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PATIENT SAFETY IN THE EMERGENCY DEPARTMENT – ERRORS, INTERRUPTIONS AND STAFF EXPERIENCE

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Patient Safety in the Emergency Department – Errors,
Interruptions and Staff Experience
THESIS FOR DOCTORAL DEGREE (Ph.D.)

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ABSTRACT

International studies have reported that injuries and complications during hospital admissions affect nearly 1 in 10 patients and that up to 50 % are the direct result of errors and therefore preventable. In Sweden, the figures are similar. The often cited report, *To err is human – building a safer health system* by the Institute of Medicine (IOM) emphasises the system approach in preventing future errors by designing safety into systems and not to blame individuals for past errors. This approach has also been implemented into the Swedish healthcare system through the Patient Safety Act and through the formation of a new agency in 2013, the Health and Social Care Inspectorate (IVO). Emergency departments (EDs) have a front position in Swedish healthcare in that a high percentage of patients have their first contact with hospital care in EDs. The ED environment has been described as complex and dynamic and one in which errors often occur. Research on patient safety in the ED has increasingly grown, with recent findings indicating that crowding, interruptions and multitasking all contribute to errors. However, there remains little knowledge on patient safety in Swedish EDs.

The overall aim of this thesis was therefore to increase our knowledge about errors, interruptions and staff experience of patient safety risks in the ED. The specific aims in paper I and II were to describe the incidence and types of reported errors and complaints in ED care and their contributing factors. In paper III the aims were to explore interruptions occurring during common activities of clinicians and their perceptions of interruptions. The final paper was designed to describe physicians and registered nurses' (RNs) perceptions and management of patient safety risks in the ED.

In this descriptive project qualitative and quantitative data were collected from national registries and through observations of and interviews with ED clinicians. Data were analysed using qualitative content analysis and non-parametric statistics.

The results represent the frequencies and characteristics of reported errors and complaints in Swedish ED care. The overall result shows that the most common errors that care providers, healthcare staff and patients reported were those concerned with diagnostic procedures, treatments and organisational matters. The contributing factors to errors in cases reported to the National Board of Health and Welfare were multifactorial: the most common contributing factor was human error that occurred most often during diagnostic procedures, followed by factors in the local environment. Interruptions took place most often on a face-to-face basis and during information exchange. Preparation of medication was the most interrupted activity in relative terms. Interruptions were not always perceived as negative, and negative feelings of interruptions were related to a disturbed work process. The physicians and RNs perceived high workload as the main patient safety concern in the ED. The most common strategy to prevent errors was to check and double check. Because the RNs felt responsible for managing patient safety risks, they reported using a strategy of taking command and control if they felt that patient safety was in jeopardy.

The level of information detail varied and was sometimes missing in the different national and local registries. Further, we found that internal investigations and root cause analysis

were sometimes missing entirely. These shortcomings constitute a risk of missing important patient safety risks and limit the development of solutions that can improve such safety. Latent conditions, such as high workload, were rarely identified and interruptions were ever identified as a contributing factor in cases reported to the National Board of Health and Welfare. The clinicians perceived high workload as the main patient safety concern in the emergency department. Interruptions during high workload were seen as increasing the risk for communication and medication errors. Some RNs taking command and control when patient safety was threatened indicating that RNs may play an important role in patient safety.

LIST OF SCIENTIFIC PAPERS

- I. **Källberg AS**, Göransson KE, Östergren J, Florin J, Ehrenberg A.
Medical errors and complaints in emergency department care in Sweden as reported by care providers, healthcare staff and patients – a national review. *European Journal of Emergency Medicine*. 2013; 20:33-8.
- II. **Källberg AS**, Göransson KE, Florin J, Östergren J, Brixey JJ, Ehrenberg A.
Contributing factors to errors in Swedish emergency departments.
Accepted in International Emergency Nursing. 2014 Oct 5.
- III. Berg LM, **Källberg AS**, Göransson KE, Östergren J, Florin J, Ehrenberg A.
Interruptions in emergency department work: an observational and interview study. *BMJ Quality & Safety*. 2013; 22:656-63.
- IV. **Källberg AS**, Ehrenberg A, Florin J, Östergren J, Göransson KE.
Physicians' and nurses' perceptions and management of patient safety risks in the emergency department. *Manuscript*.

PREFACE

The emergency department in Falun has been my working place as a registered nurse and as responsible for quality improvement for the past 20 years. It is a special and exciting work place characterized by a high degree of complexity involving collaboration with other departments and professionals both inside and outside the hospital. This collaboration is central for the workflow and working conditions in the hospital in general and in the emergency department. The workflow can change dramatically within minutes change from being “normal” to being chaotic and overwhelming. However, the collaboration with colleagues in the management of patients is both stimulating and challenging. During more intense and unpredictable times, I have often wondered how everything could go as well as it does.

Therefore, when asked to participate in a research project on patient safety in the emergency department I immediately said yes. Initially, my role was to participate in the data collection of interruptions in the emergency department; I soon enrolled as a doctoral student at the Department of Medicine, Solna at Karolinska Institutet. It has been exciting and stimulating and it has strengthened my belief that emergency department staff has an important knowledge about errors, interruptions and situations at risk for patient safety that should be used in patient safety work.

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LIST OF ABBREVIATIONS

IOM	Institute of Medicine
IVO	Health and Social Care Inspectorate
ED	Emergency Department
RN	Registered nurse
LPN	Licensed practical nurse
WHO	The World Health Organization
LÖF	Patient Insurance
HSAN	The Medical Responsibility Board
AHRQ	The Agency for Health Care Research and Quality

1 INTRODUCTION

Access to healthcare is essential, but it is also an area where patients may be exposed to injuries or complications caused by medical management or healthcare interventions. These unintended injuries or complications can result in death, disability or prolonged hospital stay. In the USA, studies have estimated that up to 98 000 people die each year as a result of injuries and complications in hospital care and that more than a half of these resulted from errors that could have been prevented (1). In Sweden, a study reported that approximately 105 000 patients suffered preventable injuries in hospital, of which 3000 may have contributed to death during a period of one year (2). EDs have a front position in Swedish healthcare in that a high percentage of patients have their first contact with hospital care in the ED. The ED is considered as a complex and dynamic high risk area that is especially prone to errors (1, 3). However, limited research has been completed on patient safety in Swedish EDs. Therefore, the area of interest in this thesis is patient safety in Swedish EDs, with a focus on errors, interruptions and staff experience of patient safety risks.

1.1 THE EMERGENCY DEPARTMENT

The number of patients seeking care in the ED internationally (4) as well as in Sweden has increased every year since 2004, although the number of hospital-based EDs in Sweden has decreased (5, 6). In 2013, there were about 2.4 million visits to 70 hospital-based EDs in Sweden (7). The main task to be performed in EDs is to provide safe emergency care to acutely ill or injured patients 24 hours a day. The ED is characterised by unscheduled visits, inconsistent arrivals of patients and the multiple care of patients with a wide variety of conditions and acuity (from non-urgent to resuscitation situations). The workload is uncontrolled and unpredictable; decisions are often made under intense pressure and interventions with sometimes incomplete information of the patient. Time pressure is more intense in the EDs than on unit floors and ED staff members must constantly shift their attention and priorities to optimise care.

The ED environment is complex and dynamic, involving multiple processes simultaneously that interact and are interdependent both inside and outside the ED, including collaboration with the radiology and operation wards. Working conditions such as crowding, interruptions and multitasking (managing multiple tasks simultaneously) are an integral part of the ED work environment. In Sweden, EDs are organised based on different medical specialties (e.g., internal medicine, surgery and orthopaedics). The physicians in the ED are consultants, residents and junior doctors from different specialities that are scheduled on an on-call basis. There is a shortage of emergency physicians in Sweden because the specialty is relatively new (5). Further, there is also a shortage of specialty training different professionals groups (e.g., RNs and licensed practical nurses, LPNs).

The ED involves several processes. Internationally, these processes are similar (an example from Canada is depicted in figure 1). At the arrival to the ED, the patient’s complaints are presented and the main task that follows is to assess the patient’s level of urgency. RNs assess the patient’s level of urgency to determine the order in which patients should be attended to, a process referred to as triage. Triage was implemented to ED care in order to ensure patient safety in the crowded ED that is to prevent seriously ill patients from dying while waiting for their turn (8). Thereafter, ED physicians are presented complaints and vital signs and from this information decide on diagnostic procedures, plausible diagnosis and proper treatment.

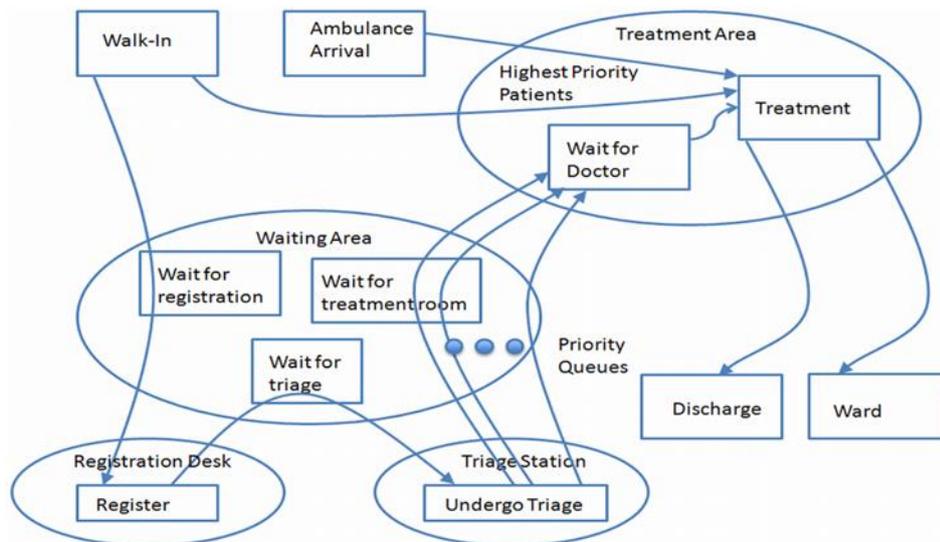


Figure 1. Patient flow in the ED as exemplified in a model by Laskowski and co-workers (9).

1.2 PATIENT SAFETY

Patient safety is a concept that includes safety in all processes in the entire healthcare system and is an important part of quality in healthcare. The World Health Organisation (WHO) defines patient safety as “the absence of preventable harm to a patient during the process of health care” (10). Over the past decade, patient safety has been recognised as an important global topic and WHO acts as a major force for patient safety improvement around the world. The Harvard Medical Practice Study in 1991 and the report from the IOM in the USA in 1999 were the starting point for increased development and research efforts to reduce errors and improve patient safety (1, 11, 12). The main conclusion in the IOM report “To err is human” was that errors most commonly are caused by faulty systems, processes and conditions in the organisation and not by individual recklessness.

In Sweden, the Swedish Association of Local Authorities and Regions, together with all county councils and regions responsible for healthcare, launched a national effort to improve patient safety in 2008 (13). Some of the initial areas for improvement were healthcare

associated infections, fall injuries and pressure ulcers associated with care. Further, a new law was launched in Sweden in 2011 with the aim to promote patient safety (14).

The Harvard Medical Practice Study showed that nearly 4% of patients' suffered an adverse event during hospital admission (11, 12). Since then, several countries have replicated the Harvard Medical Practice Study, demonstrating that adverse events during hospital admission affected nearly 1 out of 10 patients and that up to 50% of these were preventable (15-21).

In Sweden, the figures are similar. A Swedish study, based on the Harvard Medical Practice Study protocol, demonstrated that about 12% of patients in hospital care experienced an adverse event, of which 70% were preventable (2). Two studies from the USA estimated that 3% of adverse events took place in the ED; in Sweden, these figures are not available (11, 21).

1.3 PATIENT SAFETY CONCEPTS

While there are several terms and concepts used in the patient safety literature, consensus about definitions are nevertheless lacking. Both WHO and the European Union (EU) have proposed a conceptual framework for international classification and vocabulary on patient safety (22, 23). Terms vary regarding acts or situations that result in actual or potential patient harm (e.g., events, incidents, (medical) errors, preventable adverse events or unnecessary harm). Further, these terms are often difficult to translate and compare with Swedish terms and definitions. During the work with this thesis, an attempt to use few terms and references has been sought with the aim to be clear and adequate. The terms used are adverse event and error, of which error is the main focus in this thesis. Together they include most terms relevant to patient safety.

