



SCHOOL OF BUSINESS AND SOCIAL SCIENCES  
AARHUS UNIVERSITY

# Exploring and explaining the weekend effect in a Danish emergency department

PhD dissertation

Iben Duvald Pedersen

Aarhus BSS  
Aarhus University  
Department of Business Development and Technology  
2018

**PhD student:**

Iben Duvald Pedersen, cand.scient.anth.

Interdisciplinary Centre for Organizational Architecture, Department of Management, School of Business and Social Sciences, Aarhus University

DESIGN-EM – Research Network for Organization Design and Emergency Medicine, Denmark

Department of Business Development and Technology, School of Business and Social Sciences, Aarhus University

**Supervisors:**

Professor Børge Obel (main supervisor)

Interdisciplinary Centre for Organizational Architecture, Department of Management, School of Business and Social Sciences, Aarhus University

Associate Professor Rikke Sand Andersen

Research Unit for General Practice, Institute of Public Health and Department of Anthropology, School of Culture and Society, Aarhus University

## Acknowledgements

---

Being a PhD student for the last three years has been an individual journey in many ways. However, many people have contributed to make the entire process a great experience.

Firstly, I would like to express my sincere gratitude to my supervisors Børge Obel and Rikke Sand Andersen for their continuous support of my PhD study. To my main supervisor, Børge, thank you for believing in me and opening the potential for a PhD study, introducing me to the field of organizational design with great enthusiasm, and inspiring and guiding me with your immense knowledge. To my co-supervisor Rikke, thanks for continuing to ask questions about my choices, providing detailed comments on my work, and reminding me of my anthropological point of view. My supervision has been characterized by enormous patience, encouragement, inspiration, and optimism throughout the whole project, and I am grateful for that. Thanks – I have learn a lot.

To all my lovely colleagues at ICOA, thanks for an inspiring, interdisciplinary, ambitious and informal work environment. Thank you to Marianne, Karin, and Inger for secretarial assistance and cozy small talk. Thanks to the senior professors for your advice and good discussions along the way. To Erik, thanks for making it more fun working in weekends. Thanks to the PhD students: Thomas, Ioana (Jo), Maja, Henrike, Line, and Marianne for talking about everything from how to do a PhD to methodological issues to kids. In particular, I am grateful to you, Anders, for introducing me to the field and for our close collaboration during the last years. We have had endless discussions about the organization of the emergency departments, while you were eating my candy.

As a part of the research network DESIGN-EM, I would also like to thank Professor Hans Kirkegaard from the Research Center of Emergency Medicine for your support and advice during these years.

Without data, this project could not have been. A big thank-you to everyone at the emergency department at Viborg Regional Hospital, Regional Hospital Central Jutland. To the former management of the department, Larry Kristiansen and Bente Dam, and the head nurses, Helle Kornbek and Mette Haahr, thanks for believing in me and my project, and for giving me the opportunity to do fantastic fieldwork. Thanks to all the employees for letting me participate in your working day and for patiently answering my more and less meaningful questions – you all contributed with your valuable perspectives and helped to make my fieldwork a great experience. Jette Bjærge, thanks for nice accommodation when staying in Viborg. Christian Skjærbæk, thanks for your support along the way. Thanks to the new management of the department, Jacob Stouby Mortensen and Trine Agerskov, for giving me the opportunity to continue with my research based on the organization of the emergency department and improvement of patient care.

Thanks to Betina Vest-Hansen for guiding me through my epidemiological study and our interesting talks about the weekend effect and possible explanations to why it exists. Thanks to Sarah Krøtel for helping me with my statistical analysis of the adverse events, and thanks to Nikolaj Raaber for inspiring talks, support and your company on the international emergency medicine conferences.

I would also like to thank the Department of Business Development and Technology (BTECH) at Aarhus University, which hosted my enrollment into the PhD program. I am grateful for the opportunity to teach in qualitative methods and the financial support for my participation in various PhD courses, national and international conferences, and my research stay in Great Britain.

Thanks to Professor Sue Ziebland and the Health Experiences Research Group, Oxford University, for hosting me during my research stay. Your qualitative research within the field of primary care is inspiring. I enjoyed both our formal meetings and informal lunches. My research stay was made

possible by financial support from several foundations: Torben & Alice Frimodts Foundation, Christian og Otilia Brorsons Travel Grant, Oticon Foundation, and Knud Højgaards Foundation.

My greatest gratitude goes to my friends, and particularly my family and my son Laurits, for reminding me about all the other important things in life. A huge thank-you to my parents, Jette and Keld; without your help and endless support, this journey would not have been possible.

Iben Duvald

Aarhus, Marts 2018

# Contents

---

<b>English summary</b>	<b>i</b>
<b>Dansk resume (Danish summary)</b>	<b>v</b>
<b>List of figures and tables</b>	<b>ix</b>
List of figures.....	ix
List of tables.....	ix
<b>Preface</b>	<b>xi</b>
Overview of the dissertation.....	xiii
<b>Chapter 1: Introduction</b>	<b>1</b>
1.1 The weekend effect.....	1
1.2 Looking at the system: different possible explanations of the weekend effect.....	3
1.3 Zooming in on the empirical field: the Danish emergency departments.....	11
1.4 Summary and concluding comments.....	13
<b>Chapter 2: Methodology</b>	<b>15</b>
2.1 Studying a case.....	15
2.2 The setting.....	16
2.3 Definition on weekday and weekend.....	18
2.4 Research methods .....	20

2.4.1 Mixed methods research design.....	20
2.4.2 Quantitative methods (papers I + II).....	23
2.4.3 Qualitative methods (papers II + III).....	26
2.4.4 Theoretical framework used in the analysis (paper III).....	39

**Chapter 3: Paper I** **45**

*Day of the week of admission, patient characteristics and patient outcomes: a study of the weekend effect in an emergency department*

3.1 Abstract.....	46
3.2 Background.....	47
3.3 Methods.....	49
3.4 Results.....	56
3.5 Discussion.....	63
3.6 Conclusion.....	67

**Chapter 4: Paper II** **69**

*Adverse events in an emergency department weekdays and weekends – a critical study of registration practices*

4.1 Abstract.....	70
4.2 Introduction.....	71
4.3 Methods.....	74

4.4 Results.....	81
4.5 Discussion and conclusion.....	90

**Chapter 5: Paper III** **97**

*Fits and misfits between the information processing requirements and capacities: the weekend effect in a hospital emergency department*

5.1 Abstract.....	98
5.2 Introduction.....	99
5.3 An information processing perspective.....	102
5.4 Research setting and methods.....	105
5.5 Fit and misfit analysis of the emergency department, weekdays and weekends.....	111
5.6 Strategies used to deal with the misfits.....	148
5.7 Discussion and conclusion.....	157

**Chapter 6: Concluding discussion** **163**

6.1 Answering the research questions.....	163
6.2 Connecting results from the three individual papers.....	166
6.3 Limitations and contributions.....	170
6.4 Future research.....	172
6.5 Concluding remarks.....	175



**References** **176**

**Appendix** **193**

Appendix I: Questionnaire..... 194

Appendix II: Flowchart for all patient-visits to the emergency department in 2014-2015..200

Appendix III: ICD-10 codes of each primary diagnostic group.....201

**Declaration of co-authors** **202**

## English summary

---

Patients should be able to expect the same standard of emergency care whatever day of the week they are admitted. However, a large number of studies have demonstrated that patients admitted to hospitals on weekends experience worse outcomes (i.e., mortality rates, number of adverse events, and length of stay) than patients admitted during the week. Emergency patients seem to be most affected by this phenomenon, which is also called the weekend effect. Only a few studies have investigated the weekend effect in Denmark. One study shows that patients attending a Danish emergency department during weekends have a higher risk of dying within 30 days than patients attending during weekdays. The existing studies are based on epidemiological analysis of administrative data and focus on whether or not the weekend effect exists. Thus, they do not investigate explanations of this weekend effect. There are various suggestions in the existing studies as to why patient care differs weekdays and weekends: competences, number of employees, access to the service departments, and patients admitted to the hospitals on weekends being more critically ill than the patients admitted on weekdays. Several studies point to the need for research into the causes of the weekend effect.

In 2007, a major reorganization of the Danish health care sector began. The goals were to increase the quality of emergency care, to gather the competences, and to develop the capacity to manage an expected increase in the prevalence of patients with comorbidity. Due to this reorganization, the 21 newly established emergency departments have become the cornerstone of the national health care system, since most acute patients are evaluated there. Within the emergency departments, triage procedures and initial treatment are used in order to determine whether patients can be treated within the emergency department or have to be transferred to another hospital department. The guidelines from the Danish National Board of Health about how to organize the emergency departments were

limited and not very specific. As a result, the Danish emergency departments differ in organizational design. Further, many emergency departments' organizational designs change during the day and during the week. Little is known about how these changes in the design affect the quality of care and services provided by the emergency department.

This dissertation consists of three papers investigating different aspects of the weekend effect. The dissertation tries to build a wider and more complete picture of the weekend effect by investigating the existence of the weekend effect within a Danish emergency department and to explore different possible explanations for this weekend effect. In order to investigate this, different methods are used, and the analyses include different levels: patient, employee, and organizational. The research is based on data obtained in the emergency department at Viborg Regional Hospital, Regional Hospital Central Jutland.

The first paper examines the existence of the weekend effect within the emergency department. Patient characteristics for patients admitted to the emergency department on weekdays and on weekends are also investigated in order to consider whether changes in patient characteristics can be a possible explanation of the weekend effect. Thus, the search for explanations is on a patient level. The results of the cohort study show that patients with a high disease severity (triage yellow, orange, or red) who attend the emergency department during weekends have a higher risk of dying within 30 days than patients attending during the weekdays. More patients admitted on weekends (regardless of time of the day) also had a stay longer than 24 hours within the emergency department. Furthermore, more patients admitted on weekends are triaged red or orange, and more patients were transferred to the ICU on weekends. Patients arriving at the emergency department on weekends seem to be more critically ill than patients arriving on weekdays. Disease severity may be one of the explanations of the weekend effect.

In the second paper, the number and type of adverse events happening within the emergency department on weekdays and weekends are investigated together with the registration practices. Both qualitative and quantitative methods are used. The results show that most adverse events happen on weekdays rather than weekends. However, the greatest time of risk for having an adverse event was from Saturday night to Sunday morning. Different types of adverse events happened on weekdays and weekends, but the adverse events happening on weekends were not worse than those adverse events than occurred on weekdays. The results also show that the employees found it important to report the adverse events. However, because of barriers on both an organizational and a practice level, most of the adverse events were not reported. Implications of using data on adverse events from the national reporting system for research are discussed alongside to the findings about registration practices.

In the last paper, an information processing model is used to explore how the emergency department is organized in daytime on weekdays and on weekends. Furthermore, different strategies used by the employees to cope with the differences within the organization on weekdays and weekends are identified. The focus of analysis is changing from the organization to the strategies of the employees. The research is based on a longitudinal ethnographic fieldwork within the emergency department. The results show that the emergency department's needs for processing information is high on both weekdays and weekends, but the department's capacity to process the information changes from high on weekdays to low on weekends. This mismatch between demand and capacity on weekends means that patients who attend to the emergency department during weekends do not necessary receive the same quality of care as the patients attending the department during weekdays. Furthermore, the employees developed different strategies in order to cope with or compensate for the mismatch between the information processing requirements and capacities on weekends. They prioritize between the patients: for example, which patients have to be seen by an emergency physician, and in

some cases which patients need to be seen by a senior physician. The paper shows that the differences within the organization of the emergency department on weekdays and on weekends, as well as the derived strategies of the employees, may explain why the quality of patient care varies during the week. The combination of ethnographic fieldwork and organizational theory makes it possible to explore the organization of the emergency department, the place where acute patients are treated. Thus, the paper contributes a new perspective on possible explanations of the weekend effect.

## Dansk resume (Danish summary)

---

Alle skal have et sikkert og trygt møde med sundhedsvæsenet. Men en lang række studier har vist, at patientresultater som dødelighed, utilsigtede hændelser og indlæggelsestid varierer over ugens løb. Weekendeffekten, som dette fænomen kaldes, menes især at påvirke akutte patienter. Kun få studier har belyst weekendeffekten i Danmark. Et af disse studier har taget udgangspunkt i en akutafdeling og vist, at patienter indlagt i weekenden har, sammenlignet med patienter indlagt på hverdage, en højere risiko for at dø inden for 30 dage. Fælles for de eksisterende studier er, at de bygger på statistisk analyse af administrative data, og forholder sig mest til hvorvidt der er/ikke er en weekend effekt, og ikke, hvorfor der er en weekendeffekt. Der er flere bud på årsagsforklaringer; kompetenceniveau, antal ansatte, adgang til serviceafdelinger og at patienterne, der indlægges i weekenden, er mere syge end de patienter, der indlægges på hverdage. Flere studier påpeger behovet for forskning i årsagerne til, at behandlingen i weekenden adskiller sig fra den, patienterne får i hverdagen.

I 2007 påbegyndtes en reorganisering af det danske sundhedsvæsen, hvis mål var at højne kvaliteten af den akutte behandling, samle kompetencerne samt skabe mulighed for at behandle et forventet stigende antal komplekse patienter. Reorganiseringen har betydet, at de 21 nyetablerede akutafdelinger er blevet grundstenen i det danske sundhedsvæsen, idet det er her de fleste akutte patienter modtages. I akutafdelingerne triageres og undersøges patienterne indledningsvist for at finde ud af, hvilke patienter, der kan færdigbehandles i akutafdelingen og hvilke patienter, der skal overflyttes til andre afdelinger. De nationale retningslinjer for, hvordan akutafdelingerne skulle organiseres har været få og ikke særlig specifikke. Det har betydet, at de danske akutafdelinger varierer i organisationsdesign, og at mange akutafdelingers organisering ændres i løbet af dagen og ugen. Hvad disse ændringer i akutafdelingernes organisering betyder for patientkvaliteten og den behandling som akutafdelingerne tilbyder patienterne er endnu ukendt.

Denne afhandling består af tre artikler, som alle, med udgangspunkt i en dansk akutafdeling, undersøger aspekter af weekendeffekten. Afhandlingen søger overordnet at give et mere nuanceret og komplet billede af weekendeffekten ved at undersøge, hvorvidt der er en weekend effekt i en dansk akutafdeling samt forskellige mulige årsagsforklaringer. For at kunne undersøge dette har forskellige metodiske værktøjer været anvendt, og analysen har foregået på forskellige niveauer. Undersøgelsen har taget udgangspunkt i Akutafdelingen beliggende på Hospitalsenhed Midt.

Den første artikel undersøger, hvorvidt der er en weekendeffekt i akutafdelingen, samt hvorvidt patienterne, der bliver behandlet i akutafdelingen på hverdage og i weekenden, har forskellige karakteristika, og om dette kan være en årsag til eksistensen af weekendeffekten. Analyseenheden er den enkelte patient behandlet i akutafdelingen. Resultaterne af kohortestudiet viser, at kritisk syge patienter, der er triageret gul, orange eller rød har en højere risiko for at dø inden for 30 dage efter indlæggelse, hvis de indlægges i weekenden sammenlignet med patienter, der indlægges på hverdage. Sammenlignes patienter, der indlægges på hverdage og i weekenden, er der også flere patienter indlagt i weekenden, som har et ophold i akutafdelingen, der er længere end 24 timer. Det gælder både for patienter indlagt i dagtid, om aftenen og om natten. Resultaterne viser ligeledes, at der er flere af de patienter, der indlægges i weekenden, som triageres orange eller rød, og som overflyttes til intensiv afdeling. Patienterne, som indlægges i weekenden, er således mere kritisk syge sammenlignet med de patienter, der behandles i hverdagen. Dette kan være en af årsagerne til at dødeligheden er højere og indlæggelsestiden er længere for patienter, som indlægges i weekenden.

I den anden artikel undersøges antallet og typen af de utilsigtede hændelser, der sker i akutafdelingen på hverdage og i weekenden, samt registreringspraksis. I artiklen anvendes kvantitative og kvalitative metoder. Resultaterne viser, at de fleste utilsigtede hændelser sker i hverdagen, men at det tidspunkt, hvor risikoen er højest for at komme ud for en utilsigtet hændelse i akutafdelingen er natten til søndag.

Forskellige typer af utilsigtede hændelser sker på hverdage og i weekenden, men de utilsigtede hændelser der sker i weekenden er ikke mere alvorlige end dem, der sker i hverdagen. Resultaterne viser også, at medarbejderne finder det vigtigt at registrere utilsigtede hændelser, men at størstedelen af de utilsigtede hændelser ikke bliver registeret. Dette skyldes årsager på både et individuelt og organisatorisk niveau. Implikationer ved at anvende data fra den nationale database i forskningsstudier omhandlende utilsigtede hændelser diskuteres i forhold til resultaterne fundet omkring registreringspraksis.

I den sidste artikel bruges en informationsbehandlingsmodel til at undersøge, hvordan akutafdelingen er organiseret i dagstid på henholdsvis hverdage og i weekenden. Ligeledes identificeres forskellige strategier anvendt af medarbejderne til at håndtere forskellene i organiseringen, hverdag og weekend. Analyseenheden skifter fra at være akutafdelingen til at være den enkelte medarbejder. Undersøgelsen bygger på et længerevarende etnografisk feltarbejde i akutafdelingen. Resultaterne viser, at akutafdelingens behov for at behandle informationer er stort hverdag og weekend, men mens informationsbehandlingskapaciteten er høj i hverdagen, er den lav i weekenden. Dette misforhold mellem behov og kapacitet i weekenden betyder at patienter, der indlægges i weekenden, ikke nødvendigvis får den samme kvalitet i behandlingen, som patienter, der indlægges på hverdage. Endvidere viser resultaterne, at medarbejderne udvikler forskellige strategier i et forsøg på at håndtere eller kompensere for dette misforhold mellem informationsbehandlingsbehov og kapacitet i weekenden. De prioriterer mellem patienterne i forhold til hvilke patienter, der har behov for at blive set af en akutlæge, og nogle forsøger at styre de andre lægeressourcer derhen, hvor de mener behovet for en seniorlæge er størst. Artiklen viser, at forskelle i akutafdelingens organisering hverdag og weekend samt de afledte medarbejderstrategier, kan være en årsag til at kvaliteten i behandlingen af patienterne varierer over ugen. Kombinationen af etnografisk metode og organisationsteori gør det muligt at undersøge organiseringen af en akutafdeling, hvori behandlingen af akutte patienter finder



sted, og artiklen bidrager således med et nyt perspektiv på mulige årsager til eksistensen af weekendeffekten.

## List of figures and tables

---

### List of figures

Figure 2.1: Map of the five regions of Denmark.....	17
Figure 2.2: Map of hospital areas in CDR.....	17
Figure 2.3: Mixed methods research design used in this thesis.....	23
Figure 2.4: The Information Processing Model.....	41
Figure 5.1: The Information Processing Model.....	104
Figure 5.2: The sequential work processes within the emergency department.....	117
Figure 5.3: Relationship between information processing requirements and capacities within the emergency department, weekdays and weekends.....	147

### List of tables

Table 2.1: Overview of “go-alongs”.....	35
Table 2.2: Overview of interviews.....	37
Table 2.3: Overview of participants in the focus groups.....	38
Table 3.1: Demographic and clinical characteristics by time of admission.....	57
Table 3.2: Triage color of patients admitted to the emergency department by time of admission.....	58

Table 3.3: Number of patients transferred to other departments after initial treatment within the emergency department by time of admission.....	59
Table 3.4: Patients' length of stay within the emergency department and within the hospital including their stay within the emergency department by time of admission.....	60
Table 3.5: Crude and age- and sex standardized 30-day mortality rates for variation in discharge and for the six different triage colors among patients by time of admission.....	63
Table 4.1: The day and shift the 229 adverse events happened.....	81
Table 4.2: Numbers of adverse events per 1,000 patients, divided by shifts.....	82
Table 4.3: Number of adverse events per 1,000 employees, divided by shifts.....	82
Table 4.4: The adverse events' severity of impact on the patient.....	83
Table 4.5: Most common reported adverse events within each main category of events.....	84
Table 4.6: Barriers to reporting adverse events.....	87
Table 5.1: Overview of interviews.....	109
Table 5.2: The match of information processing and the differences on weekends.....	144
Table 6.1: Time of the day of the adverse events.....	167

## Preface

---

The aim of this dissertation is to explore and suggest explanations of a phenomenon that has been well known within the public health care system for several decades. The weekend effect has been explored in at least 100 studies, and these studies confirm that the weekend effect is a common finding at the hospital-wide level (Lilford & Chen 2015, Pauls et al. 2017).

Despite this large number of studies, the existence of the weekend effect is heavily discussed, both theoretically and in the public (e.g., Wise 2016). At the time I was planning my PhD project, another study about the existence of the weekend effect in Denmark was published (Madsen et al. 2014). The study found a doubling of in-hospital mortality for patients admitted outside normal working hours or on a weekend or holiday. The quality of this study and thereby the results of the study have since been discussed. However, the study started a public discussion. Several hospital managements said that there was not a weekend effect at their hospital (e.g., Hemmingsen 2014), but management of emergency departments confirmed big differences between the organization of the department on weekdays and weekends - differences, I had been studying as a research assistant. Together with a physician, I interviewed the hospital management, the management of the emergency department, and a physician, a nurse, and a secretary at each of the 21 acute hospitals in order to investigate similarities and differences within the organization of Danish emergency departments. The knowledge about these differences within the organization of the emergency departments and the knowledge from the many studies about the weekend effect were the beginning of my dissertation. I was curious to have a closer look at these differences in the organization of the emergency departments on weekdays and weekends, and I wondered if these differences could help explaining the differences in the patient care. In recent years, more studies have confirmed the existence of the

weekend effect within the Danish health care system (Vest-Hansen et al. 2015, Kristiansen et al. 2016, Biering et al. 2016).

To choose to study possible explanations of this much-discussed phenomenon was a bit daunting but also necessary. Few studies address causes of the weekend effect (Bray & Steventon 2016), maybe because it is challenging to explore a phenomenon that is highly debated but poorly understood. A complex phenomenon such as the weekend effect requires an interdisciplinary approach. Interdisciplinarity is not without challenges but thinking across boundaries makes it possible to address the phenomenon of the weekend effect from diverse disciplines. The study behind this dissertation therefore mixes different scientific fields (organizational theory, ethnography, health sciences) in order to not just explore the complexity of the weekend effect within a Danish emergency department, but also to come up with possible explanations for the weekend effect. The primary aim of this study was to provide organizational theory perspectives to why the quality of care differs within an emergency department on weekdays and weekends. However, in order to do that, I initially had to investigate and understand the nature of the actual weekend effect in the particular emergency department I chose as the setting for my fieldwork.

Moving from observing the weekend effect to doing something meaningful to mitigate it requires a good understanding of why it occurs. Therefore, I want this dissertation to express a call for researchers and society to acknowledge the differences within the health care system on weekdays and weekends and to expand our knowledge from focusing on whether the weekend effect exists or not, to searching for explanations that can highlight the reasons of these differences. So far, many potential contributing factors have received little attention.

## **Overview of the dissertation**

Chapter 1 introduces and positions the dissertation and its aims by presenting the literature on the weekend effect, identifying knowledge gaps, and motivating the research questions. This introductory chapter also includes a consideration of possible explanations of the weekend effect by looking at the patients' way through the health care system as well as the aims of the different papers in this thesis. Finally, the chapter briefly presents the empirical field of Danish emergency departments. In Chapter 2, I describe the methods of this project in terms of case selecting and the setting, research design, data collection, and analysis. Definitions of weekday and weekend are also provided. In Chapters 3 to 5, I present the three research papers that constitute the core of this dissertation. Finally, in Chapter 6, I summarize the findings by answering the research questions, draw the main conclusions together, and discuss limitations and contributions.

# Chapter 1: Introduction

---

This chapter provides an introduction and motivation for my dissertation on the weekend effect and possible explanations on this weekend effect within an emergency department. First, I introduce the existing studies of the weekend effect and my focus of investigation within this theme. Then I outline the patients' way through the health care system and different possible explanations of the weekend effect. Finally, I present the empirical field by introducing the Danish emergency departments.

## 1.1 The weekend effect

Since Bell and Redelmeier wrote their article "Mortality Among Patients admitted to Hospitals on Weekends Compared with Weekdays" (2001), more than 100 studies have shown that acute patients admitted to hospitals on a weekend experience worse outcomes than those admitted on a weekday, also known as the phenomenon called the weekend effect (Lilford & Chen 2015). In this dissertation, the weekend effect will be defined as differences in outcomes (i.e., mortality rates, length of stay, and number of adverse events) of treatments between patients admitted on weekdays and on weekends.

Previous studies of the weekend effect show that acute admission during the weekend has been associated with a 3-42 percent increase in in-hospitality mortality (Bell & Redelmeier 2001, Cram et al. 2004, Aylin et al. 2010, Sharp et al. 2013). Bell and Redelmeier (2001) examined the records of 3.8 million patients admitted over a 10-year period to emergency departments in Canada and found that 23 out of the 100 leading conditions had increased in-hospitality mortality when patients were admitted in weekends. More recently, Ruiz et al. (2015) found that the 30-day mortality was higher among patients admitted over the weekend in most of the 28 hospitals studied in England, Australia, the United States, and the Netherlands. In Denmark, a weekend effect exists too (Vest-Hansen et al.

2015, Kristiansen et al. 2016, Biering et al. 2016). In a smaller study (of 5,385 patients), Biering et al. (2016) found that there was a higher 30-day mortality for patients attending the emergency department during the evening shift than during the day shifts, and during weekends than during weekdays.

Most of the literature about the weekend effect uses in-hospital or 30-day mortality as patient outcome when comparing the quality of patient care offered on weekdays and weekends (Bell & Redelmeier 2001, Cram et al. 2004, Barba et al. 2006, Aylin et al. 2010, Sharp et al. 2013, Ruiz et al. 2015). The use of mortality as outcome when exploring the weekend effect has been discussed. Length of stay and adverse events are used as well (Barnett et al. 2002, Earnest et al. 2006, Buckley & Bulger 2012). However, studies using these outcomes are limited.

