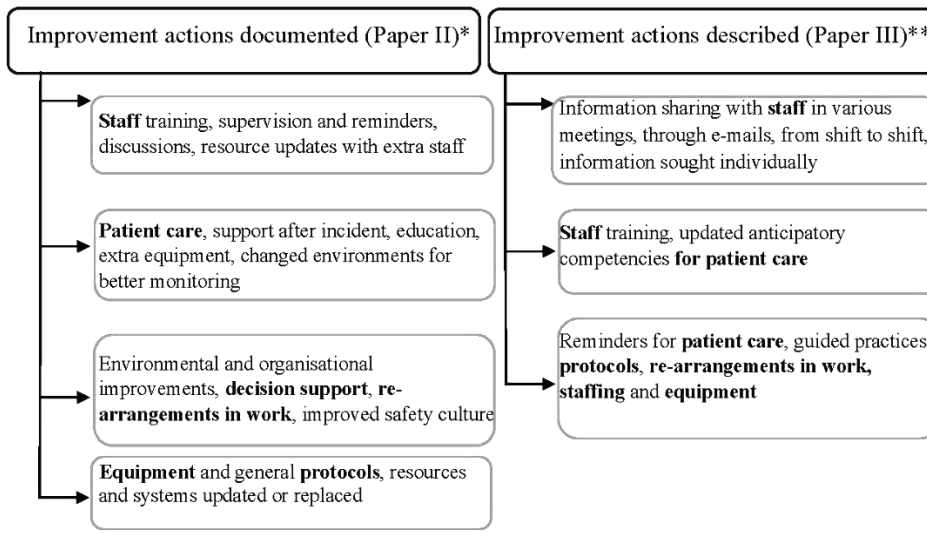

Figure 4. Synthesised results of improvement actions (Paper II and Paper III).
* Documented improvement actions in two years of data from IRS in two Estonian hospitals
** Experiences of nursing staff (n=26) with IRS information sharing

5.2. Associations between incidents and documented improvement actions (Paper II)

Significant associations were found between improvement actions and incident characteristics such as incident type (p=<0.001, Pearson's $\chi 2$ test), patient harm (p=0.001, Pearson's $\chi 2$ test), and patient age (p=0.002, Fisher's exact test). No significant associations were found between the improvement actions and the time of an incident (p=0.839, Pearson's $\chi 2$ test) (Paper II, Table 1).

Logistic regression showed that compared to incidents related to the behaviour of patients, relatives, or other people, improvement actions were most frequently planned for medication and transfusion-related incidents (OR=2.61, p=0.012) and patient accidents (OR=1.65, p=0.010). Improvement actions relating to work organisation and environment were significantly less frequently planned (OR= 0.62, p=0.007) (Paper II, Table 1).

Improvement actions focusing on staff, e.g. staff supervision, training, protocols and staffing, were documented twice as frequently following medication and transfusion-related incidents (OR = 2.51, p=0.001) as after other incident types (Table 11). Improvement actions relating to patient care, such as counselling, better monitoring and updated treatment, were most frequently noted following patient accidents (OR=18.64, p<0,001) or behaviour-related incidents (OR=8.37, p<0,001), and very infrequently after other types of incidents.

Environment and organisational improvements, such as furnishing special rooms, re-arranging work or organising audits, tended to follow patient accidents, behaviour-related incidents, and equipment-related incidents. Equipment-related improvements and protocols generally followed incidents relating to equipment, patient accidents, organisational and environmental incidents, and medication and transfusion-related incidents.

Tabel 11. Associations between incident groups and four categories of improvement actions (Logistic regression model).

Group	**Staff n=932**		**Patient n=822**		**Environment/ organisational n=520**		**Equipment/ general protocols n=260**	
	OR 95% CI	p-value	OR 95% CI	p-value	OR 95% CI	p-value	OR 95% CI	p-value
CP	1 [ref]							
MT	**2.51 1.44–4.41**	**0.001**	**0.41 0.20–0.84**	**0.014**	0.70 0.35–1.40	0.316	**2.54 1.27–5.06**	**0,008**
EQ	**0.25 0.14–0.46**	**<0.001**	**0.09 0.01–0.66**	**0.018**	**2.14 1.07–4.30**	**0.031**	**12.23 6.21–24.09**	**<0,001**
BH	**0.25 0.19–0.32**	**<0.001**	**8.37 6.38–10.97**	**<0,001**	**3.90 2.90–5.26**	**<0,001**	1.50 0.93–2.43	<0,001
PA	**0.11 0.08–0.15**	**<0.001**	**18.64 13.36–26.00**	**<0,001**	**5.07 3.68–6.98**	**<0,001**	**6.31 4.07–9.79**	**<0,001**
WO	**0.48 0.36–0.65**	**<0.001**	**0.10 0.04–0.24**	**<0,001**	1.26 0.84–1.91	0.268	**4.74 2.94–7.63**	**<0,001**

CP – Clinical Processes and related care; MT – Medications and transfusion treatment; EQ – Equipment; BH – People behaviour; PA – Patient accidents; WO – Work organisation and environment.
Bold values are statistically significant results

Regarding patient harm (Table 12), significantly higher odds were detected for patient care-focused improvement actions in relation to incidents resulting in mild and moderate harm. Staff-focused improvements however had the odds significantly lower (more than three times) for such harm-level incidents. The highest odds for environment and organisational improvements were detected for moderate and mild harm incidents, however, odds for improvements related to equipment and general protocols for moderate harm incidents were significantly lower.

Incidents resulting in mild or moderate patient harm tended to provoke significantly more care-focused improvements (OR=5.62, p<0.001; OR=8.64, p<0.001) than staff-focused improvements (OR=0.30, p<0.001; OR=0.31, p<0.001), and more environmental and organisational improvements (OR=1.63, p<0.001; OR=1.68, p<0.001) than improvements in equipment or general protocols (OR=0.66, p=0.016).

Tabel 12. Associations between patient harm and four categories of improvement actions (Logistic regression model).

Harm	Staff n=932		Patient n=822		Environment/ organisational n=520		Equipment/ general protocols n=260	
	OR 95% CI	p-value	OR 95% CI	p-value	OR 95% CI	p-value	OR 95% CI	p-value
None	1 [ref]							
Mild	**0.30 0.24–0.37**	**<0.001**	**5.62 4.39–7.19**	**<0.001**	**1.63 1.28–2.09**	**<0.001**	1.11 0.82–1.50	0.483
Moderate	**0.31 0.24–0.38**	**<0.001**	**8.64 6.71–11.13**	**<0.001**	**1.68 1.31–2.15**	**<0.001**	**0.66 0.47–0.93**	**0.016**
Severe/ Death	0.58 0.32–1.05	0.073	0.88 0.38–2.00	0.752	0.58 0.24–1.39	0.223	0.43 0.13–1.42	0.166

Bold values are statistically significant results

5.3. Nurses' and nursing managers' experiences of using IRS (Paper III)

5.3.1. Incident reporting and information sharing

Participants in the interview study shared that the main purpose of the incident reporting system (IRS) is to provide valuable information about problematic situations in everyday practice. They explained that the incident reports collected through the IRS help managers and staff to understand safety risks, raise their awareness about the improvements needed, and to report accordingly. Participants felt that sharing information from IRS and learning from mistakes helps them to earn the trust of patients and public and protects both them and the organisation from legal action.

Participants explained that the lessons learned have been put into practice by sharing information, creating practical guidance, and developing the anticipatory competencies of staff. The information shared from the IRS has been tailored to the needs and customs of each unit or clinic. Information sharing has been carried out during routine meetings or other scheduled events, between staff members or between nursing managers, and in written forms such as meeting memos, e-letters, and announcements posted on ward notice boards. Study participants highlighted that the most common form of information sharing is informal discussion among staff or directly asking a nursing manager because feedback is not always provided to reporters. Some participants reported that they noted down the incident report code so that they could later look up what findings and decisions had been reached.

Study participants shared their experiences of guided practices such as written protocols for better working flow during procedures, updated instructions for assessment and prevention of pressure ulcers and falls, and extra staffing and equipment being organised to standardise and improve care. According to participants, staff training following analysis of incidents had resulted in better skills for preventing incidents from occurring or escalating. Such training resulted in fewer bedsores, patient falls, and accidents due to the patients' violent behaviour, anxiety, or aggression.

5.3.2. Patient safety development needs

Study participants shared that more regular up-to-date training in patient safety is needed for all staff, along with skills development and guidance for staff who report incidents and managers who review those reports about how to document them in IRS. Other suggestions for improved practice included additional technical options for the IRS and specialised safety professionals forming safety units or teams.

Study participants were convinced that it is important to create an environment in which employees feel free to speak about problems without fear of punishment. Organisational leaders and nursing managements should support this by establishing a policy of shared communication within the organisation which encompasses doctors and other professionals and avoids relegating it to just nurses' 'business'. Study participants also highlighted the need for national-level regulations to enhance the understanding and collaboration between hospitals and other stakeholders.

6. DISCUSSION

6.1. Discussion of the main findings

This study generated insight into the utilisation and outcomes of incident reporting and learning for patient safety in hospitals. It found that improvement actions focus on staff, patient care, changes to equipment and general protocols, and regulating environmental and organisational issues, with a view to addressing incidents related to medication, work organisation, communication, and technology. Most improvement actions focus directly on changes in staff behaviour and patient care rather than system-level changes. Improvement actions were much more frequently planned for medication and transfusion-related incidents, patient accidents, and patient behaviour incidents than following resource management, infrastructure, and work organisation-related incidents. Nursing staff experiences support the view that reporting is useful for ensuring safety awareness among staff and that using incident reporting systems (IRS) is a legal and ethical obligation essential to maintaining public. Further, incident reporting was seen to have stimulated changes in practice. However, inconsistent incident reporting and subsequent learning, partly due to non-user-friendly technology, undermines commitment to and utilisation of IRS. There is an ongoing need for more staff training in patient safety and better dissemination of lessons learned and changes made following incidents.

6.2. Reported incidents and improvement actions

Based on study findings, reported patient safety incidents can be organised into four broad types: medication-related, work organisation-related, communication-related, and technology-related (Paper I). Medication-related incidents are the dominant type of incident reported at the hospital level worldwide, followed by work-organisation-related incidents (Paper I). This study's global findings (Paper I) align with this pattern (Goekcimen et al., 2023; Heuer et al., 2022) but the pattern in Estonia (Paper II) is different, with fewer than 5% of reports describing medication or transfusion-related incidents. The reasons for this are unclear: possibly it is a particularly well-handled area of safety practice or nurses are particularly well-educated about administering medication in Estonia, but it could also simply reflect under-reporting of this type of incident.

In Estonia, almost half of reported incidents were related to violent behaviour by or accidents involving patients (Paper II, Table 1). These results align with previous studies (de la Torre-Pérez et al., 2023; Kinnunen-Luovi et al., 2014; Kuosmanen et al., 2022; Liukka et al., 2019) which have shown that incidents which result in immediate and visible consequences, such as falls, are the most frequently reported. Since 2014, it has been obligatory in Estonia to report all patient falls that result in harm (*Minister of Social Affairs. Regulation No. 128. Health Services Quality Assurance Requirements.*, 2004). This demonstrates that

patient safety can be supported by national law (WHO, 2021). A large proportion of patient behaviour-related incidents were explained by nursing staff (Paper III) as indicative of a lack of space and understaffing for patients with mental disorders which provokes them into agitated and violent behaviour. However, previous studies categorise incident types in different ways, making it difficult to compare their results. Ideally, researchers and professionals working in this field should agree on a shared set of categories, to aid both reporting of and learning from incidents. Stricter adherence to WHO's conceptual framework (WHO, 2009), as demonstrated by this study, offers an obvious starting point for this.

In this study, nursing staff considered that they have a crucial role and duty to report patient safety incidences while delivering day-to-day care. Nurses found that reporting using an IRS enables them to get statistics about existing safety or quality problems and provides arguments to justify investments or making the necessary changes for safety in both day-to-day care and the organisation (Paper III). These results confirm previous studies' findings that most reports in IRS are made by nurses (de la Torre-Pérez et al., 2023; Goekcimen et al., 2023; Heuer et al., 2022; Ramos & Abeldaño Zuñiga, 2018) and that nurses are committed to safe and quality care (Françolin et al., 2015; Vogus & Sutcliffe, 2011; Wakefield et al., 2021). A previous study in Estonia also confirms that most reporters are nursing staff (Freimann, 2021). Nurses are also the largest group of professionals working in healthcare and the most involved in administering medicines, spending time at patients' bedsides during the procedures, monitoring patients, and documenting the data (Ramos & Abeldaño Zuñiga, 2018; WHO, 2020b). However, contemporary healthcare is a very complex and a dynamic system, and individual professional efforts may not be enough. Therefore, all stakeholders need to collaborate for co-producing solutions in order to deliver safe care (Donaldson et al., 2021; WHO, 2021).