Adverse event

When patients experience harm while receiving healthcare, it is called adverse events. The definition of adverse event used in this thesis is "an injury or complication that is caused by medical management or interventions, rather than the underlying disease" (1, 22). Adverse events can be preventable or non-preventable (1). A preventable adverse event is the result of an error (e.g., giving the wrong drug to a patient). Patient harm can also occur without being the result of an error and is then referred to as a non-preventable adverse event. An example of a non-preventable adverse event is an anaphylactic reaction to a drug given to a patient without a previous known allergy to the drug (1).

Error

The concepts “error” and “medical error” are used interchangeably in the patient safety literature. An error is a failure that occurs in healthcare and refers to failed processes and does not necessarily include harm (24, 25). In this thesis the following definition of error is used: a failure made in the process of care that results in or has the potential to result in severe harm to patients (1, 23). The term error in this thesis is used to include commonly used terms such as mistakes, failures, near misses and incidents. A serious error involves a risk of death, physical or psychological injury that is permanent (14). The probability that an error will occur is called a risk (22).

1.4 WHY DO ERRORS OCCUR

Patient safety work in health care has its origin from high risk areas such as nuclear- and aircraft industry (1). Human error is the human contribution to errors and one of the greatest contributors to accidents in high-risk industries and healthcare (1). The report “To err is human” by IOM in 1999, placed particular emphasis on preventing future errors by designing safety into systems and not blame individuals for past errors. This systematic approach also referred to as the human factor approach acknowledges that “humans are fallible and errors are to be expected even in the best organizations” (26). Errors made by humans are the result of latent errors in the work environment. The human factor approach replaced the former individual approach, which assumes that a person is responsible and should be blamed for an error (1, 26-28). Research in this area focuses on the relationship between humans and complex sociotechnical systems (1, 29, 30) in order to understand why systems or processes break down.

In recent years behavioural science has had a central role in trying to understand and explain why and how errors occur, exemplified in accident models. The Swiss cheese model of organisational accidents developed by Reason (26) is one model developed to provide explanations as to why errors occur based on the contribution of human, technological and organisational factors. The Swiss cheese model emphasises that every complex system has defences and barriers that protect potential victims from hazards. The defences and barriers (the slice of a cheese) could be alarms, automatic shutdowns, procedures, routines, administrative controls but also staff. The defences and barriers are mostly effective, but there are always weaknesses (the hole in the cheese). The weaknesses arise for two reasons: active and latent errors, but most errors involve a combination of these two. The active errors are the unsafe acts committed by staff in direct contact with the patient or system. Latent errors are often unrecognised in complex systems and may lie dormant for many years before they combine with active errors and thereby jeopardise patient safety (1, 26). A stressful environment, high workload and inadequate systems of supervision or communication are examples of latent errors (26, 29, 31). Latent errors are considered the greatest threat to

patient safety (32). The ED is a complex system (33) and latent errors in the environment are for example, human interactions with technology, high workload, multitasking, and interruptions that result in cognitive overload (24, 34, 35).

Several methods to analyse why and how an error occurs have been developed. The root cause analysis has been adapted and translated into Swedish and is used when serious errors have occurred (36). This structured method has its origins in the USA and includes a protocol that begins with a reconstruction of the error through record reviews and interviews with participants. A multidisciplinary team should then analyse the sequences of events that lead to the error. The system approach is central to the root cause analysis that is to identify underlying problems and avoid focusing on mistakes made by individuals. A goal is to identify both active and latent errors to prevent future errors by eliminating the latent errors (37).

A framework of risk factors for use in healthcare was developed by Vincent and co-workers and based on Reasons accident model (26, 29). The framework consists of components that are important in healthcare such (e.g., patient characteristics and teamwork). The framework allows a systematic approach and has different uses, including analysis of events, or design and validation of risk assessment instruments. A framework for classifying factors that contribute to errors in the ED was later developed by Cosby as based on the framework of Vincent and co-workers (38).

1.5 ERROR REPORTING

As in all healthcare environments, error reporting in the ED is an important tool for detecting safety issues, which can result in identifying solutions, learning from errors and enhancing patient safety (1, 39). The National Board of Health and Welfare (Socialstyrelsen), in Sweden, estimated that approximately one million risks and errors were reported in local incident reporting systems from all healthcare sectors in 2001. However, many similar errors occur but are not always reported and thus unknown errors are assumed to be large (40). Patient safety research in emergency care is difficult because of the complexity of the ED environment, as well as the inability to fully capture all errors (41). Improving patient safety depends on the ability of healthcare providers to accurately identify, disclose and report errors (41). However collecting reports without doing anything with the information in order to improve patient safety is not useful (1).

1.5.1 Error reporting from healthcare staff and care providers

Local incident reporting systems

According to the law in Sweden, it is mandatory for all healthcare staff to report risks and errors into local incident reporting systems (42). If a serious error has occurred and reported, the care providers are obliged, according to the Lex Maria law (43), to also report it to a government agency, namely the Health and Social Care Inspectorate.

Health and Social Care Inspectorate (IVO)

According to Lex Maria law, care providers should report all serious errors to the IVO. From June 1st 2013, the IVO is under the Ministry of Health and Social Affairs. Before IVO existed, these serious errors were reported to the National Board of Health and Welfare. The number of Lex Maria reports has increased every year since 2005, which could be explained partly by reports of suicide that were included to Lex Maria in 2006. The increased focus on patient safety issues in Sweden and the increased number of reports indicate not a decline but rather an improvement in identifying and reporting errors and patient safety risks (44).

A problem, however, both internationally and in Sweden, is the known underreporting to these systems. The unknown number of errors is assumed to be large because many similar errors occur but they are not always reported (1, 40, 45-48). Reasons not to report errors are among others time constraints, fear of reprisal, sense of futility and lack of feedback (45, 46, 49). Serious errors that should be reported according to Lex Maria are not always reported in the local incident reporting systems as they should be. These errors are considered a problem and a risk of missing serious errors (50). Further, serious errors according to Lex Maria are underreported to a greater extent in comparison with the Patient Insurance (LÖF) (47).

1.5.2 Complaints from patients or their proxies

Patients or their proxies can report complaints about the care they have received to IVO, (before IVO to the Medical Responsibility Board, HSAN), Patients' Advisory Committees (Patientnämnderna) and actual injuries to the Patient Insurance.

Health and Social Care Inspectorate (IVO)

Complaints about care and treatment can be reported to IVO. The report should include which care centre or hospital the complaints relate to and a description of the event and when it occurred. IVO investigates the event and the main focus is the system approach.

The Medical Responsibility Board (HSAN)

Before 2011, complaints from patients or their proxies were reported to the Medical Responsibility Board. These complaints include a notification of an individual healthcare staff and the investigation made by the board was conducted to identify whether the

individual healthcare staff was responsible for the error and would be blamed. The board still remains and investigates the responsibility of the individual healthcare staff. However, only the National Board of Health and Welfare can make these reports. The reports to the Medical Responsibility Board were considered valuable as part of patient safety work, and the National Board of Health and Welfare found that more than a third of the cases contained one or more risks for patient safety (40).

The Patients' Advisory Committees (Patientnämnderna)

The Patients' Advisory Committee is available in every county council and is an independent authority to which patients can turn to with complaints in the care or treatment they have received. The Committee can assist with information to patients or their proxies needed for them to get in contact with health care staff or to connect patients to the right government agency if needed. The complaints are mainly related to wrong or delayed treatment. Complaints to the Committees is thought to confirm patient safety risks and that they contribute to increased patient safety in the healthcare sector (40). International research confirms that patients are valuable in identifying risks for patient safety and errors in healthcare including EDs (51-53).

Patient Insurance

Further, patients or their proxies can also request for compensation from the Patient Insurance if they had suffered an injury from healthcare. All Swedish county councils and regions have an agreement with the Patient Insurance.

1.6 ERRORS IN THE EMERGENCY DEPARTMENT

The numbers of ED errors is estimated in some international studies, although using different methodologies and terms such as incidents or adverse events (39, 54-62). One study reported number of ED errors in 18 per 100 (18 %) patients (54) whereas another study reported 22 per 1000 (2.2 %) patients (55). Further, a study reported that 24 of 399 (6 %) patients were involved in adverse events of which 17 were preventable (56). Common categorisations of errors are into which process in the ED care they occurred: for example, during triage or, diagnostic, treatment or medication procedures. Two common processes in the ED where errors occur are during diagnostic (54, 56, 63-67) and medication procedures (68-70). Errors in diagnostic procedures are e.g. missed or delayed diagnoses because of the failure to order e.g. appropriate test or act on test results.

Another common type of error reported from international studies in the ED are communication failures (39, 54, 67, 71-80) which is because communication load in the ED is considered high (71, 73, 74, 77, 79, 81). The most common activity reported from two EDs in Sweden were information exchange between clinicians (82). Failures in communication have been reported in the USA to be the leading cause to serious errors (83), Failures in

communication can be, for example, information gaps, which is important patient information that is not transferred between clinicians or between care givers (78, 79, 84). In Sweden, an audit regarding patient safety in six EDs from The National Board of Health and Welfare in 2005 indicated that there were deficiencies in information transfers between care givers (3).

1.7 PATIENT SAFETY RISKS IN THE EMERGENCY DEPARTMENT

In the USA, the Agency for Healthcare Research and Quality (AHRQ) published a report in 2003 on the effects of healthcare working conditions on patient safety. The conclusions were that an increase in staffing levels in inpatient wards will likely improve patient outcomes and reduced interruptions will likely decrease the incidence of errors (85). A recent study reported that an increase in the workload of RNs by one patient in inpatient wards increases the likelihood of inpatient hospital mortality by 7% (86). In Sweden, a study reported that RNs' perceptions of patient safety working with inpatient care were strongly related to having adequate staffing and resources (87).

Knowledge about staff experience and perceptions of patient safety risks in the ED and their management of risks seem to be scarce. One survey in the USA reported that ED physicians' greatest concerns for patient safety were crowding, availability to consultants and nursing shortages (88). Another survey in the USA reported that ED staff perceived that the physical environment, staffing and information coordination were factors of greatest concern for patient safety (89). One interview study of ED staff members in the United Kingdom reported that perceived stress factors were the 4-hour target, high workload, staff shortages and lack of teamwork (80). The goal of the 4-hour target, launched in 2000, was that patients would be assessed, treated and admitted to the hospital within 4 hours. Another interview study in the USA with 20 emergency RNs reported that RNs were aware of potential errors, played an active role in the recovery of errors and that experience played a major role in the ability to recover errors. Some methods used to identify and recover errors included surveillance, anticipation, double checking and experiential knowing (90). In addition, inadequate equipment and inexperienced staff have been reported to affect staff performance and result in errors in the ED (58, 59, 64).

In an audit of six EDs in Sweden in 2004 by the National Board of Health and Welfare it was reported that among others high workload, waiting times, inexperienced staff and electronic health care records were perceived by staff as risk factors for patient safety (3). However, there is a lack of research that can confirm these findings and insufficient knowledge about how Swedish ED staff manage these risk factors. Research is growing internationally regarding ED patient safety and factors such as crowding, interruptions and multitasking are considered factors contributing to errors (91-93).

Crowding

In the ED, workload is a related phenomenon to crowding with potential mutual effects between the two (94). ED crowding has been considered a major threat to patient safety (4, 95) and it has been suggested that ED crowding is a response to a dysfunctional healthcare system (4).

The American definition of crowding is “a situation in which the identified need for emergency services outstrips available resources in the ED, hospital or both” (89). ED crowding has been recognised in the literature for over 20 years (96), and a growing body of data suggests that ED crowding is associated with objective outcomes (such as mortality) and clinically important processes of care (such as time to treatment for patients with time-sensitive conditions such as pneumonia and for patients with severe pain) (95, 97). ED crowding has also been associated with higher rates of patients leaving without ever being seen (98) higher rates of errors in specific diagnosis such as myocardial infarction (99), and medication errors (100).