The evidence from the literature of the weekend effect is contradictory. Some studies have shown that a weekend effect does not exist, and some researchers have questioned its existence (McKee 2016). However, the majority of the published literature shows a weekend effect, and emergency patients seems to be most affected (Webb 2011, Wise 2016).

Despite the extensive literature demonstrating poor outcomes for acute admissions to hospital at the weekend and various suggestions as to factors associated with this weekend effect, there is a lack of literature with explanations of the weekend effect (Webb 2011, Bray & Steventon 2016). The existing studies suggest different possible explanations for the weekend effect. Motivated by Bell and Redelmeier (2001, 2004), one of the most commonly cited potential causes relates to staffing at the weekend, e.g., decreased levels of staffing or availability of experienced staff (Barnett et al. 2002, Cram et al. 2004, Barba et al. 2006, James et al. 2010). Other reasons mentioned are variations in case mix of patients presenting to hospitals at different time periods, and restricted availability of



tests and procedures (Barba et al. 2006, James et al. 2010, Mikulich et al. 2011, Goddard & Lees 2012, Walker et al. 2017). However, other organizational factors might be more important.

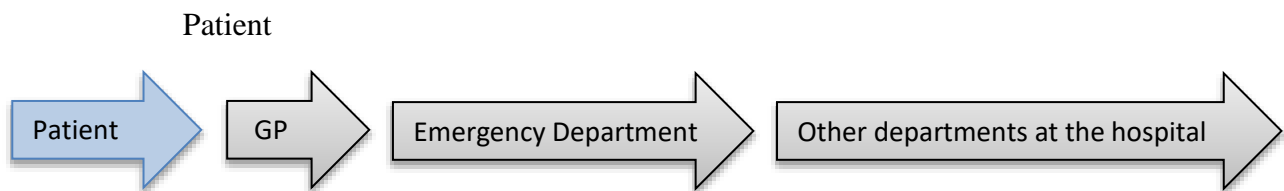
The vast majority of existing studies of the weekend effect are based on observational and epidemiologic analysis of administrative data. By looking at the relationship between time of admission/discharge and mortality, studies can explain that a weekend effect exists but are not able to explain why. They do not look at the processes of care (Hamilton et al. 2010, De Cordova et al. 2012). Why these variations occur remains unclear. Several studies point to the need for research into the causes of the weekend effect (De Cordova et al. 2012, Goddard & Lees 2012, Handel et al. 2012, Manfredini et al. 2017).

The weekend effect has been explored in a large number of studies. Replicating this further would seem to fulfil no useful purpose. The question is what causes the weekend effect. Attention should now turn to in-depth studies that shed some light on the cause of weekend effect and how it might be mitigated (Lilford & Chen 2015, Pauls et al. 2017). This thesis contributes to an understanding of why and under what circumstances the weekend effect occurs in an emergency department.

## **1.2 Looking at the system: different possible explanations of the weekend effect**

There can be multiple explanations for the weekend effect. It could be a mix of explanations. Although previous studies have shown that mortality rates are higher for acute patients admitted to the hospital on the weekend than during the week, the extent to which this weekend effect reflects the health care provided, the characteristics of the admitted patients, or both has been unclear. I try to clarify this by looking for possible explanations of the weekend effect both at a patient level and in the organization of and social practices within an emergency department. However, if looking at the patients' way through the health care system, explanations may also be found in the visitation of the

patients, or in the patients' further way through the system. After initial treatment in the emergency department, many patients are transferred to other departments at the hospital. I will therefore briefly consider other possible explanations of the weekend effect by looking at the role of the general practitioner and the other departments at the hospital. Moreover, in order to present the issues I will address in my thesis, I will sum up what is already known at the patient level and within the organization of the emergency department.



Existing studies of the weekend effect have suggested that one possible explanation of the differences in patient outcome on weekdays and weekends is changes in patient characteristics, e.g., disease severity. Bell and Redelmeier whose landmark study demonstrated higher mortality for patients admitted to hospital on weekends compared with during the week write: *“We cannot exclude the possibility that patients admitted on weekends are sicker than those admitted on weekdays. However, a greater severity of illness among patients admitted to acute care hospitals on weekends would still raise questions about the adequacy of medical care and staffing patterns.”* (2001:667). That previous studies of the weekend effect do not consider patient mortality variation, is one of the most often stated critiques (Bray & Steventon 2016). However, these existing studies are mainly based on administrative data, which contain limited information on illness severity.

One study, examining 49,337 emergency medical admissions to an Irish hospital during a 8-year period, found an 11 percent increase in 30-day in-hospital mortality for patients admitted on the weekend compared with weekday admissions. In addition, they found that the case mix for a weekend admission differed (with more respiratory and neurological diagnoses), and that age and disturbance

in biochemistry predicted a higher mortality for patients admitted at weekends (Mikulich et al. 2011). More recently, a UK study using data from electronic health records to examine the 30-day mortality among 503,938 emergency admissions on weekdays and weekends found that when adjusting for routine test results, the excess mortality on weekends was substantially reduced (Walker et al. 2017). This study shows that data from electronic patient journals might be a way to investigate possible explanations of the weekend effect on a patient level. Other studies show that a higher proportion of patients are transferred to the ICU during weekday off-hours and the weekend, and ICU admission may be an indicator of illness severity (e.g., Vest-Hansen et al. 2015).

Although many studies have documented an increase in mortality for weekend admissions, some researchers has questioned whether studies showing the existence of a weekend effect in particular contexts or in the treatment of particular populations can tell us whether the effect exists elsewhere. Can the results of one small study showing a weekend effect in one Danish emergency department (Biering et al. 2016) say anything about whether there is a weekend effect in another Danish emergency department? However, earlier findings show that studying the case mix of patients admitted to the emergency department weekdays and weekends is highly relevant when looking for possible explanations of the weekend effect in an emergency department on a patient level.

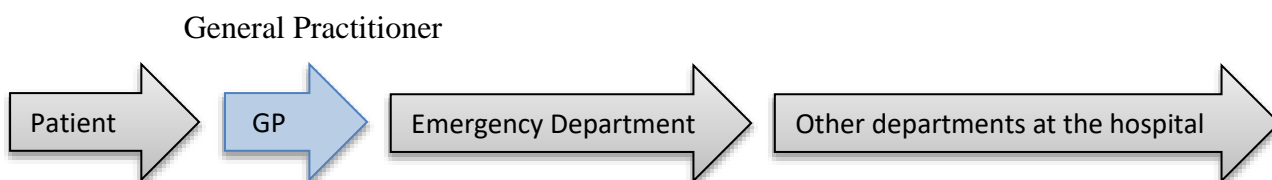
This leads to the initial research question within this dissertation:

*RQ1: Is there a weekend effect in the emergency department (when looking at mortality rate, length of stay, and number of adverse events), and if it exists, what characterizes the weekend effect?*

The first paper aims to examine the association between time of admission and outcome, measured by 30-day mortality rate and length of stay within an emergency department. Furthermore, patient characteristics, including the severity of disease, will be investigated in order to consider whether

changes in patient characteristics can be a possible explanation of the weekend effect, as suggested by previous studies. By doing this, I am able to answer the first research question except the sub-question about adverse events. This leads to the aim of the second paper, where number and types of adverse events occurring in the same emergency department on weekdays and weekends are investigated. In addition, I explore the registration practice and employees' perception of barriers to and incentives for reporting adverse events, and finally I discuss the usefulness of the data from a mandatory electronic self-reporting system in studies of adverse events.

Denmark's publicly funded health care system provides free access to general practice and hospital care. The equal access to acute hospital care together with the comprehensive data both in administrative databases but particularly in the electronic patient journals about reasons for admission, severity of disease, and process of care makes the Danish health care system an ideal setting for analyzing the weekend effect.



General practitioners (GPs) have a key role in referring patients to the hospital, since every Danish citizen is registered with a GP whom they have to consult for medical advice. The GP acts as a gatekeeper to the rest of the health care system, carrying out initial diagnostic investigations and referring patients to hospitals or outpatient clinics when necessary. As GPs are responsible for most of the admissions to the emergency departments, differences in admission practices on weekdays and weekends might be an explanation for the weekend effect (Vest-Hansen et al. 2015, Bray & Steventon 2016).

Out-of-hours primary care, where access for patients is provided through telephone triage, is in most countries managed by nurses (Huibers et al. 2016). Denmark is an exception. GPs organize care coverage for weekends and out-of-hours services. GPs in a given geographical area rotate staffing of regional out-of-hours service centers, where they receive all patient calls. Due to the large setting, involving all GPs in the region, a GP on duty seldom meets his or her own patients. The GP may give a telephone consultation, advise the patient to attend one of the out of-hours GPs located within the emergency departments, refer the patient to a hospital or outpatient clinic, or arrange for a home visit. The out of-hours service operates from 4 p.m. to 8 a.m. from Monday to Friday and 24 hours during weekends and public holidays (Christensen & Olesen 1998, Pedersen et al. 2012). In an emergency, the patients can dial 1-1-2 and present by ambulance to the emergency department. In 2014, one of five regions in Denmark, the Capital Region of Denmark changed their system to the helpline 1813, and nurses now manage most of the telephone triage instead of GPs. One study is investigating the two telephone triage systems, comparing the new system in the Capital Region of Denmark with the “old” system in the Central Denmark Region (Graversen 2015). However, this thesis is based on an in-depth study of one emergency department located in the Central Denmark Region.

GPs staffing regional out-of-hours service centers do not have ongoing relationships with the patients they advise. Therefore, it can be hypothesized that out-of-hours telephone triage results in more face-to-face contacts and admissions to the emergency department compared with telephone triage by the patient’s own GP in daytime on weekdays. However, to my knowledge, the association between access to primary care and emergency department visits at different times within Denmark has not been evaluated. Different UK studies have identified a wide variation in GPs’ referral rates, respectively in GPs’ daytime and out-of-hours referral rates (O’Donnell 2000, Rossdale et al. 2007), suggesting that GPs’ decision making varies and plays an important part in determining admission rates. Another UK study examined the association between extending access to primary care (GPs

offering 7-day extended access compared to routine access, 8.30 a.m. to 6.30 p.m. Monday to Friday) and emergency department visits, and found that extending access to primary care was associated with a reduction in emergency department visits (Whittaker et al. 2016). Due to different health care systems, the findings from the UK studies do not necessarily apply to Danish conditions. However, it is likely that variations in GP referral rates also occur in Denmark, and that these differences in admission practices could influence the admissions to emergency departments on weekdays and on weekends (e.g., the case mix and number of patients). To my knowledge, this potential contributing factor to the weekend effect has received little attention.



As in many countries, the emergency departments are the cornerstones of the Danish national health system. Up to 70 percent of all emergency patients are evaluated there, to determine whether they can be treated and discharged, or admitted for further care. The Danish emergency departments are described further in the section zooming in on the empirical field. However, in this subsection I will summarize what is already known about emergency departments and the weekend effect in order to present the issues I will address in my thesis.

Emergency admissions have often been studied in terms of weekend mortality (Webb 2011). However, studies of admissions only to emergency departments are limited. Barba et al. (2006) examined clinical data of 35,993 patients admitted to a Spanish emergency department over a 5-year period and found that mortality within the first 48 hours was higher for patients admitted on the weekend. More recently, a study evaluating 4,225,973 adults admitted through US emergency departments to the hospital found that patients were more likely to die when they were admitted on

weekends (Sharp et al. 2013). In Denmark, three studies have shown a weekend effect for acute admissions, but only Biering et al. have been investigating mortality for weekday and weekend admission in an emergency department (Vest-Hansen et al. 2015, Kristiansen et al. 2016, Biering et al. 2016). However, this study is small, including only 5,385 patients (Biering et al. 2016).

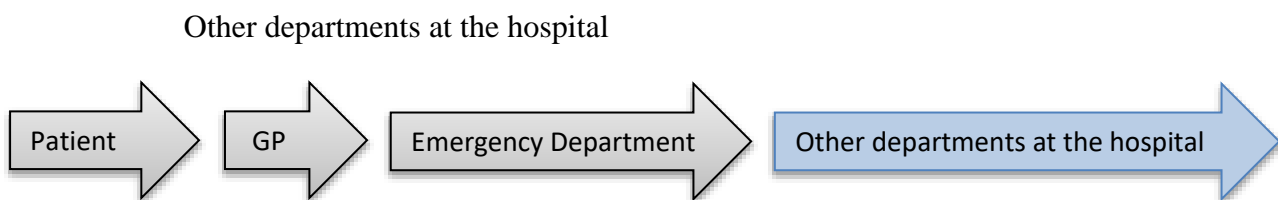
Previous studies of the weekend effect suggest that the weekend effect could be an “organizational issue”, i.e., the weekend effect exists due to reduced medical staffing levels on weekends. It could be due to a combination of medical, nursing, and other health professional staff being less available on weekends (Bell & Redelmeier et al. 2004, Barba et al. 2006, James et al. 2010, Sharp et al. 2013). There is some evidence for the importance of numbers of employees, in terms of weekend mortality. One study of a French ICU shows that the patient-to-nurse ratio is important (Neuraz et al. 2015), and a UK study of 294,602 emergency admissions to 156 hospitals observed the lowest mortality rates in hospitals with higher levels of medical and nursing staffing. Moreover, a higher mortality rate was found when patients were admitted on weekends in hospitals with fewer general surgical doctors and with lower nursing staff ratios (Ozdemir et al. 2016).

Earlier findings show that the organization of most of the Danish emergency departments changes during the day and during the week (Møllekær et al. 2017). While Møllekær et al. investigate all of the Danish emergency departments, focusing on similarities and differences within the organization of those departments, I chose an in-depth study of a single emergency department and the differences in the organization of that emergency department on weekdays and weekends. This leads to the second research question within this dissertation:

*RQ2: How is the emergency department organized, i.e., what characterizes the structure, the employees, the work processes, and the coordination in the emergency department on*

*weekdays and weekends, and can the differences within the organization be a possible explanation of the weekend effect?*

I address this research question in the third paper. The aim was to examine the relationship between the weekend effect and organizational processes, which has been another suggested explanation of previous studies of the weekend effect, but hardly investigated. Based on a longitudinal fieldwork and by using organizational design theory, I examine fits and misfits between information processing requirements and capacities in the emergency department. In addition, I explore the consequences of the different strategies developed by the employees either in order to cope with missing capacities or to compensate for information processing misfits.



After diagnosis and initial treatment within the emergency department, many patients are transferred to more specialized departments at the hospital. Differences in the organization of these other departments on weekdays and weekends could also influence patient outcomes and thus be a possible explanation of the weekend effect.

Most studies examining emergency admissions have investigated the weekend effect for patients admitted through the emergency department and transferred to other departments (e.g., Cram et al. 2004, Sharp et al. 2013). However, the weekend effect is seen in a wide range of patients, medical and surgical, non-selected and selected (i.e., disease specific), emergency and elective admissions. Moreover, the weekend effect is observed in many different countries on several continents (Webb 2011, Zhou et al. 2016, Pauls et al. 2017).



In order to provide sufficient care and treatment for in-coming patients, emergency departments are highly dependent on the other departments at the hospital. Physicians from other departments are on call and treat patients within the emergency department, many patients are after initial treatment within the emergency department transferred to other departments for further treatment, and other departments are responsible for performing clinical trials and X-rays on patients treated within the emergency department. Thus, the other departments of the hospital are in many ways included in this thesis. In the first paper, I do investigate which departments patients are admitted to after initial treatment in the emergency department. Moreover, like earlier studies of the weekend effect, I compute the 30-day mortality rate for patients admitted to the emergency department and transferred to other departments. The reason for this is explained in the paper. In addition, as a part of the organizational analysis of the emergency department in paper III, I explore how the emergency department collaborates with other departments at the hospital on weekdays and weekends. However, in my search for possible explanations of the weekend effect, I focus on the emergency department.

### **1.3 Zooming in on the empirical field: the Danish emergency departments**

As the background of this dissertation, it is central to understand the empirical field, the emergency departments in Denmark, since it has influenced both methodological choices and results. In this section, I introduce that field.

Compared to the United States, where the very first emergency department was established in 1961 (Suter 2012), the Danish emergency departments are a relatively new phenomenon. In 2007, a major reorganization of the Danish health care sector and the way acute patients were admitted to the hospitals was initiated. Acute patients are here defined as patients with a disease that appears quickly (or an acute exacerbation of a chronic disease) and who need urgent but often short-term hospital-

based treatment. Overall, the redesign meant that the acute care delivery was consolidated to fewer, larger, and more centralized emergency departments in order to concentrate specialists and increase quality. Another goal was to develop the capacity to manage an expected increase in number of patients and the prevalence of co-morbidity. Formerly acute patients were admitted in acute surgical and medical wards belonging to the various specialized departments, but they are now admitted to and sorted in 21 centralized hospital emergency departments, which focus on “the whole patient”. Triage procedures and initial treatment determine which care is needed, and many patients are treated within the emergency department and discharged without further admission. Thus, emergency departments have become the cornerstone of the Danish National Health System (Danish National Board of Health 2016).

The Danish National Board of Health published some guidelines in 2007 (Danish National Board of Health), when the decision of reorganization was made, but they were not very specific. Moreover, unlike other countries, emergency medicine has not been a formally recognized specialty in Denmark.<sup>1</sup> Consequently, the Danish emergency departments differ in organizational design and many emergency departments’ organizational design changes depending on the day and the week (Wen et al. 2013, Møllekær et al. 2014, Møllekær et al. 2017). However, little is known about how such changes in the design effect the quality of care and services provided by the emergency departments. Furthermore, the previous studies of the weekend effect showing that patient care differs between weekdays and weekends indicate that the organization of hospital departments is less effective and efficient at weekends. One of the research questions in this thesis concerns how differences within the organization of an emergency department on weekdays and weekends may

---

<sup>1</sup> The Danish National Board of Health announced 12 June 2017 that emergency medicine would become a specialty in Denmark. Sweden was the first country in Scandinavia to make that decision in 2012, and Norway followed in 2016 (Kurland & Graham 2014, Steenberger & Heissel 2017).

affect the quality of patient care. I describe the emergency department selected for this study in chapter 2.2, called “The Setting”.

#### **1.4 Summary and concluding comments**

In my thesis, I explore different possible explanations for the weekend effect in a Danish emergency department. This empirical field was chosen for different reasons: As the cornerstone of the Danish health care system, a possible weekend effect would affect numerous patients. Acute patients seem to be most affected by the weekend effect, and a previous study shows that the organizational design of the emergency department changes depending upon the day and the week – changes that may explain why the patient outcomes differs on weekdays and weekends.

The first research question in this thesis focuses on the existence of the weekend effect, and the second research question focuses on explanations for the existence of the weekend effect. However, when examining the existence of the weekend effect, possible explanations are investigated too. The research questions form the basis for the three papers that constitute the core of this thesis. The individual papers present relevant literature, further motivate the aims, outline the methods, present the results, and discuss strength and limitations. I will sum up the aim of the three individual papers:

Paper I: The aim was to examine the association between time of admission and 1) 30-day mortality rates, 2) length of stay, and 3) disease severity of patients admitted to an emergency department.

Paper II: The aim was to 1) investigate numbers and types of adverse events occurred in an emergency department weekdays and weekends, 2) explore the registration practice and employees’ perception of barriers to and incentives for reporting adverse events, and 3) discuss the usefulness of the data from a mandatory electronic self-reporting system in studies of adverse events.

Paper III: The aim was to 1) investigate the relationship between the weekend effect and organizational processes by examining fits and misfits between information processing requirements and capacities in an emergency department, and 2) explore the consequences of the different strategies the employees developed either to cope with missing capacities or to compensate for information processing misfits.

All three papers are based on data obtained in a Danish emergency department. By focusing on the emergency department, I do not investigate what happens with the patient before being admitted to the emergency department and only to a limited extent on what happens with the patient after transferred to another hospital department. However, I examine the mortality rate for patients admitted through the emergency department and transferred to other departments.

Taken together, the research questions and thus the three papers cover major analytical dimensions in studying the weekend effect:

- Possible explanations of the weekend effect including severity of disease, which is studied only to a limited extent
- Changing organization over a short time period and how it affects social practices and the patient care delivered by the emergency department
- Level of analysis - patient, employee, and organizational level

## Chapter 2: Methodology

---

This chapter outlines the methodological approach of the study. First, I introduce the case study and the case selected for this study. Second, I define weekdays and weekends. Third, I present the research design and provide a detailed overview of the design of approach used in the three papers.

### 2.1 Studying a case

In this thesis, I investigate possible explanations for the weekend effect in a Danish emergency department in order to expand and enrich the knowledge about the reasons of the weekend effect. A case study research approach has been chosen, since this study is an empirical inquiry that was planned and executed as an in-depth study of a contemporary phenomenon in its real-world context. Furthermore, case studies are suitable for investigating why-questions (Yin 2004). Over time, single-case studies have been criticized (Eisenhardt 1989), but single cases allow researchers to investigate a phenomenon in depth to provide rich and detailed description and understanding (Dyer & Wilkins 1991, Walsham 1995, Flyvbjerg 2006), which is needed if we want to understand a complex phenomenon such as the weekend effect and find possible explanations for it.

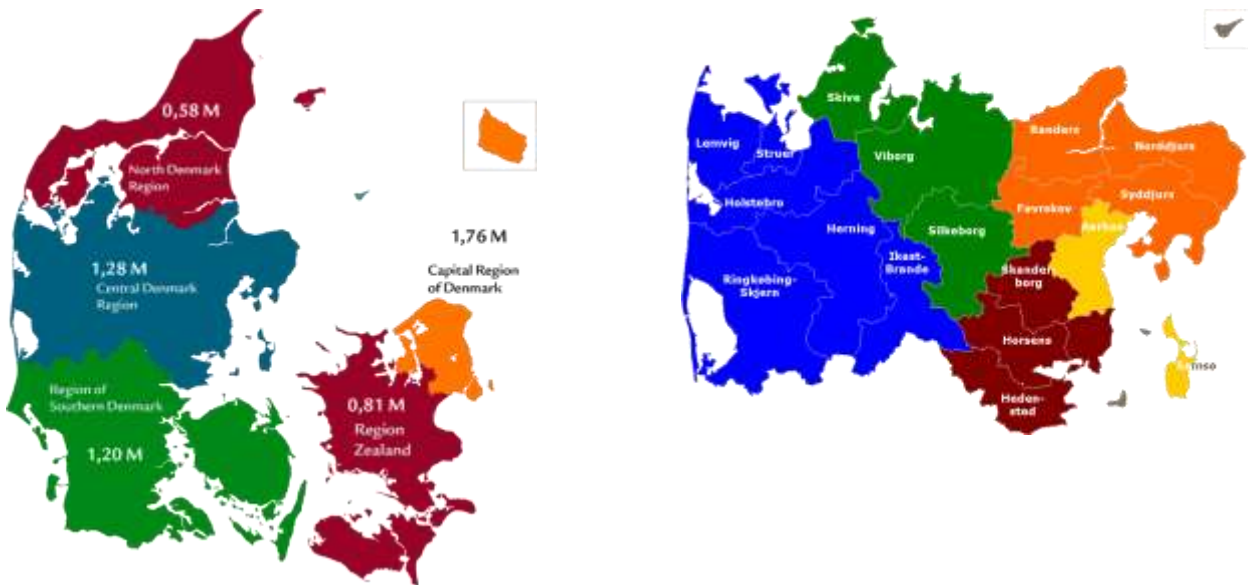
The emergency department at Viborg Regional Hospital, Regional Hospital Central Jutland, was chosen as the setting for this study, and all three papers are based on data obtained in this department. A detailed description of the emergency department can be found in the following subsection. I chose this particular emergency department based on detailed insights, which is important when doing single-case studies (Yin 2004). Møllekær et al. (2017) show that the organizational design of most Danish emergency departments, including the one at Viborg Regional Hospital, changed depending upon the day and the week. These organizational changes may explain why patient care differs within

the emergency department on weekdays and weekends. Due to the recently establishment of emergency departments and because of different phases within this ongoing reorganization, some emergency departments did not yet receive patients with both medical and surgical symptoms. I chose one that did, because the collaboration with different other departments may affect how the organization works on weekdays and weekends. Moreover, because of the reorganization of the acute care in Denmark, many emergency departments are moving to new buildings, which would affect data collection. The emergency department at Viborg Regional Hospital is scheduled to move in spring 2019.

## **2.2 The setting**

The Emergency Department at Viborg Regional Hospital, Regional Hospital Central Jutland, is one of 21 Danish emergency departments and one of 5 emergency hospitals in Central Denmark Region (CDR) receiving trauma- and critically ill patients (see Figure 2.1). The emergency departments receive patients referred by general practitioners and patients who have called 112 (the Danish emergency number). The size of CDR is 13,142 km<sup>2</sup> with a total population of 1,282,000, out of which the Viborg area constitutes approximately 233,000 people. The emergency department in Viborg serves three municipalities: Viborg, Skive, and Silkeborg (see Figure 2.2). It consists of a main unit at Viborg Regional Hospital, which this thesis is based on, and two smaller emergency clinics located in Skive and at the smaller Silkeborg Regional Hospital.

**Figure 2.1:** Map of the five regions of Denmark.<sup>2</sup> **Figure 2.2:** Map of hospital areas in CDR.<sup>3</sup>



With backing from physicians from other departments at the hospital, all acute patients with a referral diagnosis covering general surgery, orthopedic surgery, and internal medicine are diagnosed and treated within the emergency department embedded in Viborg Regional Hospital. Children, other than those with minor injuries treated in the emergency room, are admitted to the pediatric department, and patients with serious heart-related events are received at the department of cardiology. Psychiatric patients without somatic symptoms are admitted directly to psychiatric hospitals. The emergency department consists of two sections. Nurses and administrative staff in the emergency department work either at section A1, where they receive orthopedic surgery patients and some medical (e.g., gynecological and urological patients), or at section A2, where general surgical and medical patients are received. Senior and junior physicians, as well as service assistants, cover both places. The emergency department employs 145 nurses and physicians, including 8 senior physicians, and 60 secretaries and service assistants.