More work is needed to clarify which incidents should be reported and how reporting could be made less time-consuming (Evans et al., 2006; Kaya et al., 2020). In Estonia, a national-level IRS has recently been introduced, in late 2024, providing many healthcare professionals and institutions with their first opportunity to report incidents. This is both an opportunity for more multi-professional input and a challenge in terms of establishing systematic communication and a body of good practice and successful examples of change following reporting. National-level reporting has little value if it is not accompanied by clear support to healthcare providers and investments in patient safety at the state level. Best practices in reporting should be actively highlighted to encourage learning and improvements in patient safety.

The improvement actions identified in this study generally targeted changes in staff behaviour through new guidelines and protocols, training in various topics including safety (Papers I, II and III), and additional discussions or supervision (Paper II). Roughly the same proportion of improvements focused on patients, such as calming them down agitated patients, counselling or educating them, or aiding them with additional monitoring or equipment (Papers II and III). It is also noteworthy that the patient-focused improvements in Estonia (Paper II) tended to

target individual patient care, usually of the person involved in the incident, while the international data (Paper I) showed that improvements usually targeted changes in the care of all patients, indicating that they were made at a more general level. Moreover, the associations between improvement actions and incident types (Paper II) showed, that incidents involving traceable failures or visible consequences, such as medication and transfusion-related incidents, patient accidents, and behaviour-related incidents, led to more improvement actions than incidents related to work organisation, resources management, or the environments. These results align with earlier studies which show that improvements tend to focus on the behaviour of individuals rather than addressing systemic deficiencies in healthcare (Lea et al., 2023). As confirmed by this study (Paper III), the main problems with planning improvement actions are the absence of effective tools for system change (Carlfjord et al., 2018; Wood & Wiegmann, 2020) and resources scarcity (Liukka et al., 2019). Even if hospitals have implemented IRS and planned the steps for reporting, reviewing, and improving, there is no clear and agreed understanding on what constitutes a good improvement action (Carlfjord et al., 2018; Lea et al., 2023). Information about the effectiveness of improvement actions is scarce and often limited to assessment according to predefined action hierarchies or providing incident recurrence rates (Lea et al., 2023).

Although this study identified some system-level improvements, they were modestly represented. Such improvements included increasing staff resources to meet the supervisory needs of junior staff (Paper I) or monitor violent patients in psychiatry wards (Paper III), managing complex procedures (Paper III), and providing more intensive patient monitoring and care (Papers I and II). Other general (i.e. organisation-wide) improvements included ensuring suitable physical environments for care (Paper III) and changing work through leadership (Paper II). However, system-level changes consume considerable time and resources and are unfortunately not supported by leaders if these costs are too high (Wood & Wiegmann, 2020). In line with our findings, the first WHO Global report (WHO, 2024) showed, that only 11% of countries have sufficient financial and human resources for implementing policies, action plans, and programmes for patient safety, and only a one-third of countries have fully incorporated patient safety into their national strategies. However, to accomplish patient safety goals, IRS need to become more than administrative tools for detecting and responding to incidents on a case-by-case basis. Without thorough investigation of aggregated data, the latent failures that underlie patient harm are unlikely to be identified. More guidance should be made available for professionals who review and analyse incident reports in order to learn from and act upon them, and information technology and artificial intelligence should be utilised to support this.

6.3. The process of reporting and learning

This study shows that reporting and IRS utilisation are valuable for improving health services (Paper III). IRS utilisation raises safety awareness, and the information gained and shared is useful in nurses' everyday work. However, the study also confirms the need for training in patient safety in general and reporting in particular (Paper III), and that immediate feedback to reporters is often absent (Papers I and III). These findings align with previous studies into staff training on reporting, including on what constitutes a reportable incident (Afaya et al., 2021; Islam et al., 2018; Kaya et al., 2020). The absence of feedback has been described as a major barrier to reporting (Carlfjord et al., 2018; Evans et al., 2006; Kaya et al., 2020; Koskiniemi et al., 2024) which should be prioritised. Firstly, immediate feedback is essential to the reporter knowing whether a report has been received and is going to be managed (Koskiniemi et al., 2024) and all staff must be convinced that IRS use genuinely targets learning rather than simply capturing failures (Stavropoulou et al., 2015). Secondly, feedback from leaders and prioritisation of safety has a positive influence on safety behaviour (Hult et al., 2023; Sfantou et al., 2017) and staff commitment to reporting (Mattson et al., 2015). Therefore, the problem of underreporting could be improved by routinely providing immediate feedback and up-to-date training. Based on this study, safety awareness is both a prerequisite for and a consequence of reporting and learning through IRS when it is supported by immediate feedback to the reporter. A safe environment without fear of punishment and up-to-date training on what and how to report generate the ability and willingness to engage in incident detection and reporting.

The study shows that reporting through IRS is implemented as an organised form of data collection about safety incidents (Paper I) or issues influencing safety and the quality of care in general (Papers I–III). Reporting varies in terms of being paper-based or electronic, anonymous or non-anonymous, and whether all employees or only healthcare team members can report incidents (Paper I). However, nurses and nursing managers identify a need for development in the technological capacity of electronic IRS: for example, it should be possible to provide alerts within medical records (Paper III). These findings align with other studies which have highlighted criticisms of the design of IRS software (Islam et al., 2018; Koskiniemi et al., 2024). It turns out that reporting using IRS is sometimes complicated and not user-friendly, demanding too much time from busy staff (Carlfjord et al., 2018). This in turn hinders reporting (Kaya et al., 2020). The user-friendliness and accessibility of IRS could be improved through the use of different readily-available reporting platforms, such as those accessible via mobile phones (Koskiniemi et al., 2024).

At present, reporting puts unnecessary pressure on staff and diverts attention from providing patient care. IRS should be built or updated through collaboration between clinical and IT specialists and be accompanied by proper manuals and training. It is worth considering using AI to help staff members who are not proficient in the relevant national language. Almost half of the countries that have

IRS use paper-based systems (WHO, 2024), and differences between institutions and nations are to be expected (WHO, 2020a). Nonetheless, where electronic IRS exists, they should be developed in line with users' needs. This entails involving users in planning and developing systems, enhancing their interest in reporting and patient safety awareness in general.

Most IRS allow reporters to stay anonymous or offer the option of non-anonymity (Paper I). Anonymity can be problematic as it may hinder the process of reviewing and analysing the incident. Therefore, particularly in the case of serious incidents, anonymity should be set aside in order to track the case accurately and identify the staff members in need of support (Koskiniemi et al., 2024). However, only a few countries have established robust and independent committees to probe severe harm and sentinel events (WHO, 2024) and generally institutions have been advised to adopt a policy of anonymous IRS use in order to reduce the fear of punishment and the risk of underreporting. In this study, fewer than half of IRS were supported by special teams or departments responsible for managing reports (Paper I), and most reports were analysed by nursing or unit managers (Paper III). This aligns with previous which have identified nursing managers as the primary report investigators (Islam et al., 2018; Liukka et al., 2019). However, hospitals should strive to implement independent and fair investigations within clinical teams to advance the practice of interdisciplinary incident reporting and learning. Such reviewing teams should apply root cause analysis investigations to all incidents that result in patient harm, engaging with different professional groups, reporters, patients, and their relatives as necessary.

The study shows that the response to most incidents included describing improvement actions (Papers I and II). However, when and by whom those actions were to be implemented was generally unclear (Paper II). The study also shows that staff are often not clear about how to document an incident, conduct a review, analyse its findings, and note improvement actions in the IRS (Paper III). Further, the study shows that documentation of improvement actions varied by incident type, patient harm, and age group (Paper II). The improvement actions described predominantly targeted changes in people's behaviour and focused less on system-level development, which is consistent with previous studies (Lea et al., 2023)

IRS should be implemented with the clear, shared purpose of learning and improving practice, and financially supported accordingly (Carlfjord et al., 2018; Islam et al., 2018). The basic standard for IRS utilisation should be to respond constructively to incidents with action plans for improvements. This requires guidance, training, and investment. The more sophisticated the system the more resources it requires (WHO, 2005, 2020a), and concerns have recently been raised about the imbalance between collecting vast numbers of reports and the relatively scarce resources invested in responding to the relevant incidents (Liukka et al., 2019).

The study indicates that incidents are rarely followed up, e.g. by monitoring any improvements implemented or disseminating information about actions taken (Papers II–III). When information is not forthcoming to the person who submitted a report, self-initiated ways of seeking information emerge (Paper III).

However, nursing staff value sharing information from IRS and it is often spread from shift to shift or sometimes presented at department meetings (Paper III). This finding aligns with previous studies which have found that information dissemination and knowledge-sharing activities are not routinely implemented in hospitals (Carlfjord et al., 2018; Kaya et al., 2020; Koskiniemi et al., 2024). This is problematic as it has a negative influence on staff readiness to report. If health professionals get the impression that reports are not analysed, they will not waste their time on reporting the next incident.

In summary, nursing staff are on the frontline of patient care and are also the main users of IRS information. This study confirms earlier research which has highlighted that communication and collaboration are essential to improving patient safety (Savage et al., 2017; Turner et al., 2014). It reveals that such collaboration is currently sub-optimal, both within organisations and between hospitals. National guidelines and support systems do little to fill this gap. Further research is needed to develop evidence-based, cost-effective, and efficient systems for making best use of IRS systems including providing feedback to reporters, disseminating lessons learned, and building a wider culture of patient safety.

6.4. Strengths and limitations of the study

To date, little research has been conducted into the use of IRS with a focus on improvement actions. This study is the first to investigate profoundly the improvement actions documented in IRS and how this information is used by nursing staff. The role of nurses and nursing leaders in incident reporting and learning process has been under-reported to date and this study makes a significant contribution to filling that gap.

The strength of this study is its multi-method design within which each method was conducted rigorously and independently (Anguera et al., 2018; Vivek et al., 2023). This enabled findings from multiple data sources to be combined to build an enhanced understanding of current utilisation of IRS in hospitals. Data from the different studies complemented each other and the findings from sub-study I were used to develop the data extraction sheet for sub-study II and the semi-structured interview guide for sub-study III.

The main limitation of this study relates to the nature of the data documented in different IRS. Firstly, different original studies use different terms to describe responses to incidents, including improvements and follow-up activities, making it difficult to compare them (Paper I). Moreover, most IRS (Paper I) do not use the International Classification for Patient Safety categories for incidents and improvement actions (WHO, 2009), and different hospitals use different terms and explanations when documenting incidents and their characteristics (Paper II). Secondly, the odds ratio values related to incident characteristics and related improvement actions (Paper II) should be interpreted with caution as associations do not imply causality. For example, it cannot be concluded that severe harm incidents cause fewer improvements to be documented. Rather, there are simply

lower odds of improvements being documented in IRS following severe harm incidents. Thirdly, the data in IRS (Paper II) is originally collected for purposes other than research and is put there by professionals with different backgrounds. Therefore, the data from which extractions were made for this study varied noticeably in quality and detail. Lastly, it is important to note that reported incidents and improvement actions reflect only what is documented, not necessarily what is done: it is possible that improvements have been made, even if they have not been documented in IRS, and vice versa.

6.5. Practical implications

The findings of this dissertation are beneficial for all parties involved in healthcare provision and its quality assurance, i.e. professionals working directly with patients at any level of healthcare, professional organisations, leaders in healthcare institutions, educational institutions that train healthcare professionals, and healthcare policymakers. The results have significant implications for improving patient safety at various levels of healthcare, not just in hospitals.

Structures to support healthcare organisations with developing patient safety initiatives, accompanied by corresponding resources, should be established at the national level. Their focus should not be on control but on providing support in the form of evidence-based knowledge, involvement, and even rewards. This is vital as healthcare organisations differ in size and profile and need a balancing power to help them implement and follow at least a minimal information model for patient safety incident reporting in which disseminating information about lessons learned is essential (WHO, 2016a).