In the United Kingdom, the term crowding in the ED has been named as “waits” and the solution was the 4-hour target, where patients were assessed, treated and admitted within 4 hours. Although the effect is uncertain, the 4-hour target has been adopted in other countries, including Sweden (98). Crowding and waiting times have been recently set on the national agenda by the Swedish government. In 2010, The Swedish National Board of Health and Welfare has been commissioned to investigate and propose a system to measure waiting times in Swedish hospital-based EDs (101). In a 2013 report it was noted that patients’ length of stay had increased and that there were major differences between EDs in length of stay and waiting times. In addition to measure waiting times, the National Board of Health and Welfare highlighted the need for quality indicators for care with focus on patient safety and patient satisfaction (101). Further, there is a lack of comprehensive knowledge and research about patient flow and processes in the EDs and there is no adequate Swedish definition of crowding (102, 103).

While most international studies and reviews have described the negative effect on patient outcomes, crowding is also considered to have a negative effect on staff workload. Crowding contributes to stress and ED staff are more likely to be interrupted during a task; both of these factors (stress and interruption) reduce productivity and effectiveness (4, 96).

Interruptions

To be interrupted during a task can lead to memory failures and result in an error (32). An interruption is defined as “a break in the performance of a human activity initiated by a source internal or external to the recipient, with occurrence situated within a context of a setting or location. This break results in the suspension of the initial task by initiating the performance of an unplanned task with the assumption that the initial task will be resumed” (104) (p E38).

Interruptions are a complex phenomenon (92) that has been studied in psychology (105) and behavioral science (93). In a review of psychological literature, it is reported that

interruptions have negative effects on clinical tasks (e.g., more risk-taking behaviours in the decision-making process and faster task completion to the expense of increased perceived stress) (105). A primary task is the main activity, and an interruption is a secondary activity that requires attention and stops the primary task. Although some interruptions may be necessary, an interrupt-driven environment is prone to distraction and therefore potentially to error (106). Studies have shown that there is information loss due to interruptions (93). An important factor that has an impact on the interruption effect is high working memory load (105), and forgetting to carry out tasks in the future is one of the most common failures occurring because of an interruption during high working memory load (32, 105, 107). In healthcare the IOM, described interruption as a contributing factor to errors in their acclaimed report from 1999 (1). Later, the AHRQ in the USA in 2003 argued that reducing interruptions will probably decrease errors (85). Research on interruptions and their contribution to errors in healthcare has since then increased dramatically. The definition of an interruption still varies (92), although a concept analysis of the concept interruption has been conducted (104). Because definitions and instruments used to study interruptions are not standardised, comparison of studies is difficult (92).

Interruptions seem to be more frequent in the ED than in other healthcare settings (76, 108-110). In other countries, research on interruptions in the ED has focused on counting interruptions in observational studies (73, 106, 111-116). Studies on ED physicians' show an interruption rate between 5 to 12 times per hour (106, 110, 111, 113, 115). The number of interruptions of RNs in the ED has been seldom studied, but one study reported 11 interruptions per hour in a level one trauma centre (117) and 3 per hour reported from observations of 30 RNs in three major academic EDs (116). However, interruptions of registered RNs during medication management have been studied in both wards (69, 118-120) and in EDs (68, 70, 116) and are believed to contribute to medication errors. One study reports that occurrence and frequency of interruptions were significantly associated with medication errors (121).

Interruptions have mostly been considered negative, but interruptions are a complex phenomenon, and it has been suggested that interruptions may sometimes be necessary to ensure safety (92, 107, 117, 119) e.g. to be aware of a patient's deteriorating condition or prevent a medication error. The impact on the individual and outcome of an interruption may differ because of several factors: the primary task that is interrupted, the cognitive state of the individual, the workload during the interruption and the interruption itself (92, 122). It is argued that healthcare researchers need to reach a consensus on the definition of interruption and to develop a theoretical base to understand the complex phenomena of interruptions (92, 107).

Multitasking

Multitasking is closely connected to interruption. Some authors propose that research also must include methods that can distinguished between the concepts (122). Multitasking is managing multiple tasks at the same time (108). Multitasking is an integral and necessary skill in the ED, although multitasking creates higher working memory load (93). Of two Danish studies based on questionnaires to ED physicians and RNs, one reported frequent interruptions as the most common stress factor (123). The other study reported that cognitive demands (e.g. multitasking) and poor patient safety climate had the highest impact on the occurrence of errors (124).

In summary, research is increasingly growing internationally regarding patient safety and how to reduce errors and improve patient safety in the ED. Despite efforts to increase knowledge about patient safety risks, through the implementation of mandatory reporting systems, there remain knowledge gaps, partly due to underreporting. Two studies from the USA estimated that 3 % of adverse events in healthcare occurred in the ED. Several international studies have reported that common types of error in the ED are diagnostic, medication and communication errors. Commonly reported contributing factors to errors in the ED are crowding, interruptions and multitasking. In Sweden, there is a lack of knowledge and overview of reported numbers, type and contributing factors to errors in relation to ED care. There is also a lack of research on interruptions that can confirm previous findings and generalisability to Swedish ED care. Further, there is a lack of knowledge about physicians and RNs perceptions of patient safety risks in Swedish EDs.

2 AIMS

The overall aim of this thesis was to describe patient safety in Swedish EDs with respect to errors, interruptions and staff experience of patient safety risks.

Table 1. Overview of the four papers.

Paper	Aim	Design and data collection method	Sample	Analysis
I	To describe the incidence and types of reported error and complaint in ED care.	Descriptive, survey. Registry data and questionnaires.	Reported errors and complaints from Swedish EDs to three national authorities and local incident reporting systems. The National Board of Health and Welfare (<i>n</i> =64). The Medical Responsibility Board (<i>n</i> =306). Patients Advisory Committees (<i>n</i> =1341). Local incident reports (<i>n</i> =47).	Qualitative content analysis.
II	To describe contributing factors to errors occurring in EDs.	Descriptive. Registry data.	Errors reported from EDs to the National Board of Health and Welfare in 2009 (<i>n</i> =64) at 35 hospital based EDs.	Qualitative content analysis.
III	To explore interruptions occurring during common activities of clinicians working in the EDs.	Descriptive. Observation and interviews.	18 clinicians (6 physicians, 6 RNs, 6 LPNs) from two hospital- based EDs, 9 from one large university hospital and 9 from one medium- sized county hospital.	Non-parametric statistics and qualitative content analysis.
IV	To identify factors that ED clinicians perceive as patient safety risks and to study how clinicians manage these factors.	Descriptive. Interviews.	20 clinicians (10 physicians and 10 RNs). 10 from one large university hospital and 10 from one medium-sized hospital.	Qualitative content analysis.

3 MATERIAL AND METHODS

This chapter describes the study context, data sources, data collection procedures and methods used in the four papers, which are referred to in the text by their Roman numerals.

3.1 STUDY CONTEXT

The Swedish healthcare system

The study context is the Swedish healthcare system and hospital-based EDs. Sweden has 20 county councils or regions that are responsible for providing healthcare to the inhabitants (125). IVO is a government agency under the Ministry of Health and Social Affairs, which on June 1st 2013 was transferred from the National Board of Health and Welfare. The main task of IVO, which supervises health and medical care, is to monitor that healthcare is safe and of good quality in accordance with the Patient safety law and other regulations (14).

The agency also manages errors reported by care providers, and from 2012 handles complaints filed by patients or their proxies. Until 2011, patients or their proxies could file a complaint to the Medical Responsibility Board regarding the care and treatment they have received. From 2012, the complaints are directed to IVO. According to the Patient Safety Act (14), it is mandatory for care providers to report serious errors to the agency. The chief medical director of the healthcare organisation which decides if a report of a serious error is to be reported to the agency. If so, the healthcare organisation is required to investigate the event of interest and conduct an event analysis. Then, the agency investigates the event, performs reviews of health records, conducts event analysis and interviews staff members who were involved in the case. Based on this data, the agency recommends and decides actions in accordance with the systematic approach (e.g., changes in routines).

The Patients Advisory Committee is an independent authority to which patients can turn to with complaints regarding the care or treatment they have received. Another task for the committee is to provide information to patients or their proxies so they can contact healthcare staff or to connect patients to the right authority if needed. The number of complaints to all the committees has increased from 18 500 in 2000 to 29 500 in 2012 (126).

Emergency Departments

In Swedish healthcare there were 72 hospital-based EDs for ill and injured adults in 2009 that were included in paper I and II. This figure decreased to 70 EDs in 2013 (6, 7). Of these 72 EDs in 2009, two were included in paper III and IV.

Of the two EDs included in the observations of interruptions and interviews with staff, one was a level one trauma centre, located at a large urban university hospital with an annual patient flow of 72 000 and 82 000 in 2009 and 2012 respectively. The staff at the ED consisted of physicians (including emergency physicians), RNs and LPNs from different specialties and with various level of experience (consultants, residents and juniors).

The other ED was located at a medium-sized county hospital with a patient flow of 49 000 annually in 2009 and 58 000 in 2012. The staff at the ED consisted of physicians, RNs and

LPNs from different specialties, with various levels of experience (consultants, residents and juniors). None of the physicians at the county hospital were emergency physicians.

3.2 DATA SOURCES

Five data sources were used in the four papers:

1. Lex Maria cases reported to the National Board of Health and Welfare (Socialstyrelsen)
2. Patient complaints reported to The Medical Responsibility Board (HSAN)
3. Patient complaints reported to Patients Advisory Committee (Patientnämnden)
4. Errors reported to incident reporting systems
5. Interview and observation data from ED clinicians at two EDs

The National Board of Health and Welfare (I, II)

In 2009, 1346 Lex Maria cases were reported to the National Board of Health and Welfare. After the investigation of a case made by the agency, a summary of the case a report (called “decision”), is publically accessible without personal data about patients and staff. The summary of the case contains sections that describe the basis for the investigation e.g. the notification, internal investigation and/or root cause analysis made by the care provider, interviews with staff and eventually an inspection by the agency. Further, a description of the event and the error that occurred, the care providers identified causes of the event and the care providers and agency assessment and demands for action. The reports were full text documents and no categorisations of errors were made by the agency. Further, the level of information in the cases varied in detail as well as the root cause analysis made by care providers. The Lex Maria cases were sorted by the agency into medical specialties in which cases from emergency care were assumed to be found.

The Medical Responsibility Board (I)

During 2009 there were 4628 complaints reported to the board. When the board had investigated the case, a summary of the case (called “decision”) was publically accessible in a visiting room at the board office. The summary contained a full text document with information of the healthcare staff that were notified, a description of the case, a description of the investigation including record reviews and/or interviews with staff and the decision of whether the healthcare staff were responsible, and if so, the disciplinary action to be taken. The board did not make any categorisations of the complaints and the level of information in the cases varied in detail. The cases were sorted by the board only according to case number.

Patients' Advisory Committee (I)

In 2009, there were 1341 complaints related to ED care reported to all committees. The complaints were presented in a varied level of detail: in numbers, in main categories and/or subcategories.

Local incident-reporting systems (I)

There was no uniform incident reporting system in use and there were numerous systems in various county councils and regions. The reported errors were presented in varied level of detail: in numbers, in main categories and/or subcategories.

Interview data from two EDs (III, IV)

In paper III, the sample comprised 18 clinicians (9 from the two EDs), 6 physicians, 6 RNs and 6 LPNs. The clinicians were selected by purposeful sampling based on their work experience. The reason for including these three groups of clinicians was to get a comprehensive perspective of interruptions occurring in the ED. Variation in gender and length of work experience in ED care were sought. The work experience in ED care among the 18 clinicians ranged from 6 months to 30 years. Based on the length of work experience, the participants were distributed into three groups: junior, medium-experienced, and senior clinicians. One clinician from each profession at the two EDs was selected from each group to achieve variation in clinical experience. Less than 6 months of work experience from ED care was considered as an exclusion criterion.

In paper IV, the sample included 20 clinicians from the two EDs. To achieve varied and broad data a purposeful sample of participants was selected. The inclusion criteria were at least three years of professional experience from ED care. The sample consisted of 10 physicians (residents in surgery, internal medicine or emergency medicine) and 10 RNs (5 physicians and 5 RNs from each ED), whereof 11 were women. Ages ranged from 30-60 years and ED experience from 3-30 years.