<sup>2</sup> <http://www.rm.dk/service/english>

The role of the emergency department differs in the three papers in this thesis. In the two first papers, the focus of analysis will respectively be the patient, and adverse events as well as registration practices. The emergency department is the setting where it all takes place. In paper III, the unit of analysis is the emergency department. In the last part of the paper, the focus changes from the emergency department to the strategies employees develop to cope with the changes within the organization.

### **2.3 Definition on weekday and weekend**

In Danish hospitals, nurses usually work during one of following three shifts: days (7:00 a.m.-3:00 p.m.), evenings (3:00 p.m.-11:00 p.m.) or nights (11:00 p.m.-7:00 a.m.), while physicians normally work two shifts: days (8:00 a.m.-4:00 p.m.) or evenings/nights (4:00 p.m.-8:00 a.m.). A previous study showed that the organization of most of the Danish emergency departments changes in the evening, and that the organization of the emergency departments also differs between weekdays and weekends. In 2013, the emergency department used in this study had one kind of organization in daytime (7:00 a.m.-2:59 p.m.) on weekdays, and another kind of organization in evening and nighttime (3:00 p.m.-6:59 a.m.) and on weekends (Møllekær et al. 2017). The results of the longitudinal field study of the organizational changes within the emergency department presented in paper III confirm this. Based on this knowledge gained from the organization of acute hospital care during the weekend, defining the weekend as the time from midnight Friday to midnight Sunday as previous studies of the weekend effect have done (De Cordova et al. 2012, Pauls et al. 2017), raises questions about the appropriate definition for the weekend. When the weekend is defined by the quality and extent of care delivered, the time from Friday evening to Friday midnight as well as the time from Sunday midnight to Monday morning should be included.



This leads to a definition of time as weekday (Monday 7:00 a.m.-Friday 2:59 p.m.) or weekend (Friday 3:00 p.m.-Monday 6:59 a.m.). Public holidays, (e.g., Easter and Christmas) were considered weekend. In paper I and paper II, where the case mix of patients and the adverse events are investigated between 1 January 2014 and 31 December 2015, 59.1 percent of the total shifts were defined as weekday (Monday 7:00 a.m.-Friday 2:59 p.m.) and 40.9 percent as weekend (Friday 3:00 p.m.-Monday 6:59 a.m.). In paper III both the data collection (e.g., participant observations) and the results was structured using the same definition of weekday and weekend.

The comparison between weekdays and weekends risks blinding us to a bigger picture, that variations also occurs over days. Classifying time of admission into six periods, including daytime, evening, and nighttime on weekdays and on weekends, was an attempt to provide a more subtle description of the weekend effect. Earlier studies examined this effect by defining the weekend as starting on Friday at midnight and ending on Sunday at midnight (Pauls et al. 2017). Few studies have examined mortality associated with admissions during off-hours (e.g., Maggs & Mallet 2010). Three Danish studies investigating the weekend effect have done it to some degree but in different ways. One study found that the mortality rate was higher for patients attending a Danish emergency department in evening compared to daytime, and on weekends compared to weekdays (Biering et al. 2016). A cohort study of acute medical patients distinguished between weekday off-hours and weekend daytime and nighttime hours (Vest-Hansen et al. 2015), and a cohort study of patients undergoing hip fracture surgery compared admissions during weekends (Friday 11:00 p.m.-Monday 6:59 a.m.) with admissions during weekdays (Monday 7:00 a.m.-Friday 10:59 p.m.). In addition, they compared patients admitted on weekdays in daytime with admission in evening or nighttime (Kristiansen et al. 2016).

## **2.4 Research methods**

In order to be able to answer my research questions, I used varied methods. In this section, I will explain why I chose to use mixed methods. Afterward I will elaborate upon my use of both quantitative and qualitative methods.

### **2.4.1 Mixed methods research design**

As the title of this dissertation, “Exploring and explaining the weekend effect in a Danish emergency department,” indicates, the aim of this study is twofold. My primary aim is to explore the organization of and social practices within an emergency department in order to find possible explanations of the weekend effect. Therefore, I initially had to situate the sample and understand what characterizes the potential/actual weekend effect (i.e., mortality, length of stay, and adverse events) in this particular emergency department I have chosen as the setting for my research.

Organizational issues are not the only explanation suggested by previous studies for why the weekend effect exists. Another suggestion is disease severity, i.e., that patients admitted on weekends are more critically ill than patients admitted on weekdays. However, because of the methods chosen for and data used in these previous studies, they may prove that a weekend effect exists, but they are not able to explain why. They examine the relationship between time of admission or discharge and mortality rate, but they do not look at the processes of care, nor examine the severity of disease. Thus, why these variations occur remains unclear.

Nevertheless, the suggestions mentioned in the previous studies of the weekend effect have inspired me in my search for possible explanations as to why the patient care in emergency departments differs weekdays and weekends. Another inspiration has been the study of Møllekær et al. (2017) showing

that the organizational design of most Danish emergency departments changes during the day and, more importantly, during the week. Thus, I would like to examine both the organizational differences, including social practices within the emergency department on weekdays and weekends, and the patient characteristics of the patients admitted on weekdays and weekends. In order to explore the weekend effect and investigate these possible explanations for why it exists, different methods are required. As Johnson and Onwuegbuzie (2004) say, research approaches should be mixed in ways that offer the best opportunities for answering important research questions. My thesis therefore consists of a set of related studies, in which I combine quantitative and qualitative methods. This approach is also known as mixed methods. Johnson and Onwuegbuzie define mixed methods as *“...the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study.”* (2004:17).

Qualitative and quantitative methods provide different type of information, and by choosing mixed methods as the overall design for my thesis, I am able to extend the knowledge about the weekend effect. I search for possible explanations on three levels: patient, employee, and organizational. Previous studies of the weekend effect show that a study of the case mix of patients admitted to the emergency department weekdays and weekends is highly relevant when looking for possible explanations of the weekend effect in an emergency department. I therefore chose an epidemiological study for my first paper in order to search for explanations on a patient level. In paper II, other quantitative methods were used to investigate the number and types of adverse events as well as common registration practices within the emergency department. The use of quantitative methods is elaborated upon in the next subsection, “Quantitative methods.”

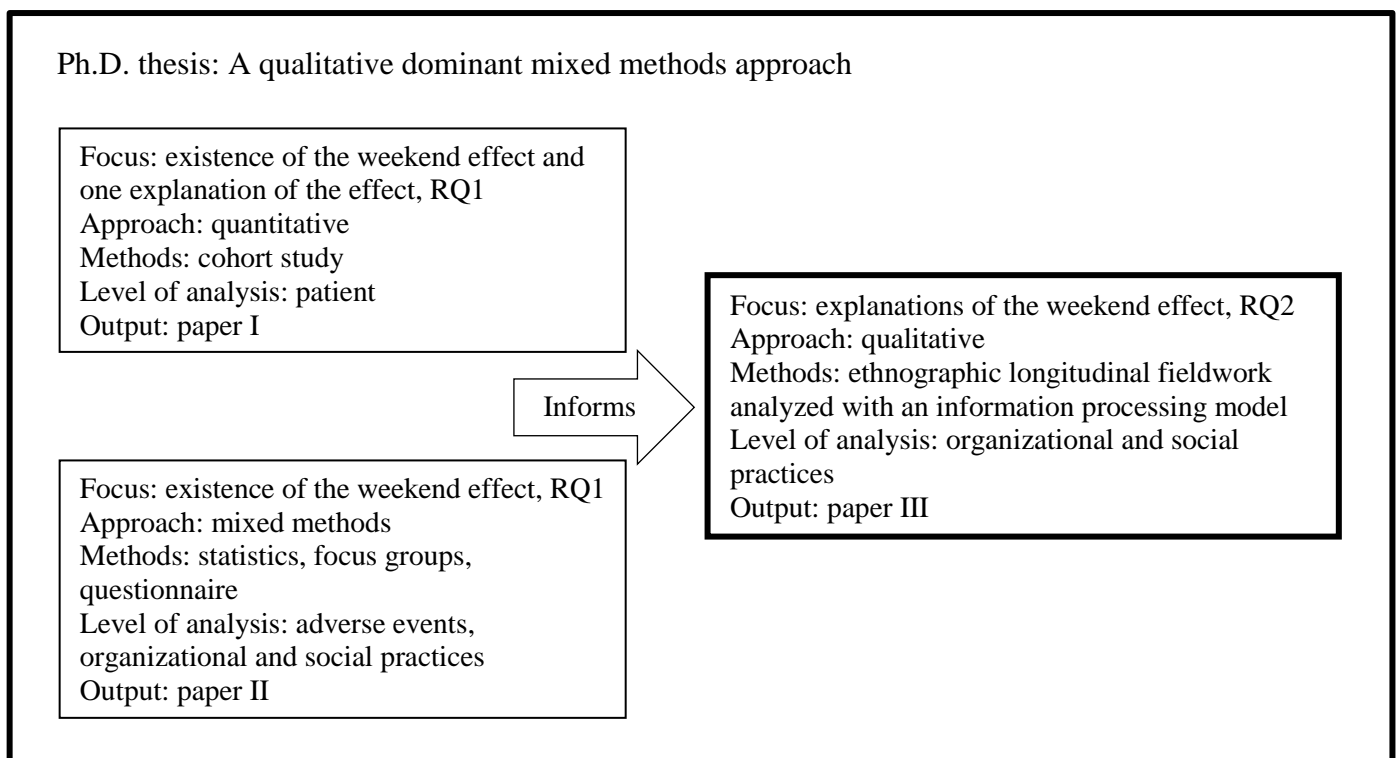
By using quantitative data, I can show that the weekend effect exists and what characterizes the weekend effect in the emergency department, but besides the possible explanation of disease severity, quantitative methods are not able to explore why. Here the qualitative methods have their strengths,

and for paper II and especially paper III, an ethnographic longitudinal fieldwork was chosen as comprehensive approach for this part of the study. Ethnographic research has been concerned with producing descriptions and explanations of particular phenomena (Hammersley & Atkinson 2007). Through participant observation and interviews, both individually and with focus groups, and by using an information processing model, I have been able to go into details of how work practices within the organization of the emergency department change during the week. Thus, I am able to investigate not only the formal organization but also the individual employees' social practices. The use of qualitative methods is elaborated upon in the subsection, "Qualitative methods."

Thus, in my choice of methods, I acknowledge that both quantitative and qualitative methods have benefits and complement each other. To borrow an expression from Johnson and Onwuegbuzie (2004), qualitative research is my primary home, but it makes sense to visit other homes when my research can benefit from such a visit. However, when using a mixed methods approach, either qualitative and quantitative methods are used equally or one of the methods is prioritized (Johnson et al. 2007). In my thesis, I use what Johnson et al. called a qualitative dominant mixed methods approach (2007). I mainly use qualitative methods when investigating possible explanations for why the weekend effect exists in an emergency department, but quantitative methods are used to determine the extent of the issues I want probe deeper within the qualitative study. The quantitative study eliminates doubts about whether a weekend effect exists in emergency departments and what characterizes this effect, and the qualitative methods highlight possible explanations and come up with different action-oriented possibilities if the organization is going to give the same quality of care on both weekdays and weekends. My qualitative findings help explain in more detail the quantitative findings. Thus, by examining the weekend effect with both quantitative and qualitative methods, I am able to enhance both the description and the understanding of the weekend effect within an

emergency department. In Figure 2.3, I provide an overview of the mixed methods research design that I applied for this study, and the following subsections include a detailed explanation.

**Figure 2.3:** Mixed methods research design used in this thesis



#### 2.4.2 Quantitative methods (papers I + II)

A quantitative approach was chosen as a comprehensive approach to answer the first research question in this thesis about the extent of the weekend effect in the emergency department and what characterizes that effect. The quantitative phase of the study aims to form a preliminary understanding of the weekend effect within the emergency department chosen as setting for this study. Thus, by documenting variations, this quantitative phase provides the foundation for the qualitative phase, where possible explanations of the weekend effect are explored further.

Previous studies of the weekend effect investigated different patient outcomes: mortality rate, length of stay, and adverse events. Thus, in order to examine the weekend effect in the emergency department different, quantitative methods were required, and the examination of the extent of the weekend effect is divided into two individual studies presented in papers I and II.

Earlier findings from national and international studies show that the use of an epidemiological study is highly relevant when investigating differences in mortality rate for patients admitted to the hospital on weekdays and weekends. Thus, a cohort study was chosen as a comprehensive method for the study of the patient characteristics, 30-day mortality rate, and length of stay presented in paper I. Moreover, by choosing a research method similar to those used in previous studies, the results are more comparable to those from previous studies. However, one of the criticisms of previous studies is that they do not investigate disease severity, which is one of the suggested explanations of the weekend effect. In the present study, we used data from the electronic patient records (EPR). Compared with the administrative data used in most previous studies, this data source offers more clinical information, e.g., the triage score. Triage is widely used in emergency departments to evaluate disease severity (Christ et al. 2010), and using EPR data makes it possible to examine patient characteristics, including disease severity. Yet EPR has only been used to a limited extent (e.g., Biering et al. 2016, Walker et al. 2017). One explanation for this may be that EPR is a new tool to document patient morbidity, treatment, and care over time. This study, (co-authored with Møllekær, Boysen, and Vest-Hansen) included data on patients admitted to the emergency department from 1 January 2014 to 31 December 2015. The EPR was implemented in the emergency department in 2013. One limitation of using EPR data and other administrative data is variations in practice resulting in missing data. Thus, although some of the missing data was avoided due to an extensive knowledge of registration practices, the triage score of approximately one quarter of the patients admitted to the emergency department is still missing. In contrast to previous studies (e.g., Biering et al. 2016), we

chose to include patients with missing triage scores, but as an independent group. The strengths and limitations of the methods used in this study are elaborated upon in paper I.

The two-year period (2014-2015) was chosen due to organizational changes within the emergency department. The emergency department became an independent department on 1 January 2014. It was assigned a department code, which also makes it possible to use the EPR data for research purposes. Organizationally, more categories of patients were admitted to the emergency department, and the department doubled in size. On 1 January 2016, the emergency department began to receive more medical patients, and the organization changed again.

The same time period was used in the second study, in which the numbers and types of adverse events occurred in the emergency department on weekdays and weekends was investigated. Despite research showing weekend effect and extensive research into adverse events, the research about the occurrence of adverse events on weekdays and weekends is limited (Buckley & Bulger 2012). I chose to do a simple statistical descriptive analysis of data from the national electronic self-reporting system. Since 2010, it has been mandatory for all health professionals to report all adverse events they may observe. However, the total number of adverse events (within the emergency department) reported to the system and results from previous studies of adverse events pointed to a need for an empirical investigation of registrations practice and attitudes toward adverse events registration within the emergency department. Thus, a second, more exploratory phase was added. Based on the results of focus groups and informal interviews with employees collected as part as a longitudinal fieldwork within the department (these methods are elaborated in the subsection about qualitative methods), a self-completion paper-and-pencil questionnaire was developed and handed out to the employees in the emergency department in November 2016 (Leeuw & Hox 2008, Creswell 2014). The questionnaire is available in Appendix I. By using a questionnaire, it was possible to explore the registration practices within the department, including employees' perception of barriers to and

incentives for reporting adverse events. Thus, the combination of focus groups and the questionnaire was an effective way of identifying and exploring general patterns in registration practices within the department in a detailed and nuanced manner without having to talk with every employee. Moreover, previous studies examining in-hospital adverse events have used various methods, including retrospective record review, prospective observational studies, or voluntary and mandatory electronic reporting systems. However, research of how adverse events are reported in actual clinical practices is limited. The intention was for these collected data to not only explain the findings from the statistical descriptive analysis of the reported adverse events, but also to uncover the registration practices. The exploratory phase showed that few of the adverse events occurring in the emergency department are reported. This both explains the result of the first phase of the study and is a well-known limitation within research of adverse events. The employees' perceptions to why only few of the adverse events are reported were also identified. Paper II presents the findings from this study.

By using quantitative methods, I was able to examine the extent of the weekend effect within the emergency department. Moreover, disease severity was investigated as a possible explanation for the weekend effect. However, the primary aim of this thesis was to provide organizational theory perspectives to the question of why the quality of care differs within an emergency department on weekdays and weekends. To answer the second research question about changes within the organization of the emergency department on weekdays and weekends, qualitative methods were selected as the most appropriate.

### **2.4.3 Qualitative methods (papers II + III)**

Despite extensive literature documenting a weekend effect, little is known about why patient care differs on weekdays and on weekends. Inspired by suggestions in the previous studies regarding why



the weekend effect exists, I chose to do a qualitative ethnographic in-depth study of the emergency department chosen as the case for the overall study presented in this thesis. By choosing a qualitative approach, I was able to explore possible explanations of the weekend effect on both an organizational and a social practice level. Thus, the qualitative methods enable me to access areas not amenable to quantitative research, which is the methodological approach dominating the previous research of the weekend effect.

Qualitative research, including ethnography, is about understanding a phenomenon as detailed and nuanced as possible rather than enumerate. Thus, qualitative research is particularly useful in areas that have received little previous investigation, such as, for example, the explanations of the weekend effect. The goal of qualitative analysis is to explore reasons behind action by observing, jotting in, talking, and reading about the people and studying people in situ. The research method in which the researcher is present in a particular social and cultural setting for an extensive period of time is called ethnographic fieldwork (Hammersley & Atkinson 2007).

To ensure consistency between the three studies, the qualitative study exploring explanations of the weekend effect is informed by the two first studies examining the extent of the weekend effect. Most of the ethnographic fieldwork took place in 2015, which was the last part of the two-year period used in the quantitative studies (2014-2015). Fieldwork consisted of approximately 700 hours of participant observations conducted in the emergency department between August 2015 and February 2016. Most of the 25 individual interviews were conducted simultaneously with the observations. However, because of the physicians' workload, some of the interviews with the emergency physicians were canceled several times, and thus conducted after the observations. Qualitative research is a cyclic process rather than linear, and the decision to conduct four focus groups was made later. Moreover, because of organizational changes in the spring of 2016, the subsection A1 found it

difficult to allocate nurses for focus groups in that period. Thus, the fieldwork was conducted over a 1½-year period between August 2015 and February 2017.

Based on data collected during the ethnographic fieldwork and analyzed with an information processing model, the study presented in paper III examines fit and misfit between information processing requirements and capacities in order to identify possible explanations of the weekend effect. Moreover, different strategies developed by employees in order to cope with changing information capacities on weekdays and weekends have been identified. Due to the high amount of information that must be processed by physicians and nurses in order to diagnose and treat various acutely ill patients within an emergency department, the information processing view is highly relevant as a theoretical framework when analyzing differences within an emergency department's organization on weekdays and weekends. The combination of ethnographic fieldwork and an information processing perspective provides me with an in-depth understanding of the people, the organization, and the broader context within which they work. In contrast to previous studies' suggestions for why the weekend effect exists focusing on individual parts of the organization such as number of employees, competences and access to the service departments (Bell & Redelmeier 2001, Barba et al. 2006, Aylin et al. 2010, James et al. 2010), I capture the complexity that is characteristic for the work within an emergency department. This complexity is important to understand when searching for possible explanations as to why the weekend effect exists. Thus, the combination of the use of ethnographic fieldwork and the information processing perspective enables me to find possible explanations for the weekend effect within both the formal organization and the employees' social practices on a micro level. This detailed and in-depth empirical investigation of the work practices within the health care setting in which the patient care is delivered provides a new perspective on the causes of the weekend effect.

The data collected during my ethnographic fieldwork within the emergency department was also used in the study of adverse events and registration practices presented in paper II. Based on informal interviews with employees collected during the fieldwork and previous studies of adverse events, I conducted four focus groups with 16 nurses. The aims of these focus groups have already been mentioned: however, the choice of this method will be elaborated upon further in one of the following subsections, where some methodological reflections on my qualitative data collection, which is not included in the papers, will be presented. These reflections include gaining access to the field, my role during my fieldwork, and a more detailed description of how I did my observations and interviews, including the focus groups.

#### Gaining access to the field

Getting access to the field is an ongoing process during fieldwork (Sanjek 1990, Hammersley & Atkinson 2007). The “gatekeepers” (Bernard 2011) from whom I gained admission to the emergency department were the management of the emergency department. I knew them from earlier research (Duvald & Kirkegaard 2014). I met with them and explained the project and methods. By writing a recommendation, they formally supported the research for the purpose of the hospital management’s approval. I got the approval two and a half months later.

Before starting at my fieldwork, I got access to the intranet used at the hospital. Here I found most of the documents used in this study (the use of documents is elaborated upon later). I also got an email address, which made it possible for me to a) receive the electronic newsletters from the department, and b) contact employees by email when making agreements with them about observations and interviews.

I started my fieldwork by presenting the study and myself in the departments' newsletter, which all employees receive. At morning meetings ahead of the observations, I gave a short talk about my project, told the employees about what I would do in practice during my fieldwork, and answered questions. The first that I observed were the nurses at A2. Informing and recruiting nurses for observations and interviews, I consulted with the ward managers on A2 and A1. I gave them a list of the shifts in which I wanted to follow a nurse and what role I wanted to follow. They looked in the roster and marked whom I should follow. Thus, the nurses knew in advance, when I would follow them in their shifts. On the day, I found the nurse I was to follow and said that I would like to follow her and I hoped that was okay. However, due to changes (e.g., sickness), and the fact that we did not always know in advance which role each nurse would have on a particular shift, some of the appointments were made ad hoc. Only one nurse asked me to follow somebody else. The nurses' age and experience varied.

When moving on to observe the junior physicians, I agreed with the shop steward for the junior physicians that I could participate in one of their meetings and introduce them to the project. Afterward, I sent each an email with the shifts in which I wanted to follow him or her. During my observations of the nurses and junior physicians, I met the emergency physicians and followed the same email process. After observations at A2, I went on to observe the employees on A1. However, when observing the emergency physicians, who often treat patients on both sections within their shifts, we often walked back and forth between the two sections. All patients were informed and verbally consented to allow my presence. Further details about both observations and interviews can be read in the sections where the individual data collection methods are described in detail.

## Role

The current empirical field's opportunities and conditions constitute a context for the study, as the role you choose to take as a researcher and the relationships you build up during the fieldwork affect the information obtained (Gulløv & Højlund 2003). As a researcher in a hospital department, if you want to be a "natural" person, whose presence in the ward can be continuous, you can choose between three roles: joining the staff, the patients, or the visitors/relatives. Most researchers do the first and "play" the role of doctor or nurse (Van der Geest & Finkler 2004). I also chose to join the employees. The aim of this study is to investigate the changes within the organization and social practices in an emergency department on weekdays and on weekends, and to get insider knowledge about this, the role of an employee seemed an obvious choice. Wearing nurse clothes, indoor shoes, and a nametag reading "Iben, PhD student" did that the patients did not ask many questions about my presence, and it gave me access to all spaces within the hospital. Moreover, it communicated to the employees "I am one of you". However, I was aware, as Wind (2008) has problematized, that I could not fully participate as a nurse or a doctor because of their highly specialized roles within the health care system. It was not possible for me to "go native" or participate at a complete level but rather at a passive level, and later on at a more moderate level (Spradley 1980).

When you participate in a department for so long, your role changes. In the beginning, some of the employees were very aware of my role as a researcher and sometimes they acted as if they did not know if they could tell or show me the things they were doing. There was a lack of confidence, and I got (just as much as I myself chose it) the role as the neutral observer. An ethnographer cannot choose roles; roles are as much something informants assign you (Wadel 1991). Over time, I participated more during the observations. The nurses began joking, "*You are allowed to help us, aren't you*" and asked me to hold things, shake a bottle of antibiotics, or even help them to move a patient. The junior physicians began asking me, when we were sitting by the computer and they were documenting the

treatment, “*Was it her left or right knee that was sore?*” or asked me to remember things they should do later. They saw my notes as a sort of checklist. Sometimes I did not help, if I wanted to see how they then solved it. I would not “disturb” the activities. However, often I helped as a sort of “thank you for letting me shadow you in your shift.” In the patient room, I mostly observed and took notes. I shifted into being the “fly on the wall” to keep an eye on the activity.

The fact that they involved me in their activities can be understood as follows: in a busy shift, where few employees were on duty, sometimes they considered me as an extra recourse. Another explanation is that I became “one of them.” My relationship with the individual employees changed. After a shift, where I followed a nurse, she said, “*It was nice getting to know the girl with the iPad a little better.*” We both felt we know each other better. Another day, I talked with a nurse about a seminar. She said, “*I do not understand why they (the management) hired an anthropologist from somewhere else, when we have our own.*” With time, the employees told me things they would not have told me in the beginning, when I was a stranger. The small room with medication became a place where the nurses spoke more freely about their experiences. As Bernard (2011) writes, the amount of time you spend in the field can make a significant difference in what you learn.

Other informants trusted me from the beginning. I had not been in the field that long when I followed a nurse on a night shift. The nurse explained that the management had decided that only one of the nurses in the team should find the next day’s medication for the patients, but tonight they would both find the medication. I asked why, and she answered, “*When the management is not around, they cannot decide, how we are going to do it.*” The employees kept doing things even though I was observing them. The Hawthorne effect is inevitable in all observational data collection techniques; that is, by virtue of being observed, what is being observed changes. One commonly found Hawthorne effect is the disruption of the normal flow of activities (McDonald 2005), and sometimes the nurses said that they did not walk as fast as they were used to, because I could not walk that fast while jotting

down notes. I responded that they should just walk fast. Mintzberg (1970) discusses possible observer effects in his classic study of CEOs, but does not believe that they are significant. My experiences confirm this.

### Participant observations

In light of the aim of the study, participant observation became an important strategy for collecting data (Spradley 1980, Hammersley & Atkinson 2007). The aim of the participant observations was to observe how the admission and treatment of patients in the emergency department were organized on weekdays and on weekends, and at the same time to ask employees how they did things, and why they did things as they did, in the moment they were performing the task. Between August 2015 and February 2016, I conducted approximately 700 hours of participant observations.