A stronger safety culture requires continuing work to educate and train healthcare professionals in patient safety and associated initiatives, including working IRS. The courage and willingness to speak about safety issues demand an environment which is open to discussions and free from attitudes of hiding and denial. Such open communication between all professional groups requires stronger cooperation between educational institutions, practice environments, and administrative levels.

Sustainable implementation of IRS and other patient safety initiatives demands a human-centred healthcare approach (The National Health Plan 2020–2030, 2020) in which both those who receive healthcare and those who provide it are valued, educated, and involved in its provision and development. Healthcare staff must be supported in their work on patient safety by updated and user-friendly IRS, immediate and regular feedback and information about the lessons learned, and active support initiatives for them as second victims. This would improve staff retention and reduce the costs of healthcare, benefitting the sector more widely.

7. CONCLUSIONS

This study investigated the utilisation and outcomes of incident reporting and learning for patient safety improvement in hospitals.

1. Incident reporting systems (IRS) have been implemented in hospitals to facilitate patient safety incident reporting, identify potential risks and problems with service quality, and identify improvements where needed. The most frequently reported incidents are those which have clearly identifiable or visible consequences. Improvement actions are responses to incidents, either planned or already fulfilled, which are usually noted without detailed action plans or measures for monitoring possible outcomes. Most improvement actions are directed towards responding immediately and specifically to a particular incident and the people involved. System-level improvements are less common, and immediate feedback to reporters and routine systematic knowledge dissemination are rarely implemented. Therefore, healthcare organisations need to pay more attention to developing systems for planning improvement actions, assessing their implementation, and consistently sharing feedback and the information necessary for learning.
2. Improvement actions in IRS are not documented consistently and for some incidents are significantly more likely than others to generate documented improvement actions. Significantly fewer improvements are documented for work organisation, resource, and infrastructure-related incidents, incidents involving severe patient harm, and incidents involving adult patients. The reasons for this are unclear, but insufficient skills and training in how to develop improvement actions may be a leading factor. The questionable anonymity of IRS and persistent cultures of blame within organisations may also play a role. The associations detected between incidents and improvement actions show that improvement actions focus more on changing staff behaviour than on changing their working conditions. Further work on developing more systemic responses and improvement actions is required.
3. Nursing staff consider IRS to be a good monitoring tool for raising safety alerts and staff awareness. They see its value in gaining the trust of patients and the public as IRS information allows them to justify, initiate and implement changes to improve safety and quality in general. Nurses know that they are the main users of the IRS, but are not satisfied or in agreement with the view that reporting incidents is primarily their job or responsibility. Greater awareness and support from hospital managers is urgently needed to promote the use of IRS among all professional groups. Nurses see a need for further development of the IRS, both in terms of the system's technical capabilities advancement and the sharing of and learning from the information collected.

Planning and implementing actions to improve patient safety in hospitals requires a systemic approach and detailed action plans with subsequent monitoring of outcomes achieved. Moreover, a system for immediate feedback and information sharing about lessons learned and improvements made needs to be established to shift the focus from individual to system-wide changes and organisational learning. The use of IRS should be accompanied by changes which reduce the fear of being blamed, enhance the practice of learning from failures, and enable collaboration at institutional and national levels. To achieve this, all hospitals must find ways to develop robust safety cultures and systems that support employees in their safety-related work. This includes providing guidance manuals and an updated technical structure for the IRS, ensuring that safety teams work routinely in a standardised manner, and implementing regular patient safety training that engages all professional groups in utilising IRS information to improve safety.

This study suggests initiatives and further research to support the education and long-life training in patient safety for healthcare professionals, from the frontline to hospital leaders. The study highlights the need to build up a stronger basis for different safety initiatives, including organisations' ability to analyse incidents and develop action plans with follow-up monitoring to ensure that the changes made really work for patient safety. The study provides a tool, the data extraction form developed for document analysis (Paper II), for future research based on IRS. In terms of organisational learning, further research is needed to investigate and monitor the outcomes of evidence-based methods and systems for using IRS information.

8. REFERENCES

Afaya, A., Konlan, K. D., Kim Do, H. (2021). Improving patient safety through identifying barriers to reporting medication administration errors among nurses: An integrative review. *BMC Health Services Research*, *21*(1), 1156. https://doi.org/10.1186/s12913-021-07187-5

Aiken, L. H., Sloane, D., Griffiths, P., Rafferty, A. M., Bruyneel, L., McHugh, M., Maier, C. B., Moreno-Casbas, T., Ball, J. E., Ausserhofer, D., Sermeus, W. (2017). Nursing skill mix in European hospitals: Cross-sectional study of the association with mortality, patient ratings, and quality of care. *BMJ Quality & Safety*, *26*(7), 559–568. https://doi.org/10.1136/bmjqs-2016-005567

Aiken, L. H., Sloane, D. M., Barnes, H., Cimiotti, J. P., Jarrín, O. F., McHugh, M. D. (2018). Nurses' And Patients' Appraisals Show Patient Safety In Hospitals Remains A Concern. *Health Affairs*, *37*(11), 1744–1751. https://doi.org/10.1377/hlthaff.2018.0711

Anguera, M. T., Blanco-Villaseñor, A., Losada, J. L., Sánchez-Algarra, P., Onwuegbuzie, A. J. (2018). Revisiting the difference between mixed methods and multimethods: Is it all in the name? *Quality & Quantity*, *52*(6), 2757–2770. https://doi.org/10.1007/s11135-018-0700-2

Bates, D. W., Levine, D. M., Salmasian, H., Syrowatka, A., Shahian, D. M., Lipsitz, S., Zebrowski, J. P., Myers, L. C., Logan, M. S., Roy, C. G., Iannaccone, C., Frits, M. L., Volk, L. A., Dulgarian, S., Amato, M. G., Edrees, H. H., Sato, L., Folcarelli, P., Einbinder, J. S., … Mort, E. (2023). The Safety of Inpatient Health Care. *New England Journal of Medicine*, *388*(2), 142–153. https://doi.org/10.1056/NEJMsa2206117

Bowen, G. A. (2009). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal*, *9*(2), 27–40. https://doi.org/10.3316/QRJ0902027

Brennan, T. A., Leape, L. L., Laird, N. M., Hebert, L., Localio, A. R., Lawthers, A. G., Newhouse, J. P., Weiler, P. C., Hiatt, H. H. (1991). Incidence of Adverse Events and Negligence in Hospitalized Patients. *New England Journal of Medicine*, *324*(6), 370–376. https://doi.org/10.1056/NEJM199102073240604

Brunsveld-Reinders, A. H., Arbous, M. S., De Vos, R., De Jonge, E. (2016). Incident and error reporting systems in intensive care: A systematic review of the literature. *International Journal for Quality in Health Care*, *28*(1), 2–13. https://doi.org/10.1093/intqhc/mzv100

Carlfjord, S., Öhrn, A., Gunnarsson, A. (2018). Experiences from ten years of incident reporting in health care: A qualitative study among department managers and coordinators. *BMC Health Services Research*, *18*. https://doi.org/10.1186/s12913-018-2876-5

Compulsory Liability Insurance of Health Care Providers Act. RT I, 29.04.2022, 1. (2022). https://www.riigiteataja.ee/en/eli/ee/516092024001/consolide

Cooper, H., Hedges, L. V., Valentine, J. C. (Eds.). (2009). *The Handbook of Research Synthesis and Meta-Analysis* (Second Edition). New York: Russell Sage Foundation. https://www.russellsage.org/publications/handbook-research-synthesis-and-meta-analysis-second-edition

de la Torre-Pérez, L., Granés, L., Prat Marín, A., Bertran, M. J. (2023). A hospital incident reporting system (2016–2019): Learning from notifier's perception on incidents' risk, severity and frequency of adverse events. *Journal of Healthcare Quality Research*, *38*(2), 93–104. https://doi.org/10.1016/j.jhqr.2022.08.004

Department of Health. (2000). *An organisation with a memory: Report of an expert group on learning from adverse events in the NHS chaired by the Chief Medical Officer*.

https://qi.elft.nhs.uk/wp-content/uploads/2014/08/r_02-an-organisation-with-a-memory-l-donaldson.pdf
Donaldson, L., Ricciardi, W., Sheridan, S., Tartaglia, R. (Eds.). (2021). *Textbook of Patient Safety and Clinical Risk Management*. Springer International Publishing. https://doi.org/10.1007/978-3-030-59403-9
Ellamaa, A., Gross, J., Kokk, H., Zupping. (1994). *Ravi kvaliteedi uuring Eesti haiglates*. Medaudit, Tallinn.
Esteves, J., Pastor, J. (2003). Using a Multimethod Approach to Research Enterprise Systems Implementations. *Electronic Journal of Business Research Methods*, *2*(2), Article 2.
Estonian code of conduct for research integrity. (2017). Centre for ethics, University of Tartu. https://dspace.emu.ee//handle/10492/4541
Evans, S. M., Berry, J. G., Smith, B. J., Esterman, A., Selim, P., O'Shaughnessy, J., DeWit, M. (2006). Attitudes and barriers to incident reporting: A collaborative hospital study. *Quality & Safety in Health Care*, *15*(1), 39–43. https://doi.org/10.1136/qshc.2004.012559
Feeser, V. R., Jackson, A., Senn, R., Layng, T., Santen, S. A., Creditt, A. B., Dhindsa, H. S., Vitto, M. J., Savage, N. M., Hemphill, R. R. (2020). Patient Safety Event Reporting and Opportunities for Emergency Medicine Resident Education. *Western Journal of Emergency Medicine*, *21*(4), 900–905. https://doi.org/10.5811/westjem.2020.3.46018
Finfgeld-Connett, D. (2014). Use of content analysis to conduct knowledge-building and theory-generating qualitative systematic reviews. *Qualitative Research*, *14*(3), 341–352. https://doi.org/10.1177/1468794113481790
Françolin, L., Gabriel, C. S., Bernardes, A., Silva, A. E. B. de C., Brito, M. de F. P., Machado, J. P. (2015). Patient safety management from the perspective of nurses. *Revista Da Escola de Enfermagem Da USP*, *49*, 0277–0283. https://doi.org/10.1590/S0080-623420150000200013
Freimann, T. (2021). Patsiendiohutus ning ohu- ja kahjujuhtumite käsitlemine Tartu Ülikooli Kliinikumis. *Eesti Arst*. https://ojs.utlib.ee/index.php/EA/article/view/17023
Freimann, T., Karro, H., Lember, M., Läänelaid, S., Põlluste, K., Rosenberg, M., Runnel, R., Siigur, U., Sokk, J., Starkopf, J., Tähepõld, H., Uibu, E. (2021). *Patsiendiohutuse teadus- ja arendustegevuse strateegia 2022–2026*. Tartu Ülikool Meditsiiniteaduste valdkond. https://kliinilinemeditsiin.ut.ee/sites/default/files/2022-02/T%C3%9C%20patsiendiohutuse%20TA%20strateegia%202022-2026_0.pdf
Freimann, T., Põlluste, K., Calsbeek, H., Kangasniemi, M., Lember, M., Orrego, C., Vall-Roqué, H., Tuijl, A. van, Starkopf, J. (2022). Identifying patient safety research priorities in Estonia: Results of a Delphi consensus study. *BMJ Open Quality*, *11*(3), e001907. https://doi.org/10.1136/bmjoq-2022-001907
Goekcimen, K., Schwendimann, R., Pfeiffer, Y., Mohr, G., Jaeger, C., Mueller, S. (2023). Addressing Patient Safety Hazards Using Critical Incident Reporting in Hospitals: A Systematic Review. *Journal of Patient Safety*, *19*(1), e1. https://doi.org/10.1097/PTS.0000000000001072
Graneheim, U. H., Lundman, B. (2004). Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today*, *24*(2), 105–112. https://doi.org/10.1016/j.nedt.2003.10.001
Hafsteinsdóttir, T. B. (2019). Introduction on Leadership, Nursing and the Nordic Countries. In T. B. Hafsteinsdóttir, H. Jónsdóttir, M. Kirkevold, H. Leino-Kilpi, K. Lomborg, I. Rahm Hallberg (Eds.), *Leadership in Nursing: Experiences from the European Nordic Countries* (pp. 1–17). Springer International Publishing. https://doi.org/10.1007/978-3-030-10964-6_1