3.3 DATA COLLECTION AND ANALYSIS

This section describes the data collection and methodology adopted in the four papers.

Reported errors and complaints in ED care (I)

During 2009, 1346 Lex Maria cases were reported from care providers to the National Board of Health and Welfare. Of these 1346 cases, 524 were sorted under somatic specialised care according to the agency. These 524 cases were retrieved in a file from the agency and screened for inclusion in two stages (figure 2).

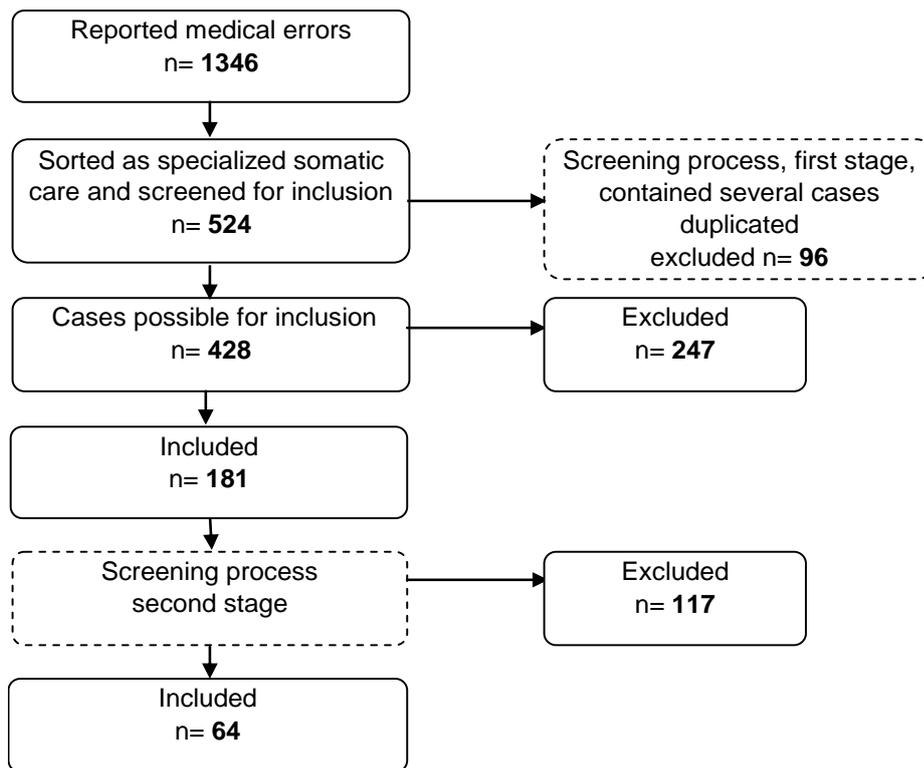


Figure 2. The screening process of cases reported to the National Board of Health and Welfare.

The first screening was conducted to find cases from ED care. The inclusion criteria for the first screening included the following: the department was a hospital-based ED for somatically ill and injured adults, the heading of the case contained the word ED, or the description of the error indicated the possibility that it was related to ED care. The exclusion criteria were that the error had occurred in a non-hospital ED or at a specialised ED for children, or if the heading and its description indicated the error was not related to the ED. To reach consensus about cases to include the research group reviewed this first screening process several times. In the first screening process, 247 cases did not meet inclusion criteria, which resulted in 181 cases that were assessed to have occurred in ED care.

In the second stage these 181 cases were ordered in full text from the agency and read through. The full text document is a summary of the case with a decision from the agency consisting of the following sections: basis (the basis for the agency's investigation including the notification from the care provider, internal investigation, root cause analysis, interviews with staff and inspection by the agency), description of the case (a description of the event and the error that had occurred), the care providers identified causes of the event, the care providers actions and the agency's assessment and demands for actions. The exclusion criterion in the second stage was cases that did not involve EDs: 117 cases did not involve ED care, resulting in a final sample of 64 cases.

In total, 4629 complaints about perceived errors were reported from patients or their proxies to the Medical Responsibility Board in 2009. One complaint was a duplicate, resulting in 4628 unique complaints. The decisions from the board were screened in two stages (figure 3) in attempt to capture complaints that had involved ED care. In the first stage, the publicly accessible decisions were screened in place, in the authority's room for visitors. The inclusion and exclusion criteria for the initial screening were the same as for the National Board of Health and Welfare. The first screening resulted in 362 cases that were assessed to have occurred in ED care.

In the second stage, exclusion criteria included complaints not involving ED care, incomplete complaints, statute-barred (more than two years old), withdrawn complaints, or complaints directed to the regional Patients' Advisory Committees that had not been handled by the board. All complaints that involved ED care were included, resulting in a final sample of 306 cases.

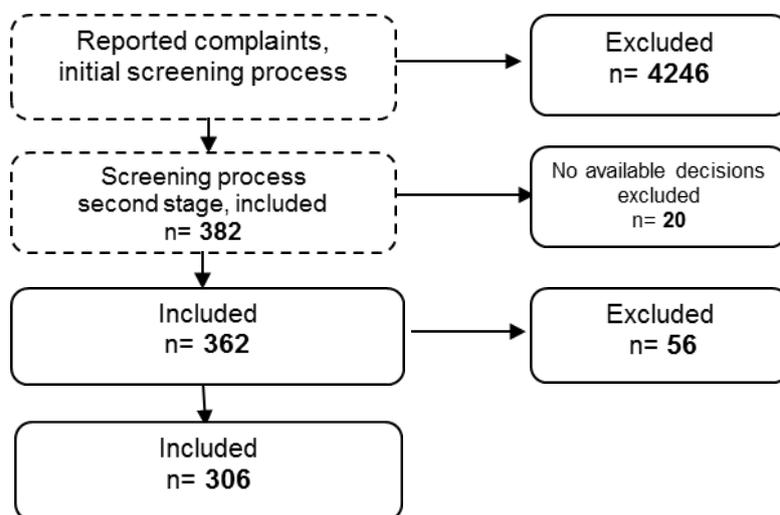


Figure 3. The screening process of cases reported to the Medical Responsibility Board.

All 21 regional Patients Advisory Committees were contacted by e-mail and asked for statistics regarding the number and types of complaints in ED care during 2009. Reminders were sent three times to non-responding committees in intervals of three weeks resulting in responses from all 21 committees and a final sample of 1341 complaints.

A questionnaire was developed by the research team to collect data from the local incident reporting systems in use at Swedish county councils and regions. The questionnaire contained 16 questions pertaining to number, types and classification of errors reported by staff. Additional questions covered number of ED patient visits per year, catchment area, type of hospital and type and name of local incident reporting systems. Finally, the remaining questions were about if and how the follow-up of errors was performed.

RNs responsible for the incident reporting system at the EDs at one county and one local hospital tested the questionnaire in a pilot test resulting in minor revisions to the instrument.

The questionnaire was then sent to the head of the department of all 72 EDs in Swedish hospitals. Reminders were sent to non-responding EDs after two weeks and again after four weeks. Further reminders were made by telephone calls and e-mail during the following two months, resulting in a final sample of 47 EDs (65%). The respondents represented EDs from 19 local, 19 county and 9 university hospitals. The non-responding EDs constituted 20 local, 4 county and 1 university hospital.

To identify the type of errors a qualitative content analysis approach was used (127), which refers to both quantitative and qualitative analysis. Frequencies of errors and complaints in each category were counted for all data sources. The analyses were inductive and the categorisations emerged from the written text. The cases from the National Board of Health and Welfare and from the Medical Responsibility Board were read in their entirety to acquire a general sense of the cases as a whole. The next step of analysis involved the identification of text that was related to the error that had occurred. The texts were extracted into meaning units. The meaning units were then condensed into codes (codes were a short description of the error that had occurred: e.g., “insufficient examination”). In the final step of the analysis the codes were sorted into categories based on their similarities. The categories represented a process in ED care (e.g., “diagnostic procedures”) or a process related to staff performance (e.g., “documentation”) in which the error occurred. A sample of 5% of the cases was independently analysed by four of the researchers with the aim to establish consensus on the coding and categorisation. Revisions were made until consensus was achieved.

The complaints from the Patients’ Advisory Committees were already categorised, although the level of detail of this categorisation varied. Eight (38%) committees reported the type of complaint in main categories while 12 committees (57%) reported both main and subcategories based on common predefined categories established by the Patients’ Advisory Committees. One committee only reported the number of complaints. No analysis was carried out in that we did not have access to the original complaints and therefore the predefined main categories by the Committees were used.

Errors reported from the local incident reporting systems were presented in varying levels of detail (e.g., only number of errors, numbers and types of error or in predefined categories). In the analysis, types of error and the predefined categories of errors were coded. Coded errors with similar characteristics were categorised together. The research group discussed and revised the categorisations until consensus was reached.

Contributing factors to errors (II)

The data collection of the Lex Maria cases that were reported to the National Board of Health and Welfare were the same as in paper I. This collection process resulted in 64 cases. For paper II, internal investigations and root cause analysis made by the care providers in the 64 cases were ordered from the agency. Totally, 45 internal investigations were retrieved of which 35 were root cause analysis.

Data were analysed by deductive content analysis (128) using Cosby's framework (38) with predefined categories of factors contributing to errors in the ED. The framework, adapted from the work of Vincent and co-workers (29), was developed based on hundreds of cases of errors identified in the ED. The framework (table 2), which consists of 10 categories, has not yet been validated. Initially, in our analysis each case was read through in its entirety to determine a sense of the whole. Each case was then read a second time focusing on two sections: the causes of the event as identified by care providers and the authority's assessment and demands for actions with the aim to identify contributing factors to the errors that had occurred. In addition, the section describing the identified causes in the root cause analysis was reviewed to find any additional information about the contributing factors. The extracted texts about the contributing factors (identified by either or both the care providers and the agency) were sorted into 10 predefined main categories using Cosby's framework (38). To make a more detailed description of the contributing factors a subordinate categorical level was created for some categories. The subcategories were identified and labelled according to the framework. Totally, five cases were reviewed by a second researcher to establish consensus.

Table 2. Description of main categories of contributing factors to errors (38).

Contributing factor	Summary description of content
1 <i>Patient factors</i>	Patient characteristics e.g., critically ill, demented, delirious or under influence of substances, language and communication barriers or multiple diseases that may place the patient at risk.
2,3 <i>Outside systems and ED access</i>	Errors before arriving to the ED, such as society (e.g., nursing homes) or the emergency medical service (EMS).
4 <i>Triage</i>	Errors within the triage process.
5 <i>Teamwork failure</i>	With emphasis on communication between clinicians in teams, specialties, different levels of care (units outside the ED) and between patient and their proxies. This study distinguished face-to-face communication, written information transfer and cooperation.
6 <i>The local ED environment (the micro system)</i>	Errors occur when the ED staff are stressed and overloaded. Relates also to keeping adequate resources (staffing), equipment and supplies for the unexpected. Routine functions, policies and guidelines.
7 <i>The hospital environment (the macro system)</i>	Hospital services such as consultants, inpatient beds and specialty treatments.
8 <i>Hospital administration and third parties</i>	Budgetary constraints, policies and regulations.
9 <i>Community level</i>	Care the patients receive after the ED visit, access and interaction to primary care and society's health services.
10 <i>Human error</i>	<i>Errors in planning:</i> primarily cognitive, incorrect clinical assessment and flawed planned interventions. <i>Errors in execution:</i> the diagnostic work-up plan and treatment were not carried out as intended.

Interruptions in emergency department work (III)

During a study period of eight days in 2009, 18 ED clinicians were observed while carrying out their work at two EDs. The observations were made at different times of the day and night (from 8 am to 3 am) and different weekdays (Monday to Thursday). Mondays were chosen because they are typically characterised by a high workload at the two EDs in this study. At both EDs, the observations were conducted on representative days for the ED environment, covering patients with different symptoms of varying urgency. The direct observations lasted for two hours each, in total 36 hours. Directly after the observations, a short (approximately 15 minutes) semi-structured interview was held by one of the observers with each observed clinician to let him or her reflect on their perceptions of interruptions that had occurred during the observation period. The interviews took place at an undisturbed location in the ED.