In order to gain insights into all aspects of the clinical setting and all work practices in the field, I followed each of the roles an emergency physician, a junior physician, and a nurse can have during two day, evening, and night shifts on weekdays and during one day, evening, and night shift on weekends. Each of these shifts was between eight and sixteen hours long. During the shifts, I participated in all their daily activities. This involved accompanying the employees and recording as closely as possible their activities, conversations, interactions, movement, and use of objects over an entire shift. I observed diagnoses and treatments of patients, the administrative work in front of the computer, and various conversations and supervisions. I participated in their breaks, in various conferences and meetings, and I observed when trauma patients were admitted. When entering a patient room, the employee told the patient about my presence and that the notes I took was about the work carried out and not about the patient himself, and asked the patient for his or her approval for me to remain in the room. All patients accepted my presence. For ethical reasons, I sometimes left

the room or tried to place myself somewhere where I could observe the interaction between the employees and the patient without seeing all activities, e.g., when nurses washed a patient. During the observations, extensive field notes were written to capture actions (Emerson et al. 1995).

When appropriate, small informal interviews took place during the observations (Bernard 2011). I asked the employees to comment on whatever came to their mind while they were, for example, looking at the computer screen or before and after they had been taking care of a patient. I asked them to verbalize what they were doing as they were doing their work. By gaining access to both the activity and the explanation behind it, actions are contextualized by the running commentary and every opinion is related to the situation that produced it (McDonald 2005).

This research tool where the researcher accompany the individual informants during their “natural” working processes through asking questions, listening and observing, and actively exploring their experiences and practices within their physical and social environment is known as “go-along” within anthropology (Kusenback 2003) and as “shadowing” within organizational studies (McDonald 2005).

Usually people do not comment on “what is going on” while working and thus it can be difficult to access their concurrent experiences if only observing their actions, and when interviewing people, people cannot explain in details how they actually are performing different tasks, because they are “taken out” of the environment where those activities take place (Kusenback 2003). Thus, the hybrid between participant observation and interviewing provides insights into otherwise invisible aspects of people’s work (McDonald 2005, Gill et al. 2014). By using shadowing, I was able to empirically examines the organizational processes of care and social practices within the emergency department on weekdays and on weekends, and thus explore possible explanations of why the patient care differs.

In total, I did 77 “go-alongs” covering 88 shifts and 674 hours. I followed 39 nurses in 48 shifts of 8-12 hours, 13 junior physicians in 15 shifts of 7-16.5 hours, and all 6 emergency physicians and 2



temporary physicians acting as “emergency physician” in 14 shifts of 7.5-16 hours. Table 2.1 provides an overview of the different roles the employees could have during their working hours, and which day of week and type of shift I followed for each individual role.

**Table 2.1:** Overview of “go-alongs”

Participant observations: Employees and their function / When they were followed	Day shift (7:00 a.m. - 2:59 p.m.)		Evening shift (3:00 p.m. - 10:59 p.m.)		Night shift (11:00 p.m. - 6:59 a.m.)	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
<b>Working at section A2</b>						
<b>Nurses</b>						
Coordinating nurse coordinating the work of the nurses and the in- and outflow of patients	Monday + Tuesday	Saturday	Thursday + Friday	Saturday	Monday	Sunday
Primary nurse in team taking care of medical patients, primary	Tuesday + Thursday	Saturday	Wednesday + Friday	Saturday	Wednesday	Sunday
Primary nurse in team taking care of surgical patients, primary	Tuesday + Wednesday					
Secondary nurse in team receiving new patients	Monday + Monday	Sunday	Wednesday	Sunday	Tuesday + Wednesday	Saturday
<b>Junior physicians</b>						
Junior physician treating medical patients, primary	Monday + Tuesday	Saturday + Sunday	Wednesday + Thursday	Sunday	Wednesday + Thursday	Sunday
Junior physician treating surgical patients, primary (exists in daytime until 6:00 p.m.)	Wednesday	Sunday				
<b>Senior physicians</b>						
Senior physician* - flow master coordinating the work of the physicians	Thursday + Friday					
Senior physician doing ward rounds, treating medical and surgical patients	Monday + Wednesday + Friday					
<b>Working at section A1</b>						
<b>Nurses</b>						
Coordinating nurse coordinating the work of the nurses and the in- and outflow of patients	Wednesday + Thursday	Saturday	Wednesday + Friday	Saturday	Monday + Tuesday	Sunday
Emergency room nurse	Monday + Thursday	Sunday	Tuesday + Thursday	Sunday	Friday	Saturday
Receiving nurse	Wednesday	Saturday	Monday + Friday	Saturday		
<b>Junior physicians</b>						
Junior physician treating orthopedic patients in the emergency room	Friday	Sunday	Monday + Friday	Sunday	Monday + Friday	Sunday
Junior physician treating other patients at A1	Thursday					
<b>Senior physicians</b>						
Senior physician treating patients	Tuesday + Thursday					

<b>Working at both sections</b>						
Senior physician (only one senior physician on duty in evenings, nights, and weekends)		Sunday + Sunday	Monday + Tuesday + Friday	Saturday + Sunday	Monday + Tuesday + Friday	Saturday

\* The term “senior physician” is used in the table because temporary physicians sometimes “act” as emergency physician.

## Interviews

To get a deeper understanding of everyday practice, interviews with different employees were conducted (see Table 2.2). Interviews are about the informant jointly, with the ethnographer, building up a picture of the social world unfolding around them (Otto 1997). Therefore, it is a method that is particularly suitable, when you want people to describe their experiences, and want to examine their own perspective on their social life, including their work situation (Kvale & Brinkmann 2009, Bernard 2011). While I could, during my participant observations, observe the employees and their interactions, it was possible during the interviews to gain insight into aspects that are not expressed in everyday life. Thus, in my interviews, I was not only interested in factual information about the organization of the emergency department, such as when was the therapist on duty in the department, but also the employees’ perceptions of the work and activities in the department (Kvale & Brinkmann 2009).

Different types of interviews produce various kinds of knowledge (Kvale & Brinkmann 2009). In my fieldwork, I used three different types of interviews. In addition to the informal interviews taking place during the observations, where employees were asked to elaborate on their work practices, I conducted 25 in-depth semi-structured individual interviews and four focus group interviews. To get a varied understanding, different health care professionals with different experiences were invited to participate in the individual interviews. During these formal interviews, I used an interview guide consisting of questions prepared in advance. The interview guide included questions about roles and

tasks within the department, the patient’s way through the department, coordination and communication, collaboration within the emergency department and with other departments at the hospital, and leadership style. The questions were asked openly, such as, “What roles can a nurse have at A1, and can you describe which tasks the different roles perform?” and “How do you perceive the relationship/interactions between the emergency department and other departments, e.g., the surgical department?” These open questions generated themes and perspectives about the emergency staffs’ worlds of work. Moreover, I had the freedom to modify the questions and order of the questions according to the responses of the informant, and the informants were encouraged to speak freely and to raise issues of importance to them (Hammersley & Atkinson 2007, Kvale & Brinkmann 2009). The interviews lasted between 1 and 1½ hours, and they took place at an empty office at the hospital, where the informants had the opportunity to speak freely.

**Table 2.2:** Overview of interviews (the table is also presented in paper III)

Type of interview	Informants	Number of informants per session	Total number of interviews
Individual interviews	Junior physicians	1	4
	Emergency physicians	1	6
	Nurses (2 from section A2, 1 from section A1)	1	3
	Ward nurses (1 from each section)	1	2
	Therapists (1 physiotherapist and 1 ergo therapist)	1	2
	Residents from other departments working within the emergency department	1	2
	Secretaries (2 from each section)	1	4
	Management of department	1	2
Focus groups	Nurses (8 from each section)	4	4

The individual interviews were supplemented with four focus groups with four nurses in each group (Morgan 1996). With this method, the main concern is to encourage a variety of viewpoints on the topics. It includes and uses the group dynamics and interaction to generate data, providing the researcher with elaborated perspectives on the discussed topics. The focus groups were conducted in order to a) discuss some of the findings from the observations and individual interviews, b) identify

and explore possible reasons for the results of the descriptive statistical analysis of the adverse events data, and c) identify relevant and appropriate questions for the questionnaire about registration practices.

With the assistance of the ward managers, 16 nurses were selected based on experience and section (see Table 2.3). One participant canceled due to sickness, but another nurse involved participated despite short notice. The participants in the individual groups were of similar professional status; they were all nurses, and there were no differences of rank.

Prior to the interviews, the participants were given written information. I moderated the focus groups, which were based on a semi-structured interview guide including questions about nurse roles within the context of adverse events. The guide stimulated the conversations, and topics previously uncovered were discussed. The focus groups took place in May and September of 2016. They were approximately two hours long, recorded and verbatim transcribed.

**Table 2.3:** Overview of participants in the focus groups

Focus group	Employment	Years of experience*	Age
1	A2	13	44
		13	46
		8,5	49
		13	51
2	A2	7	45
		3,5	29
		7	42
		2	32
3	A1	9	36
		17	53
		10	37
		12	41
4	A1	0.5	27
		0.5	33
		1.5	25
		0.5	33

\* Number of years, each nurse has worked within the department (or within a section that became a part of the emergency department when it was established in 2014)

## Documents

In order to understand the context of both the emergency department's organization and the social practices within the department, private documents produced by the emergency department for internal purpose (e.g., work schedules, role descriptions, and collaboration agreements), as well as public documents (e.g., the reports written by the Danish Board of Health) were collected (Payne & Payne 2004, Hammersley & Atkinson 2007). However, the documents were not only used to understand the context of the study. The private documents in particular were used for different purposes in different phases of the study. The observations were planned with the different staff roles in minds, and here the role descriptions available on the intranet were an important tool to get an overview of the different roles. Moreover, in order to see how different employees performed the different roles, work schedules were used to plan when to observe the individual emergency physicians and junior physicians. During the data collection, the written role descriptions were used to discuss the different roles during the interviews (e.g., who were responsible when the management of the department and ward managers were not on work on the weekends). Furthermore, the work schedules were used in the analysis phase to calculate what percent of the total shifts were covered by temporary physicians on weekdays and on weekends.

### **2.4.4 Theoretical framework used in the analysis (paper III)**

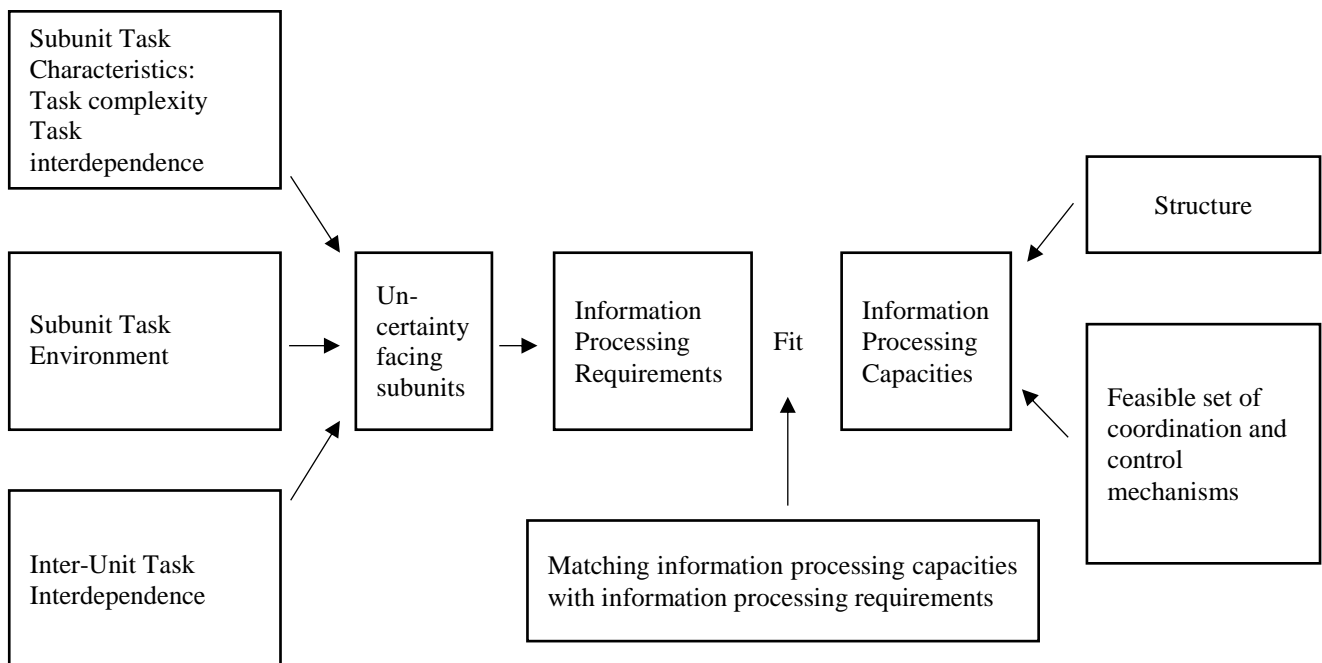
The theoretical framework I chose to use in the analysis of my qualitative study of differences within the organization of the emergency department on weekdays and weekends, is the information processing model presented by Tushman and Nadler (1977). The model is presented in paper III. However, in order to elaborate on my choice of theoretical framework, I will briefly summarize the model.

The model is based on an information processing perspective, which is an approach within the field of organizational design. Within this perspective, an organization processes information to perform tasks and coordinate and control its activities, e.g., physicians and nurses working in an emergency department collect, produce, analyze, and share information in order to diagnose, treat, and take care of patients. It is not only people who process information; various media are available to facilitate information processing, such as computers or information technology (Galbraith 1973, Tushman & Nadler 1977, Burton et al. 2015). When analyzing an organization's capacity to process information, the structure of the organization and the different kind of coordination and control mechanisms are important (Tushman & Nadler 1977). In order to be effective and attain greater performance, an organization must be designed so its information processing requirements and capacities are aligned (Burton et al. 2015). The information processing requirements depend on the level of uncertainty the organization is facing. The greater the uncertainty of the task, the greater the amount of information that has to be processed during the execution of the task (Galbraith 1973). Uncertainty is the differences between information processed and information required to complete a task, i.e., lack of information (Tushman & Nadler 1977). According to Tushman and Nadler (1977), three sources of work-related uncertainty are important when analyzing an organization's requirements. First, the subunit task characteristics regarding the tasks' complexity, i.e., amount of predictability (e.g., the emergency department cannot predict the arrival of the patients) and task interdependence, i.e., the extent to which employees are dependent upon another to perform their individual tasks. Second, the subunit task environment and how it affects the way the organization operate. Third, the inter-unit task interdependence, i.e., the extent to which the emergency department is dependent upon other departments at the hospital in order to perform its tasks effectively (see Figure 2.4).

By examining match and mismatch between the emergency department's information processing requirements and capabilities, I am able to identify the performance level of the emergency

department on weekdays and on weekends. Performance is, within the setting of an emergency department, the quality of care. Thus, a mismatch between the emergency department’s information processing requirements and capacities may explain why the quality of care differs on weekdays and on weekends.

**Figure 2.4:** The Information Processing Model (the figure is also presented in paper III)



The information processing model was chosen as the theoretical framework during the analysis of the empirical findings from my ethnographic fieldwork. My empirical data showed that in order to perform tasks (i.e., treat patients), the employees collect, produce, analyze, and distribute information, which makes an information processing perspective an appropriate theoretical framework. Through open coding, I identified differences between the organizing of the emergency department on weekdays and weekends (Emerson et al. 1995, Bernard 2011). One theme that emerged from this initial inductive analysis was the emergency department’s dependence on the other hospital departments and the resulting challenges, including a high level of uncertainty. By using the information processing model, which distinguishes between task environment and inter-unit task

interdependence, it is possible to highlight these challenges and how they affect the task solving within the emergency department. Another theme was the differences in number of employees and their way of solving tasks depending on their level of experience, which is possible to highlight in the analysis by the model's identification of capacities. Moreover, the uncertainty of letting a temporary physician manage the department on the weekends is highlighted by what Tushman and Nadler have called external actors, who attend to "organizational members" (1977:616). Within the context of an emergency department, in which various acute patients are diagnosed and treated, the organization must cope with several sources of uncertainty, making the information processing model an appropriate theoretical framework to guide the final, more focused analysis on the empirical data.

The information processing model presented by Tushman and Nadler is one of many contingency theories, which is an organizational theory that claims that there is no one best way to organize; however, any way of organizing is not equally effective, and the optimal organization is contingent upon the internal and external situation (Galbraith 1973, Scott & Davis 2014). However, their model is based on earlier contingency theories, including Burns and Stalker's different approaches to structuring organizations, Galbraith's identification of a range of coordination and control mechanisms, and Lawrence and Lorsch's perspective that different environments (with different levels of uncertainty) place different requirements on organizations (Tushman & Nadler 1977). Thus, by choosing this theoretical framework, I base my analysis on several classical contingency theories.

Contingency theory has been criticized for being too static and failing to deal with organizational change (Donaldson 2006, Scott & Davis 2014). However, based on empirical data, I use the information processing model to analyze the emergency department's capability to process information on weekdays and on weekends, and the results show that the organization of the emergency department changes during the week. Thus, by using the model I am able to identify organizational changes within the emergency departments.



One limitation of the information processing model is its simplicity. However, this is also one of the model's strengths. Tushman and Nadler presented their model more than forty years ago. Over time, contingency theory has become elaborated and extended - more and more factors, on which the design of organizations is contingent, are included (Scott & Davis 2014). One example of a newer model, which also integrates earlier contingency theories (e.g., Miles and Snow's strategy, structure and process model and Galbraith's star model), is the multi-contingency design model developed by Burton and Obel (2004). Their model includes goal, strategy, environment, structure, task design, people, leadership and organizational climate, coordination, control and information systems, and incentives (Burton et al. 2015). When analyzing the organizational changes within the emergency department on weekdays and weekends, I could have chosen this model as the theoretical framework. However, more of these elements are not relevant for this analysis, either because of the setting or because they do not really change during the week. An example is the leadership: the multi-contingency model distinguishes between a leader who is directive, short term, and control-oriented, or one who delegates, is long term, and motivates through inspiration (Burton et al. 2015). However, although in this in-depth empirical study the management of the department are not present on weekends it does not change the workflow or treatment of patients if the management is at work or not, because these tasks are managed by the emergency physician on duty. Changes within the role on weekdays and on weekends are captured by the capacity element within the information processing model. Thus, the information processing model includes all the elements important for this study, and by this rather simple model it is possible to show various differences within the emergency department's way of operating on weekdays and on weekends.

However, due to the simplicity, it is not possible to incorporate social practices into an organizational analysis based on the model - social practices that might influence or be influenced by the results identified by using the model. To gain a more comprehensive understanding of the differences within

the organization and the social practices between weekdays and weekends, I combine the information processing perspective and ethnography. Thus, by combining different perspectives (Astley & Van de Ven 1983, Scott & Davis 2014), I am able to examine both the formal organization and the strategies developed by the employees.

To ensure the validity of the analysis (and the study), communicative validation, also known as member validation, was used (Hammersley & Atkinson 2007, Kvale & Brinkmann 2009). In order to explore the extent to which employees recognize the organization and social practices presented in the findings, two physicians who no longer work within the emergency department read and commented on the findings from the studies, and some small modifications were made. Moreover, the findings from the studies have been presented at various emergency medicine conferences.

## **Chapter 3: Paper I**

---

Day of the week of admission, patient characteristics and patient outcomes:  
a study of the weekend effect in an emergency department

By: Iben Duvald, Anders Møllekær, Mathias A. Boysen, Betina Vest-Hansen

In January 2018, the article was submitted for publication in:

Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine

---

### **Corrigendum**

Within the paper “Day of the week of admission, patient characteristics and patients outcomes: a study of the weekend effect in an emergency department”, I have discovered some errors after the submission, which are corrected in the revision for the resubmission to Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine. The revised version is available from the author.

---

### 3.1 Abstract

**Background:** Despite extensive research on the “weekend effect” i.e., the increased mortality associated with hospital admission during weekend, knowledge about disease severity in previous studies is limited. The aim of this study is to examine patient characteristics, including disease severity, 30-day mortality, and length of stay, according to time of admission to an emergency department.

**Methods:** We conducted a cohort study of patients admitted to a Danish emergency department from 1 January 2014 to 31 December 2015. Using data from electronic patient records, this study examines patient characteristics including age, gender, Charlson Comorbidity Index score, and primary diagnosis. Triage score and transfer to ICU were used as indicators of disease severity. Length of stay within the emergency department and within the hospital was examined. Age- and sex-standardized 30-day mortality rates comparing patients with different triage admitted at daytime, evening, and nighttime on weekdays and on weekends were computed.

**Results:** We included 35,459 patient visits, of which 10,435 (29%) started on a weekend. There were no large differences in baseline characteristics between patients admitted on weekdays and those admitted on weekends. In total, 5.2 percent of the patients admitted on weekdays have a high-severity triage score (red or orange), while 6.1 percent of the admitted patients on weekends have a high-severity triage score (red or orange). More patients were transferred to the ICU at weekends (3.3% vs. 1.7%). The percentage of patients who had a stay longer than 24 hours within the emergency department increased 2 percent for patients admitted on weekends in all three time periods. The 30-day mortality rate increased with disease severity regardless of time of admission. When comparing the 30-day mortality rate for patients with the same triage score, the trend was toward a higher mortality when admission occurred during the weekend.

Conclusions: When comparing weekday and weekend admissions, the length of stay and the 30-day mortality rate increased on weekends for critically ill patients. On weekends, more patients had high-severity triage scores (red or orange), and more patients were transferred to the ICU. Disease severity may be one of the explanations of the weekend effect.

Keywords: weekend effect, patient characteristics, 30-day mortality, disease severity, triage, length of stay, emergency department

### **3.2 Background**

Today, most acute patients are admitted to hospital with an initial stay in the emergency department. A reorganization of the Danish health care system and the establishment of 21 emergency departments has directed about 70 percent of acute patients to an emergency department (Mattsson & Jørsboe 2014). Many patients remain in the emergency department and are discharged without in-hospital admission. Due to an aging population and an increasing number of patients with chronic conditions, the number of patients admitted to hospital, and therefore treated within emergency departments, is increasing (Sørup et al. 2013).

A large number of national and international studies have documented a difference in mortality rate for acute patients admitted to hospital on the weekend compared to those admitted on a weekday. This phenomenon is also called the weekend effect (Bell & Redelmeier 2001, Cram et al. 2004, Barba et al. 2006, Aylin et al. 2010, Mikulich et al. 2011, Sharp et al. 2013, Ruiz et al. 2015, Vest-Hansen et al. 2015). The extent to which this effect reflects the health care provided or the characteristics of the admitted patients is unclear.

Previous studies suggested that one explanation of the weekend effect may be changes in patient characteristics, e.g., disease severity. In their landmark study, Bell and Redelmeier (2001) demonstrated higher mortality for patients admitted to hospital during weekends compared with patients admitted during the week, and they conclude that patients admitted on weekends might be sicker than those admitted on weekdays. Early studies were criticized for not considering disease severity variation (Lilford & Chen 2015). However, the studies have mainly used administrative data, which contain limited information on disease severity. Thus, rigorous analysis using databases with clinical information on the patients is needed.

In recent years, electronic patient records (EPR) have been recognized as a rich data source when examining differences in patient outcomes. Several studies of the weekend effect use data from EPR (e.g., Biering et al. 2016, Walker et al. 2017). One UK study, using EPR data to investigate 30-day mortality among emergency admissions on weekdays and on weekends, suggests that the weekend effect arises from patient-level differences at admission. By linking administrative and laboratory data, the authors found that adjusting for 15 routine hematology and biochemistry test results (hemoglobin, platelets, lymphocytes, neutrophils, eosinophils, monocytes, C-reactive protein, urea, bilirubin, creatinine, albumin, alanine aminotransferase, alkaline phosphatase, sodium, and potassium) was highly prognostic for mortality (Walker et al. 2017). Thus, the use of data from the EPR can be important in the search for explanations of the difference in mortality for patients admitted during weekdays and weekends.

The weekend effect is well documented among acutely hospitalized patients, and emergency department admissions in Canada, the United States, UK, and other European countries (Webb 2011, De Cordova et al. 2012, Zhou et al. 2016). However, there has been limited research on the weekend effect for acute patients admitted to Scandinavian emergency departments, including Danish emergency departments. One small study, examining the medical records of 5,385 patients admitted

to a Danish emergency department during a three-month period, found that patients attending on weekends had indications of increased 30-day mortality compared with patients attending on weekdays. The study was able to adjust for disease severity based on clinical information from EPJ (Biering et al. 2016).

To address these gaps in the literature, we conducted a cohort study of all patients admitted to a Danish emergency department during daytime, evening, or nighttime in a two-year period (2014-2015). By using administrative and clinical data from the EPR, we examined patient characteristics including age, gender, CCI score, primary diagnoses, triage score, transfers to ICU, and length of stay (LOS) of weekend versus weekday admissions. In addition, we calculated and compared the age- and sex-standardized 30-day mortality for patients clustered in six different triage groups (red, orange, yellow, green, blue, and patients without a triage score). Triage data are widely used in emergency departments to evaluate disease severity (Christ et al. 2010). By using the EPR data, we are able to get data about patients' triage scores. To our knowledge, the triage score has not been used before as an indicator for disease severity in studies comparing mortality rates for acute patients admitted on weekdays and on weekends.

### **3.3 Methods**

#### Study design and setting

We conducted a cohort study. We identified all admissions to the emergency department at Viborg Regional Hospital, Regional Hospital Central Jutland, between 1 January 2014 and 31 December 2015 using administrative data from the EPJ.

In Denmark, a free, tax-funded health care system ensures that all citizens have unrestricted and equal access to general practitioners (GPs) and hospital care. Every Danish citizen is affiliated with a GP who in daytime refers the patient to the hospital. In evening, at nighttime, and on weekends, GPs rotate staffing of regional out-of-hours service centers, where they receive all patient calls. In case of a life-threatening condition or injury, patients can dial 1-1-2 and present by ambulance to the emergency department.

The Emergency Department at Viborg Regional Hospital is one of five emergency hospitals in Central Denmark Region. The emergency department employs 145 nurses and physicians, including eight senior physicians. With backing from physicians from other departments, all acute patients with a referral diagnosis covering general surgery, orthopedic surgery, and internal medicine are diagnosed and treated in the emergency department. Children, other than those with minor injuries, are received in the pediatric department, and patients with serious heart-related events bypass the emergency department are directed to the department of cardiology. Patients with psychiatric diseases are admitted to a psychiatric hospital. The emergency department, Viborg Regional Hospital, has previously been described in detail (Duvald 2017).