Hamilton, A. B., Finley, E. P. (2019). Qualitative methods in implementation research: An introduction. *Psychiatry Research*, *280*, 112516. https://doi.org/10.1016/j. psychres.2019.112516

Hammarberg, K., Kirkman, M., de Lacey, S. (2016). Qualitative research methods: When to use them and how to judge them. *Human Reproduction*, *31*(3), 498–501. https://doi.org/10.1093/humrep/dev334

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, *42*(2), 377–381. https://doi.org/10.1016/j.jbi.2008.08.010

Heckathorn, D. D. (2011). Comment: Snowball Versus Respondent-Driven Sampling. *Sociological Methodology*, *41*(1), 355–366. https://doi.org/10.1111/j.1467-9531. 2011.01244.x

Heuer, L., Lehner, M., Stocker, M., Szavay, P., Zundel, S. (2022). A qualitative analysis of critical incident reporting in a paediatric hospital: Benefits and weaknesses. *Swiss Medical Weekly*, *152*(0304), Article 0304. https://doi.org/10.4414/SMW.2022.w30051

Hollnagel, E., Wears, R. L., Braithwaite, J. (2015). *From Safety-I to Safety-II: A White Paper*. https://www.england.nhs.uk/signuptosafety/wp-content/uploads/sites/16/2015/10/safety-1-safety-2-whte-papr.pdf

Hsieh, H.-F., Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, *15*(9), 1277–1288. https://doi.org/10.1177/1049732305276687

Hult, M., Terkamo-Moisio, A., Kaakinen, P., Karki, S., Nurmeksela, A., Palonen, M., Peltonen, L.-M., Häggman-Laitila, A. (2023). Relationships between nursing leadership and organizational, staff and patient outcomes: A systematic review of reviews. *Nursing Open*, *n/a*(n/a). https://doi.org/10.1002/nop2.1876

Institute of Medicine. (2001). *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington (DC): National Academies Press. https://doi.org/10.17226/10027

Islam, T., Hutchinson, A. M., Bucknall, T. K. (2018). Nurse manager risk information management for decision-making: A qualitative analysis. *Collegian*, *25*(4), 401–407. https://doi.org/10.1016/j.colegn.2017.10.009

Jeffrey, H., Samuel, T., Hayter, E., Schwenck, J., Clough, O. T., Anakwe, R. E. (2021). The Perceptions and Experience of Surgical Trainees Related to Patient Safety Improvement and Incident Reporting: Structured Interviews With 612 Surgical Trainees. *Cureus*, *13*(12), e20371. https://doi.org/10.7759/cureus.20371

Jha, A. K., Larizgoitia, I., Audera-Lopez, C., Prasopa-Plaizier, N., Waters, H., Bates, D. W. (2013). The global burden of unsafe medical care: Analytic modelling of observational studies. *BMJ Quality & Safety*, bmjqs-2012-001748. https://doi.org/10.1136/bmjqs-2012-001748

Kallio, H., Pietilä, A.-M., Johnson, M., Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, *72*(12), 2954–2965. https://doi.org/10.1111/jan.13031

Kaya, S., Karaman, S., Bilgin Demir, İ., Ürek, D., Kandemir, A., Yiğit, D. (2020). Attitudes and Barriers to Incident Reporting for Doctors and Nurses in a University Hospital's Surgery Departments. *The Journal of Basic and Clinical Health Sciences*. https://doi.org/10.30621/jbachs.2020.930

Kinnunen-Luovi, K., Saarnio, R., Isola, A. (2014). Safety incidents involving confused and forgetful older patients in a specialised care setting – analysis of the safety incidents reported to the HaiPro reporting system. *Journal of Clinical Nursing*, *23*(17–18), 2442–2450. https://doi.org/10.1111/jocn.12364

Kohn, L. T., Corrigan, J. M., Donaldson, M. S. (Eds.). (2000). *To Err Is Human: Building a Safer Health System*. Institute of Medicine, National academy Press, Washington, D.C. https://doi.org/10.17226/9728

Koskiniemi, S., Syyrilä, T., Hämeen-Anttila, K., Manias, E., Härkänen, M. (2024). Health professionals' perceptions of the development needs of incident reporting software: A qualitative systematic review. *Journal of Advanced Nursing*, *80*(9), 3533–3546. https://doi.org/10.1111/jan.16106

Kuosmanen, A., Tiihonen, J., Repo-Tiihonen, E., Turunen, H. (2022). Voluntary patient safety incidents reporting in forensic psychiatry-What do the reports tell us? *JOURNAL OF PSYCHIATRIC AND MENTAL HEALTH NURSING*, *29*(1), 36–47. https://doi.org/10.1111/jpm.12737

Lea, W., Lawton, R., Vincent, C., O'Hara, J. (2023). Exploring the 'Black Box' of Recommendation Generation in Local Health Care Incident Investigations: A Scoping Review. *Journal of Patient Safety*, *19*(8), 553–563. https://doi.org/10.1097/PTS.0000000000001164

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. *BMJ*, *339*(jul21 1), b2700–b2700. https://doi.org/10.1136/bmj.b2700

Lincoln, Y. S., Guba, E. G., Pilotta, J. J. (1985). Naturalistic inquiry: Beverly Hills, CA: Sage Publications, 1985, 416 pp., $25.00 (Cloth). *International Journal of Intercultural Relations*, *9*(4), 438–439. https://doi.org/10.1016/0147-1767(85)90062-8

Liukka, M., Hupli, M., Turunen, H. (2019). Problems with incident reporting: Reports lead rarely to recommendations. *Journal of Clinical Nursing*, *28*(9–10), 1607–1613. https://doi.org/10.1111/jocn.14765

Mannion, R., Braithwaite, J. (2017). False Dawns and New Horizons in Patient Safety Research and Practice. *International Journal of Health Policy and Management*, *6*(12), 685–689. https://doi.org/10.15171/ijhpm.2017.115

Mastroianni, P. de C. (2018). Incidents reporting: Barriers and strategies to promote safety culture. *Revista Da Escola de Enfermagem Da U S P*. https://www.academia.edu/122453168/Incidents_reporting_barriers_and_strategies_to_promote_safety_culture

Mattson, M., Hellgren, J., Göransson, S. (2015). Leader communication approaches and patient safety: An integrated model. *Journal of Safety Research*, *53*, 53–62. https://doi.org/10.1016/j.jsr.2015.03.008

Mills, D. H. (1978). Medical Insurance Feasibility Study. *Western Journal of Medicine*, *128*(4), 360–365.

Minister of Social Affairs. Regulation no. 128. Health services quality assurance requirements. (2004). https://www.riigiteataja.ee/akt/115012019005

Mira, J. J., Carrillo, I., Lorenzo, S., Ferrús, L., Silvestre, C., Pérez-Pérez, P., Olivera, G., Iglesias, F., Zavala, E., Maderuelo-Fernández, J. Á., Vitaller, J., Nuño-Solinís, R., Astier, P., & on behalf of the Research Group on Second and Third Victims. (2015). The aftermath of adverse events in Spanish primary care and hospital health professionals. *BMC Health Services Research*, *15*(1), 151.

https://doi.org/10.1186/s12913-015-0790-7
Moilanen, T., Sivonen, M., Hipp, K., Kallio, H., Papinaho, O., Stolt, M., Turjamaa, R., Häggman-Laitila, A., Kangasniemi, M. (2022). Developing a Feasible and Credible Method for Analyzing Healthcare Documents as Written Data. *Global Qualitative Nursing Research*, *9*, 23333936221108706. https://doi.org/10.1177/23333936221108706
Myren, B. J., de Hullu, J. A., Bastiaans, S., Koksma, J. J., Hermens, R. P. M. G., Zusterzeel, P. L. M. (2022). Disclosing Adverse Events in Clinical Practice: The Delicate Act of Being Open. *Health Communication*, *37*(2), 191–201. https://doi.org/10.1080/10410236.2020.1830550
National Institute for Health Development. (2022). *Health Statistics and Health Research Database* [Dataset]. http://statistika.tai.ee/pxweb/en/Andmebaas/Andmebaas__04THressursid__11HAHaiglad/HH08.px/
NHS. (2019). *The NHS Patient Safety Strategy: Safer culture, safer systems, safer patients*. https://www.england.nhs.uk/wp-content/uploads/2020/08/190708_Patient_Safety_Strategy_for_website_v4.pdf
Olev, A., Alumäe, T. (2022). Estonian Speech Recognition and Transcription Editing Service. *Baltic Journal of Modern Computing*, *10*(3). https://doi.org/10.22364/bjmc.2022.10.3.14
Palojoki, S., Mäkelä, M., Lehtonen, L., Saranto, K. (2017). An analysis of electronic health record-related patient safety incidents. *Health Informatics Journal*, *23*(2), 134–145. https://doi.org/10.1177/1460458216631072
Panagioti, M., Khan, K., Keers, R. N., Abuzour, A., Phipps, D., Kontopantelis, E., Bower, P., Campbell, S., Haneef, R., Avery, A. J., Ashcroft, D. M. (2019). Prevalence, severity, and nature of preventable patient harm across medical care settings: Systematic review and meta-analysis. *BMJ*, l4185. https://doi.org/10.1136/bmj.l4185
Personal Data Protection Act. (2018). Riigi Teataja. https://www.riigiteataja.ee/en/eli/523012019001/consolide
Petschnig, W., Haslinger-Baumann, E. (2017). Critical Incident Reporting System (CIRS): A fundamental component of risk management in health care systems to enhance patient safety. *Safety in Health*, *3*(1), 9. https://doi.org/10.1186/s40886-017-0060-y
Pope, C., Mays, N. (Eds.). (2006). *Qualitative Research in Health Care, 3th Edition | Wiley*. Blackwell Publishing Ltd.
QSR International Pty Ltd. (2020). *NVivo*. NVIVO (Released in March 2020). https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home
Ramos, F. O., Abeldaño Zuñiga, R. A. (2018). Underutilization of the reports of adverse events in an Argentine hospital. *International Journal of Risk & Safety in Medicine*, *29*(3–4), 159–162. https://doi.org/10.3233/JRS-180003
Riigikogu. Health Services Organisation Act, RT I 2001, 50, 284. (2001). [Riigi Teataja]. https://www.riigiteataja.ee/en/eli/ee/Riigikogu/act/513122024001/consolide
Rossignol, N., van Oudheusden, M. (2017). Learning from Incidents and Incident Reporting: Safety Governance at a Belgian Nuclear Research Center. *Science, Technology, & Human Values*, *42*(4), 679–702. https://doi.org/10.1177/0162243916686168
Ryan, F., Coughlan, M., Cronin, P. (2009). Interviewing in qualitative research: The one-to-one interview. *International Journal of Therapy and Rehabilitation*, *16*(6), 309–314. https://doi.org/10.12968/ijtr.2009.16.6.42433
Savage, C., Gaffney, F. A., Hussain-Alkhateeb, L., Olsson Ackheim, P., Henricson, G., Antoniadou, I., Hedsköld, M., Pukk Härenstam, K. (2017). Safer paediatric surgical teams:

A 5-year evaluation of crew resource management implementation and outcomes. *International Journal for Quality in Health Care: Journal of the International Society for Quality in Health Care*, *29*(6), 853–860. https://doi.org/10.1093/intqhc/mzx113

Serou, N., Sahota, L. M., Husband, A. K., Forrest, S. P., Slight, R. D., Slight, S. P. (2021). Learning from safety incidents in high-reliability organizations: A systematic review of learning tools that could be adapted and used in healthcare. *International Journal for Quality in Health Care*, *33*(1), mzab046. https://doi.org/10.1093/intqhc/ mzab046

Sexton, J. B., Adair, K. C., Leonard, M. W., Frankel, T. C., Proulx, J., Watson, S. R., Magnus, B., Bogan, B., Jamal, M., Schwendimann, R., Frankel, A. S. (2018). Providing feedback following Leadership WalkRounds is associated with better patient safety culture, higher employee engagement and lower burnout. *BMJ Quality & Safety*, *27*(4), 261–270. https://doi.org/10.1136/bmjqs-2016-006399

Sfantou, D. F., Laliotis, A., Patelarou, A. E., Sifaki- Pistolla, D., Matalliotakis, M., Patelarou, E. (2017). Importance of Leadership Style towards Quality of Care Measures in Healthcare Settings: A Systematic Review. *Healthcare*, *5*(4), Article 4. https://doi.org/10.3390/healthcare5040073