Because no previous data collection protocol existed for the specific purpose of the present study, a protocol was developed based on previous studies within the research field (111, 129, 130). The observations were conducted concurrently by two of the researchers, both RNs with extensive clinical experience from ED care. The two observers worked as a pair during data collection and observed the same clinician to help ensure that all conducted activities and interruptions were captured. The observers documented the continuous work process on a minute-to-minute basis as well as all received interruptions and self-interruptions (interruptions initiated by the clinicians themselves) that the clinicians were exposed to. The data recorded in the protocol were divided into six categories: (1) type of conducted activity (e.g., reading a patient's chart), duration of the activity in minutes, (3) location and person involved in the activity, (4) occurrence of interruptions in each activity, (5) whether the observed clinician was a recipient of an interruption or caused self-interruptions, and (6) whether the previously observed activity was resumed after the interruption. Four pilot observations were conducted to test the protocol, resulting in minor changes. Interruptions of non-observed clinicians were not counted. No pre-defined categories were used to identify the clinicians' activities during the observations and the researchers used their own words to describe their observations.

Based on the observation data, frequencies of how often interruptions occurred in each activity and the locations in the EDs were counted. In a previously published study (82), 15 categories of activities conducted by the clinicians were identified and 12 of these categories were used in this study in the analysis of frequencies of interruptions. Further, the type of clinician involved in the interruption, whether an activity was resumed after an interruption or not, and whether the observed clinician was involved in self-interruptions or was the recipient of an interruption were also counted. Chi-square analysis was used to analyse differences in being recipient of or causing self-interruptions for each category of clinicians.

Inductive content analysis was used to analyse the interviews (127, 131). The whole text was subsequently extracted into meaning units and then the text was condensed and subcategories and categories developed (127). The interviews were tape-recorded and transcribed verbatim

and read through several times to get a sense of the whole. The text was extracted into meaning units. The meaning units were condensed and organised into subcategories and categories (table 3). The subcategories were divided into three domains that represented the locations in the ED where the interruption occurred, the clinicians need to interrupt someone else and the clinicians' perceptions of interruptions. The data were primarily categorised by two of the authors. Consensus on the categories was reached through repeated discussions of the data in the research group until inter-rater agreement was attained.

Table 3. Example of the analysis of the interviews with ED clinicians on their perceptions of interruptions during their work processes

Meaning units	Condensation	Subcategories	Categories
"I guess it was someone who asked me something." (8: <i>junior LPN</i>)	Occasional questions	Infrequent communicative interruptions	Undisturbed work process
"There are other days when there are significantly more calls on the pager than today and then it (disturbance) gets obvious. There are usually many more pagers than there were today"(1: <i>senior physician</i>)	Many pagers are disturbing	Frequent communicative interruptions	Disturbed work process
"No, normal (amount of interruptions). The phone rings, people ask you questions, but it isn't something I get disturbed by." (12: <i>medium RN</i>)	Questions and phone calls part of the normal work environment	Expectations of the work environment	Undisturbed work process
"I get disturbed by having to wait for the person who will help me make a decision. Yes, one gets disturbed by waiting". (16: <i>junior physician</i>)	Disturbed by waiting	Waiting	Disturbed work process

Perceptions of patient safety risks in the ED (IV)

In 2012, two professional interviewers with experience from the healthcare sector carried out telephone interviews with 20 ED clinicians employed at two EDs. The interviewers contacted the participants by e-mail to schedule an interview. Telephone interviews were chosen for feasibility i.e. it is easier to schedule than a personal meeting and the participant can choose the most appropriate time. The interviews lasted 12-57 minutes (mean 30 minutes). All interviews were tape-recorded and transcribed verbatim. Initially, the interview guide was pilot-tested by the first author, while the professional interviewers were listening. The pilot-test resulted in rearranging the order of some of the questions but no change of the content was needed. The semi-structured interview began with the question of whether the respondent had experience of patient safety risks in the ED. If so, the respondent was asked to describe the events or circumstances that were perceived as risks. Further questions covered the respondent's experience of revealing and preventing errors and the feelings following the disclosure.

The interviews were analysed using inductive content analysis (127, 132). The text from each interview was read by the first author several times to achieve a general sense of the whole. The text relating to the clinicians perceptions and management of patient safety risks was then extracted into meaning units, one consisting of the text relating to the clinicians perceptions and the other part relating to managing patient safety risks. Thereafter, the extracted texts about perceptions were condensed and coded. The codes, based on their similarities, were sorted into subcategories that represented the emerging category (table 4). Each step of the analysis was discussed within the research team. To ensure that the core concept was kept constant throughout the analysis, there was movement back and forth between the whole interview texts, meaning units, condensed texts and codes. Discussions regarding the analysis continued until consensus was achieved in the research group. The meaning units about managing patient safety risks was also condensed and coded. The codes were grouped into categories based on their similarities.

Table 4. Examples of the analysis of ED clinicians' perceptions of patient safety risks.

Meaning unit	Condensed meaning unit	Code	Subcategory	Category
<i>We have many emergency situations and many severely ill patients, which means that it may take time before the patient is assessed (1)</i>	<i>Many emergency situations, many severely ill patients may result in delayed assessment of patients</i>	<i>High workload results in delays of assessments</i>	High patient load	High workload
<i>When there is a lot to do, my experience is that communication is lacking. When you are busy performing your task with the aim to move forward, communication between teams is lacking (1)</i>	<i>When there is a lot to do, communication is lacking because you are too busy to come forward</i>	<i>The communication fails when there is high workload</i>	Lack of information	Communication failure

3.4 RESEARCH ETICS

The studies were approved by the Regional Ethical Review Board in Stockholm (Dnr: 2009/1413-31/4, 2012/2237-32)). For paper I and II, the filed reports of the errors and complaints to all the above-mentioned authorities are publicly accessible documents and no personal identifiable data were used. For paper III and IV, the managers of the EDs gave their permission and each participating clinician gave written informed consent. For paper III, information to patients about the study was posted in the ED waiting rooms. Because some of the observed activities were patient-related, the observers sometimes refrained from following the clinicians' into examining rooms to protect patient integrity. In other situations, i.e. if the patients were involved in the observed activities, the patients were asked for informed consent.

4 RESULT

In this chapter results for the four papers are presented.

4.1 REPORTED ERRORS AND COMPLAINTS IN ED CARE (I)

During 2009, errors and complaints related to diagnostic procedures were reported most frequently to the National Board of Health and Welfare, and to the Medical Responsibility Board. Errors and complaints related to care and treatment were reported most often to the local incident reporting systems and to the Patients' Advisory Committees. In all registries combined (table 5) the most common category of errors and complaints was related to care and treatment (24.3%), followed by organisation, routines and resources (19.0%) and unspecified medical errors (14.5%).

Table 5. Overview of numbers and types of error and complaint from Swedish national, regional and local incident reporting registries during 2009.

Category for type of error and complaint	The National Board of Health and Welfare	The Medical Responsibility Board	Patient Advisory Committees (n=21)	EDs (n=45)	Total n (%)
Care and treatment	11	146	655*	1450	2262 (24.3)
Organisation/routines/resources	6	16	334	1405	1761(19.0)
Unspecified error	0	0	47	1302	1349 (14.5)
Information/communication/to be treated politely	18	34	305	771	1128 (12.1)
Diagnostic procedures	39	189	0	732	960 (10.3)
Nursing care	0	2	0	578	580 (6.2)
Documentation	2	9	0	568	579 (6.2)
Medication	8	10	0	279	297 (3.2)
Cooperation	3	0	0	257	260 (2.8)
Technology, medical	0	0	0	61	61 (0.7)
Triage	5	10	0	31	46 (0.5)
Waiting times	0	21	0	0	21 (0.2)
Total	92	437	1341	7434	9304 (100)

*Bold numbers represent the highest number of reported errors or complaints per data source.

Errors reported to the National Board of Health and Welfare

Of 428 cases in somatic specialised care, 64 (15%) involved ED care. Because several cases contained more than one error, 92 errors were identified and subsequently classified into eight categories. Of the reported errors from healthcare providers, 42 % concerned diagnostic procedures, followed by errors related to information/communication (19.6%).

Complaints reported to the Medical Responsibility Board

From 4628 cases, 306 (6.6%) were found to involve ED care. Because several cases contained more than one complaint, 437 complaints involving perceived errors were identified and subsequently classified into 11 categories. Errors in diagnostic procedures (43.2%) were the most commonly reported complaints from patients, followed by complaints related to care and treatment (33.4%).

Complaints reported to the Patients' Advisory Committees

The regional Patients' Advisory Committees (n=21) reported 1341 patient complaints in ED care. Nearly half (48.8%) of these complaints were related to care and treatment. From the 12 (57%) committees that reported data also at the subcategory level, the main category care and treatment comprised the following subcategories: diagnosis/treatment (65.8%), nursing care (10.2%), blood specimen collection/examination (2.6%), medication (2.3%), technical equipment (0.1%) assistive device (0%) and unspecified (19.0%).

Errors reported to the local incident reporting systems

Of the 47 responding EDs, 45 reported 1 666 506 ED visits per year in a catchment area of 6 612 600 inhabitants (or about 73% of the Swedish population). Of these EDs, 43 reported the use of eight incident reporting systems and health care staff reported 7434 errors in ED care during 2009. Of these errors, 1450 (19.5%) were related to care and treatment, closely followed by 1405 (18.9%) related to organisation, routines and resources. Of the reported 7434 errors, 1302 (17.5%) were unspecified.

4.2 CONTRIBUTING FACTORS TO ERRORS (II)

In total, there were 157 contributing factors to errors (table 6). In each case at least one (m= 2.5, SD= 1.0) factor was identified. More than one contributing factor was identified in 50 (78%) cases, whereas 30 (47%) cases had more than three identified contributing factors. An internal investigation had been conducted out in 45 (70%) of the 64 cases in which the care providers had identified contributing factors in 44 (69%) cases. As Table 6 illustrates, nine of the 10 categories of Cosby's contributing factors were represented in the data. The most common factor was human errors, which were identified in 44 (69%) cases followed by the local ED environment and teamwork failure. These three contributing factors constituted 69% (n=109) of all identified contributing factors.

Table 6. Contributing factors to errors (n= 157) in Swedish EDs.

Factor	n	(%)
Human error	44	28
Local ED environment	38	24
Teamwork failure	27	17
Patient factors	21	13.5
Hospital environment	11	7
Triage	7	4.5
Outside systems and ED access	6	4
Community	3	2
Hospital administration	0	0
Total	157	100

Human error

Human error was identified in 44 (69%) cases and as the single contributing factor in nine (14%) of the cases. In five cases there were two types (error in the planning phase or execution phase) of human error resulting in a total of 49 human errors. Human errors occurred in combination with factors in the local ED environment in 23 cases, most often related to flaws in routines followed by lack of support/supervision to junior physicians and in four cases to high workload. Overall, the cognitive errors in the planning phase were the most common (69%), involving both novice and experienced clinicians in seven cases respectively. In 31 (70%) of the cases human error was related to diagnostic procedures, the most common being insufficient examination that resulted in either the occurrence of a missed or a delayed diagnosis.

Local ED environment

In this category three subcategories were identified: routines, resources and high workload. In these cases more than one subcategory was found in 11 cases, resulting in a total of 58 contributing factors related to the local ED environment (table 7). The dominating subcategory was routines 53% (n= 31). Missing routines were related to triage that occurred because of a lack of decision support and a deficient routine, e.g. that the routines for triage performed by RNs were not fully implemented, which resulted in an incorrect triage level. High workload was identified as a contributing factor in nine (16%) cases, of which two cases were described in the section “description of the case”, and in three cases in the root cause analysis.

Table 7. Factors in the local ED environment that contributed to errors.

Subcategories	n	(%)
Routines (total)	31	53
<i>Missing</i>	12	21
<i>Unspecified</i>	10	17
<i>Deficient</i>	9	16
Resources (total)	18	31
<i>Low staff level</i>	4	7
<i>Space shortage/facilities</i>	2	3
<i>Lack of support/supervision to junior doctors</i>	9	16
<i>Lack of introduction to staff</i>	3	5
High workload (total)	9	16
Total	58	100

Teamwork failure

Communication failures were identified in all 27 cases. Additionally, transfer of written information and failure in collaboration were identified in 13 (48%) of the 27 cases. More than one type of communication failure was identified in nine cases, resulting in 40 communication failures. The distribution of communication failures in the ED is represented in four subcategories as described in Table 8.