#### Data source

We have used data from MidtEPJ, the EPR developed by Systematic and used by all somatic and psychiatric hospitals in Central Denmark Region. Viborg Regional Hospital, as a part of Regional Hospital Central Jutland, was one of the last hospitals in the region to implement MidtEPJ in 2013. The MidtEPJ is a work, communication and documentation tool. It is accessible by multiple authorized users (e.g., nurses, physicians, and secretaries) and supports the clinical workflow across groups of health professionals, departments, and hospitals. The MidtEPJ documents patient



morbidity, treatment, and care over time. It contains both administrative data on hospital admission, including date (hours and minutes), department, source of admission, and clinical data such as age, gender, primary and secondary diagnoses, and triage score. The MidtEPJ is linked to the unique Civil Personal Registration number (CPR number) every Danish citizen is assigned at birth and to residents upon immigration. The CPR number is a 10-digit number that contains embedded information on birth date and sex. The CPR number ensures unambiguous patient identification. When using MidtEPJ data for research, the data is extracted directly from the source system itself and is stored in a regional data warehouse (named the Business Intelligence Portal). The data warehouse gathers data from a number of the region's different electronic systems, including MidtEPJ for quality assurance and health statistics purposes.

To compute the Charlson Comorbidity Index (CCI) score for each patient, data were obtained from the Danish National Registry of Patients (DNRP), which is a central medical registry that has recorded information on all hospital admissions to emergency departments since 1995. The record of each admission is linked to the CPR number.

Information on all-cause mortality within 30 days following the admission date was captured by linking the patient's CPR number to the Danish Civil Registration System (CRS). Established in 1968, the CRS stores complete and daily updated information on vital events, and can be retrieved for research purposes while protecting the Danish citizens' anonymity (Schmidt et al. 2014). CRS thus contains complete information on vital events of all patients included in this study. Patients were followed from date of admission until the date of death from any causes, the 30th day after discharge, or emigration, whichever occurred first.

## Study population

We included all admissions to the emergency department between 1 January 2014 and 31 December 2015 (a flowchart for the patient visits included in the study is available in Appendix II). This time interval was chosen because the emergency department became an independent department (independent leadership, budget, unique administrative department code) on 1 January 2014. The emergency department started receiving a wider range of patient categories, and the emergency room, formerly a part of the department of orthopedic surgery, became a part of the emergency department. On 1 January 2016 the organization of the emergency department changed again, as the department began to receive more medical patients who earlier would have been admitted to a nearby hospital.

To ensure complete follow-up, we only included patients with a CPR number.

A patient's visit at the hospital may consist of admissions to one or more departments. A patient admitted to the emergency department may be transferred to the ICU and afterward transferred to an internal medical department. During one hospital visit, some patients may be admitted to the same department more than once. In this study, we included hospital visits with up to five consecutive admissions. Furthermore, if more than four hours elapsed between two admissions, we considered it as two different hospital visits.

We excluded those patients treated at two clinics, that are organizationally part of the emergency department but are physically located in the cities of Skive and Silkeborg. Moreover, we excluded patients with missing information about date of finishing treatment within the emergency department. For the 30-day mortality analysis, we excluded nine patients due to invalid date of death.

## Time of admission

In this study, the exposure was the time of admission. We defined six time periods: daytime (from 7:00 a.m. to 2:59 p.m.), evening (from 3:00 p.m. to 10:59 p.m.), and nighttime (from 11:00 p.m. to 6:59 a.m.) on weekdays and on weekends. Patients were considered weekend admissions if they were admitted between 3:00 p.m. on Friday and 6:59 a.m. on Monday. Patients admitted on all other days and times were considered weekday admissions. We chose the time periods based on knowledge about how the emergency department was organized on weekdays and on weekends (Duvald 2017). Classifying time of admission into six periods, including daytime, evening, and nighttime on weekdays and on weekends, is an attempt to provide a more subtle description of the weekend effect.

## Outcomes

For each of the six time periods we described age, gender, comorbidity, triage score, and source of admission (GP, other hospital departments, self-referral, or other). Patient age was described based on five groups: 0-19, 20-39, 40-59, 60-79, and >80. The department (and hospital) the patients were transferred to after initial treatment within the emergency department, as well as primary diagnosis reflecting the reason for admission and identified at the time of discharge, was examined too. According to Danish guidelines and the guidelines of World Health Organization, the primary diagnosis assigned at hospital discharge should be the main reason for a patient's hospitalization (Vest-Hansen et al. 2014). We coded the diagnoses according to the International Classification of Diseases, 10th revision (ICD-10). However, we combined the infectious diseases in one group and merged other non-infectious diseases into a single diagnostic group, leaving us with fourteen diagnostic groups (details are outlined in Appendix III).

The CCI score was computed for each patient. This index reflects the number and seriousness of comorbid diseases. In this study, we collected data based on admissions recorded within the 10 years prior to admission. Three groups were created: Low (index score 0), Moderate (index score 1-2) and High (index score  $\geq 3$ ), categorical based on ICD-10 codes.

As a proxy for disease severity, we included the triage score. All emergency departments in Central Denmark Region use the tool Danish Emergency Process Triage system (DEPT). DEPT is a five-step triage system that prioritizes patients according to the degree of life or trunacy threat and thereby is indicative of how fast they are to be seen by a physician. It is based on triage using vital signs (airway, oxygen saturation, respiratory rate, pulse, blood pressure, Glasgow Coma Score, and temperature), which are collected by nurses as an integral part of the initial process of care, combined with pre-defined attention points related to the symptoms the patient had when admitted. The DEPT score is categorized by five groups of triage scores: blue (minor injury, only used in the emergency room), green (not urgent), yellow (less urgent), orange (urgent) and red (life-threatening).

The main outcome in this study was 30-day mortality and LOS for consistency with previous studies of the weekend effect. Emergency department and hospital LOS was calculated as the number of minutes from admission to the emergency department to final discharge or transfer to another hospital department from the emergency department. During the two-year study period, several patients had multiple emergency department visits. In the analysis of 30-day mortality, we included the last admission to the emergency department for each patient. In total, 21,736 patient-visits were included.

### Statistical analysis

We calculated the proportions of patients admitted during daytime, evening, and nighttime on weekdays and on weekends and characterized them according to patient characteristics. For each time

group, we collected data on age, gender, CCI score, source of admission, primary diagnosis, triage score, transfer to another department, and LOS.

Direct standardization adjusted for age and gender was used to compute the 30-day mortality rate for patients admitted to the emergency department in each of the six time periods (daytime, evening, and nighttime on weekdays and on weekends) (Kirkwood & Sterne 2003). As standard population for the mortality analysis, we applied the patients admitted in daytime on weekdays. Thus, for each time period, we estimated what would have been the 30-day mortality rate in this time period, if the population in that particular time period was equal according to age and gender with the one in our standard population. Mortality rates were displayed with their 95% confidence intervals (CIs) to indicate precision of the estimate. Subgroup analyses were performed for each triage score (red, orange, yellow, green and blue). Mortality rates for patients with missing triage score data were added. More subgroup analyses were performed, comparing the mortality rates for patients discharged to home from the emergency department and the mortality rates for patients transferred to other departments after initial treatment within the emergency department. Analyses were performed using the statistical software package STATA (version 11, Stata Corp, College Station, Texas, USA).

#### Ethical considerations

The Danish Data Protection Agency (record number 2015-57-0002) approved the study. The study was based on MidtEPJ data, but because all analyses were performed on an anonymous data set, no further approval from the National Committee on Health Research Ethics was required. The study was approved by the Viborg Regional Hospital, Regional Hospital Central Jutland.

### 3.4 Results

During the two-year study period, 35,459 visits were made to the emergency department, or about 49 visits per day. The total number of patients was 21,738, which means that many of the patients made several visits to the department. The median age of the patients was 48 years (IQR 25-70). Table 3.1 illustrates the demographic and clinical characteristics of the patients by time of admission. Patients admitted at nighttime were more frequently male, both on weekdays (53.2%) and on weekends (54.6%). There were no large differences in baseline characteristics between patients admitted on weekends and those admitted on weekdays. The percentage of patients admitted on weekends in the age group 20-39 was slightly higher than the percentage of patients in the same age group on weekdays. In total, 70.5 percent of the patients had a low CCI score, 19.6 percent had a moderate CCI score, and 9.9 percent had a high CCI score. As shown in Table 3.1, patients admitted during weekdays tended to have slightly higher CCI scores than patients admitted in the same time periods on weekends. This difference is most likely because the patients admitted on weekdays are slightly older than the patients admitted on weekends. In total, 75.7 percent of the patients were referred by the GP, 11.5 percent by other hospital departments, and 9.7 percent by others, while 3.1 percent of the patients were self-referrals. Most referrals from other hospital departments were during daytime, while most self-referrals presented during nighttime on weekends. Among the patients admitted at daytime or nighttime on weekdays the diagnosis “Factors influencing health status and contact with health services” were more prevalent, whereas patients admitted on weekends had a greater tendency to have diagnoses indicating injury or poisoning.

Overall, 29.4 percent of the patients were admitted on a weekend. Previous studies of the weekend effect found similar results (Biering et al. 2016).

**Table 3.1:** Demographic and clinical characteristics by time of admission

	Weekday (From 7:00 am on Monday to 2:59 p.m. on Friday)			Weekend (From 3:00 p.m. on Friday to 6:59 a.m. on Monday)		
	Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)	Nighttime (11:00 p.m. – 6:59 a.m.)	Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)	Nighttime (11:00 p.m. – 6:59 a.m.)
	n (% of group)					
<b>Overall</b>	15494 (43.7)	7674 (21.6)	1856 (5.2)	3192 (9.0)	5277 (14.9)	1966 (5.5)
<b>Age groups</b>						
0-19	2515 (16.2)	1646 (21.5)	220 (11.9)	492 (15.4)	1059 (20.1)	286 (14.6)
20-39	3090 (19.9)	1830 (23.9)	534 (28.8)	739 (23.2)	1322 (25.1)	642 (32.7)
40-59	3525 (22.8)	1622 (21.1)	408 (22.0)	686 (21.5)	1119 (21.2)	429 (21.8)
60-79	4146 (26.8)	1625 (21.2)	458 (24.7)	806 (25.3)	112 (21.4)	406 (20.7)
>80	2218 (14.3)	951 (12.4)	236 (12.7)	469 (14.7)	649 (12.3)	203 (10.3)
<b>Gender</b>						
Female	7742 (50.0)	3948 (51.5)	868 (46.8)	1576 (49.4)	2666 (50.5)	892 (45.4)
Male	7752 (50.0)	3726 (48.6)	988 (53.2)	1616 (50.6)	2611 (49.5)	1074 (54.6)
<b>CCI score</b>						
Low (0)	10698 (69.1)	5503 (71.7)	1280 (69.0)	2221 (69.6)	3899 (73.9)	1409 (71.7)
Moderate (1-2)	3122 (20.2)	1488 (19.4)	373 (20.1)	652 (20.4)	966 (18.3)	348 (17.7)
High (>=3)	1674 (10.8)	683 (8.9)	203 (10.9)	319 (10.0)	412 (7.8)	209 (10.6)
<b>Admission source</b>						
GP	11026 (71.2)	6281 (81.9)	1342 (72.3)	2506 (78.5)	4353 (82.5)	1318 (67.0)
Another hospital department	2717 (17.5)	524 (6.8)	101 (5.4)	349 (10.9)	322 (6.1)	75 (3.8)
No reference	519 (3.4)	209 (2.7)	46 (2.5)	75 (2.4)	138 (2.6)	119 (6.1)
Other	1232 (8.0)	660 (8.6)	367 (19.8)	262 (8.2)	464 (8.8)	454 (23.1)
<b>Primary diagnosis</b>						
Infectious diseases	1062 (6.9)	399 (5.2)	88 (4.7)	194 (6.1)	257 (4.9)	80 (4.1)
Neoplasm	11 (0.1)	5 (0.1)	1 (0.1)	2 (0.1)	1 (0.0)	0 (0)
Hematological diseases	164 (1.1)	45 (0.6)	2 (0.1)	16 (0.5)	16 (0.3)	0 (0)
Endocrine and nutritional diseases	143 (0.9)	113 (1.5)	22 (1.2)	21 (0.7)	54 (1.0)	17 (0.9)
Mental and behavioral disorders	94 (0.6)	106 (1.4)	43 (2.3)	19 (0.6)	68 (1.3)	94 (4.8)
Diseases of the nervous system	89 (0.6)	47 (0.6)	10 (0.5)	31 (1.0)	52 (1.0)	12 (0.6)
Diseases of the circulatory system	368 (2.4)	120 (1.6)	27 (1.5)	64 (2.0)	71 (1.4)	28 (1.4)
Diseases of the respiratory system	101 (0.7)	54 (0.7)	12 (0.7)	17 (0.5)	30 (0.6)	5 (0.3)
Diseases of the digestive system	398 (2.6)	145 (1.9)	53 (2.9)	82 (2.6)	112 (2.1)	55 (2.8)
Diseases of the musculoskeletal system	317 (2.1)	87 (1.1)	15 (0.8)	45 (1.4)	59 (1.1)	22 (1.1)
Diseases of the genitourinary system	183 (1.2)	66 (0.9)	21 (1.1)	55 (1.7)	51 (1.0)	25 (1.3)
Injury and poisoning	4144 (26.8)	2841 (37.0)	496 (26.7)	1125 (35.2)	2001 (37.9)	680 (34.6)
Factors influencing health status	7020 (45.3)	2952 (38.5)	782 (42.1)	1255 (39.3)	2018 (38.2)	703 (35.8)
Symptoms, signs, and abnormal findings	1308 (8.4)	644 (8.4)	271 (14.6)	233 (7.3)	432 (8.2)	224 (11.4)
Other	92 (0.6)	50 (0.7)	13 (0.7)	33 (1.0)	55 (1.0)	21 (1.1)

### Severity of disease

Table 3.2 portrays the triage score of patients admitted to the emergency department by time of admission. In total, 25.3 percent of the patients were triaged blue (24.6% on weekdays and 26.9% on weekends), 30.5 percent green (30.8% on weekdays and 29.9% on weekends), 12.2 percent yellow (11.8% on weekdays and 13.0% on weekends), 3.8 percent orange (3.6% on weekdays and 4.3% on weekends) and 1.7 percent red (1.6% on weekdays and 1.8% on weekends). The triage score of 26.6 percent of the patients admitted to the emergency department is unknown, because of missing data

(Table 3.2). Looking at the disease severity on weekdays and on weekends, 5.2 percent of the admitted patients on weekdays had a red or orange triage color, whereas 6.1 percent of the admitted patients on weekends have been triaged red or orange. Throughout the day, there is a steady increase of patients triaged red, orange, or yellow, both on weekdays and on weekends. The only exception is patients who are triaged red and admitted in the evening on weekdays. When comparing patients admitted in the evening on weekdays and on weekends, more patients admitted on weekends were triaged red, orange, and yellow.

**Table 3.2:** Triage color of patients admitted to the emergency department by time of admission

	Weekday (From 7:00 am on Monday to 2:59 p.m. on Friday)			Weekend (From 3:00 p.m. on Friday to 6:59 a.m. on Monday)		
	Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)	Nighttime (11:00 p.m. – 6:59 a.m.)	Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)	Nighttime (11:00 p.m. – 6:59 a.m.)
	n (% of group)					
<b>Overall</b>	15494 (43.7)	7674 (21.6)	1856 (5.2)	3192 (9.0)	5277 (14.9)	1966 (5.5)
Triage 5 (blue, minor injury)	3687 (23.8)	2130 (27.8)	336 (18.1)	850 (26.6)	1527 (28.9)	428 (21.8)
Triage 4 (green, not urgent)	4856 (31.3)	2172 (28.3)	679 (36.6)	934 (29.3)	1465 (27.8)	720 (36.6)
Triage 3 (yellow, less urgent)	1728 (11.2)	944 (12.3)	290 (15.6)	374 (11.7)	695 (13.2)	288 (14.7)
Triage 2 (orange, urgent)	496 (3.2)	294 (3.8)	110 (5.9)	119 (3.7)	231 (4.4)	101 (5.1)
Triage 1 (red, life-threatening)	246 (1.6)	113 (1.5)	52 (2.8)	49 (1.5)	85 (1.6)	51 (2.6)
Triage missing	4481 (28.9)	2021 (26.3)	389 (21.0)	866 (27.1)	1274 (24.1)	378 (19.2)

While 66 percent of the patients admitted to the emergency department have been discharged to home, 34 percent (n = 12,147) have either been transferred to another part of the emergency department (n = 1132, 3%), to another department at the hospital (n = 10,619, 30%), or to another hospital (n = 396, 1%) (Table 3.3). Three quarters of the patients transferred to another department at the hospital were transferred to either medical departments (n = 2718, 26%), the orthopedic surgery department (n = 2175, 20%), or other surgical departments (n = 3037, 29%). More patients are transferred to other surgical departments at night both on weekdays and on weekends. The relatively large proportion of patients transferred to a neurological department at another hospital (24% of all patients are



transferred to a neurological department) is because thrombolysis is not performed at Viborg Regional Hospital, Regional Hospital Central Jutland.

When comparing the proportion of patients transferred to the ICU from the emergency department in the different time periods, there is a steady increase in ICU admission rates throughout the day, both on weekdays and on weekends. On weekdays, the percentage increases from 0.9 in daytime to 5.1 percent at nighttime, while on weekends the percentage increases from 2.2 in daytime to 6.9 percent at nighttime. Nighttime, especially on weekends, was associated with the highest proportion of patients admitted to ICU. When comparing weekdays and weekends, the increase is also observable. More patients were transferred to the ICU at weekends (3.3% vs. 1.7%).

**Table 3.3:** Number of patients transferred to other departments after initial treatment within the emergency department by time of admission

	Weekday (From 7:00 am on Monday to 2:59 p.m. on Friday)			Weekend (From 3:00 p.m. on Friday to 6:59 a.m. on Monday)		
	Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)	Nighttime (11:00 p.m. – 6:59 a.m.)	Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)	Nighttime (11:00 p.m. – 6:59 a.m.)
	n (% of group)					
<b>Overall</b>	5293 (43.6)	2566 (21.1)	730 (6.0)	1146 (9.4)	1784 (14.7)	628 (5.2)
<b>Departments within the hospital</b>						
Cardiology department	402 (7.6)	137 (5.3)	48 (6.6)	67 (5.9)	93 (5.2)	25 (4.0)
Neurological department	166 (3.1)	78 (3.0)	24 (3.3)	29 (2.6)	46 (2.6)	11 (1.8)
Other medical departments	1238 (23.4)	607 (23.7)	148 (20.3)	217 (18.9)	385 (21.6)	123 (19.6)
Orthopedic surgery department	805 (15.2)	469 (18.3)	146 (20.0)	285 (24.9)	353 (19.8)	117 (18.6)
Other surgical departments	1358 (25.7)	620 (24.2)	199 (27.3)	263 (23.0)	418 (23.4)	179 (28.5)
Gynecology department/obstetrics	249 (4.7)	151 (5.9)	38 (5.2)	75 (6.5)	93 (5.2)	23 (3.7)
Psychiatry	56 (1.1)	23 (0.9)	11 (1.5)	2 (0.2)	31 (1.7)	10 (1.6)
Pediatric ward	229 (4.3)	132 (5.1)	11 (1.5)	53 (4.6)	103 (5.8)	9 (1.4)
Intern transferring within the ED	574 (10.8)	219 (8.5)	52 (7.1)	86 (7.5)	139 (7.8)	62 (9.9)
ICU (intensive care unit)	49 (0.9)	61 (2.4)	37 (5.1)	25 (2.2)	49 (2.8)	43 (6.9)
<b>Departments at other hospitals</b>						
Cardiology department	6 (0.1)	0	0	1 (0.1)	4 (0.2)	1 (0.2)
Neurological department	48 (0.9)	19 (0.7)	6 (0.8)	14 (1.2)	23 (1.3)	4 (0.6)
Other medical departments	16 (0.3)	11 (0.4)	6 (0.8)	3 (0.3)	12 (0.7)	2 (0.3)
Orthopedic surgery department	20 (0.4)	2 (0.1)	0	8 (0.7)	0	0
Other surgical departments	55 (1.0)	21 (0.8)	1 (0.1)	13 (1.1)	21 (1.2)	12 (1.9)
Gynecology department/obstetrics	0	0	0	0	0	0
Psychiatry	1 (0.0)	7 (0.3)	2 (0.3)	0	2 (0.1)	4 (0.6)
Pediatric ward	1 (0.0)	0	0	0	0	0
Another ED	15 (0.3)	8 (0.3)	1 (0.1)	5 (0.4)	10 (0.6)	3 (0.5)
ICU (intensive care unit)	5 (0.1)	1 (0.0)	0	0	2 (0.1)	0

## Length of stay

The emergency department has a rule that patients who are expected to stay within the hospital more than 48 hours, are transferred to other departments early during their admission. Only 1.5 percent of the patients have a LOS within the emergency department longer than 48 hours. Table 3.4 shows LOS within the emergency department and within the hospital by time of admission.

When comparing LOS within the emergency department on weekdays and on weekends, more patients admitted on weekends, regardless of what time of the day they were admitted, had a short stay (less than 3 hours) than patients admitted on weekdays. Relative to weekdays, the percentage of patients who had a stay longer than 24 hours within the emergency department on weekends increased in daytime from 11 percent to 13.3 percent, in evening from 5.2 percent to 6.9 percent, and at nighttime from 4.8 percent to 6.7 percent.

**Table 3.4:** Patients' LOS within the emergency department and within the hospital including their stay within the emergency department by time of admission

	Weekday (From 7:00 am on Monday to 2:59 p.m. on Friday)			Weekend (From 3:00 p.m. on Friday to 6:59 a.m. on Monday)		
	Daytime (7:00 a.m. - 2:59 p.m.)	Evening (3:00 p.m. - 10:59 p.m.)	Nighttime (11:00 p.m. - 6:59 a.m.)	Daytime (7:00 a.m. - 2:59 p.m.)	Evening (3:00 p.m. - 10:59 p.m.)	Nighttime (11:00 p.m. - 6:59 a.m.)
	n (% of group)					
<b>Overall</b>	15494 (43.7)	7674 (21.6)	1856 (5.2)	3192 (9.0)	5277 (14.9)	1966 (5.5)
<b>Length of stay within the emergency department</b>						
0-59 minutes (<1 hour)	2389 (15.4)	1082 (14.1)	254 (13.7)	528 (16.5)	858 (16.3)	350 (17.8)
60-179 minutes (1-2.59 hours)	4640 (30.0)	2523 (32.9)	511 (27.5)	994 (31.1)	1802 (34.2)	576 (29.3)
180-259 minutes (3-5.59 hours)	3291 (21.2)	1459 (19.0)	162 (8.7)	618 (19.4)	939 (17.8)	237 (12.1)
360-719 minutes (6-11.59 hours)	2529 (16.3)	376 (4.9)	477 (25.7)	427 (13.4)	225 (4.3)	395 (20.1)
720-1439 minutes (12-23.59 hours)	937 (6.1)	1837 (23.9)	363 (19.6)	203 (6.4)	1089 (20.6)	277 (14.1)
1440-2879 minutes (24-47.59 hours)	1407 (9.1)	355 (4.6)	74 (4.0)	350 (11.0)	288 (5.5)	113 (5.8)
More than 2880 minutes (>48 hours)	301 (1.9)	42 (0.6)	15 (0.8)	72 (2.3)	76 (1.4)	18 (0.9)
<b>Length of stay within the hospital</b>						
0-59 minutes (<1 hour)	1923 (12.4)	859 (11.2)	171 (9.2)	427 (13.4)	676 (12.8)	248 (12.6)
60-179 minutes (1-2.59 hours)	3718 (24.0)	2029 (26.4)	366 (19.7)	740 (23.2)	1401 (26.6)	438 (22.3)
180-259 minutes (3-5.59 hours)	2310 (14.9)	990 (12.9)	102 (5.5)	404 (12.7)	614 (11.6)	180 (9.2)
360-719 minutes (6-11.59 hours)	1432 (9.2)	228 (3.0)	302 (16.3)	247 (7.7)	131 (2.5)	327 (16.6)
720-1439 minutes (12-23.59 hours)	727 (4.7)	1259 (16.4)	237 (12.8)	132 (4.1)	816 (15.5)	206 (10.5)
1440-2879 minutes (24-47.59 hours)	1474 (9.5)	578 (7.5)	173 (9.3)	332 (10.4)	364 (6.9)	131 (6.7)
More than 2880 minutes (>48 hours)	3910 (25.2)	1731 (22.6)	505 (27.2)	910 (28.5)	1275 (24.2)	436 (22.2)

Both on weekdays and on weekends, 40-50 percent of the patients, regardless of what time of the day they are admitted, are discharged to home from the emergency department or transferred to another department within 3 hours.

### Mortality

In total, 664 patients (3.1%) died within 30 days after admission date. Table 3.5 shows the crude and age- and sex-standardized 30-day mortality rate for patients discharged from the emergency department and from another department, and for the six different triage groups. The age- and sex standardized 30-day mortality rate for patients admitted in daytime was 2.8 percent (95% CI 2.5-3.1%) on weekdays and 3.2 percent (95% CI 2.5-4.0%) on weekends. For patients admitted in the evening, the rate was 3.4 percent (95% CI 2.9-3.9%) on weekdays and 3.8 percent (95% CI 3.1-4.4%) on weekends, and for patients admitted in nighttime, the rate was 3.5 percent (95% CI 2.4-4.5%) on weekdays and 4.7 percent (95% CI 3.4-5.9%) on weekends.