Slawomirski, L., Klazinga, N. (2022). *The economics of patient safety: From analysis to action* (OECD Health Working Papers 145; OECD Health Working Papers, Vol. 145). https://doi.org/10.1787/761f2da8-en

Slawomirski, L., Auraaen, A., Klazinga, N. S. (2017). *The economics of patient safety*. https://www.oecd.org/en/publications/the-economics-of-patient-safety_5a9858cd-en.html

Stavropoulou, C., Doherty, C., Tosey, P. (2015). How Effective Are Incident-Reporting Systems for Improving Patient Safety? A Systematic Literature Review. *The Milbank Quarterly*, *93*(4), 826–866. https://doi.org/10.1111/1468-0009.12166

Tage, P. K. S., Berkanis, A. T., Betan, Y., Pinis, E. B. (2021). A Qualitative Study on Nurses' Experiences of Reporting Patient Safety Incidents in East Nusa Tenggara, Indonesia. *Nurse Media Journal of Nursing*, *11*(3), 359–369. https://doi.org/10.14710/nmjn.v11i3.38400

The European Code of Conduct for Research Integrity (Version Revised Edition 2023). (2023). Published by ALLEA. https://doi.org/10.26356/ECOC

The Future of Nursing: Leading Change, Advancing Health (with Institute of Medicine). (2011). National Academies Press. https://doi.org/10.17226/12956

The National Health Plan 2020–2030. (2020). The Ministry of Social Affairs. https://www.sm.ee/sites/default/files/documents/2023-03/National%20Health%20Plan%202020-2030.pdf

Tong, A., Sainsbury, P., Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*, *19*(6), 349–357. https://doi.org/10.1093/intqhc/mzm042

Trochim, W. (2007). *The Research Methods Knowledge Base, 3rd edition, [Student Edition]*. Thomson.

Turner, S., Higginson, J., Oborne, C. A., Thomas, R. E., Ramsay, A. I. G., Fulop, N. J. (2014). Codifying knowledge to improve patient safety: A qualitative study of practice-based interventions. *Social Science & Medicine*, *113*, 169–176. https://doi.org/10.1016/j.socscimed.2014.05.031

Vandenbroucke, J. P., von Elm, E., Altman, D. G., Gøtzsche, P. C., Mulrow, C. D., Pocock, S. J., Poole, C., Schlesselman, J. J., Egger, M. (2007). Strengthening the Reporting of

Observational Studies in Epidemiology (STROBE): Explanation and Elaboration. *PLoS Medicine*, *4*(10), e297. https://doi.org/10.1371/journal.pmed.0040297

Vanhaecht, K., Seys, D., Russotto, S., Strametz, R., Mira, J., Sigurgeirsdóttir, S., Wu, A. W., Põlluste, K., Popovici, D. G., Sfetcu, R., Kurt, S., Panella, M. (2022). An Evidence and Consensus-Based Definition of Second Victim: A Strategic Topic in Healthcare Quality, Patient Safety, Person-Centeredness and Human Resource Management. *International Journal of Environmental Research and Public Health*, *19*(24), Article 24. https://doi.org/10.3390/ijerph192416869

Vincent, C., Amalberti, R. (2016). *Safer Healthcare*. Springer International Publishing. https://doi.org/10.1007/978-3-319-25559-0

Vivek, R., Nanthagopan, Y. (2021). Review and Comparison of Multi-Method and Mixed Method Application in Research Studies. *European Journal of Management Issues*, *29*(4), 200–208. https://doi.org/10.15421/192119

Vivek, R., Nanthagopan, Y., Piriyatharshan, S. (2023). Beyond Methods: Theoretical Underpinnings of Triangulation in Qualitative and Multi-Method Studies". *SEEU Review*, *18*(2), 105–122. https://doi.org/10.2478/seeur-2023-0088

Vogus, T. J., Sutcliffe, K. M. (2011). The Impact of Safety Organizing, Trusted Leadership, and Care Pathways on Reported Medication Errors in Hospital Nursing Units. *JONA: The Journal of Nursing Administration*, *41*(7/8), S25. https://doi.org/10.1097/NNA.0b013e318221c368

Wakefield, M. K., Williams, D. R., Menestrel, S. L., Flaubert, J. L. (Eds.) (with Committee on the Future of Nursing 2020–2030, National Academy of Medicine, & National Academies of Sciences, Engineering, and Medicine). (2021). *The Future of Nursing 2020-2030: Charting a Path to Achieve Health Equity*. National Academies Press. https://doi.org/10.17226/25982

Waring, J., Currie, G., Crompton, A., Bishop, S. (2013). An exploratory study of knowledge brokering in hospital settings: Facilitating knowledge sharing and learning for patient safety? *Social Science & Medicine*, *98*, 79–86. https://doi.org/10.1016/j.socscimed.2013.08.037

WHO. (2005). *World alliance for patient safety: WHO draft guidelines for adverse event reporting and learning systems: from information to action* (WHO/EIP/SPO/QPS/05.3). World Health Organization. https://apps.who.int/iris/handle/10665/69797

WHO. (2009). *The conceptual framework for the international classification for patient safety. Final Technical Report January 2009* (Version 1.1; p. 154). https://www.who.int/publications-detail-redirect/WHO-IER-PSP-2010.2

WHO. (2016a). *Minimal information model for patient safety incident reporting and learning systems: User guide* (WHO/HIS/SDS/2016.22). World Health Organization. https://apps.who.int/iris/handle/10665/255642

WHO. (2016b). *Technical Series on Safer Primary Care: Patient engagement*. https://www.who.int/publications/i/item/9789241511629

WHO. (2020a). *Patient safety incident reporting and learning systems: Technical report and guidance*. https://www.who.int/publications-detail-redirect/9789240010338

WHO. (2020b). *State of the world's nursing 2020: Investing in education, jobs and leadership.* https://reliefweb.int/report/world/state-world-s-nursing-2020-enarruzh

WHO. (2021). *Global Patient Safety Action Plan 2021–2030*. Global Patient Safety Action Plan 2021–2030. Towards Eliminating Avoidable Harm in Health Care. https://www.who.int/publications-detail-redirect/9789240032705

WHO. (2024). *Global patient safety report 2024*. WHO. https://www.who.int/publications/i/item/9789240095458

WHO, OECD, & International Bank for Reconstruction and Development/The World Bank. (2018). *Delivering quality health services: A global imperative for universal health coverage*. https://www.who.int/publications/i/item/9789241513906

Wood, L. J., Wiegmann, D. A. (2020). *Beyond the corrective action hierarchy: A systems approach to organizational change.* 438–444. https://doi.org/10.1093/intqhc/mzaa068

SUMMARY IN ESTONIAN

Patsiendiohutusjuhtumitest teavitamine ja õppimine ning selle tulemused haiglates õenduse vaatenurgast: mitmemeetodiline uuring

Sissejuhatus

Tänapäevane tervishoid on kõrgtehnoloogiat rakendav kompleksne süsteem, mille olulisim ülesanne on tagada elanikkonnale kvaliteetsed ja ohutud tervishoiuteenused. On lubamatu, kui inimesele, kes on pöördunud oma tervisemurega tervishoiusüsteemi, saab süsteemi kitsaskohtade tõttu osaks hoopis tervisekahju, mida oleks saanud vältida. Seega on tervishoiuteenuste jätkusuutlikkuse ja kvaliteedi tagamiseks ning hindamiseks äärmiselt vajalik ära tunda riskiolukorrad ning vältida vigu ja kahju kogu tervishoiusüsteemis (WHO, 2020a, 2021). Ometi ei ole ka aastakümneid kestnud töö patsiendiohutuse nimel kaasa toonud ihaldatud olukorda, kus ükski patsient teenuse osutamise ajal kahjustatud ei saaks ning kahjujuhtumite esinemus tervishoius on üle maailma endistviisi suur (Donaldson et al., 2021; WHO, 2020a).

Tervishoiuorganisatsioonid kui teenuseosutajad vastutavad teenuste kvaliteedi, sh patsiendiohutust tagavate tegevuste ja keskkondade eest. See tähendab patsiendiohutuskultuuri väärtustamist ja seda soodustava keskkonna loomist, töötajate teadlikkuse kasvatamist, süüdistamisvaba suhtumise kujundamist ning ohutust toetavate protsesside ja tehnoloogiate kasutusele võtmist. Kõik need aspektid koos võimaldaksid vähendada riske ning patsiendikahju tekkimise tõenäosust. Kui patsiendikahju on siiski tekkinud, tuleb rakendada meetmeid selle mõju vähendamiseks ning vältida kahju või muude tagajärgede süvenemist.

Üle 15 aasta tagasi publitseeris Maailma Terviseorganisatsioon patsiendiohutuse rahvusvahelise klassifikatsiooni, millesse on koondatud patsiendiohutuse info ning terminoloogia (WHO, 2009). Samuti soovitas tervishoius kasutusele võtta patsiendiohutusjuhtumite teavitus- ja õpisüsteemid, lühidalt juhtumiteavitussüsteemid (WHO, 2005, 2016a). Praeguseks on need kasutusele võetud eelkõige suure sissetulekuga riikides (Slawomirski & Klazinga, 2022; Slawomirski et al., 2017) ja enamasti haiglates, kusjuures nende rakendumine on riigiti ja organisatsiooniti väga varieeruv.

Uurimistööd näitavad, et kõige agaramad juhtumiteavitussüsteemide kasutajad on õed ja õendusjuhid. Osalt seletab seda õdede arvuline ülekaal teiste tervishoius töötavate kutse- ja erialade esindajate seas (WHO, 2020b) ning asjaolu, et õed tegutsevad kõigil tervishoiuteenuste osutamise tasanditel (Wakefield et al., 2021), kusjuures haiglas on nad kogu ööpäeva patsiendi kõrval (Aiken et al., 2018; *The Future of Nursing*, 2011). Õed ja õndusjuhid on aktiivsed kvaliteeditöösse panustajad (Wakefield et al., 2021) ning sageli on õendusjuhid ka peamised juhtumiteavitussüsteemides dokumenteeritud juhtumite menetlejad (Hafsteinsdóttir, 2019; Islam et al., 2018; Liukka et al., 2019; Wakefield et al., 2021). Õdede kui juhtumiteavitussüsteemide kõige aktiivsemate kasutajate kogemused

kajastavad juhtumitest teavitamise ja õppimise tegelikku toimimist ning on seega patsiendiohutuse arendamise nurgakiviks (Islam et al., 2018; Turner et al., 2014).

Tänapäevaseid elektroonseid juhtumiteavitussüsteeme on Eestis kasutanud üle viie aasta vaid kaks haiglat ning ülejäänud haiglates, muudes tervishoiuasutustes ja ka riiklikul tasandil ei ole sel viisil juhtumitest teavitamine veel tavapraktika. Mõlemad haiglad on oma juhtumiteavitussüsteemid loonud Soomes välja töötatud HaiPro (Palojoki et al., 2017) eeskujul ning on neid aastate jooksul arendanud, lähtudes oma profiilist ja institutsioonilistest vajadustest. 2014. aastal kehtestati Eestis sotsiaalministri määruse muudatusega (*Minister of Social Affairs. Regulation No. 128. Health Services Quality Assurance Requirements.*, 2004) nõue, mille järgi tervishoiuteenuse osutajal on kohustus tagada patsiendiohutuse juhiste olemasolu, kuid tänaseni puudub ühtne strateegia, mis käsitleks põhjalikult patsiendiohutuse edusamme ja arendusvajadusi.

Rahvusvahelised patsiendiohutuse uurimistööd keskenduvad suuresti juhtumitest teavitamise tavade ja takistuste kirjeldamisele ning juhtumiteavitussüsteemide kasulikkuse analüüsimisele kliinilise riskijuhtimise ning patsiendiohutuskultuuri kontekstis, kuid napib süstemaatilisi ja ülevaatlikke tõendeid teavitatud juhtumitest lähtuvate parendustegevuste kohta. Samuti selgub publitseeritud uurimistöödest, et juhtumiteavitussüsteemide kasutamine, eelkõige juhtumitele reageerimine, võib olla ebapiisav (Goekcimen et al., 2023; Liukka et al., 2019) ning ei ole selge, kuidas organisatsioonides juhtumitest õpitakse (Goekcimen et al., 2023; Serou et al., 2021; Stavropoulou et al., 2015). Seega on teemat vajalik uurida.