Table 8. The distribution of teamwork failures in errors in ED care.

Subcategories of teamwork failures	n	(%)
Between team members (total)	12	30
Between the ED and; (total)	11	27.5
<i>Nursing home</i>	3	7.5
<i>EMS (emergency medical service)</i>	3	7.5
<i>Reception</i>	2	5
<i>ICU (intensive care unit)</i>	1	2.5
<i>Primary care</i>	2	5
Between specialties (total)	9	22.5
Between clinicians and patient/proxies (total)	8	20
Total	40	100

The fourth most common category of factors contributing to errors was the patient factor, which was described in 21 (33%) cases. Of these, a third of the patients (n=7) were described with multiple diseases, four (19%) with chronic diseases (physical), and three (14%) with mental illness, three (14%) had communication disabilities, two (10%) were under the influence of alcohol, one (5%) was unconscious and one (5%) suffered from dementia.

The hospital environment category, identified in 11 (17%) cases, was related to flaws in the electronic health record, low staff level of physicians and lack of inpatient beds, routines and technical support. Errors in triage were found in combination with other factors in seven (11%) cases, the most common was the local ED environment factor (6 cases).

The categories outside systems, ED access and community level were identified in 9 (14%) cases. In these cases the failure was related to communication failure and therefore they were also placed in the category teamwork failure.

4.3 INTERRUPTIONS IN EMERGENCY DEPARTMENT WORK (III)

Of the 1882 activities being observed, 184 (10%) were interrupted, which yields a mean rate of 5.1 interruptions per hour. Interruptions were observed during 12 of the previously identified 15 activities (table 9). The most commonly occurring interruptions were observed during information exchange (20%), that is every time clinicians are asking for or giving information through interaction with each other, for example, discussing a patient. The activity that was most exposed to interruptions in relative terms was preparation of medication (29%), followed by documentation (27%) (e.g., signing or dictating a patient's chart), patient/family-nurse/doctor interaction (19%) (all situations where clinicians interact with patients or their proxies) and preparation of medical-technical tasks (19%) (e.g., time spent working on the computer).

Table 9. The distribution of interruptions in observed activities.

Frequency of interruptions in activities and for the three groups of clinicians (n=18)						
Categories of activities	Frequency of observed activities n	Frequency of interruptions per each category of activity n (%)	Physicians n (%)	RNs n (%)	LPNs n (%)	Total n (%)
<i>Preparation of medication</i>	7	2 (28.6)	0 (0.0)	2 (4.0)	0 (0.0)	2 (1.1)
<i>Documentation</i>	119	32 (26.9)	24 (32.9)	4 (8.0)	4 (6.6)	32 (17.4)
<i>Patient/family-nurse/doctor interaction</i>	176	34 (19.3)	10 (13.7)	5 (10.0)	19 (31.1)	34 (18.5)
<i>Preparation of medical-technical tasks</i>	21	4 (19.0)	0 (0.0)	3 (6.0)	1 (1.6)	4 (2.2)
<i>Administration</i>	133	21 (15.8)	4 (5.5)	8 (16.0)	9 (14.8)	21 (11.4)
<i>Patient data analysis</i>	57	8 (14.0)	2 (2.7)	1 (2.0)	5 (8.2)	8 (4.3)
<i>Transportation</i>	117	12 (10.3)	4 (5.5)	3 (6.0)	5 (8.2)	12 (6.5)
<i>Organisational planning</i>	20	2 (10.0)	1 (1.4)	0 (0.0)	1 (1.6)	2 (1.1)
<i>Information seeking</i>	243	23 (9.5)	10 (13.7)	9 (18.0)	4 (6.6)	23 (12.5)
<i>Maintenance</i>	69	5 (7.2)	0 (0.0)	1 (2.0)	4 (6.6)	5 (2.7)
<i>Information exchange</i>	793	37 (4.7)	14 (19.2)	14(28.0)	9 (14.8)	37 (20.1)
<i>Break</i>	104	4 (3.8)	4 (5.5)	0 (0.0)	0 (0.0)	4 (2.2)
Total	1882	184	73 (100)	50(100)	61(100)	184(100)

There were 73 interruptions identified for physicians, 50 for RNs, and 61 for LPNs. Collectively, the clinicians were more often recipients of interruptions (63%) than causing self-interruptions (37%) ($p < 0.001$). Both physicians' and RNs were more often recipients of interruptions (physicians' 78%, RNs 66%) than causing self-interruptions (physicians' 22%, RNs 34%) (physicians $p < 0,001$, RNs $p < 0.05$). The physicians were primarily recipients of interruptions while documenting patient care. LPNs (59%) caused self-interruptions ($p < 0.004$) to a higher extent as compared with physicians (22%) and RNs (34%). The LPNs self-interruptions mostly took place when they were involved in the activity patient/family-nurse/doctor interaction (e.g., needing to leave the patient alone in the assessment room for a short time because of missing equipment).

Among all clinicians, the most common way to be interrupted was by face-to-face interaction with a colleague (51%). Most interrupted activities ($n=161$, 87.5%), were observed to be resumed shortly after the interruption. Of the remaining 23 (12.5%) interrupted activities, nine were prematurely terminated before attending to another task, one was handed over to a colleague, and the final handling of the 13 interrupted activities was not observed during the remaining observation session. The locations at the ED where most of the interruptions occurred were at the physicians (19 %) and RNs (49 %) stations.

The clinicians' perceptions of interruptions – interview data

The interview data supported the observation data regarding in which locations of the ED clinicians were exposed to interruptions. The clinicians in most cases felt interrupted in the nurses' and physicians' stations and also in stations with a high workload and in the triage area. The question concerning whether the clinicians had to interrupt someone else to be able to perform their tasks showed that there was uncertainty among the clinicians if they had interrupted someone else. The uncertainty was related to that the clinicians did not remember or reflect upon if they interrupted someone else, as it was perceived as a commonplace event.

Some clinicians used the terms interruption and disturbance as representations of the same concept; others, however, distinguished between the two as separate concepts. Further, regardless of the terms used (interrupted or disturbed), data from the interviews showed that the concept of interruption was not always limited to a negative feeling, i.e. some interruptions were perceived as expected and necessary in order to pursue the work process. Figure 4 illustrates, whether an interruption was perceived as something negative or not was related to whether the interruption disturbed the work process.

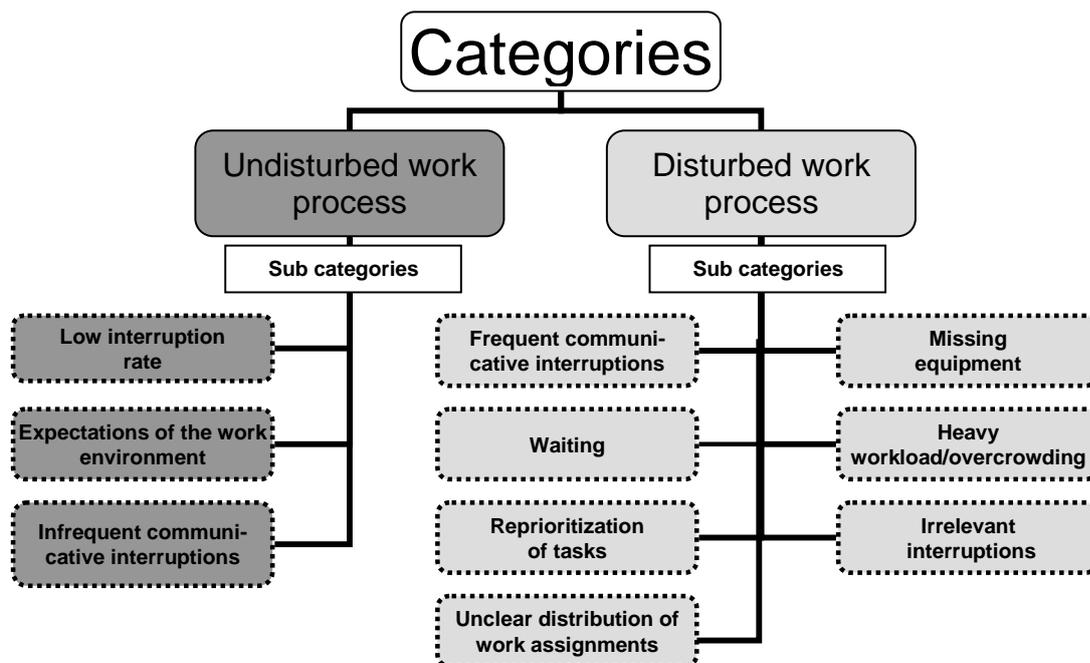


Figure 4. A schematic sketch of the categories and subcategories identified in the study.

The clinicians' perceptions of interruptions were categorised as either an undisturbed work process or a disturbed work process. The most common reasons for clinicians not to perceive an interruption as something negative (undisturbed work process) were related to their own expectations of the work environment or whether the interruption rate was perceived as low. The clinicians' perceptions in the sub-category expectations of the work environment often consisted of thoughts about being interrupted as a natural part of their professional role. An example was: *"That's the job at the ED; it is always decisions and you are always interrupted; it comes something between"* (10: senior physician). This perception was most often expressed by the physicians. Another perceptions in the sub-category expectations of the work environment was that interruptions were commonplace events. An example was: *"It's so commonplace; this is happening every day, so I don't think of it as an interruption"* (2: senior LPN). If the interruption occurred with low frequency (low interruption rate), it was not considered as something negative for the on-going work.

The primary reason for perceiving an interruption as something negative (disturbed work process) was clinicians' exposure to frequent communicative interruptions, mostly by colleagues, pagers, or phones. Examples given were: *"There are other days when there are significantly more calls on the pager than today and then it (disturbance) gets obvious. There are usually many more paging's than there were today"* (1: senior physician). Another reasons for perceiving an interruption as something negative was if the interruption was perceived as irrelevant, *"When you get disturbed by, what I think is an irrelevant interruption, it is often from wards. Paging of a non-urgent character that can wait"* (7: junior physician). Further, having to wait for someone else to get on with the tasks at hand, *"I get disturbed by having to wait for the person who will help me make a decision. Yes, one gets disturbed by waiting"* (16: junior physician). Furthermore, missing equipment was

another reason for being negatively influenced by the interruption, *“It was poorly refilled in the boxes that I brought in when we would insert the catheter, so then I had to go out and get more equipment, this is disturbing because you have to interrupt what you were doing in there”* (14: junior LPN).

4.4 PHYSICIANS’ AND NURSES’ (RN) PERCEPTIONS OF PATIENT SAFETY RISKS (IV)

The result reflects a complex professional practice in everyday work. The findings regarding physicians and RNs’ perceptions of patient safety risks are presented in four categories: high workload, lack of control, communication failures and organisational failures (table 10). The 10 subcategories represent factors that were perceived by clinicians as patient safety risks in the ED. Some general reflections about patient safety risks were expressed by the physicians, namely that things could go wrong and that they had to live with it or that it was expected of the work environment.

Table 10. Factors perceived as patient safety risks by physicians and RNs in the ED.

Theme	Categories	Subcategories
Complex professional practice	High workload	High patient load
		Critically ill patients
	Lack of control	Interruption
		Inexperience
	Communication failures	Information gap
		Lack of information
	Organisational failures	Unclear ED structure
		Lack of inpatient beds
		Lack of resources
		Electronic health record (EHR) flaws

Overall, most respondents included high workload as a perceived patient safety risk. Patient safety risks related to high workload were seen as causing too long a waiting time until assessment. Another perceived risk was not detecting deteriorating patient conditions. Further, perceived risks for the patients were mixing up patients. High workload was thought to cause time constraints and thus pose a risk for medication error. One RN expressed this thought as: *“When you don’t have time to double-check and document the medication, it is not safe for the patient”* (4: RN). High workload was perceived to affect communication: *“When there is a lot to do, the communication is lacking, which happens quite often”* (RN: 1). Interruptions were expressed by both groups of clinicians as risk factors that affect work performance. The clinicians stated that interruptions may lead to forgetting things, as exemplified in the following quote: *“If one has too much in the head and gets interrupted, then one forgets”* (2: physician).