Regardless of what time the patients were admitted to the emergency department, the mortality rate for patients who were transferred to another department after their initial treatment in the emergency department was higher than for patients discharged from the emergency department. When looking at the patients discharged to home from the emergency department, the age- and sex- standardized 30-day mortality rate for patients admitted on weekends compared to those admitted on weekdays were similar. However, if we compare the patients discharged from another department on weekdays and on weekends, the age- and sex standardized 30-day mortality rate for patients admitted in daytime was 7.2 percent (95% CI 6.3-8.1%) on weekdays and 8.0 percent (95% CI 6.0-10.0%) on weekends. For patients admitted in the evening, the rate was 7.9 percent (95% CI 6.5-9.3%) on weekdays and

9.4 percent (95% CI 7.6-11.2%) on weekends, and for patients admitted in nighttime, the rate was 6.6 percent (95% CI 4.3-8.9%) on weekdays and 10.0 percent (95% CI 6.9-13.1%) on weekends.

The triage score was directly associated with the 30-day mortality rate, which is lowest for patients triaged blue and highest for patients triaged red. When comparing the 30-day mortality rate for patients with the same triage score admitted in the same time periods on weekdays and on weekends, weekend admission was associated with increased mortality for patients triaged yellow, orange, or red, with two exceptions: the patients triaged yellow admitted at nighttime and patients triaged red admitted in daytime. When comparing the patients triaged orange admitted on weekdays and on weekends, the age- and sex standardized 30-day mortality rate for patients admitted in daytime was 15.0 percent (95% CI 10.9-19.2%) on weekdays and 23.9 percent (95% CI 12.0-35.9%) on weekends. For patients admitted in the evening the rate was 18.0 percent (95% CI 11.5-24.6%) on weekdays and 20.9 percent (95% CI 13.7-28.2%) on weekends, and for patients admitted in nighttime, the rate was 8.1 percent (95% CI 1.4-14.7%) on weekdays and 20.0 percent (95% CI 8.6-31.5%) on weekends. For patients triaged orange, mortality rate more than doubled for patients admitted to the emergency department in weekend nighttime compared with weekday nighttime. For patients triaged red admitted in the evening on weekdays the 30-day mortality rate was 25.0 percent, as compared with 34.6 percent for weekend admissions in same time period.

For patients triaged green, weekend admission was associated with increased 30-day mortality rate only in nighttime, where the mortality rate nearly doubled, increasing from 2.3 percent (95% CI 0.7-3.8%) to 4.4 (95% CI 2.2-6.7%). The mortality rate for patients with missing triage score data is higher than for patients with a blue triage color, indicating that it is a group of patients with varying disease severity.

**Table 3.5:** Crude and age- and sex standardized 30-day mortality rates for variation in discharge and for the six different triage colors among patients by time of admission to the emergency department

The patient's last visit to the ED (21,736)	Weekday (From 7:00 am on Monday to 2:59 p.m. on Friday)					Weekend (From 3:00 p.m. on Friday to 6:59 a.m. on Monday)					
	Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)		Nighttime (11:00 p.m. – 6:59 a.m.)		Daytime (7:00 a.m. – 2:59 p.m.)	Evening (3:00 p.m. – 10:59 p.m.)		Nighttime (11:00 p.m. – 6:59 a.m.)		
	Reference	Crude (%)	Adj. % (95% CI)	Crude (%)	Adj. % (95% CI)	Crude (%)	Adj. % (95% CI)	Crude (%)	Adj. % (95% CI)	Crude (%)	Adj. % (95% CI)
<b>Overall</b>	2.8 (2.5-3.1)	3.0	3.4 (2.9-3.9)	3.5	3.5 (2.4-4.5)	3.5	3.2 (2.5-4.0)	3.3	3.8 (3.1-4.4)	3.5	4.7 (3.4-5.9)
<b>Discharge</b>											
Discharged from the ED	0.9 (0.7-1.1)	1.0	1.2 (0.8-1.6)	1.4	1.7 (0.7-2.8)	1.2	1.1 (0.6-1.7)	0.8	1.0 (0.6-1.5)	1.4	2.1 (1.0-3.2)
Discharged from another department	7.2 (6.3-8.1)	8.0	7.9 (6.5-9.3)	7.0	6.6 (4.3-8.9)	8.6	8.0 (6.0-10.0)	9.1	9.4 (7.6-11.2)	9.3	10.0 (6.9-13.1)
Triage missing	1.9 (1.4-2.3)	2.5	2.8 (1.9-3.7)	5.3	5.4 (2.8-8.0)	3.5	2.2 (1.2-3.1)	3.0	3.0 (1.9-4.2)	4.4	5.9 (2.6-9.1)
Triage 5 (blue)	0.2 (0.1-0.4)	0.3	0.3 (0.0-0.7)	0	0 (0.0-0.0)	0.2	0.2 (0.0-0.6)	0	0 (0.0-0.0)	0.3	0.9 (0.0-2.2)
Triage 4 (green)	2.8 (2.2-3.4)	2.8	3.2 (2.2-4.2)	1.9	2.3 (0.7-3.8)	2.3	2.4 (1.1-3.6)	2.8	3.2 (2.0-4.4)	2.9	4.4 (2.2-6.7)
Triage 3 (yellow)	6.8 (5.2-8.4)	5.8	6.1 (4.1-8.0)	4.9	5.2 (1.8-8.7)	9.2	8.1 (4.6-11.6)	6.2	7.1 (4.4-9.8)	4.2	5.4 (1.6-9.3)
Triage 2 (orange)	15.0 (10.9-19.2)	15.0	18.0 (11.5-24.6)	8.6	8.1 (1.4-14.7)	20.3	23.9 (12.0-35.9)	18.8	20.9 (13.7-28.2)	11.7	20.0 (8.6-31.5)
Triage 1 (red)	20.0 (13.3-26.7)	21.7	25.0 (0-)	21.4	29.6 (9.9-49.2)	13.3	10.7 (1.8-19.7)	28.9	34.6 (21.4-47.7)	23.8	32.9 (0-)

### 3.5 Discussion

In this study of 35,459 visits to a Danish emergency department, we found that 29.4 percent of the patients were admitted on a weekend. There were no large differences in baseline characteristics between patients admitted on weekends and on weekdays. We demonstrated that patients admitted via the emergency department on weekends had an increased risk of dying within 30 days when compared with patients admitted on weekdays. In particular, patients attending on weekends and who were triaged yellow, orange, or red had indications of increased mortality compared with patients attending on weekdays. For critically ill patients, who had a red triage score, evenings on weekends were associated with the highest risk of 30-day mortality, whereas nighttime on weekends was associated with the highest risk for patients triaged orange. The results are in line with previous findings (Biering et al. 2016). The increase in mortality persisted after adjusting for two confounders, age and gender. Due to the choice of six time periods, this study shows both a daily variation and a

variation between weekdays and weekends. Furthermore, more patients had a long stay (a stay longer than 24 hours) within the emergency department on weekends.

There are several possible explanations for our results. One explanation of the weekend effect found in this study may be the severity of disease. More patients admitted at weekends were triaged orange or red, and more patients were transferred to the ICU on weekends. Nighttime on weekends was associated with the highest proportion of patients transferred to the ICU from the emergency department. However, we are aware that ICU transfers also depended on the availability of ICU beds. Vest-Hansen et al. (2015) found a similar result in their study of acute medical patients' out-of-hours and weekend admissions to Danish medical departments. Another explanation of the weekend effect suggested by previous studies is the health care provided. The current study did not directly examine the organization and delivery of care on weekdays and on weekends. However, ethnographic fieldwork conducted in the same emergency department showed differences within the organization of the emergency department, weekdays and weekends, including a reduction in staffing and staffing experience, and changing working patterns (Duvald 2017). Similar organizational differences have been observed in other Danish emergency departments (Møllekær et al. 2017).

As EPR systems become the norm in modern health care, it is natural to explore this treasure trove of data for improving health care and research. The key strength of this study was its use of data from the MidtEPJ, allowing us to analyze the disease severity using the data on triage score. Emergency departments use triage to determine the clinical priority of patients based on their presenting features in order to decrease morbidity and mortality. With the triage system, health care personnel can identify patients who need immediate attention, who can safely wait, or who may not need emergency care at all. However, using triage categories as indicators for disease severity has limitations. Only the initial triage color was used, and as described elsewhere, the triage score is sometimes changed,

either because of changes in patient's condition or due to organizational reasons such as lack of resources and time (Duvald 2017).

Variations in practices is a known limitation when using administrative data. However, some of the differences in registration practices resulting in missing data was avoided by the first author's extensive knowledge of registration practices due to an ethnographic fieldwork within the emergency department. The results of the fieldwork are described elsewhere (Duvald 2017). One example was about how the nurses documented the triage score in the emergency room, which differed from the rest of the department. The blue triage color of 9,168 patients was documented differently, which we were aware of when extracting the data. Thus, we avoided a huge gap within the data about triage score, where it otherwise appears that 25.9 percent (9.168/35.459) of the included patients have not been triaged. A gap that has been mentioned as a limitation in studies where data from the MidtEPJ are used (Møllekær 2016). The triage score of 26.6 percent of the patients admitted to the emergency department is still missing. In contrast to a previous study (Biering et al. 2016), we included patients without a triage score, but as an independent group. We expect that this group consists of patients either not ill (blue triage color) or critically ill. The patients admitted to the emergency department as trauma patients do not have a regular triage and will appear as not being triaged. The emergency department received 507 trauma patients during the two-year study period.

The Danish health care system may differ from the systems in other countries. However, the results of this study support the evidence of a higher mortality for acute patients admitted on weekends when compared with admissions on weekdays (Bell & Redelmeier 2001, Cram et al. 2004, Barba et al. 2006, Aylin et al. 2010, Mikulich et al. 2011, Sharp et al. 2013, Ruiz et al. 2015, Vest-Hansen et al. 2015). This study extends this by grouping patients according to their triage score in order to find an association between mortality risk and disease severity. One previous study has used the triage score as an indicator for disease severity, but only as a confounder (Biering et al. 2016). Moreover, no

studies of acute patients admitted to emergency departments have distinguished between daytime, evening, and nighttime on weekdays and on weekends, when comparing mortality rates, LOS, and patient characteristics including disease severity. This distinction is highly relevant when looking at how the Danish emergency departments, including the one at Viborg Regional Hospital, are organized (Duvald 2017, Møllekær et al. 2017).

Also mentioned in a previous study, it is being admitted at weekends, rather than merely being in hospital at weekends, that has been consistently associated with higher mortality risk. Reduced weekend staffing and resources should affect all patients in hospital at weekends, not just those newly admitted (Walker et al. 2017). However, within an emergency department, most patients only stay for a shorter while, which makes the admission time highly relevant when investigating the mortality rate for patients admitted to an emergency department on weekdays and on weekends. In this study, 40-50 percent of the patients admitted to the emergency department, regardless of what time of the day they were admitted, were discharged to home or transferred to another department within 3 hours, and 91 percent within 24 hours. Thus, only a few patients admitted on a weekday will be affected by how the emergency department is organized on weekends.

Death within 30 days of discharge from an emergency department is a rare event. During the two-year study period, only 13 patients triaged red and discharged from the emergency department died within 30 days of admission date. The reason for this is that critically ill patients often have a longer hospital stay, and after initial treatment in the emergency department, they are transferred to other departments. The results of this study confirm this by showing that the 30-day mortality rate was higher for patients transferred to and discharged from other departments. The differences within the 30-day mortality rate for patients admitted in the emergency department on weekdays and on weekends are still interesting, especially when the triage score of the patients is included. The triage is performed within the emergency department, and differences within this crucial and complex



diagnostic and treatment phase within patients' hospital stay may cause differences within the mortality rate. In this study, the 30-day mortality rate was also chosen, because of the possibilities to compare the results with other studies of the weekend effect. However, when analyzing the quality of treatment within emergency departments, the mortality rate may not be the most important parameter.

### **3.6 Conclusion**

In conclusion, when comparing acute patients' admissions to an emergency department on weekdays and on weekends, the LOS and the 30-day mortality rate increase on weekends, especially among critically ill patients. The facts that the number of patients transferred to the ICU increases on weekends and that more patients admitted on weekends are triaged red or orange indicate that changes in disease severity may be one of the explanations of the weekend effect.

#### **Acknowledgement**

I would like to thank the emergency department for their willing participation in this project.

#### **Authors' contributions**

All authors contributed to the study conception and design and were responsible for the acquisition of data. I analyzed the data with help from BV-H, and I drafted the manuscript. All authors critically revised the manuscript and approved the final version. For details, see the declaration of co-authors.



## **Chapter 4: Paper II**

---

Adverse events in an emergency department weekdays and weekends – a critical study of registration practices

By: Iben Duvald

A shorter version of this article is prepared for submission for publication in:

Journal of Evaluation in Clinical Practice

## 4.1 Abstract

Admission to the hospital on weekends has been associated with a higher risk of adverse events. However, limited information is available concerning this “weekend effect.” This study investigates numbers and types of adverse events occurred in an emergency department on weekdays and on weekends, and explore the registration practices and how the employees relate to these adverse events, including their perception of barriers to and incentives for reporting the adverse events.

This study followed a mixed-methods design: 1) a descriptive observational study consisting of 229 adverse events occurred in a Danish emergency department and reported to the mandatory national reporting system during a two-year period (2014-2015), 2) qualitative unstructured interviews with different employees and four focus groups with 16 nurses, and 3) a questionnaire distributed to all employees.

The analysis showed that most adverse events happen on weekdays (0.13 per shift) when compared to weekends (0.07 per shift). Of the reported adverse events, 26.6 percent (61/229) occurred on weekends, and the greatest risk of adverse events in the emergency department comes in the night between Saturday and Sunday. Most of the adverse events on weekdays are related to 1) samples, patient examination, and test results and 2) medication. Adverse events related to 3) treatment and nurse care and 4) information handover, patient responsibility, and documentation happen more often in weekends. The qualitative interviews and questionnaire suggest that employees perceive reported adverse events as a tool to optimize the work processes and quality of patient care provided in the emergency department. However, because of barriers on both an organizational and a practice level, they did not report all adverse events, which creates bias in the register data. This study presented different tendencies regarding when and what kinds of adverse events are happening in an emergency

department weekdays and weekends. However, when only some adverse events are reported to the mandatory national reporting system, this study also indicated problems in registration practices.

## 4.2 Introduction

*“Everyone must report every adverse events, they observe. I think.*

*I myself do not do it, but I think it is a good idea.” (Nurse)*

In recent years, it has become widely recognized both internationally and nationally that errors and adverse events are a major problem in health care, with implications for patient safety and patient care. Furthermore, admission to the hospital on weekends has been associated with a higher risk of adverse events (Redelmeier & Bell 2007, Buckley & Bulger 2012).

Learning from mistakes is a key to maintain and improve the quality of care. In 2000, the Institute of Medicine (now National Academy of Medicine, or NAM) recommended expanding reporting of adverse events particularly mandatory reporting (Kohn et al. 2000, Leape 2002). Within the Danish health sector, the extent of the problem of adverse events has been highlighted by knowledge collected in the Danish Patient Safety Database (DPSD), a national electronic self-reporting system established in 2004. The DPSD defines an adverse event as *“any event that results from treatment at or stay in a hospital, and which is not caused by the patient’s illness, and which is concomitantly either harmful or could have been harmful, but was prevented from occurring or did not occur for other reasons (...) The adverse event has to take place as a result of the patient’s treatment, i.e., examination, diagnosis, clinical treatment, rehabilitation, health care and prophylactic health care, or as the result of the hospital stay itself, e.g., falling out of bed.”* (National Board of Health 2007). This definition includes both adverse events and near misses. The definitions used internationally are

slightly different, but there is a basic agreement that an adverse event is an unintended injury or complication caused by health care management or procedure rather than the patient's disease (De Vries et al. 2008, Stang et al. 2013).

The purpose with the DPSD is to create a systematic attention to the adverse events and a tool by which patient safety issues can be identified and addressed to reduce the occurrence of clinical incidents and to improve quality of patient care. The reporting system is based on the assumption that it is human to err, and that errors usually occur due to the way the work is organized. This approach is also called the systems approach (De Vries et al. 2008). When reporting an adverse event, a standard incident form, requiring basic clinical details and a brief narrative describing of the incident, is used. Reports are analyzed at a local level and are subsequently collected in anonymous form by the Board of Health in the DPSD. The first year (2004) almost 6,000 adverse events were reported, and in 2009 25,249 adverse events were reported in Danish hospitals. Since 2010, health professionals have been required to report all adverse events they may observe. In 2011, the system was expanded to the practice sector, the municipal health care, and the pre-hospital area, and patients and their relatives could report adverse events. In 2015, the number of reported adverse events increased to 183,445, whereas 47,444 were reported in Danish hospitals (Patient Safety Board 2016). These numbers indicate a rising trend to report errors and adverse events, but the actual number and types of events is unknown. Despite the acknowledged importance of adverse events reporting, it is known that underreporting is usual (Stanhope et al. 1999, Barach & Small 2000, Tchijevitch et al. 2017). Interviews and informal conversations with staff and risk managers within Danish Hospitals suggest a reporting frequency of approximately 5-10 percent (Steenberger 2013, Vibjerg 2013). Moreover, Tchijevitch et al. (2017) found that more life-threatening and fatal adverse events were not reported in the reporting system.

Several studies have reported different barriers employees face in reporting all adverse events, including time constraints, lack of adequate reporting systems, fear of litigation, uncertainty of the clinical importance of the events, lack of changes after reporting and lack of education (Vincent et al. 1999, Barach & Small 2000, Evans et al. 2006, Brubacher et al. 2011).

With an underreporting rate to DPSD at around 90 percent it is, because of registration practices, difficult to get an overview of the health consequences for patients of adverse events. Nor is it possible to see if there are types of adverse events that were not or rarely reported. Furthermore, when not all adverse events are reported to the DPSD, does research using data from the DPSD then tell more about registration practice than about the trends in adverse events? Using the results of the prospective descriptive observational study, this article reflects on this question.

Inspired by the Harvard Medical Practice Study (Brennan et al. 1991), previous studies about in-hospital adverse events have mainly used retrospective record review or prospective observational studies (Leape et al. 1991, Stanhope et al. 1999, Baker et al. 2004, Soop et al. 2009), including a Danish study of incidence of adverse events in hospitals (Schiøler et al. 2001). In some studies, the data from these approaches were compared with voluntary reporting data (De Vries et al. 2008). Other studies use and advocate the use of voluntary or mandatory electronic reporting systems when describing the rates and types of adverse events occurred at hospitals (Milch et al. 2006, Tighe et al. 2006, Andersen et al. 2010). However, little attention has been paid to how adverse events are reported in actual clinical practice (Smith et al. 2006).

Emergency departments are considered to be at particularly high risk for adverse events. Reasons include high patient volume, patient complexity, and a work environment characterized by time constraints and multiple interruptions (Tighe et al. 2006, Stang et al. 2013). Studies about adverse events occurring in the setting of emergency departments have focused on a single type of adverse

event, such as adverse drug events (e.g., Hafner et al. 2002) or registration errors (e.g., Hakimzada et al. 2008). Those focusing on all adverse events in emergency departments have mainly used a prospective observational study or prospective cohort study (Fordyce et al. 2003). A systematic review literature regarding adverse events related to emergency department care concludes that further research in this area is needed (Stang et al. 2013). One study has been carried out in a Danish emergency department and focused on work-related stressors and occurrence of adverse events (Nielsen et al. 2013).

The “weekend effect” or higher rates of mortality and morbidity among hospital inpatients on weekends has previously been reported in the literature (Bell & Redelmeier 2001, Cram et al. 2004, Barba et al. 2006). Furthermore, admission to the hospital on weekends has been associated with a higher risk of adverse events (Redelmeier & Bell 2007). Despite extensive research into adverse events, the occurrence of adverse events weekdays and weekends has received less analysis, despite research showing a strong weekend effect (Buckley & Bulger 2012).

Accordingly, this article has the following aims: 1) to use information from the mandatory electronic self-reporting system to investigate numbers and types of adverse events that occurred in an emergency department on weekdays and weekends, 2) to explore the registration practice and how the employees in the emergency department relate to these adverse events, including their perception of barriers to and incentives for reporting the adverse events, and 3) to discuss the usefulness of the data from a mandatory electronic self-reporting system in studies of adverse events.

### **4.3 Methods**

This study followed a sequential explanatory and exploratory three phase-approach (Creswell 2014). First, a prospective descriptive observational study has been used to investigate numbers and types



of adverse events occurring in an emergency department on weekdays and weekends. This first phase was followed up with qualitative interviews, which builds to a questionnaire that examined the prevalence of issues or themes from the focus groups (Wolff et al. 1993, Morgan 1996). The last two phases were added to explore the registration practice and the attitudes and perceptions of employees about the reporting of adverse events in the emergency department. The goal of following a mixed-methods design has been to expand the understanding of adverse events that happen in an emergency department on weekdays and weekends (Johnson et al. 2007).

An emergency department at a Danish regional hospital was selected for the actual study since up to 70 percent of all acute patients in Denmark are evaluated in emergency departments. A weekend effect in an emergency department will affect numerous patients. Furthermore, the emergency department is considered at particularly high risk for adverse events (Tighe et al. 2006, Stang et al. 2013). The Emergency Department at Viborg Regional Hospital, Regional Hospital Central Jutland is one of five emergency hospitals in Central Denmark Region. The size of Central Denmark Region is 13,142 km<sup>2</sup> with a total population of 1,282,000, out of which the Viborg area constitutes approximately 233,000 people. The emergency department serves 18,000 patients annually and receive patients referred by general practitioners and patients who have called 1-1-2. All acute patients with referral diagnosis covering orthopedic surgery, general surgery, and internal medicine (except children and some cardiologic patients) are diagnosed and treated in the emergency department with backing from physicians from other departments. The emergency department consists of two sections. Nurses in the emergency department work either at the section where they receive orthopedic surgery patients and some medical patients or at the section where they receive general surgical and medical patients, while the physicians cover both places.

## Descriptive observational study

The descriptive observational study consists of 229 adverse events that occurred in the emergency department and were reported anonymously to the mandatory national reporting system during a two-year period. This paper describes adverse events reported from January 1, 2014, through December 31, 2015. In Denmark, emergency departments are a new type of organization. The decision to establish emergency departments was made in 2007. The emergency department in this study became an independent department January 1, 2014. Before that, the emergency room was part of the department of orthopedic surgery, while acutely ill medical and surgical patients were received in a division within the department of medicine.

The quality consultant of the hospital, who normally processes the officially reported adverse events, collected all the reported adverse events during the study period directly from the database and ensured that they were localized to the emergency department. Data on each adverse event included date and time (time was not always given), location (the emergency department is divided in to different sections in terms of both geography and what symptoms patients are received with), and type of adverse event (main category and two subcategories). A free-text description of the adverse event and the severity of impact on the patient (from no harm to deadly) were available too. The data were anonymized before the author got them.

All reports were entered into a database and were reviewed by the author. The review involved categorizing the events into different weekdays, shifts (day, evening, and night shifts) and weekday and weekends. Simple descriptive statistics were used to aggregate and summarize adverse event characteristics. The number of adverse events that happened on weekdays and weekends was calculated. The data were adjusted for number of patients staying in the emergency department in different types of shifts and number of employees working within the department in different types

of shifts. Data on number of patients were available from a cohort study described in detail elsewhere (Duvald et al. 2018). Information about numbers of employees was collected during a prolonged ethnographic study conducted in the emergency department.

Time of adverse events was defined as weekday or weekend. In this study, six time periods was used: dayshift (from 7:00 a.m. to 2:59 p.m.), evening shift (from 3:00 p.m. to 10:59 p.m.), and nightshift (from 11:00 p.m. to 6:59 a.m.). In this study 59.1 percent of the total shifts were defined as weekday (Monday from 7:00 a.m. to Friday 2:59 p.m.) and 40.9 percent as weekend (Friday from 3:00 p.m. to Monday 6:59 a.m.). Public holidays (e.g., Easter and Christmas) were considered weekends.

### Qualitative interviews

The author did a prolonged ethnographic study in the emergency department. Fieldwork consisted of approximately 700 hours of participant observations. In order to gain insight into all aspects of the clinical setting and all work practices in the field, the author followed senior physicians, junior physicians, and nurses in their daily activities in day, evening and night shifts on weekdays and in weekends. All patients were informed and verbally consented to allow the presence of the author. Informal interviews took place during the observations. The informants were asked to elaborate and reflect on their work practices and the organizational structure of the department. The observations were supplemented with 25 in-depth semi-structured interviews with ward managers, senior physicians, junior physicians, nurses, secretaries, therapists, and the management of the department. Moreover, four focus groups with four nurses in each group were conducted. All the interviews took place at the hospital. The empirical material was generated between August 2015 and February 2017. All who participated in the study have been anonymized. The fieldwork is described in detail elsewhere (Duvald 2017). The empirical material containing information on the registration of

adverse events are primary based on the focus groups and the informal interviews with employees during the observations.

The use of focus groups in this stage of the project enabled a broad exploration of the subject of adverse events, providing insights into the nurses' experiences of registration practices and thus informing subsequent research design. For this study, benefits of focus groups included the capacity to (a) identify and explore a range of beliefs, attitudes, ideas, opinions, and behaviors in the population of interest, and (b) identify relevant and appropriate questions for the questionnaire.

Due to potential for emotionally charged topics, smaller groups that generated high levels of participant involvement were appropriate for this study (Morgan 1996). With the assistance of the ward managers, 16 nurses from the emergency department were recruited to participate in four focus groups with four nurses in each group. In order to cover a broad range of perspectives, informants were selected based on experience and section. The emergency department consists of two sections. From each section, four experienced nurses, who have worked in the department (or sections that have become a part of the emergency department) between 8.5 and 17 years were gathered in a group, and four nurses who have worked in the department between 0.5 and 7 years, were selected for a group. A focus group is a constructed social situation where multiple informants discuss and share information about their practices with other participants. The groups were composed to be as homogeneous as possible: the participants were all nurses, they were of similar professional status, and there were no differences of rank. Thus, there was no opportunity for one to exert authority over another.