Uurimistöö eesmärgid

Doktoritöö eesmärk oli analüüsida, kuidas kasutatakse haiglates patsiendiohutusjuhtumitest teavitamisega kogutud infot õppimiseks ja patsiendiohutuse tagamiseks. Saadud teadmised soodustavad juhtumitest teavitamise protsessi mõistmist ja arendamist ning toetavad õppimist patsiendiohutuse parandamiseks. Eesmärgi saavutamiseks püstitati järgmised alaeesmärgid:

1. Selgitada, missugustest juhtumitest teavitatakse, ning kirjeldada nendest lähtuvaid parendustegevusi.
2. Analüüsida juhtumiteavitussüsteemis kirjeldatud parendustegevusi seoses juhtumite taustaga.
3. Uurida ja kirjeldada õdede ja õendusjuhtide kogemusi juhtumiteavitussüsteemides sisalduva teabe kasutamisega ning arusaamu patsiendiohutuse arengusuundadest.

Metoodika

Doktoritöös kasutati mitmemeetodilist uuringudisaini, et koondada eesmärgipäraselt võimalikult mitmekülgset ning vastastikku täiendavat teavet (Anguera et al., 2018; Vivek et al., 2023). Uurimistöö koosnes süstemaatilisest ülevaatest

(Liberati et al. 2009), dokumendianalüüsist (Bowen, 2009; Moilanen et al., 2022) ning poolstruktureeritud intervjuu-uuringust (Pope & Mays, 2006).

Süstemaatilisse ülevaatesse koondati uusim teaduslik teave haiglate juhtumiteavitussüsteemides dokumenteeritud juhtumite, nendest lähtuvate planeeritud või ellu viidud parendustegevuste, tagasiside ning õppimiseks mõeldud info levitamise kohta. Kaasatud 16 originaaluurimuse andmed analüüsiti sisuanalüüsi meetodil (Finfgeld-Connett, 2014; Hsieh & Shannon, 2005), lähtudes ülevaate eesmärgist ning originaaluurimuste metoodilisest mitmekesisusest. Tulemuste esitamisel järgiti PRISMA süstemaatiliste ülevaadete ja metaanalüüside koostamise ja hindamise protokolli.

Dokumendianalüüs võimaldas uurida juhtumiteavitussüsteemis dokumenteeritud parendustegevusi ning nende seoseid juhtumite taustaga. Analüüsi kaasati kõik aastatel 2018–2019 kahes Eesti haiglas dokumenteeritud juhtumid (n= 1973), millest tehti andmete väljavõtt, kasutades spetsiaalselt sel otstarbel koostatud andmete väljavõtu protokolli (Moilanen et al., 2022). Protokolli koostamise aluseks oli eelmainitud süstemaatiline ülevaade, samuti varasemate autorite süstemaatiliste ülevaadete tulemused ning rahvusvaheline patsiendiohutuse mõisteline raamistik (WHO, 2009). Protokoll testiti ning vormistati REDCapi keskkonda, kuhu koguti turvaliselt kõik dokumendianalüüsi andmed. Dokumendianalüüsi andmestik analüüsiti sisuanalüüsi ja kirjeldava statistika meetodeid kombineerides (Bowen, 2009; Moilanen et al., 2022; Trochim, 2007). Kahe juhtumiteavitussüsteemi erinevad juhtumite ja patsiendikahju liigitused ühtlustati, juhtumite vabatekstid loeti läbi ning sisuanalüüsiga eristati uurimistöö eesmärgist lähtuvad teemad, mis omakorda kodeeriti ja kategoriseeriti. Kirjeldava ja analüüsiva statistika jaoks kasutati programmi R versiooni 4.1.2. Analüüsi tulemusena esitati dokumenteeritud juhtumite jaotus ning neile vastavate parendustegevuste olemasolu või puudumine. Kujunenud gruppide vahel erinevuste leidmiseks kasutati Pearsoni hii-ruut-testi ja Fisheri täpset testi. Parendustegevuste dokumenteerimise erinevusi hinnati logistilise regressiooni meetodiga.

Poolstruktureeritud intervjuu-uuring tehti õdede ja õendusjuhtidega (n=26), kes olid nõus osalema kas individuaal- või rühmaintervjuudes, andmaks edasi oma kogemusi juhtumiteavitussüsteemis sisalduva teabe jagamise ja kasutamisega ning arusaamu patsiendiohutuse arengusuundadest. Poolstruktureeritud intervjuu kava küsimused lähtusid eelnenud süstemaatilise ülevaate tulemustest ning nende sobivus hinnati heaks pärast ühte prooviintervjuud (Kallio et al., 2016). Kokku tehti 19 intervjuud, kõik Zoomi keskkonnas. Intervjuude lõplik arv tulenes andmete küllastumisest, mis ilmnes 16. intervjuuga. Intervjuude andmestik analüüsiti induktiivse sisuanalüüsi meetodil (Graneheim & Lundman, 2004).

Tulemused

Teavitatud juhtumid ja nendest lähtuvad parendustegevused

Süstemaatilise ülevaate ning täiendava kirjanduse otsingu tulemused (kokku 18 eelretsenseeritud teadusartiklit) näitasid, et juhtumitest teavitamine on haiglates

levinud praktika, kuid juhtumeid käsitleva info dokumenteerimine juhtumiteavitussüsteemides erineb riigiti ja asutuseti märkimisväärselt. Mainitud erinevuse tõttu on keeruline täpselt eristada parendustegevusi ning teisi juhtumitest tulenevaid toiminguid. Siiski näitavad tulemused, et parendustegevused on juhtumiteavitussüsteemides enamasti dokumenteeritud, kuid tagasisidet teavitajatele, samuti viise, kuidas saadud õppetundide ja tehtud muudatuste kohta infot levitatakse, on kirjeldatud vaid alla kolmandiku uurimistöödes.

Rahvusvaheliste uuringute tulemused näitavad, et enim teavitatakse juhtumiteavitussüsteemides ravimitest tingitud juhtumitest. Nendele järgnevad töökorralduslikud juhtumid, mida on põhjustanud kas töötaja ebapiisav väljaõpe protseduuri sooritamiseks, tegevuse kontrollimata jätmine või patsiendi seisundile mittevastav jälgimine või ravikorraldus. Eesti andmete põhjal tehtud dokumendianalüüs näitas, et kahes haiglas kahe aasta jooksul teavitatud juhtumitest (n=1973) suurima osa (30%) moodustasid patsiendi jälgimisest ja ravikorraldusest tingitud juhtumid, näiteks patsientide agressiivse käitumise ja enesevigastamise juhtumid. Küll vähem (19%), kuid siiski märkimisväärsel hulgal teavitati patsientide õnnetusjuhtumitest, peaasjalikult kukkumistest. Järgnesid juhtumid, mis seostuvad protseduuride teostamise, dokumenteerimise ja töökorraldusega. Kõigist analüüsitud juhtumitest 60% põhjustasid patsiendikahju, neist omakorda 3,8% rasket kahju. Juhtumite kirjeldustest vaid 18% sisaldas infot patsiendi vanuse kohta ning vaid 16% juhtumi toimumise aja kohta.

Teadusartiklitest leitud tulemused näitavad, et enamik planeeritud või juba ellu viidud parendustegevusi, mida juhtumiteavitussüsteemides on kirjeldatud, hõlmab juhiste ja protokollide väljatöötamist ning personali koolitamist. Pisut vähem kirjeldatakse süsteemi tasandil muudatuste tegemist ning infosüsteemide, seadmete ja vahendite uuendamist. Uued juhised ja protokollid ning samuti personali koolitus kätkevad peamiselt ravimite käitlemist, suhtlusvigade vältimist, aga ka tööjõu organiseerimist ning meeskonnatööoskuse lihvimist. Üldiste, süsteemi tasandil parenduste ning tehnika täiustamisega taotletakse laiaulatuslikumaid muudatusi – kirjeldatud on tegevusi, nagu patsiendi jälgimissüsteemide ja -ruumide täiustamine, probleemse tehnika väljavahetamine, tööjõuressursi ja -vajaduse ülevaatamine ning kohandamine, dokumentide auditeerimine ja riskihindamine üksustes.

Eesti haiglate andmestikul põhineva dokumendianalüüsi ning õdede ja õendusjuhtidega tehtud intervjuu-uuringu tulemused näitavad, et kõige sagedasemad parendustegevused puudutavad personali: koolitused, töönõustamine, arutelud, meeldetuletused ja ka täiendava tööjõuressursi hankimine. Järgnevad parendustegevused, mis puudutavad juhtumiga seotud patsienti: patsiendi rahustamine ja õpetamine, jälgimise tõhustamine keskkonna muutmisega ning abivahendite andmine või täiendavate abivahendite soetamine patsiendi liikumise turvamiseks. Juhtumiteavet jagatakse personalile asjakohastel koosolekutel ja valvelt valvele. Õendusjuhid, kes osalevad juhtumiteabe aruteludel, edastavad infot ülejäänud personalile ka e-posti teel.

Parendustegevuste seosed juhtumite taustaga

Eesti andmetele tuginev dokumendianalüüs näitas statistiliselt olulisi erinevusi ühelt poolt parendustegevuste olemasolu või puudumise ning teiselt poolt juhtumi tüübi, kahju suuruse ja patsiendi vanuse vahel. Logistiline regressioon näitas, et teatud juhtumite korral rakendatakse teistega võrreldes enam parendustegevusi. Näiteks dokumenteeritakse ravimitest ja transfusioonravist tingitud juhtumite ning patsientide õnnetusjuhtumite korral parendustegevusi rohkem võrreldes patsientide ja teiste inimeste käitumisest tingitud juhtumitega, šansside suhe vastavalt 2,61 (95% CI 1,23–5,53) ja 1,65 (95% CI 1,13–2,41), ning töökorraldusest, ressurssidest ja infrastruktuurist tulenevate juhtumite korral vähem (OR = 0,62; CI 0,44–0,88). Seostest patsiendikahjuga ilmnes, et võrreldes kahjuta juhtumitega olid parendustegevused tõenäolisemalt dokumenteeritud mõõduka kahjuga juhtumite korral (OR = 1,58; CI 1,16–2,16) ning kaks korda vähem raske kahjuga juhtumite korral (OR = 0,50; CI 0,26–0,96). Seos patsiendi vanusega näitas, et täiskasvanutega toimunud juhtumite korral dokumenteeriti parendustegevusi üle kolme korra vähem (OR = 0,29; CI 0,10–0,88) kui juhtumite korral, mille keskmes oli laps või teismeline.

Õdede ja õendusjuhtide kogemused juhtumiteavitussüsteemide teabe kasutamisega

Õdede ja õendusjuhtidega tehtud intervjuu-uuringu tulemused näitavad, et juhtumiteavitussüsteemi dokumenteeritud infot ning selle jagamist peetakse vajalikuks, kuna see aitab teada saada probleemsituatsioonidest, algatada parendustegevusi ning kasvatada personali ohutusteadlikkust. Mõistetakse, et vigadest õppimine aitab kaasa praktika arengule, pakub õiguskindlust ning suurendab patsientide ja avalikkuse usaldust organisatsiooni vastu. Tulemused näitavad, et juhtumiteavitussüsteemide infost õpitakse, mis väljendub muutunud praktikas ning töötajate kasvanud pädevuses. Infot jagatakse üksustes aga väga erinevalt, nii formaalselt kui ka mitteformaalselt, andes seda edasi valvelt valvele. Info jagamine ning juhtumist teavitajatele tagasiside andmine ei ole järjepidev ega süstemaatiline. Puudust tuntakse regulaarsetest koolitustest, mis käsitleksid juhtumite dokumenteerimist juhtumiteavitussüsteemi ning juhtumite menetlemist, samuti vajatakse üldisi patsiendiohutuse koolitusi kõigile organisatsiooni töötajatele. Soovitakse enam tuge ja patsiendiohutuse tähtsustamist organisatsiooni juhtidelt ning juhtumiteavitussüsteemi tehnilise võimekuse arendamist. Oluliseks peetakse karistus- ja hirmuvaba keskkonna loomist ning patsiendiohutuse spetsialistide või meeskondade rakendamist patsiendiohutuse arendamiseks organisatsioonis.