Interruptions make it difficult to concentrate and jeopardise patient safety. Interruptions were also experienced as increasing the risk for communication failures and medication errors, as exemplified by the following quotes: *“We don’t allow each other to complete reports about patients without interrupting, even though it may not be important, which means that important information may be missed, which happens daily”* (8: RN). *“One can mix the drug incorrectly, but the risk is low because one checks several times”* (17: RN).

The analysis of managing patient safety risks resulted in five categories that reflected strategies to prevent errors. Strategies for managing patient safety risks were to check and double check, do one thing at a time, rely on and help each other, take command and control, and to be thorough. The most common strategy to prevent errors was to check and double-check. This practice was thought to prevent medication errors when a healthcare worker was being interrupted, as expressed: *“The risk of mixing up the drugs is small, because you double-check”* (17: RN).

Some RNs used a strategy of taking command and control. The RNs expressed responsibility for managing patient safety risks, as conveyed by a RN in a situation with less experienced colleagues: *“Had to go in and simply take over, even though it was not my patient, but I felt that my colleague could not handle it anymore”*(16: RN). Another RN said *“You have to take a lot of responsibility and question when the physician is not sure”* (19: RN). Experience may be an advantage in preventing medication errors, as expressed by a RN: *“From experience, I know that it’s not an appropriate prescription”* (4: RN). When discussions about who will care for the patients were ongoing, a RN stated: *“I steer and interfere [to], hasten up the decision’* (11: RN).

5 DISCUSSION

This chapter discusses the main findings and methodological considerations from the four studies contained in this thesis, followed by conclusions and suggestions for future research in this area.

General discussion of main findings

This is the first national overview of reported errors and complaints pertaining to ED care in Sweden. The main findings were that errors reported from care providers and patients to the National Board of Health and Welfare and the Medical Responsibility Board were mainly related to diagnostic procedures in which the human error was largely involved. In addition, complaints from patients to the Patient Advisory Committees were principally related to care and treatment, of which a large part (65.8%) of the complaints was subcategorised as diagnosis/treatment. Emergency care was not represented as a specialty in the registries, despite the large number of visits to hospital-based EDs in Sweden, which increases yearly. The level of information and terms used in the data sources varied considerably, which emphasises the need for a national standard in terminology and categorisations of errors in national registries. Although they are national agencies, neither the National Board of Health

and Welfare nor the Medical Responsibility Board used standardised systems for classification or categorisation of error and complaints.

Contributing factors to errors were multifactorial, with the most common factor being human errors, but high workload were rarely identified as a contributing factor in cases from the National Board of Health and Welfare neither in the root cause analysis made by care providers. This finding is surprising and in contrast to ED clinicians who perceived high workload as the main concern for patient safety. The subcategory high workload was identified as a contributing factor in nine cases of which three were found as a complementary finding in the root cause analysis and two in the description of the case but not documented as a contributing factor in the agency's full text summary. There seems to be a degree of uncertainty in these cases as to whether high workload should be considered as a contributing factor to errors although a growing body of research indicates that overcrowding, which can be related to high workload, constitutes a risk for patient safety (95, 98, 99, 133). The reason might be that high workload could be perceived by care providers and healthcare managers as a normal state and expected in the ED, or perhaps that the individual approach still exists instead of the system approach to errors. If so, there is a risk that situations of risk for patient safety are not identified as errors that should have been reported.

High workload and interruptions were factors identified by ED clinicians as risks for patient safety. High workload were rarely identified and interruptions were ever identified in the registries used in this thesis. They are factors not always acknowledged or identified as contributing to errors in incident reporting systems and analysis of errors (3, 38) although they are reported in the literature as contributing factors to errors in the ED (113, 133). Based on these findings, one can discuss if high workload deserves more attention as a factor that contributes to errors in complex systems such as the ED. ED crowding has been discussed in the literature but solutions and interventions to maintain patient safety in the crowded ED are lacking (134, 135). This problem may be due to organisational difficulties because that many solutions to ED crowding concerns also the hospital wards which often have a shortage of inpatient beds (4). In Sweden, the number of hospital-based EDs has decreased, whereas ED visits and patients' length of stay have increased (102). Thus, crowding still remains a patient safety risk.

ED clinicians from the two participating EDs in paper IV could identify situations at risk for patient safety with the most common strategy to prevent errors being to check and double-check. Some RNs reported to taking command and control when patient safety was jeopardised which indicates that RNs may play an important role for patient safety, which supports findings from previous international studies (86, 136, 137).

Reported errors and complaints and contributing factors to errors

The finding that the most commonly reported errors and complaints were related to diagnostic procedures is consistent with previous reports (55, 56, 67). Errors in the diagnostic process can result in delayed or missed diagnoses and are more likely to occur in the ED, resulting in more severe harm to patients than other errors (64, 66, 67).

Based on the four data sources used in this study, 9304 errors and complaints were reported from ED care in 2009, of which 7434 were directed to local incident reporting systems. According to the calculations reported by the National Board of Health and Welfare in 2004, approximately 1 000 000 errors annually are reported to local incident reporting systems representing all Swedish healthcare areas. Thus, less than 1% of all reported errors to local incident reporting systems in the study took place at the ED. This finding, however, is not reliable because of the assumed underreporting. Eight local incident reporting systems in use were reported and the categorisations were similar but a substantial proportion of errors could not be specified. Too many complex and different reporting systems in use complicate making comparisons and probably contribute to underreporting (45).

The contributing factors to errors in EDs were multifactorial in nature and consisted of factors that included both organisational factors in the local environment, as well as teamwork failure. The most common factor was the human error in 44 of 64 (69 %) cases, a result consistent with other findings (59, 64, 67, 138). In this study human errors were mainly related to diagnostic procedures where the most common were errors in planning. This finding agrees with other findings (64, 67). Human errors were represented in 23 (36 %) cases together with factors in the local environment. These human errors were most often related to flaws in routines and in four cases to high workload. Applying the system approach to these errors, it can be assumed that the human errors in this study were affected by organisational factors such as high workload, that are known to affect humans negatively in complex sociotechnical systems (26, 29, 35). Interruptions in the care process and crowding in the ED are considered risk factors for patient safety in some studies (64, 123) but not in others (58, 59). This contradiction may be the result of using different models to identify and categorise contributing factors that may not be adapted to disclose latent system problems that affect human behaviour. Alternatively, perhaps common working conditions in the ED, such as frequent interruptions, overcrowding and multitasking that are assumed to have a negative impact on patient safety are perceived as normal and expected in the ED by staff, care providers and healthcare managers (139).

Failures in communication and teamwork are the leading contributors to serious errors according to the Joint Commission on accreditation of Healthcare Organization in the USA (83). However, communication failures were not the leading contributor to errors in this study, perhaps because communication failures are not always easy to identify when communication load is high and one of the most common activities (71, 77, 81, 82). The finding that internal investigations and root cause analysis are not always carried out and that mandatory information is missing is consistent with a previous review of Lex Maria cases from all health care areas in 2012 (44). Further, of 175 Lex Maria cases reported during two years in a Swedish county council, 118 (67%) had been analysed using root cause analysis and half of these cases were judged to be of low quality such as that information was missing about e.g. contributing factors to errors (140). The lack of internal investigations and that information is missing may create a risk of missing important patient safety risks and limits the development of solutions that can improve patient safety.

Interruptions in ED work

The mean interruption rate of 5.1 per hour for all the clinicians in this study was low compared with findings in other studies reporting twice as many interruptions for physicians and RNs in the ED (107, 111, 113, 121). One explanation might be that the workload at the EDs was relatively low during the data collection period. Several other factors also need to be considered, including countries, type of ED, the length of the observations and that different terms and definitions of interruption are used in the literature, all of which makes it difficult to compare studies (105, 107, 119). The findings that face-to-face interruptions were most common concurs with other studies (111, 116, 130). The highest number of interruptions occurred during information exchange, which also was the most common activity. This finding is consistent with other studies reporting that communication load is high in the ED (71, 77, 79). The most commonly interrupted activity in relative terms was preparation of medication (28.6%), a result similar to that of another study in which interruptions during medication-related activities accounted for 27.5% of all interruptions (116). This type of interruption is of particular concern because, medication errors are known to occur frequently in the ED and that interruptions during preparation of medication increase the risk for error (121, 141).

The main finding from the interviews was that clinicians did not always perceive interruptions as something negative. In this study, an interruption was perceived as negative when it was related to a disturbed work process, including high workload. Having to wait disturbs or delays clinicians' work processes, even though the interruption is not face-to-face and not obvious to the observer. This observation confirms previous findings that have presented waiting times using different terms (such as impediments/delays) that cause delays in the workflow (111, 142). The finding that clinicians perceived interruptions as commonplace events and did not remember if they had to interrupt someone else raises questions about how to manage and decrease unnecessary interruptions, if the clinicians are not always aware of when they occur.

Patient safety risks in the ED

The focus of this study was to identify factors that ED clinicians perceived as patient safety risks and how they managed these factors. The main finding was that factors perceived as risks were multifactorial and involved situations related to both organisational factors and interactions between staff members. The most common factor perceived as a risk for patient safety was high workload. Communication and interruptions were perceived to be negatively affected by high workload. High workload is a related phenomenon to overcrowding (94). The finding that high workload was perceived as one of the main patient safety risks is in accordance with international findings (91, 98, 133, 143). Patient safety has been identified to be compromised by overcrowding and has been associated with medication errors, patient mortality and poor care for patients with severe pain (91, 95, 97, 100).

In addition to high workload, communication failures and interruptions were perceived by ED staff as common risks for patient safety, which is consistent with other findings (123, 144). In this study, both high workload and interruptions were expressed by RNs as risks for medication errors.

5.1 METHODOLOGICAL CONSIDERATIONS

There are several limitations with the data used in paper I and II. The main limitation is the assumed underreporting that occurs in reporting systems (40, 45, 47). Paper I provides a presentation of only reported errors and complaints of perceived errors. Therefore, the results can only be used as an indication of the number of errors that actually occurred in ED care. However, the data provide knowledge about what types of errors that are reported. In a few cases the complaints from patients were related to waiting times, which did not necessarily result in an error. Patients are suggested to be reliable in reporting errors (52, 53) and waiting times can be seen as a risk factor for patients in a crowded ED. The level of detail of information and terms used varied within and between the different data sources. This variation is probably the result of lack of standardisation in terminology and categorisation of errors. The categorisation of errors reported to local incident reporting systems varied, although the categorisations were similar. The participating EDs reported eight local incident reporting systems in use and a substantial part of the errors was unspecified. However, this thesis provides the first overview and characterisation of reported errors and complaints in emergency care in Sweden.

Emergency Care is not categorised as a specialty of its own in the registries of the National Board of Health and Welfare. Therefore, cases in the first screening stage might have been missed although the inclusion criteria were deliberately broad and the screening process was reviewed and discussed within the research team. Another limitation is that some information may have been omitted because the cases in full texts were summaries made by the agency and interviews with staff. Further, inspections made by the agency were not reproduced in their entirety. The cases also varied in level of detail and categorisation of errors were lacking. Another limitation is that, despite mandatory regulations that internal investigations have to be conducted by health care providers, 19 cases were found to be missing. Further, reported injury claims to the Patient Insurance were not included in the study. The categorisations of errors and complaints were influenced by categoriations used in the other registries and from the literature. To strengthen credibility, an independent analysis on a sample of cases from the National Board of Health and Welfare and the Medical Responsibility Board was made by four of the researches in the researchgroup.

In paper II, an already existing framework by Cosby was used to categorise contributing factors to errors in the 64 cases reported to the National Board of Health and Welfare. To our knowledge no other framework to categorise ED errors exists. A limitation was that the framework was not yet validated and has been used previously only in one setting. A strength was that the model was developed based on hundreds of cases from a similar setting, an urban public teaching hospital-based ED. Another limitation, previously mentioned, is that

some information in the 64 cases may have been missing. Because the cases in full texts were summaries made by the agency and because interviews with staff and inspections made by the agency were not reproduced in their entirety, contributing factors might have been missed. The framework is probably best suited to be used in a root cause analysis and not retrospectively in a summary of a case. The framework used the category “human error” as a contributing factor to errors. Such an approach may be questioned in the sense that it indicates an individual approach instead of system approach. Hence, it might lead to the possibility that healthcare staff perceive that the individual blame still has preference, a belief that may negatively affect incident reporting (145). According to the system approach to patient safety, even if the primary cause of an error is systems failures, active errors pass through the hands of a human. Most of these active errors seem to be reported. Further, the categories in the framework are broad. Both cases of errors and root cause analysis vary in level of detail and seem to fail to some extent capturing the latent errors. Although the size of the sample was small and the categories of errors can be judged as general, the study does provide a national overview of contributing factors to errors based on reported cases from Swedish EDs. Such an overview, has not previously been presented.