Participants were given written information about the study prior to the interviews. The focus groups were moderated by the author and were based on a semi-structured interview guide including one main question and different sub-questions about adverse events. The questions asked during the

interviews were inspired by both information collected through informal interviews with different employees during the observations and previous studies about adverse events (e.g., Vincent et al. 1999). The nurses discussed what they perceived as an adverse event in the setting of an emergency department, which adverse events they would report, the reasons why they did or did not report adverse events, and experiences with the work with the adverse events within the department. The guide was designed to stimulate conversation and promote interactive discussion to explore topics previously uncovered. Follow-up questions were used extensively to pursue relevant information. The interviews took place in May and September 2016. The focus groups, each approximately two hours in length, were recorded and transcribed verbatim. Following careful reading for emergent themes, data from each focus group were coded within its context into index categories.

All data were analyzed by the author and discussed with two senior researchers. Ethnographic principles of analysis were followed when analyzing the interview data. Inspired by a process approach that sees causal explanations as fundamentally a matter of identifying the actual processes that resulted in a specific outcome in a particular context (Maxwell 2012), different incentives and barriers were identified in order to explain the results of the analysis of the reported adverse events happened in the emergency department.

### Questionnaire

An anonymized self-completion paper-and-pencil questionnaire was conducted in November 2016 (Creswell 2014). The questionnaire was developed based on the interview data, including questions concerning employees' practices and actions in terms of registration of own adverse events, knowledge of the reporting system, and experiences with the work with the adverse events within the department. The questionnaire contained 31 items, and response opportunities were either tick box or

free text. Staff were asked to state their profession, age, gender, and years of experience in the department. As pretesting is extremely important for self-contained questionnaires (Leeuw & Hox 2008), a pilot questionnaire had been tested on two employees beforehand to assess the clarity and relevance of the questions and to improve the format. One week prior to the study, all employees received a short advance notice within the electronic newsletter at the two sections. On the day, they received the questionnaire, they were given oral information about the study, and detailed instructions on how to respond were included in the cover letter (Creswell 2014). To achieve a high response rate in self-completion questionnaires requires special effort in the contact phase (Leeuw & Hox 2008). Thus, to secure a higher response rate, the modified questionnaire was printed and handed out personally by the author to each employee in the department. The employees were explained the purpose of the questionnaire and encouraged to cooperate. However, the answer process was still self-administered. The employees completed the questionnaire during working hours and deposited their completed questionnaires in a box placed in an office at the department. To increase the response rate, two reminders were sent out. The questionnaire was included to find out more about registration practices and attitudes and, furthermore, to provide a numeric description of trends indicated in the interviews (Morgan 1996). A total of 89 nurses and 9 senior physicians were invited to take part. A few employees did not participate due to maternity, long-term sickness, or long-term holiday. Completed questionnaires were received from 55 nurses and 8 senior physicians, yielding a response rate of 64 percent.

Responses from the questionnaire were analyzed in Excel through descriptive analysis of the survey responses (Creswell 2014).

## Ethics

Ethical approval was not required for this study. According to Danish law, formal ethical approval is not mandatory for studies that do not involve biomedical issues. The management of the hospital and the management of the emergency department approved the data collection. The emergency department choose not to be anonymized. The staff participating in the study did so freely. All data, including data from the reported adverse events collected from the database and the data from the various interviews and the questionnaire were anonymized.

## 4.4 Results

### Numbers and types of adverse events

229 adverse events that occurred in the emergency department were reported to the national reporting system during a two-year period from 1 January 2014 to 31 December 2015 (136 in 2014, 93 in 2015).

The median value of number of reports per month was 9 (range 3-17).

**Table 4.1:** The day and shift the 229 adverse events happened

Adverse events	In total		Day shift (7:00 a.m. - 2:59 p.m.)		Evening shift (3:00 p.m. - 10:59 p.m.)		Night shift (11:00 p.m. - 6:59 a.m.)		Unknown	
	Number ( <i>n</i> )	Rate, %	Number ( <i>n</i> )	Rate, %	Number ( <i>n</i> )	Rate, %	Number ( <i>n</i> )	Rate, %	Number ( <i>n</i> )	Rate, %
Tuesday	45	20	15	26	8	13	4	11	18	24
Wednesday	44	19	13	22	7	12	6	17	18	24
Thursday	42	18	10	17	15	25	7	20	10	13
Friday	27	12	9	16	8	13	2	6	8	11
Saturday	22	10	3	5	12	20	5	14	2	3
Sunday	24	10	2	3	4	7	8	23	10	13
Monday	25	11	6	10	6	10	3	9	10	13

The analysis showed that during the two-year period most adverse events happen on weekdays (0.13 per shift, 168/1287) when compared to weekends (0.07 per shift, 61/903). Most adverse events happen Tuesday (20%), Wednesday (19%), and Thursday (18%). However, the results of this study also showed that 26.6 percent (61/229 including four on a public holiday) of the reported adverse events occurred on weekends (marked with a red border). Adverse events that happened on Mondays and Fridays without a time stamp were considered to have occurred on a weekday.

The number of patients staying within the emergency department and the number of employees working within the emergency department varies over time, both in the different shifts and on the different days on the week. If we adjust the number of adverse events we have a timestamp for, with number of patients (Table 4.2) and number of employees (Table 4.3), respectively, the results look different.

**Table 4.2:** Numbers of adverse events per 1,000 patients, divided by shifts

Adverse events	Day shift (7:00 a.m. - 2:59 p.m.)	Evening shift (3:00 p.m. – 10:59 p.m.)	Night shift (11:00 p.m. – 6:59 a.m.)
Tuesday	2.76	1.70	1.76
Wednesday	2.50	1.45	2.80
Thursday	1.97	3.27	3.09
Friday	1.73	1.74	0.91
Saturday	0.81	3.15	2.09
Sunday	0.56	1.07	3.36
Monday	1.12	1.17	1.50

**Table 4.3:** Number of adverse events per 1,000 employees, divided by shifts

Adverse events	Day shift (7:00 a.m. - 2:59 p.m.)	Evening shift (3:00 p.m. – 10:59 p.m.)	Night shift (11:00 p.m. – 6:59 a.m.)
Tuesday	3.43	2.33	2.56
Wednesday	2.95	2.02	3.81
Thursday	2.27	4.33	4.17
Friday	2.01	2.33	1.20
Saturday	0.99	4.44	3.00
Sunday	0.66	1.48	5.13
Monday	1.34	1.75	1.92

There is an increased risk of experiencing an adverse event when staying within the emergency department, after adjusting for number of patients and number of employees working within the emergency department in the different type of shifts, comes Thursday evening, the night between Wednesday and Thursday, and Saturday evening. However, the night between Saturday and Sunday



is the shift with the highest risk (3.36 adverse event per 1,000 patient, and 5.13 adverse events per employee).

The adverse events ranged in severity on weekdays and weekends. In Denmark, the adverse events are divided into five different groups when looking at the severity of impact on the patient: no harm, minor (i.e., transient damage that does not require increased treatment or care), moderate (i.e., transient damage requiring (increased) treatment or care), serious (i.e., permanent injury requiring hospitalization, (increased) treatment or care, or other injuries requiring emergency treatment) and deadly (Patient Safety Board 2016).

**Table 4.4:** The adverse events’ severity of impact on the patient

Severity of impact on the patient	All adverse events (n=229)		Weekdays (n=168)		Weekends (n=61)	
	Number (n)	Rate, %	Number (n)	Rate, %	Number (n)	Rate, %
No harm	125	55	89	53	36	59
Minor	34	15	23	14	11	18
Moderate	59	26	46	27	13	23
Serious	10	4	9	5	1	2
Deadly	1	0	1	0	0	0

Table 4.4 shows that the majority of adverse events were classified as no harm, i.e., they had the potential to cause harm to the patient but did not actually result in any harm. The number of serious and deadly adverse events reported was considerably lower than adverse events classified as minor and moderate. When looking at the severity of impact on the patients, the adverse events on weekends are not worse than those adverse events occurring on weekdays.

Different types of adverse events occur most often on weekdays and on weekends. Table 4.5 shows the most common reported adverse events within each main category of events happened within the emergency department on weekdays and on weekends.

**Table 4.5:** Most common reported adverse events within each main category of events

Main category of event	All adverse events (n=229)		Adverse events on weekdays (n=168)		Adverse events on weekends (n=61)	
	Number (n)	Rate, %	Number (n)	Rate, %	Number (n)	Rate, %
Samples, patient examination, and test results	48	21	39	23	9	15
Patient identification	15	7	13	8	2	3
Treatment and nurse care	35	15	23	14	12	20
Medication	49	21	37	22	12	20
Information handover, patient responsibility, and documentation	27	12	18	11	9	15
Blood and blood products	9	4	6	4	3	5
Referrals, admission and discharge, and prescribed medication	28	12	21	12	7	11
Other kinds of adverse events*	18	8	11	6	7	11

\*Examples include medical equipment, gases and air, and patient accidents (e.g., falls).

The categories “samples, patient examination, and test results” (23%, 39/168) and “medication” (22%, 37/168) were the most common types of adverse events happen on weekdays. Adverse events related to “treatment and nurse care” (20%, 12/61), “information handover, patient responsibility, and documentation” (15%, 9/61) and “other kinds of adverse events” (11%, 7/61) happen often on weekends. “Blood and blood products” (4%, 6/168 on weekdays and 5%, 3/61 on weekends) were less frequent. That percentage is almost equal to “medication” adverse events on weekdays and weekends, but the types of medical adverse events vary on weekdays and weekends. There is a distinction between “dispensing” (22% on weekdays and 8% on weekends), “prescribing” (49% on weekdays and 42% on weekends), “administration” (27% on weekdays and 50% on weekends) and “emergency calls” (3% on weekdays and 0% on weekends).

#### Employees’ perception of incentives for and barriers to reporting adverse events

The questionnaire showed that all employees thought it important to report adverse events. The focus group interviews suggest that employees perceive reported adverse events as a tool to optimize the work processes and quality of patient care provided in the emergency department. They came up with

different reasons why they thought it was important to report the adverse events. Their incentives were learning experiences (avoiding similar adverse events in the future), securing the patients' safety, their duty to report the adverse events, improving the workflows, and improving the work environment. Some nurses mentioned the importance of reported adverse events being used to change things in the department.

One nurse said: *"I reported one, and then I was contacted and asked to explain in detail what had happened. It was cool to experience that someone was actually reading my report. Somebody did follow up on this."*

Another nurse gave this example: *"I participated in a root-cause analysis of an adverse event that happened in the department, and I actually think it was very interesting and a learning experience. It was about who reads the ECG. As a result, they changed the workflow at the ward. The bio analysts should place the ECGs in another place, and the emergency physician was told to see all of them and control them. So, in that sense we learned something."*

The majority of nurses and physicians did report adverse events (69% of the nurses and 88% of the physicians). Most employees did the registration at work. Many tried to report the event just after they discovered it (38%, 17/45), but most adverse events were reported later in the shift (56%, 25/45) or in another shift (51%, 23/45). However, only a few adverse events were reported, and underreporting was both stated in the questionnaire and mentioned during the interviews as an acknowledged problem in the department.

As a nurse said: *"I have reported, but I do not report enough."*

Another nurse said: *“No, the adverse events are not reported - not many. I myself have, within the last 5 years, reported two, and I have made several adverse events. I have certainly been able to report some more, but I did not.”*

A third nurse said: *“I have only reported one single adverse event during the last 10 years, but you could report an adverse event every single day if you want to. Just to mention one thing, you receive a new patient and on the table beside the bed the old medicine has not been removed. It is an adverse event that occurs every day.”*

Of the employees who reported adverse events, 76 percent noted that they had only reported 1-5 adverse events during their career in the emergency department. When asked in the questionnaire about how many of those adverse events they were responsible for they reported, more than half of the employees responded that they report only few of them or some of them (51%, 23/45). Health professionals are required to report all adverse events they may observe; however, few employees (9%, 4/45) responded that they reported all the adverse events they observed.

According to the employees, there are many different reasons for the low rates of reporting. Table 4.6 summarizes different reasons for why not all adverse events are reported.

**Table 4.6:** Barriers to reporting adverse events

Categories	Results from the questionnaire and citations from the focus groups
<b>Organizational Level</b>	
Lack of education	25% answered that they have not been introduced. Another 10% doubted that they were introduced. <i>"Someone else has told me where to start reporting - the rest has been self-taught (learning by doing)."</i> <i>"A colleague has shown me how to report"</i>
Uncertainty about practice	37% were uncertain about which adverse events to report. <i>"One day I received a phone call about a sample that had been placed in a wrong place, and now the sample could not be analyzed. We had to make a new sample, and that kind of sample in the knee is not without risks for the patient. I found the nurse who was responsible for the patient and the sample and explained her the situation. Then should she have reported the event, or should I have reported that event? I think I should."</i>
The role of the management	<i>"It has something to do with that we do not have a leader who asks us to do it. I think, if our leader was more visible, saying that it is just important that you make these reports on the adverse events, then..."</i>
<b>Level of Practice</b>	
Lack of time	Chosen as a reason by 84% of the nurses and 63% of the physicians. <i>"I have reported adverse events during or after a shift, but it can be difficult to find the time for it."</i> <i>"A half year ago I was responsible for an adverse event. I did not report it. I could not see when I should have time to do it. It was a very busy shift."</i>
Prioritizing other tasks	Chosen as a reason by 33%.
Subjective judgement	<i>"The case was insignificant"</i> was the second most frequently noted reason (chosen by 42% of the nurses and 75% of the physicians). <i>"Sometimes when I read about which adverse events my colleagues did report, I think, my god is it such small things they report, it is just a minor thing, but it is my colleagues who are doing the right thing. I should report much more than I do today."</i> <i>"Sometimes I have been in a situation, where I thought, this is really fatal, and the patient is not dead, but it resulted in something really bad, and I have no doubt, I reported it."</i> <i>"If I am going to report an adverse event, then it has to have a consequence for the patient. I do not report near misses, because... - well, nothing was going wrong."</i>
Not natural to report	37% agreed that they did not report simply because they forgot. <i>"We can all learn from each other's mistakes and failures, but often I do not think about that this is actually an adverse event and I should report it. Often you are just happy that you manage to solve/avoid the event, and then the day is going on. You do not think, I should report it, because we could all learn from this."</i>

The questionnaire and interviews showed different barriers to reporting adverse events, which can be divided into barriers on an organizational level and barriers at a practice level.

One of the reasons, why not all employees reported adverse events, is highlighted by the question in the questionnaire, *have you been introduced to the work with the adverse events?* Of respondents, 25

percent (16/63) answered that they had not been introduced, while another 10 percent doubted that they were introduced. When looking at the experience of the employees who answered that they had not been introduced, some were new employees. However, some had been working in the department for years. Several employees wrote that they had learned it by doing it or other colleagues had shown them how to report. This **lack of education** could be a reason for the uncertainty about which adverse events the department expected the employees to report, and 37 percent (23/63) answered that they were in doubt about this. Another kind of uncertainty is an **uncertainty about practice** - who should report the adverse events happening in the emergency department? Uncertainty about practices was discussed during the focus groups.

*“Is it me, who discovered the adverse event, who should report it, or should my colleague, who was responsible for it, report it? I am in doubt about it.”* (Nurse)

Other nurses agreed they had been in that situation too. This uncertainty likely contributes to why not all employees reported the adverse events they observed in the department.

Time conflict between clinical workload and reporting was the most frequently noted reason for not reporting adverse events. **Lack of time** was chosen as a reason by 84 percent of the nurses and 63 percent of the physicians. In addition, several nurses highlighted this reason during the interviews. This factor is especially important during times when employees are most busy, which may also be when adverse events are most likely to occur. Of respondents, 37 percent (23/63) believed that most adverse events occur when they are busy, and the nurses expressed the same attitude in the focus groups:

*“Many adverse events happen during a day, because we run so fast then we forget something, or we do not manage to do things at the right time.”* (Nurse)

Another question is whether, when employees are too busy to report, they then do the reporting of the adverse events in their spare time. In the questionnaire, 29 percent of the nurses wrote that they would not use their spare time to make the reports, and this is one of the reasons why they do not report all the adverse events. However, when asked, when reports are made, a number of employees admit that they do report adverse in their spare time (20%, 9/45).

Some of the nurses participating in the focus groups disagreed that lack of time was a barrier, but said the **lack of focus** on reporting was.

*“The excuse, we are too busy to report, it is too simple, too easy, I believe. You do not have to report it the same day, you can just wait until the next morning, and we are sitting in front of that computer all the time. It does not take that much time to report those events. It is something else it is more a lack of focus.”* (Nurse)

The result of the lack of focus on reporting adverse events was, according to the nurses, that they did not think about reporting in the moment. Thus, they simply forgot to report. Moreover, often they did even not recognize that something was actually an adverse event.

*“I did not even report that I found an unconscious patient who had a low blood sugar of 1.5 (...) I was really happy I found him and was able to do something about it.”* (Nurse)

The statement “the case was insignificant” was the second most frequently noted reason in the questionnaire (chosen by 42% of the nurses and 75% of the physicians). This statement, as well as prioritizing other tasks (chosen by 33% of the respondents), showed that the employees exercised a considerable degree of **subjective judgement** in their reporting, i.e., the individual employee chose subjectively which adverse events he or she chose to report. Several wrote that it was often a matter of time and the severity of the event that decided whether they reported the event.

Moreover, individual employees had different perceptions of what an adverse event is. Is an event an adverse event you should report, or is it just something you forgot or did not manage to do because of unsuccessful management of your own tasks?

Another key reason for non-reporting highlighted by the questionnaire is **the system**. Of employees, 41 percent selected the statement “it is cumbersome to report the adverse events”. Another question about their experiences with the electronic reporting system supports this statement. Most felt that it was difficult and took a long time to report the adverse events in the electronic system.

The nurses in the focus groups agreed that if they did not report adverse events in the department, then they could not learn from these earlier experiences. They thought this was important, but at the same time, they said, just sitting and talking about the importance of the reporting would not change their behavior they would not report more adverse events.

*“Something is going to happen before we get better at reporting; otherwise I think we would just do as we do already I am not getting better at it, just talking about it.” (Nurse)*

If they were going to report more adverse events, most of the employees would like the management to have more focus on reporting. Previous studies highlight that high rates of reporting depend on the continual reinforcement and education of the aims on adverse events reporting to employees (Hart et al. 1994).

#### **4.5 Discussion and conclusion**

The association between adverse events and time of day and day of week (weekday vs. weekend) has not been extensively studied. Within the current Danish reporting system of adverse events, reporting does not provide a distinction between weekdays and weekends, which shows that the distinction has



not been in focus when designing the system. The distinction between day, evening, and night shifts does not exist as well.

Descriptive observational studies based on reported adverse events like this does give an idea of when the adverse events are happening and what type of adverse events are happening in the setting of an emergency department on weekdays and on weekends. The adverse events reported represent clear hazards and opportunities to learn and improve patient safety. However, we know from previous studies, from those working with the reporting system, and from the employees who responsible for reporting the adverse events that not all adverse events that occur are reported (Stanhope et al. 1999, Brubacher et al. 2011). Underreporting to the Danish national database has also been indicated in previous studies (Viskum et al. 2011, Nielsen et al. 2013). The interviews with the nurses working in the emergency department and the results of the questionnaire support this.

Previous studies have shown that there are various reasons for this (Vincent et al. 1999, Barach & Small 2000, Evans et al. 2006, Brubacher et al. 2011). Our findings are consistent with previous research. Brubacher et al. (2011) explored nurses' perceptions of barriers to and incentives for patient safety events reporting. They identified six main barriers: 1) time constraints, 2) a sense of futility, 3) fear of reprisal, 4) a lack of education on reporting, 5) reports viewed as indicators of incompetence, and 6) an inaccessibility of reporting forms. In this study, some of the identified barriers are the same: lack of time and lack of education/introduction. However, fear of reprisal is not a main barrier found in this study. Only a few nurses chose the statement "I am worried about litigation." The possibility to anonymize the reports may explain this. However, it can be difficult to guarantee anonymity if an adverse event happens in a night shift when a limited number of employees are on duty. This may explain why the number of reported adverse events is lower in night shifts. However, a smaller number of patients or a smaller number of employees could also be explanations (e.g., fewer adverse events are happening, or the employees do not have time to report if they are too busy). Lack of time

was a frequently mentioned barrier. Inaccessibility of reporting forms is not a barrier within this context, because all employees have access to the electronic reporting system from the computers within the department and even at home.

The staff in the emergency department knew about the Danish incident-reporting system, but they did not report all adverse events. In the questionnaire, the employees were asked to come up with one example of an adverse event in the emergency department. Many of them were not reported. The aim of the interviews and questionnaire was to explore the reasons for the low rates of reporting. One strength of this study is the combination of using both focus groups and a questionnaire. The focus groups went beyond the information obtained in the survey, amplifying our understanding of the various facets of barriers to adverse events reporting and specifying more exactly how some of the barriers work in practice. The questionnaire covered many more topics than the focus groups. The questionnaire is effective for determining the prevalence of any given attitude or experience. Various barriers on both an organizational level and at a practice level were identified. Furthermore, the results show what the employees find necessary to report is subjective, and several employees simply did not know which adverse events should be reported.

The result showing that only a limited number of adverse events are reported indicates that this study demonstrates more about reporting practice than about when the adverse events actually are happening. If an argument is that the reported adverse events says more about registration practice, then the adverse events have to be reported by health personnel and not the patients. This is the case. In 2015, patients and relatives reported 1,834 adverse events. Reports from patients and relatives constitute 0.5 percent of all reports submitted to the Danish Patient Safety Database (Patient Safety Board 2016).

The adverse events analyzed in this study are only the top of the iceberg why do the health personnel and patients not report the adverse events they observe? Reporting practice is also about how the organization relates to the adverse events: does the organization encourage the employees to report? One of the barriers identified was the management's lack of focus on reporting. As Vincent et al. (1999) write, high rates of reporting depend on the continual reinforcement and education of the aims of incident reporting to staff.

One of the main differences between working weekdays and weekends according the employees is that there are fewer employees at work and they run faster in the weekend-shifts. If this were correct, it would be likely that more adverse events happen on weekends, but that the adverse events are not reported, because of the workload. Further research is needed.

A descriptive analysis such as this departs from an implicit and simplified notion of causality, which impedes reflexivity on social context. These data do not show the actual numbers and types of adverse events occurring in the emergency department on weekdays and on weekends but can only show some trends. When establishing a causal link between these trends and adverse events occurring on weekends, we forget the wider social and historical setting and the causal explanation may very well be too simple. To get a more holistic explanation, we must look at the social contexts and the registration practices - why do the employees not report the adverse events?

It is not enough to say that this is the data we have and therefore this is the data we use to say something about the trends in adverse events. There is not a systematic relationship between the results of the statistical analysis of the reported adverse events and the weekend effect. The quantitative conception of causality primarily pertains to whether x caused y, rather than how it did so, and why x is looking at it is. It depends on the context within which the mechanism operates (Maxwell 2004a). Process theory, in contrast, deals with events and the processes that connect them;

it is based on an analysis of the causal processes by which some events influence others (Maxwell 2004a). Causal explanation is defined by Maxwell (2012) as fundamentally a matter of identifying the actual processes that resulted in a specific outcome in a particular context. This article both offers a description of the reported adverse events and investigates the processes and mechanism that explain why the description looks as it does. It does not investigate only the systematic relationship between variables, but also causal processes that can explain the results. For social sciences, the social and cultural contexts of a phenomenon studied are crucial for understanding the operation of causal mechanisms. Similarly, realist social scientists see the meanings, beliefs, values, and intentions held by participants in a study as essential parts of the causal mechanisms operating in that setting. This view of intentions, beliefs, and meanings as causes is fundamental to our common-sense explanations of actions. Further research is needed to investigate these causal processes in detail.

This study presented different tendencies regarding when and what kinds of adverse events are happening in an emergency department weekdays and weekends. Additionally, when only some adverse events are reported to the mandatory national reporting system, this study also indicated problems in registration practices. However, the adverse events reported represent clear hazards and opportunities to learn and improve patient safety. This study offers insights into the problems underlying low rates of reporting in an emergency department.

The lack of education and introduction makes it clear that the work with the adverse events has not been implemented in the emergency department, even though many employees know how to report an adverse event. Many of them mentioned that they have learned it by doing it. When the employees discover failures, they are not thinking about reporting it - the day just continues, as one nurse said. Only if events had clear consequences for the patient will they report the adverse events.

The primary purpose of reporting is to learn from experience. Adverse events need to be reported if the organization is going to know the reasons for them in order to prevent them from happening in the future, which is the real intervention. There appears to be room for further improvement.

### Acknowledgements

I would like to thank the quality consultant and particularly the employees at the emergency department for their willing participation in this project. Furthermore, I thank Assistant Professor Sarah Maria Lysdal Krøtel for her statistical support and advices.



## **Chapter 5: Paper III**

---

Fits and misfits between information processing requirements and capacities: the weekend effect in a hospital emergency department

By: Iben Duvald

In the process of revision and resubmission for publication in:

Journal of Organizational Design

## 5.1 Abstract

This study examines fits and misfits between information processing requirements and capacities in a hospital emergency department in order to identify possible explanations of the “weekend effect”. Previous research has shown that acute patients admitted to hospital emergency departments on a weekend experience, on average, worse outcomes than those admitted on a weekday. Why the weekend effect exists remains unclear. Based on an ethnographic field study conducted within an emergency department, our findings indicate that information processing requirements are extensive on both weekdays and weekend, while the information processing capacities are high on weekdays, but low on weekends. A misfit between information processing requirements and capacities on weekends appears to be one explanation to why the quality of care differs on weekdays and weekends.

We also find that employees developed different strategies in an attempt either to cope with the missing information processing capacities or to compensate for the information processing misfits. Most of the strategies resulted in a prioritizing of some patients rather than others, which may affect the quality of care of some patients. By combining the information processing perspective and ethnography, we were able to find possible explanations of the weekend effect within the formal organization on a macro level and within the employees’ attempts to cope with the misfits on a micro level. The findings provide a new perspective on the causes of the weekend effect by investigating the setting in which the patient care is delivered, and how it varies between weekdays and weekends. Furthermore, this paper describes a process to estimate the information processing requirements and capacities.