Järeldused

Doktoritöös uuriti patsiendiohutusjuhtumitest teavitamist ja õppimist ning selle tulemusi haiglates.

1. Patsiendiohutusjuhtumitest teavitamiseks on haiglates kasutusele võetud juhtumiteavitussüsteemid eesmärgiga tuvastada võimalikud riskid ja kvaliteedi-

probleemid ning vajaduse korral parendustegevustega sekkuda. Enim teavitatakse juhtumitest, millel on selgesti tuvastatavad või nähtavad tagajärjed. Parendustegevustena dokumenteeritakse kas kavandatud või juba ellu viidud toiminguid, kuid detailsed tegevuskavad, konkreetsed vastutajad ning tulemushindamised valdavalt puuduvad. Enamasti on parendustegevused suunatud konkreetse juhtumi tagajärgede leevendamisele ning juhtumiga seotud inimestele, nii personalile kui ka patsiendile. Süsteemi tasandil parendustegevused on vähem levinud ning vahetu tagasiside andmine teavitajatele ja info jagamine õppimiseks on pigem harv praktika. Seega peavad tervishoiuorganisatsioonid rohkem tähelepanu pöörama parendustegevuste planeerimisele ja hindamisele, samuti õppimiseks vajaliku tagasiside ja info järjepidevale jagamisele.

2. Parendustegevuste dokumenteerimine juhtumiteavitussüsteemi ei ole ühtlane ja järjepidev ning osa juhtumite korral on see teistega võrreldes tõenäolisem. Vähem parendustegevusi saavad töökorralduse, ressursside, infrastruktuuri ning personali käitumisega seostuvad juhtumid, samuti raske kahjuga lõppenud juhtumid ning täiskasvanud patsiente puudutavad juhtumid. Selliste tulemuste põhjused on ebaselged, kuid peamised asjaolud, mis võiksid neid selgitada, on parendustegevuste väljatöötamise keerukus ning vastavate koolituste puudumine. Samuti võib selliseid tulemusi põhjustada ka juhtumiteavitussüsteemide küsitav anonüümsus ning organisatsioonides endiselt eksisteeriv süüdistamiskultuur, mis takistab juhtumite koondatud kujul analüüsimist. Dokumendianalüüsist selgunud seosed eri tüüpi juhtumite ning nende ennetamiseks planeeritud parendustegevuste vahel viitavad, et parendustegevused kalduvad pigem töötajate käitumise muutmisele, mitte niivõrd nende töötingimuste muutmisele. Seega vajavad juhid ja juhtumeid menetlevad spetsialistid koolitusi, mis soodustaksid juhtumite põhjalikku analüüsimist ning enamat keskendumist süsteemi muutmisele parendustegevuste väljatöötamisel.
3. Õed ja õendusjuhid peavad juhtumiteavitussüteemi heaks seirevahendiks, mis võimaldab kasvatada personali ohutusteadlikkust ja -valvsust. Samuti nähakse selle väärtust patsientide ja avalikkuse usalduse võitmisel, kuna juhtumiteavitussüsteemist saadud info võimaldab õigustada, algatada ja ellu viia vajalikke muutusi patsiendiohutuse ja tervishoiuteenuste kvaliteedi parandamiseks. Õed teavad, et nad on juhtumiteavitussüsteemi peamised kasutajad, kuid ei ole rahul ega nõustu seisukohaga, et juhtumitest teavitamine on eelkõige õdede töö või kohustus. Seetõttu on juhtumiteavitussüsteemide kasutajaskonna laiendamiseks hädasti vaja haiglajuhtide teadlikkust ja toetust. Õed näevad juhtumiteavitussüsteemi kasutamise ja edasiarendamise vajadust, seda nii süsteemi tehnilise võimekuse parendamise kui ka kogutud info jagamise ja õppimise aspektist.

Uurimistöö praktiline väärtus

Doktoritöö tulemused on väärtuslikud kõigile spetsialistidele, kes töötavad vahetult patsientidega, osutades tervishoiuteenuseid ja tagades nende kvaliteeti. Samuti on need tulemused olulised tervishoiuvaldkonna kutse- ja erialaorganisatsioonidele, tervishoiuasutuste juhtidele, tervishoiuspetsialiste koolitavatele õppeasutustele ning tervishoiupoliitikat kujundavatele organisatsioonidele. Tulemusi arvesse võttes on võimalik ellu viia mõjusaid muutusi patsiendiohutuse heaks tervishoiuteenuste osutamise eri tasanditel, mitte pelgalt haiglates.

Tervishoiuspetsialistidel lasub otsene vastutus olla oma tegevusvaldkonnas pädev ning asutuste ja üksuste juhtide ülesanne on olla teadlik töötajate vaimsetest ja füüsilistest jõuvarudest, samuti olukordadest ja seisunditest, mis tekivad ülekoormuse ja väsimuse mõjul. Töötajaid tuleb toetada regulaarsete ning aja- ja asjakohaste koolitustega, mis soodustavad nii ohutusteadlikkust kui ka juhtumite äratundmist ja nende dokumenteerimise oskust. Juhtumiteavitussüsteeme tuleb ajakohastada ning arendada kasutajasõbralikumaks, et teavitusi saaks vormistada kiiresti ja kvaliteetselt. Teavitajatele tuleb anda võimalikult kohest tagasisidet ning juhtumite ülevaatuse ja analüüsi käigus selgunud infot tuleb õppimise eesmärgil jagada süsteemselt kogu organisatsioonis. Organisatsioonid ja nende juhid saaksid koostöös kutse- ja erialaühendustega algatada tegevusi, mida rakendada juhtumi teisese kannatanu trauma leevendamiseks, et mitte kaotada väärtuslikku tööjõudu.

Nii tervishoiuasutustel kui ka kõigil tervishoiuspetsialiste koolitavatel õppeasutustel tuleb järjepidevalt pingutada positiivse patsiendiohutuskultuuri saavutamise nimel. Selleks et töötaja julgeks ja tahaks ohutusküsimustes kaasa rääkida, on vaja aruteludeks avatud keskkonda ning varjamist ja eitamist esile kutsuvate hoiakute kõrvaldamist. Tervishoius töötavate kutse- ja erialade esindajate avatud suhtluse tagamine peaks algama juba tihedast koostööst õppeasutuste ja praktikabaaside vahel ning kaasata tuleks ka tervishoiupoliitika kujundajad.

Riigi tasandil tuleks luua tugistruktuurid, mis aitaksid tervishoiuasutustel patsiendiohutust soodustavaid tegevusi välja töötada ja algatada. Keskenduda ei tohiks kontrollile, vaid kaasamisele ning tõenduspõhiste teadmiste levitamisele. See on ülioluline, kuna tervishoiuasutused on erineva suuruse ja profiiliga ning selleks, et nad saaksid võtta juhtumiteavitussüsteemid kasutusele viisil, mis päriselt soodustaks juhtumitest õppimist ja patsiendiohutuse parandamist, vajavad nad tasakaalustavat toetust.

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APPENDICES

Appendix 1. Literature searches updated for the literature review.

Table 1. Search combinations used in databases (last in October 2024).

Database*	Search statement**
CINAHL, PubMed, Scopus, WoS	"patient safety" [All Fields] AND ("incident reporting" [All Fields] OR "reporting system" [All Fields]) AND ("safety management" [All Fields] OR "report handling" [All Fields]) AND "organi*ational learning" [All Fields] AND "hospital setting" [All Fields]
Cochrane	"patient safety" [All Text] AND ("reporting system" [All Text]) AND ("safety management" [All Text] OR "report handling" [All Text]) AND hospital* [All Text]

*All search results were limited to English and no date restrictions were imposed.
**The combinations of main terms used for literature searches throughout the study 2018–2024.

Table 2. Literature search: items identified relating to patient safety and IRS in hospitals.

Items found (October 2024) *	Database				
	CINAHL	**PubMed**	**Scopus**	**WoS**	**Cochrane**
	586	257	23	917	389
Items selected**					
based on titles	13	14	5	25	9
based on abstracts	6	5	3	15	9
based on full texts	2	2	3	5	0
Duplicates removed			2		
The final number of papers			10		

* The oldest item found throughout the searches was from 1991 on PubMed, 2/3 of all findings in CINAHL and Web of Science were published during the last 10 years (2014–2024).
** The inclusion criteria for selecting material relevant to the topic were scientific papers focusing on patient safety and IRS information handling activities in hospitals, and the roles, involvement, and perspectives of nursing managers or clinical experts concerning those activities. Of the 2 172 items found, 66 items were selected based on title, 38 based on abstracts, and 10 based on full texts.

Appendix 2. Studies (n=10) describing patient safety, IRS use and safety management aspects in hospitals.

Author(s), title, year, country	Purpose	Design and data collection tools, method	Sample size and characteristics	Main results	Main topic
1. Turner S, Higginson J, C. Oborne A, Thomas R.E, Ramsay A.I.G, Fulop N.J. Codifying knowledge to improve patient safety: A qualitative study of practice-based interventions (2014), UK	To implement organisational learning projects and analyse their use for quality improvement Ultimate aim: to develop interventions that would really support patient safety	A Qualitative Approach Observations and interviews	Two sample sets: Hospital A: three clinical specialities, observations on meetings (n=30) and interviews with frontline clinicians, including nurses and managers (n=40). Hospital B: general medicine and elderly care wards, observations on meetings (n=18), interviews with staff, including nurses (n=10).	• Codified knowledge use increases the potential for professional learning by providing a structure and helping to focus on learning and changing practices • Professional and managerial boundaries exist at the organisational level and are influenced by interests, fears of losing reputation, power relations and collective safety norms of different professional groups • Those interprofessional boundaries and power asymmetry are barriers to forming and sharing knowledge • Central and local leadership could strengthen the vertical coordination of professional communities	Challenges and possibilities in organisational learning

Author(s), title, year, country	Purpose	Design and data collection tools, method	Sample size and characteristics	Main results	Main topic
2. Waring J, Currie G, Crompton A, Bishop S. An exploratory study of knowledge brokering in hospital settings: Facilitating knowledge sharing and learning for patient safety? (2013) UK	To identify and compare 'embedded' knowledge brokers working within and between organisational teams, departments and units, especially clinical and managerial groups. To examine how structural position shapes brokers' ability to access, share and support the use of practice-based knowledge across professional boundaries.	A Qualitative Approach Observations and interviews 1 stage: site visits 5-10 days, c7 hours to review policies and observe committees work and interview key informants 2 stage: non-participant observations, shadowing of work for 3-5 days (about 5 h per day, c250 +10 h in total), and semi-structured interviews	Three teaching hospitals, data collection in two stages. 1) Medical Director (3), Nursing Director (3) and senior managers responsible for clinical quality, safety and risk (5). 2) In total 19 selected participants.	• One individual can't fulfil the full range of knowledge brokering activities needed for patient safety • Those with more informal and hybrid roles and connections, reputation, trust, and shared understanding – such as clinical leaders and middle managers – might be more effective at sharing patient safety knowledge given their access to and understanding of clinical practice • Differences in knowledge and the persistence of professional boundaries continue to separate professional and managerial communities and prohibit knowledge sharing and learning	Challenges and possibilities in organisational learning

Author(s), title, year, country	Purpose	Design and data collection tools, method	Sample size and characteristics	Main results	Main topic
3. Lea, W.B.M, BS, Lawton R, Vincent C, O'Hara J. Exploring the "Black Box" of Recommendation Generation in Local Health Care Incident Investigations: A Scoping Review (2023) UK	To explore hospitals' approaches to incident investigation, recommendation generation, the types of recommendations proposed and how their effectiveness is judged.	Scoping review method	Original studies (n=11). Content analysis.	• The dominant method for analysis is RCA • Most recommendations focused on individuals' behaviour rather than addressing deficiencies in systems (<7% classified as strong). • No specific tools or methods for generating recommendations have been reported • Recommendation effectiveness was judged against predefined "action" hierarchies or by incident recurrence • A wide variety of terms are in use and a there is a lack of consensus/understanding of what makes a "good" recommendation • This indicates differences about the vision and purpose of this work	Missing tools for the development of effective recommendations