In paper III, both observations and interviews were conducted. The authors’ and the pre-understanding might have influenced the observations as well as the interpretation of the interviews. On the other hand, pre-understanding of the study context as well as using two observers facilitated the capturing of details of activities and interruptions. Credibility in the data collection was ensured by concurrent data collection by two researchers. Using observations and interviews in the data collection also strengthened the credibility and dependability. The interviews were made immediately after the observation period. Because the clinicians were still on duty, they might have felt time pressure, pressure that could have had a negative effect on the richness of data from the interviews. However, our intention was to minimise the time between the observations and the interviews so that the clinicians could reflect upon their perceptions of interruptions that had occurred during their two hours of observation. The observations were not made in all week days and during some of the observations the workload was considered low by the observers. The use of a structured protocol at two EDs and ensuring a variation of the clinicians’ age, gender, profession and experience strengthen the credibility and transferability of the findings. Further, independent analysis of interviews were made by four of the researchers in the research group, as well as repeated discussions about categories to reach consensus.

However, a limitation was that the perceptions of interruptions expressed by the clinicians were referring both to the observation periods and to their work experience in general. Both expressions were included in the analysis to get broader perspective on the phenomenon in question. The concepts interruption and disturbance were used synonymously by the clinicians, which complicated the analysis. In the analysis efforts were made to assure that the inherent meaning of the answers was categorised correctly rather than focusing on the concept used by the clinicians.

In paper IV, the interviews about the participants' perceptions of patient safety risks were conducted by telephone by two professional interviewers with no experience or familiarity with the ED context, which might have limited the richness of the interviews. My pre-understanding of the ED work environment might have influenced the analysis of the interview data. However, a combination of experience from everyday work in practice and research gives a perspective from two directions that can be an advantage. The analysis was also made together with researchers not familiar with the ED context, in an effort to broaden the perspective. To strengthen credibility, an independent analysis on a sample of cases was made by four of the researchers in the research group and the categorisations were discussed until consensus was achieved. To further strengthen credibility and transferability the interviews were conducted with participants from two EDs, with participants from different professions and of various ages, both genders and a varied level of experience. Because the findings are consistent with those in similar settings (90) and because the interviews were conducted with varying professions and both genders at two Swedish EDs, transferability to other Swedish EDs is likely possible.

5.2 CONCLUSION

- Errors and complaints reported by care providers and patients in Swedish emergency departments were mainly related to diagnostic procedures, treatment and organisational matters. The level of information detail varied and was sometimes missing in the different national and local registries. Internal investigations and root cause analysis were sometimes missing entirely. These shortcomings constitute a risk of missing important patient safety risks, a fact that limits the development of solutions that can improve patient safety.
- The most common contributing factors to errors in cases reported to the National Board of Health and Welfare were human errors that occurred most often during diagnostic procedures, followed by factors in the local environment and teamwork failure. High workload was rarely identified and interruptions were never identified as a contributing factor.
- Most interruptions occurred during information exchange and preparation of medication was the activity most interrupted in relative terms.
- Interruptions were not always seen as negative by emergency care clinicians, but only when the interruptions resulted in a disturbed work process.
- Clinicians perceived high workload as the main patient safety concern in the ED. Interruptions during high workload were viewed as increasing the risk for communication and medication errors.
- The most common strategy emergency care clinicians used to prevent errors was to check and double check. Some RNs reported taking command and control when patient safety was jeopardised.

5.3 CLINICAL IMPLICATIONS AND FUTURE RESEARCH

The main contribution of this thesis is advancing our knowledge about errors, interruptions and patient safety risks in the ED.

Clinical implications

The results underscore the need for a standardisation of terms and categorisations of reported errors and complaints in national registries and in local incident reporting systems for the purpose of facilitating the compilation of error types.

National registries for errors and complaints should be organised so that cases from emergency care can be identified and easily compiled to enhance quality improvement in ED care.

Information and education as well as user friendly incident reporting systems are needed to facilitate and increase reporting to minimise uncategorised errors and underreporting.

Internal investigations and root cause analysis of errors can be improved by emphasising the system approach to enable identification of latent errors.

Staff members at EDs should be involved in patient safety work so they can identify and increase knowledge about latent risk factors, as well as to help develop strategies that maintain patient safety.

Staff need to be attentive as to when negative effects of interruptions are to be expected, such as during high workload, and especially during medication management activities. Further actions may include the creation of interruption free zones or the use of signs by clinicians to alert others when interruptions should be avoided (e.g., during the preparation of medications).

Development of guidelines or routines in how to manage high workload that are in line with how strategies and plans exist to manage catastrophic events is needed to minimise the risk of errors. High workload in the ED should be acknowledged as a risk factor rather than as a normal state.

Future research

As previously noted, this thesis has contributed to our knowledge about patient safety in the ED in terms of errors, interruptions and patient safety risks. However, future research is needed to study errors and interruptions in the ED and how to design research studies in complex environments. Areas of special interest are the following:

- to study errors that are not reported by ED staff and to determine why they are not reported.
- to determine whether patients in Swedish EDs can contribute to identifying errors.
- to identify, analyse and compare processes in the ED in which errors do and do not occur.
- to study the relation between interruptions and errors.
- to define and distinguish a negative interruption from a neutral and positive interruption
- to study interventions to reduce negative interruptions.

6 SVENSK SAMMANFATTNING

Hälso- och sjukvård är i huvudsak till stor nytta för patienter men är också en verksamhet fylld med risker som kan leda till att patienter skadas. Dessa skador eller komplikationer kan resultera i dödsfall, invaliditet eller förlängda vårdtider. Studier från andra länder har rapporterat att skador och komplikationer drabbar ungefär var tionde patient och att upp till 50 % av dessa var orsakade av hälso- och sjukvården och kunde därför ha undvikits. I Sverige publicerades 2009 en studie genomförd av Socialstyrelsen där en granskning av vårdtillfällen under ett år fann att skador inträffat vid ungefär 12 % av vårdtillfällena, av vilka 70 % bedömdes kunde ha undvikits.

I rapporten *To err is human* som publicerades 1999 av the Institute of Medicine i USA angavs att upp till 98 000 amerikanska patienter dog årligen till följd av skador som orsakats av hälso- och sjukvården. Den här rapporten anses vara startskottet för ett ökat intresse och forskning gällande patientsäkerhet. I rapporten föreslogs åtgärder för att förbättra patientsäkerheten och man betonade ett systemperspektiv, d.v.s. att orsaken till att skador inträffar ligger på organisatorisk nivå och inte på en enskild individ. System perspektivet har också implementerats i den svensk hälso- och sjukvården genom den nya Patientsäkerhetslagen och bildandet av Inspektionen för Vård och Omsorg (IVO).

Akutmottagningar har en central roll i hälso- och sjukvården eftersom en stor del av patienterna har sin första kontakt med sjukhusvård på en akutmottagning. Akutmottagningar har beskrivits som komplexa och dynamiska system där avvikelser ofta inträffar. Forskning om patientsäkerhet på akutmottagningar har växt internationellt de senaste åren, där resultat indikerar att överbelastning, frekventa avbrott och multitasking (att hantera flera arbetsuppgifter samtidigt) alla är bidragande faktorer till avvikelser. Sådan forskning saknas dock i stor utsträckning vad gäller den svenska akutmottagningsjukvården.

Det övergripande syftet för avhandlingen, som består av fyra delarbeten, var därför att öka kunskapen om avvikelser, avbrott och personalens uppfattningar om patientsäkerhetsrisker på akutmottagningen. De specifika syftena i delarbete I och II var att beskriva förekomst och typ av rapporterade avvikelser och klagomål gällande akutmottagningsvård samt deras bidragande faktorer. Syftet i delarbete III var att undersöka förekomsten av avbrott som personal på akutmottagningen blir utsatt för och deras uppfattning om avbrott. Slutligen, i delarbete IV, var syftet att beskriva personalens uppfattning om och hanterande av patientsäkerhetsrisker. Från nationella register och genom observationer och intervjuer med akutmottagningspersonal inhämtades kvalitativa och kvantitativa data. Registerdata, observationer och intervjuer sammanställdes och kategoriserades med icke parametrisk statistik och innehållsanalys.

I delarbete I inhämtades uppgifter om avvikelser och klagomål rapporterade under 2009 från Socialstyrelsen (Lex Maria), Hälso-och sjukvårdens ansvarsnämnd (HSAN) och Patientnämnderna i alla landsting. Enkät med frågor om rapporterade avvikelser i lokala incidentrapporteringsystem skickades till 72 sjukhusbundna akutmottagningar för vuxna.

Resultatet visade att rapporterade avvikelser till Socialstyrelsen och HSAN oftast var relaterade till diagnostik. Rapporterade avvikelser till Patientnämnderna och de lokala incidentrapporteringssystemen på akutmottagningarna var oftast relaterade till vård och behandling. I alla register sammantaget så var den vanligaste kategorin av avvikelser och klagomål relaterat till vård och behandling (24.3 %) följt av organisatoriska avvikelser (19.0 %) och en stor andel avvikelser var inte specificerade (14.5 %).

I delarbete II granskades 64 Lex Maria fall som involverade akutmottagningsvård och rapporterats till Socialstyrelsen under 2009. Totalt identifierades 157 bidragande faktorer och mer än en bidragande faktor ($m=2.5$, $SD=1.0$) till avvikelserna identifierades i 50 (78 %) av fallen. Den mest förekommande bidragande faktorn var den mänskliga faktorn i 44 fall, följt av organisatoriska faktorer på akutmottagningen i 38 fall och faktorer relaterade till kommunikation i 27 fall. Dessa tre faktorer utgjorde totalt 69 % av de bidragande faktorerna.

I det tredje delarbetet observerades sammanlagt 18 läkare, sjuksköterskor och undersköterskor från två olika akutmottagningar under två timmars tjänstgöring på akutmottagningen. Av sammanlagt 1882 observerade aktiviteter avbröts 184 (10 %), vilket är cirka 5 avbrott i timmen. Kommunikation var den aktivitet där flest (20 %) avbrott observerades. Iordningställande av läkemedel var den aktivitet som oftast blev avbruten i relativa tal (29 %) följt av dokumentation (27 %). Avbrott upplevdes inte alltid som negativa. Informanterna upplevde avbrott som störande då avbrotten skedde frekvent eller inträffade under hög arbetsbelastning.

I det sista delarbetet intervjuades 10 läkare och 10 sjuksköterskor från två akutmottagningar angående deras uppfattning om patientsäkerhetsrisker och hur de hanterar dessa. Resultatet visade att hög arbetsbelastning, brister i kommunikation och avbrott upplevdes som de huvudsakliga riskerna för patientsäkerheten. En vanlig strategi för att förhindra att något ska gå fel, till exempel att förväxla läkemedel var att dubbelkontrollera sig själv. Vissa sjuksköterskor uttryckte att de känner ansvar för patientsäkerheten och att de kan ta kontroll över situationer där de upplever att patientsäkerheten är hotad.

Sammanfattningsvis så visar resultatet att rapporterade avvikelser och klagomål från vårdgivare, sjukvårdspersonal och patienter till störst del är relaterat till diagnostik, vård och behandling samt organisatoriska faktorer. Flera bidragande faktorer till en avvikelse kunde identifieras i de fall som rapporterats till Socialstyrelsen (Lex Maria). Den mest förekommande bidragande orsaken var den mänskliga faktorn. Läkare och sjuksköterskor upplevde hög arbetsbelastning, brister i kommunikation och avbrott som de största patientsäkerhetsriskerna. De flesta avbrotten som personalen utsattes för var av varandra och oftast avbröts kommunikation. Avbrott upplevdes dock inte alltid negativt, de upplevdes negativt om det skedde ofta och under hög arbetsbelastning.

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