Author(s), title, year, country	Purpose	Design and data collection tools, method	Sample size and characteristics	Main results	Main topic
4. Carlfjord S, Öhrn A, Gunnarsson A. Experiences from ten years of incident reporting in health care: a qualitative study among department managers and coordinators (2018) Sweden	To explore the experiences of incident reporting among heads of departments and coordinators of incident reporting	Qualitative design with individual interviews and focus group discussions	Individual interviews with physician leaders (n=7) and nurse leaders (n=2). Two focus group discussions (n=5, n=4) with incident reporting coordinators.	• A shift from reporting to action is necessary and this needs time and resources from managers to whom reports are given as part of their work • The challenge is suggesting effective improvements as there is a lack of tools for this task • Improvements should be made more visible and feedback should be provided as it is mostly missing • Incident reporting helps to put patient safety on the agenda • The reporting tool has to be improved to be more user-friendly	Missing tools for the development of effective recommendations Missing feedback and knowledge dissemination Scarce resources Problems with IRS technical design
5. Savage C, Gaffney A, Hussain-Alkhateeb L, Ackheim O.P, Henricson G, Antoniadou I, Hedsköld M, Härenstam K.P. Safer paediatric surgical teams: A 5-year evaluation of crew resource management implementation and outcomes (2017) Sweden	Evaluate changes and outcomes of intervention: crew resource management (CRM) safety programme (training)	Before and after (2 and 4 years later) measurements: surveys, non-participatory observations (10 tests), retrospective analysis of documents	Large university paediatric surgical service, 153 managers and staff, electronic medical records, administrative data.	• Team-training interventions improved adherence to new work practices, non-technical and technical skills, surgical outcomes and safety culture • The key is to involve staff in repeated evaluations and planning of training • Teamwork skills take a longer time to develop and require more tenacity to result in changed practices (at least 5 years for implementation)	Team-training characteristics and benefits for holding on the learning loop

Author(s), title, year, country	Purpose	Design and data collection tools, method	Sample size and characteristics	Main results	Main topic
6. Françolin L, Gabriel C.S, Bernardes A, Silva A.E.B.d.C.E, Brito M.d.F.P, Machado J.P. Patient safety management from the perspective of nurses (2015) Brazil	To evaluate the actions of patient safety management developed in hospitals	A cross-sectional survey	Seven hospitals, nurse managers (n=7) and sector coordinator nurses (n=49).	• Fear of punishment is the greatest problem which needs to be dealt with at organisational level • Risk assessments implemented by nurses are clinical audits (adopted by four (57.1%) institutions); the Braden Scale and the Nursing Activities Score (adopted by three (42.9%) institutions)	Blame culture Risk assessment tools implemented
7. Mattson M, Hellgren J, Göransson S. Leader communication approaches and patient safety: An integrated model. (2015) Sweden	To investigate the influence of leader communication approaches (safety priority communication and feedback) on safety behaviours and safety outcomes	A cross-sectional survey	Two hospital wards. All employees N=260 (response rate 85%) Sample: 15% medical doctors, 71% nurses, 10% administrative personnel, 4% other personnel.	• Leaders communicating that safety is a priority and giving feedback to subordinates proved to be both useful for patient safety outcomes • They are associated with employee safety behaviours and commitment to report	Leaders' safety communication has influence on staff safety behaviour
8. Islam T, Hutchinson A.M, Tracey K. Bucknall T.K. Nurse manager risk information management for decision-making: A qualitative analysis (2018) Australia	To explore nurse manager information requirements, risk management practices, and influences on decision-making when interacting with an electronic risk management and incident reporting system	Qualitative interview study	One teaching hospital, medical and surgical ward nurse managers. Two focus group interviews (n=4, n=4). Inductive content analysis.	• Nurse managers are the main investigators and handlers of the incident data • Main problem is lack of training for managers and staff on how to write reports, as incomplete data puts an extra burden on reviewers, as well as how to analyse incidents, especially aggregated data • Nurse managers consider the technical design of IRS not user-friendly for reporters • Feedback from leadership to nurse managers about the work done is mostly absent	Problems with training for nurse managers and staff to use the IRS Problems with IRS technical design Missing feedback from hospital leaders

Author(s), title, year, country	Purpose	Design and data collection tools, method	Sample size and characteristics	Main results	Main topic
9. Koskiniemi S, Syyrilä T, Hämeen-Anttila K, Manias E, Härkänen M. Health professionals' perceptions of the development needs of incident reporting software: A qualitative systematic review. Journal of Advanced Nursing (2024) Finland	Systemically identify and synthesise information on health professionals' and students' perceptions regarding the development needs of incident reporting software.	A systematic review of qualitative research	Original studies (n=10) describe the perspectives of various health professionals, including managers, nurses, physicians, physical therapists, and students. Thematic analysis.	• IRS technical design is not user-friendly for reporters – a software that includes only essential fields and is quick and easy to use is advised • Anonymity of reporting is not guaranteed • In cases of serious incidents anonymity should be ignored as the name of the patient and reporter would help tracking of the case and identification of the staff members in need of support • Tracking options and instant feedback are limited • The use of diverse reporting platforms, including mobile phone reporting, would support accessibility of reporting	Problems with IRS technical design, anonymity and accessibility Missing feedback Second victim support
10. Vogus T.J, Sutcliffe K.M. The Impact of Safety Organizing, Trusted Leadership, and Care Pathways on Reported Medication Errors in Hospital Nursing Units (2007) US	To examine the benefits of bundling safety organising with leadership (trust in manager) and design (use of care pathways) factors on reported medication errors.	A cross-sectional survey, two sets of data.	10 hospitals. 1) Nurses from different units (n=1033), nursing managers (n=78). 2) Reported medication errors from the hospital risk management system related to investigated units collected 6 months after the survey.	• Implementation of care pathways (standardised protocols and interaction) and a well-led caregiving system increase the positive effects of IRS use and have positive outcomes for patient safety • Safety organising works better when nurses' trust in their manager is high and vice versa	Care pathways and trust in leaders have a positive influence on IRS use and patient safety outcomes

Appendix 3. The scales for harm assessment (Paper II).

WHO degree of harm*	HOSPITAL 1	HOSPITAL 2**
None – patient outcome is not symptomatic, or no symptoms detected, and no treatment is required	A – situations or cases that can cause an error B – an error that occurred but did not reach the patient C – an error in the patient's treatment occurred but did not cause harm to the patient	I, II, III, Low / Mild – consequences of the event: discomfort, delay or prolongation of treatment without significant health effects. probability: situations are random, short-term, occur rarely
Mild – patient outcome is symptomatic, symptoms are mild, loss of function or harm is minimal or intermediate but short term, and no or minimal intervention (e.g., extra observation, investigation, review or minor treatment) is required	D – the error occurred and reached the patient, the patient needed to be monitored to deny the injury, or the intervention prevented the injury	
Moderate – patient outcome is symptomatic, requiring intervention (e.g., additional operative procedure; additional therapeutic treatment), an increased length of stay, or causing permanent or long-term harm or loss of function	E – an error occurred that caused the patient such temporary damage that necessitated intervention F – an error occurred that caused temporary harm to the patient and required hospitalisation or extension of hospital stay	II, III, IV, Harmful – consequences of the event: health problems requiring intervention, prolongation of treatment, excessive stress, temporary incapacity for work; probability: situations are routine, incidents or potential incidents have occurred
Severe – patient outcome is symptomatic, requiring life-saving intervention or major surgical/medical intervention, shortening life expectancy or causing major permanent or long-term harm or loss of function	G – an error occurred that caused permanent damage to the patient H – an error occurred that required intervention to save the patient's life	III, IV, V, Severe – consequences of the event: death or permanent serious damage to health, disability significantly impairing quality of life, permanent incapacity for work; probability: situations occur frequently and systematically
Death – on the balance of probabilities, death was caused or brought forward in the short term by the incident	I – an error occurred that caused the patient's death	

* The International Classification for Patient Safety (ICPS) (WHO, 2009).
** The matrix is based on the degree of harm that happened to the patient and on the probability of incident recurrence.

PUBLICATIONS

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SELECTED CONFERENCES

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patient safety, quality of healthcare, quality of nursing care, evidence-based nursing, nursing leadership, nursing management

PUBLICATIONS IN INTERNATIONAL PEER-REVIEWED JOURNALS

1. **Uibu**, E., Binsol, K., Põlluste, K., Lember, M., Kangasniemi, M. (2024). Results of a qualitative semi-structured interview study with hospital nursing staff to improve incident reporting systems in Estonia. *Journal of Healthcare Quality Research*, 40 (1), 39−47. DOI: 10.1016/j.jhqr.2024.10.003.
2. Inkeroinen, S., Kangasniemi, M., Kukkonen, P., Leino-Kilpi, H., Pajakoski, E. Pellikka, H-K., Puustinen, J., **Uibu**, E. (2024). International collaboration of early-stage researchers in nursing science: A discussion paper. *Nordic Journal of Nursing Research*, 44. DOI:10.1177/20571585241237886.
3. Mägi, L., **Uibu**, E., Moi, A.L., Mortensen, M., Naustdal, K., Põlluste, K., Lember, M., Kangasniemi, M. (2024). Collaborative learning linking nursing practice and education – Interview study with master's students and teachers. Nurse Education Today, 139, 106261. DOI: 10.1016/j.nedt.2024.106261.
4. **Uibu**, E., Põlluste, K., Lember, M., Toompere, K., Kangasniemi, M. (2023). Planned improvement actions based on patient safety incident reports in Estonian hospitals: a document analysis. *BMJ Open Quality*, 12 (2), e002058. DOI: 10.1136/bmjoq-2022-002058.
5. Peterson, H., **Uibu**, E., Kangasniemi, M. (2022). Care left undone and work organisation: A cross-sectional questionnaire-based study in surgical wards of Estonian hospitals. *Scandinavian Journal of Caring Sciences*, 36 (1), 285−294. DOI: 10.1111/scs.12987.
6. Mortensen, M., Naustdal, K.I., **Uibu**, E., Mägi, L., Kangasniemi, M., Põlluste, K., Moi, A.L. (2022). Instruments for measuring patient safety com-

petencies in nursing: a scoping review. *BMJ Open Quality*, 11 (2), e001751. DOI: 10.1136/bmjoq-2021-001751.
7. **Uibu**, E., Põlluste, K., Lember, M., Kangasniemi, M. (2020). Reporting and responding to patient safety incidents based on data from hospitals' reporting systems: A systematic review. *Journal of Hospital Administration*, 9 (2), 22−32. DOI: 10.5430/jha.v9n2p22.
8. Usberg, G., **Uibu**, E., Urban, R., Kangasniemi, M. (2020). Ethical conflicts in nursing: An interview study. *Nursing Ethics*, 1−12. DOI: 10.1177/0969733020945751.

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07–09, 04/2022	Töötoa läbiviimine rahvusvahelisel NCPC2021 konverentsil, Pärnu, Eesti
12–14, 09/2019	Suuline ettekanne 14. ENDA kongressil, Helsingi, Soome

12–14, 06/2019 Suuline ettekanne 4. Läänemereriikide personaliseeritud tervishoiu võrgustiku suvekoolis, Riia Stradiņši Ülikool, Läti

KUULUVUS ÜHENDUSTESSE
Euroopa Õendusjuhtide Ühing
Eesti Õdede Liit
Eesti Ornitoloogia Ühing

TEADUSTÖÖ SUUNAD
patsiendiohutus, tervishoiu kvaliteet, õendusabi kvaliteet, tõenduspõhine õendusabi, õendusjuhtimine

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1. **Heidi-Ingrid Maaroos**. The natural course of gastric ulcer in connection with chronic gastritis and *Helicobacter pylori*. Tartu, 1991.
2. **Mihkel Zilmer**. Na-pump in normal and tumorous brain tissues: Structural, functional and tumorigenesis aspects. Tartu, 1991.
3. **Eero Vasar**. Role of cholecystokinin receptors in the regulation of behaviour and in the action of haloperidol and diazepam. Tartu, 1992.
4. **Tiina Talvik**. Hypoxic-ischaemic brain damage in neonates (clinical, biochemical and brain computed tomographical investigation). Tartu, 1992.
5. **Ants Peetsalu**. Vagotomy in duodenal ulcer disease: A study of gastric acidity, serum pepsinogen I, gastric mucosal histology and *Helicobacter pylori*. Tartu, 1992.
6. **Marika Mikelsaar**. Evaluation of the gastrointestinal microbial ecosystem in health and disease. Tartu, 1992.
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