## 5.2 Introduction

A large number of studies have shown that, on average, patients admitted to hospital emergency departments on a weekend experience worse outcomes than those admitted on a weekday (Aylin et al. 2010, Barba et al. 2006, Bell & Redelmeier 2001, Cram et al. 2004, James et al. 2010, Ruiz et al. 2015, Sharp et al. 2013). This phenomenon is called the “weekend effect” and it is defined as differences in outcomes (e.g., 30-day mortality rate, length of stay, number of adverse events) experienced by patients with the same diagnosis, who are admitted and treated on a weekday versus on the weekend. Despite an extensive literature demonstrating relatively poor outcomes for admissions to hospital at the weekend, and various suggestions regarding factors associated with the weekend effect (Aylin et al. 2010, Barba et al. 2006, Bell & Redelmeier 2001, James et al. 2010), the answer to why the weekend effect exists remains unclear. Existing studies are based on epidemiological analyses and do not look at the processes of care. There is a lack of empirical literature that examines the organizational processes of emergency department care, which could explain the weekend effect (Becker 2008, De Cordova et al. 2012, Goddard & Lees 2012, Hamilton et al. 2010, Lilford & Chen 2015).

The weekend effect has also been documented in Danish hospitals (Biering et al. 2016, Kristiansen et al. 2016, Vest-Hansen et al. 2015). The present study investigates the relationship between the weekend effect and organizational processes. The analysis will be focused on a single emergency department in a Danish hospital and use ethnographic research methodology to determine how organizational processes differ between weekdays and weekends.

## Reorganization of the Danish Health Care Sector

In Denmark, a major reorganization of the health care sector began in 2007. The Danish National Board of Health decided to redesign the way acute patients were admitted to the hospitals. An acute patient is defined as a patient with an illness that appears quickly (or an acute exacerbation of a chronic problem) and who needs active but often short-term hospital-based treatment. Overall, the redesign meant a centralization of the acute care intended to increase quality and specialization of hospital admittance, as well as to develop capacity to manage expected increase in the prevalence of comorbidity. The number of acute hospitals was reduced from 40 to 21, and acute patients, who were formerly admitted in specialized acute surgical and medical wards, are now sorted in centralized hospital emergency departments. Due to this reorganization, emergency departments have become the cornerstone of the Danish National Health System, since up to 70 percent of all acute patients are evaluated there (Danish National Board of Health 2016). Triage procedures and initial treatment focusing on “the whole patient” are used in order to determine which care is needed, and if the patients can be treated within the emergency department and discharged without further admission. The guidelines from the Danish National Board of Health published in 2007 were limited and not very specific. As a result, Danish hospital emergency departments differ in organizational design. Further, many emergency departments’ organizational designs changing during the day and during the week (Møllekær et al. 2014, Møllekær et al. 2017). However, little is known about how such changes in the design over a short time period affect the quality of care and services provided by the emergency departments. Moreover, the studies of the weekend effect showing that patient care differs between weekdays and weekends indicates that the organization of the hospital departments is less effective and efficient on weekends. The central research question in this paper concerns how differences within the organization of an emergency department on weekdays and weekends may affect the quality of patient care.

Based on an ethnographic fieldwork with emphasis on participant observation and interviews, this study will go into details of how work practices within the organization of an emergency department changes during the week. Ethnographic fieldwork is an in-depth research method in which the researcher is present in the organization for an extensive period of time (Hammersley & Atkinson 2007). From the ethnographic analysis, we find that within the hospital emergency department, the amount of information that must be processed is high. Clinical staff has to interpret and analyze high amounts of data (e.g., patients' history, clinical examinations, lab results) in order to diagnose and treat various acute ill patients. How clinician gather this information in order to make decisions about what to do next is fundamental, and makes an information processing perspective highly relevant, when investigating differences within the organization of an emergency department on weekdays and weekends. The information processing view is an approach within the field of organizational design. Galbraith (1973) described information processing as a design problem of organizations based on three main concepts: information processing requirements, information processing capacities, and the match between the two to attain greater organizational performance. Based on an information processing perspective on requirements and capacities, it is possible to find fits or misfits within the organizational design (Burton et al. 2015, Galbraith 1973, Tushman & Nadler 1977). A good fit has been shown to result in a better performance, while a misfit will result in lower organizational performance (Burton et al. 2015, Donaldson 1987, Tushman & Nadler 1977). Within the setting of an emergency department, performance is the quality of care. A mismatch within the emergency department's capability to process information may be a possible explanation of why the quality of care differs on weekdays and weekends.

In order to contribute new knowledge about why the weekend effect exists within emergency departments, I use the information processing model presented by Tushman and Nadler (1977) to analyze an emergency department's capability to process information on weekdays and weekends. I

investigate how the environment affects the work within the emergency department, how the emergency department is structured, and which coordination and control mechanisms the emergency department uses on weekdays and weekends. By combining the information processing perspective and ethnography, I am able to investigate not only the formal organization on a macro level, but also how individual employees develop different strategies in order to deal with the challenges as a result of the mismatch found in the initial analysis (Moorhead 1981). I study the interaction between the social practices on an individual level, and the conditions on which the organization has been designed.

The remainder of the paper is organized as follows. First, I present the theoretical framework of the information processing perspective. Then I describe how I collected data. This is followed by the analysis divided into two parts. In the first part of the analysis, I use the information processing model to do an analysis of the match within the emergency department's capability to process information on weekdays and weekends, which provides a more detailed understanding of how the design of the emergency department is changing. This leads to the second part of the analysis, where I investigate the micro processes within the organization by identifying different strategies developed and used by the employees in order to deal with the misfits within the organization of the department. Lastly, I provide the discussion and a conclusion.

### **5.3 An information processing perspective**

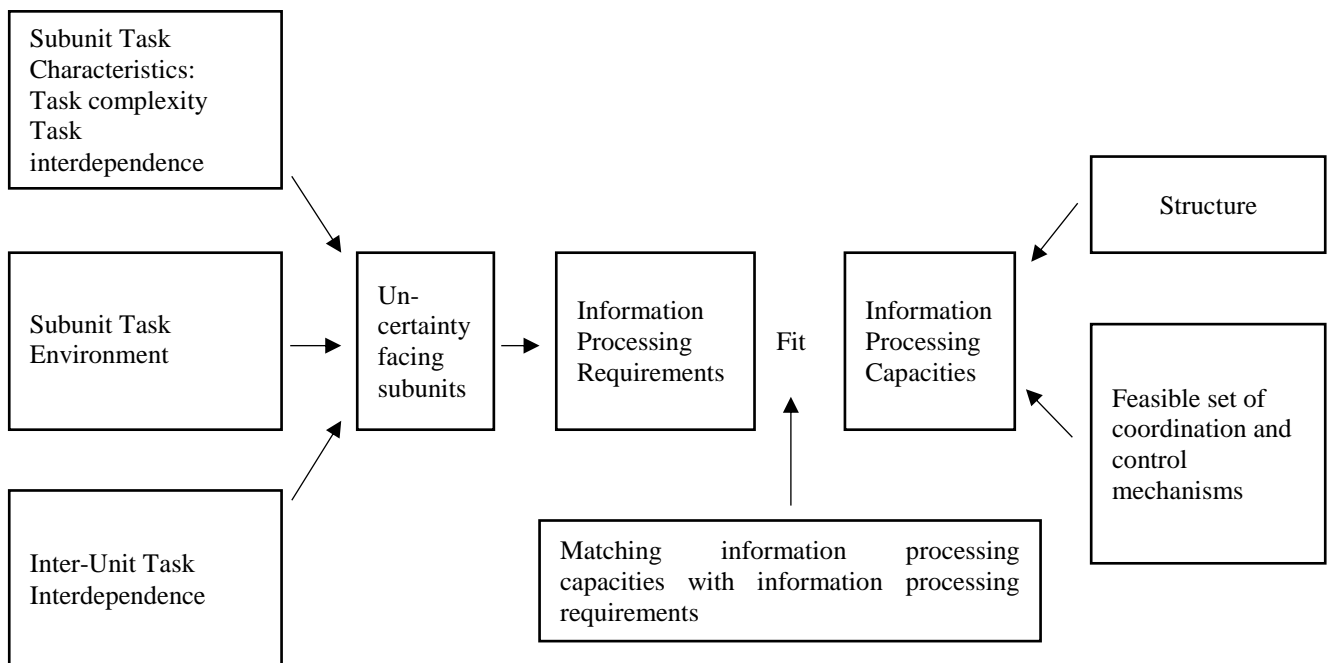
Within an information processing perspective, an organization is considered an information processing system, which processes information to perform tasks and coordinate and control its activities (Burton et al. 2015, Galbraith 1973, Tushman & Nadler 1977). Work such as clinical work within an emergency department involves information processing: individuals such as physicians

collect, produce, and analyze information in order to make decisions about what to do, and they communicate these decisions to other. Various media are available to facilitate information processing for example, face-to-face communication, computers, networks, and different information technology such as the clinical logistic system called Cetrea, which is a user-driven electronic information system presenting a real-time overview of work- and patient flows in the emergency department and across the entire hospital. Thus, both information systems and people process information (Burton et al. 2015, Galbraith 1973, Tushman & Nadler 1977). An effective organization must be designed so that the information processing demands are aligned with the information processing capacities of the organization (Burton et al. 2015). A basic proposition is that the greater the uncertainty of the task, the greater the amount of information that has to be processed between decision makers during the execution of the task (Galbraith 1973). Uncertainty is lack of information; that is the difference between information possessed and information required to complete a task (Tushman & Nadler 1977). Lack of information and thus uncertainty can be due to unpredictability (e.g., the emergency department cannot predict the arrival of the patients), or due to a lack of knowledge (e.g., a temporary physician and specialist within a particular medical specialty may not know how to treat a surgical patient). Uncertainty is low if the information processing demand comes from routine and predictable tasks, that are well understood prior to performing them (e.g., treatment of patients with known symptoms), and rules and programs are ways to handle the information requirement. If the task is complex or not understood, e.g., treatment of a critically ill patient, then during the actual task execution more knowledge is acquired and thus the information processing requirement is high (Burton et al. 2015).

Based on this information processing view, Tushman and Nadler have developed the information processing model (shown in Figure 5.1) presented within their 1977 article “Information Processing as an Integrating Concept in Organizational Design”. The model is a way to analyze fits and misfits

within an organization's capability to process information, i.e., does an organization's demands for information processing match the information processing capacities? When analyzing the information processing requirements, three sources of work-related uncertainty are important: 1) subunit task characteristics regarding the tasks' complexity, i.e., amount of predictability and task interdependence, 2) subunit task environment, and 3) inter-unit task interdependence, i.e., the degree to which a subunit is dependent upon other subunits in order to perform its tasks effectively. This distinction between subunit task environment and inter-unit task interdependence makes it possible in this study to highlight the complex collaboration between the emergency department and the other departments at the hospital found in the empirical material, and how the design of this collaboration creates uncertainty, which affects the task solving within the emergency department. In addition, organizations with different structures and kinds of coordination and control mechanisms have different capacities for effective information processing (Tushman & Nadler 1977).

**Figure 5.1:** The Information Processing Model (Tushman & Nadler 1977:622).



## 5.4 Research setting and methods

As demonstrated by the literature, little is known about the reasons for the weekend effect (Lilford & Chen 2015). Qualitative approaches are particularly suitable when we seek to understand a social situation about which we have limited understanding, as is the case in this study. Since the study examines possible explanations of the complex but delimited phenomenon of the weekend effect, this study is based on a single case (Yin 2014), and data were collected through prolonged ethnographic fieldwork within an emergency department. Over time, the use of single case studies has been criticized (Eisenhardt 1989), but single cases allow researchers to investigate a phenomena in depth to provide rich description and understanding (Walsham 1995).

Ethnographic fieldwork can be defined as the firsthand experience and exploration of a particular social or cultural setting on the basis of (though not exclusively by) participant observation (Hammersley & Atkinson 2007). As the researcher spends a long period in the “field”, and sees what people do as well as what they say they do, ethnography is well suited to providing researchers with a nuanced and in-depth understanding of the people, the organization, and the broader context within which they work. The aim is to provide an empathetic understanding of the daily activities of employees.

The suggestions mentioned in the previous studies regarding why the weekend effect exists focused on individual parts of the organization such as competences (e.g., Barba et al. 2006, Bell & Redelmeier 2001, James et al. 2010) and number of employees (e.g., Aylin et al. 2010, Barba et al. 2006, Bell & Redelmeier 2001). Access to service departments has also been mentioned as an explanation (e.g., Aylin et al. 2010, Barba et al. 2006). By using ethnography, I capture the complexity that is characteristic for the work within an emergency department (Long et al. 2008) and in which we have to search for explanations as to why the weekend effect exists. There may be multiple or

different explanations of the weekend effect. The combination of data collected through ethnographic fieldwork and the use of information processing theory offers a more detailed and holistic picture of how the patient care within the emergency department is organized on weekdays and weekends.

### The empirical setting

The fieldwork took place in one of the 21 Danish emergency departments. The Emergency Department at Viborg Regional Hospital, Regional Hospital Central Jutland is one of five emergency hospitals in Central Denmark Region receiving trauma patients and critically ill patients. The size of Central Denmark Region is 13.142 km<sup>2</sup> with a total population of 1.282.000, out of which the Viborg area constitutes approximately 233.000 people. The emergency departments receive patients referred by general practitioners and patients who have called 112 (the Danish emergency number). The emergency department employs 145 nurses and physicians, including 8 emergency physicians. With backing from physicians from other department, all acute patients with referral diagnosis covering general surgery, orthopedic surgery, and internal medicine are diagnosed and treated in the emergency department. Children, other than those treated in the emergency room, are received in the pediatric department, and patients with some heart-related events are directed straight to the department of cardiology. Patients with psychiatric diseases are admitted to psychiatric hospitals.

The case was chosen based on detailed insights, which is important when doing single-case studies (Yin, 2014). A previous study of all Danish emergency departments (Møllekær et al. 2017) shows that the organizational design of most emergency departments, including the one at Viborg Regional Hospital, changed during the day and the week. These changes may affect how the organization works on weekdays and weekends. Due to the recent establishment of emergency departments, some emergency departments did not yet received patients with both medical and surgical symptoms. I



chose one that did, because the collaboration with different other departments may affect how the organization works on weekdays and weekends. Moreover, because of the reorganization of acute care in Denmark, and because the building layout is designed to fit the new organizational structure, many emergency departments are moving to new buildings, which would affect the data collection. This emergency department in this study is scheduled to move in 2018.

### Data collection

I did a prolonged ethnographic fieldwork in the emergency department. The fieldwork consisted of approximately 700 hours of **participant observation** (Hammersley & Atkinson 2007, Spradley 1980). In order to gain insights into all aspects of the clinical setting and all work practices in the field, I participated on a passive to moderate level by following individual emergency physicians, junior physicians, and nurses in their daily activities in day, evening, and night shifts on weekdays and weekends (Spradley 1980). For seven months (from August 2015 to February 2016), I followed the employees from the moment they began their working day until they left for home. This involved accompanying the employee and recording as closely as possible his or her activities, conversations, interactions, movement, and use of objects over an entire shift. I participated in various conferences and meetings and observed treatments of patients, the administrative work in front of the computer, and various conversations and supervisions. This research tool is within anthropology known as “go-along” (Kusenback 2003) and within organizational studies known as “shadowing” (McDonald 2005). The observation of seemingly every-day social interactions allows me to see the complex in the routine and the routine in the complex. Information about the data collection was provided in the department’s electronic newsletter and at morning meetings ahead of the observations. The observations were planned with the different staff roles in mind. Appointments were made in advance

with physicians, while appointments with nurses were made ad hoc, due to the fact that I did not know in advance which role each nurse would have on a particular shift. Oral consent from each employee who was followed was obtained prior to the observation. In total, I followed 39 nurses in 48 shifts of 8-12 hour. The nurses' age and years of experience varied. In addition, I followed 13 junior physicians in 15 shifts of 7-16.5 hour, and 6 emergency physicians and 2 temporary consultants in 14 shifts of 7.5-16 hour. All patients were informed and verbally consented to allow the presence of the author. When appropriate, small informal interviews took place during the observations, allowing informants to attach meaning to observed transactions in their own words (Bernard 2011). The informants were asked to elaborate and reflect on their work practices and the organizational structure of the department. Extensive field notes were written during observations to capture actions (Emerson et al. 1995).

To get an even deeper understanding of everyday practice, observational data were supplemented with 25 in-depth semi-structured **interviews** with employees and the management of department (See Table 5.1) (Bernard 2011, Kvale & Brinkmann 2009). To get a varied understanding, the inclusion criteria for interviewees were diversity of health care professionals and of experiences. The interview guide included questions about the patient's way through the department, roles and tasks within the emergency department, coordination and communication, collaboration within the department and with other departments, and leadership style. However, according to ethnographic principles the informants were encouraged to speak freely and to raise issues of importance to them (Hammersley & Atkinson 2007). Moreover, four focus groups, with four nurses in each group, were conducted. The strength of focus groups lies in the group dynamics, which provide the researcher with elaborated perspectives on the discussed topics (Morgan 1996). Four experienced and four less experienced nurses from each section were invited to participate. The nurses discussed roles and tasks within the department, collaboration within the department and with other departments, as well as some of the

findings from the observations. All interviews lasted 1-2 hours and took place at a quiet place at the hospital (e.g., an empty office), where the informants had the opportunity to speak freely. The interviews were recorded and transcribed verbatim (Kvale & Brinkmann 2009). All the empirical material was generated between August 2015 and February 2017.

**Table 5.1:** Overview of interviews

Type of interview	Informants	Number of informants per session	Total number of interviews
Individual interviews	Junior physicians	1	4
	Emergency physicians	1	6
	Nurses (2 from section A2, 1 from section A1)	1	3
	Ward nurses (1 from each section)	1	2
	Therapists (1 physiotherapist and 1 ergo therapist)	1	2
	Residents from other departments working within the emergency department	1	2
	Secretaries (2 from each section)	1	4
	Management of Department	1	2
	Focus Groups	Nurses (8 from each section)	4

In order to understand the context of both the organization of the emergency department and the social practices within the emergency department, private **documents** produced for internal purposes (e.g., work schedules, collaboration agreements, and role descriptions), as well as public documents (e.g., the reports written by the Danish Board of Health) were collected (Hammersley & Atkinson 2007, Payne & Payne 2004).

### Analysis

Following accepted procedures for qualitative data analysis, the first part of the analysis was data driven, and the empirical material were looked through with the purpose of identifying themes through open coding, capturing differences between the organizing of the emergency department on weekdays and weekends (Bernard 2011, Emerson et al. 1995). The preliminary themes were discussed with senior researchers and laid the ground for a more intense reflection. The material showed that, in

particular, the people solving tasks within the emergency department and the collaboration between the emergency department and the other departments at the hospital differed between weekdays and weekends. Due to these results of the initial analysis of the empirical material, the information processing model was chosen as the theoretical model, and a more focused analysis followed. In this phase, the interplay between theory and data was strengthened as the theoretical concepts that could render our data meaningfully and guide our final analysis were identified (Emerson et al 1995, Kvale & Brinkman 2009).

Ethical approval was not required for this study. According to Danish law, formal ethical approval is not mandatory for studies that do not involve biomedical issues. It was exempted from the informed consent requirements (inquiry 151/2015). The management of the hospital and the management of the emergency department approved the data collection. The emergency department chose not to be anonymized. All individuals, who participated in the study have been anonymized.

In Danish hospitals, nurses commonly work during one of three shifts: days (7 a.m.-3 p.m.), evenings (3 p.m.-11 p.m.) or nights (11 p.m.-7 a.m.), weekdays and weekends. Physicians normally work two shifts: days (8 a.m.-4 p.m.) or evenings/nights (4 p.m.-8 a.m.). A previous study showed that the emergency department's organizational design at the day-shift weekdays differed from the rest of the shifts (Møllekær et al. 2017). The empirical material in this study confirmed this. To gain further insight into the differences between weekdays and weekends in order to explain the weekend effect, I will analyze the potential misfits within the emergency department's ability to process information and the behavioral consequences of these misfits in daytime on weekdays and weekends.

## **5.5 Fit and misfit analysis of the emergency department, weekdays and weekends**

Based on the information processing model presented by Tushman and Nadler (1977) I did a fit and misfit analysis. First, I identify and describe the basic unit of analysis. Thereafter, I did an analysis of both the information processing requirements and capacities within the emergency department on weekdays and weekends in order to find the fits and misfits within the organization's capability to process information effectively. Then I compare fits and misfits on weekdays and weekends.

### Unit of analysis

In this study, the unit of analysis is the emergency department in Viborg, which is divided into two subunits: A1, on the second floor, and A2, on the fourth floor. The emergency department became an independent department on January 1, 2014. Before that, A2 belonged to the department of internal medicine, while A1 was a part of the department of orthopedic surgery. The subunits are divided not only geographically but also according to the type of patients they treat. A1 receives some medical patients as well as subspecialized patients such as urological and gynecological patients. The emergency room, where orthopedic surgery patients are received for a shorter stay, and the trauma rooms for critically ill patients is placed here too. A2 receives most of the internal medical patients and general surgical patients. Due to the different tasks, the two subunits deal with different specialized departments at the hospital - departments, on which the emergency department in many ways is dependent. Consultants are on call, and the emergency department transfers patients to other departments after initial treatment. Patients can stay within the emergency department for up to two days, if the emergency department believes that they can treat and discharge the patient. In total, the department has 38 beds, 4 beds in the emergency room for short stays, and 2 trauma rooms. As in other health care organizations, the emergency department has a two-by-two model of management

with a physician and a nurse on each level, designed to promote teamwork between the two major professional groups responsible for patient care (Hoff et al. 2016). Besides the management of the department, consisting of a chief physician and a head nurse, each subunit is formally managed by an emergency physician and a section nurse, while a flow master (an emergency physician) and a coordinating nurse manage the clinical everyday life in each shift. Their task is to keep an overview of and manage the resources (see Figure 5.2). The flow master on A2 makes sure that the activities across the sections are linked together. The role of the flow master and coordinating nurse are elaborated upon later in this article. The administrative employees and nurses are employed on either A1 or A2, while the physicians (both emergency physicians and junior physicians) having shifts on both A1 and A2. The physicians are a shared and limited resource.

#### Information processing requirements

Tushman and Nadler (1977) have identified three important sources of work-related uncertainty when analyzing the information processing demands: 1) subunit task characteristics regarding the tasks' complexity and interdependence, 2) subunit task environment, and 3) inter-unit task interdependence, i.e., the degree to which a subunit is dependent upon other subunits in order to perform its tasks effectively. In order to find the amount of uncertainty facing the emergency department and the information processing requirements on weekdays and weekends, each of these three sources of work-related uncertainty is analyzed.

## *1) Subunit task characteristics*

### 1a) Task complexity

The first aspect to analyze when looking at task characteristics is the task complexity. According to Tushman and Nadler, task complexity is a source to predictability and the extent to which the information is available (1977). Work procedures at the emergency department are characterized by high degrees of complexity; they diagnose and treat acutely ill patients, and both time and information may be limited. Moreover, the emergency department cannot predict the arrival of patients; hence, there is within the context itself several sources of uncertainty.

The patients admitted to the emergency department have various symptoms, some have a complex mix of coexisting conditions, and they need various kinds of treatment and care. The emergency department's goal is to decide how to treat the patient, and whether the patient can be treated within the emergency department, or which department the patient should be transferred to. Diagnosing the various patients involves collecting and analyzing a lot of information as well as decision making. When the degree of differentiations within the subtasks is high (e.g., treatment of patients with various symptoms), it is difficult to achieve effective collaboration, and a lot of information processing and coordination is needed to integrate the different subtasks in order to fulfill the common goal of the organization (Galbraith 1974), which increases the task complexity and thus information processing requirements.

Another thing characterizing task complexity is whether the tasks are known to the organization or not. If the tasks are routine tasks and the organization can solve the tasks by following a known procedure that specifies the sequence of steps, then task complexity is low. However, if the tasks frequently require different procedures and possible solutions are considered, the task complexity is high and requires greater information processing. If a task is complex and not well understood, then

an employee may not have the right information available (Tushman & Nadler 1977). If a patient admitted to the emergency department is not critically ill and his or her symptoms are seen regularly, a less experienced physician can by following standard operating procedures (SOPs) solve the task, which is considered routine. An illness, however simple in appearance, can prove unpredictable (Strauss et al. 1997). Therefore, junior physicians, many without any previous clinical experience before working within the emergency department for six months, must consult a senior physician when they receive and treat patients. However, if a patient admitted to the emergency department is seriously ill, an emergency physician will see the patient immediately or within a quarter of an hour. Different solutions and treatment options may be considered, and the demand of information processing is high.

Patients within the emergency department are in various stages of their treatment. This includes newly admitted patients, who are not diagnosed yet, and patients who can be treated within the department and are expected to be discharged within 48 hours. Diagnosing the various newly admitted patients often requires greater information processing than treating those patients who have been within the department for a while. As time passes, more and more information is available. The information must be considered, but others will already have collected it and partly analyzed the information.

The diagnosis of patients with different symptoms requires capacities that are able to process information. Many tasks cannot be pre-planned, and even though an illness appears simple, the condition of the patient can suddenly change and resources must be reorganized. In addition, the treatment of the various kinds of patients requires coordination. Thus, the task complexity within the emergency department in general is high, and it is the same on weekdays and weekends.



## 1b) Task interdependence

Task interdependence describes the extent to which employees are dependent upon another to perform their individual tasks (Thompson 1967, Tushman & Nadler 1977). Within the emergency department, tasks (i.e., the treatment and care of patients) are co-solved and the different subtasks are related.

One example is the physicians' use of triage colors to prioritize their tasks: *The emergency physician asks the coordinating nurse to put on the triage color on those patients who have not yet been seen by a physician. The emergency physician tells me that she wants to know how she is going to prioritize the newly arrived patients. The coordinating nurse calls the individual nurses who are responsible for the patients and gets the triage colors. She puts the colors on the board. Now everybody can see the triage color of the patients. The coordinating nurse points out that they are not finished with the triage yet* (Observation, flow master, day shift, Friday, October 2015).

This field note shows how the physician needs the triage colors in order to prioritize the tasks within the department. The triage subtask is performed by the nurses. This is just one example of how the subtasks within the emergency department are related. The interdependence of the individual tasks is highlighted when describing a patient's way through the department.

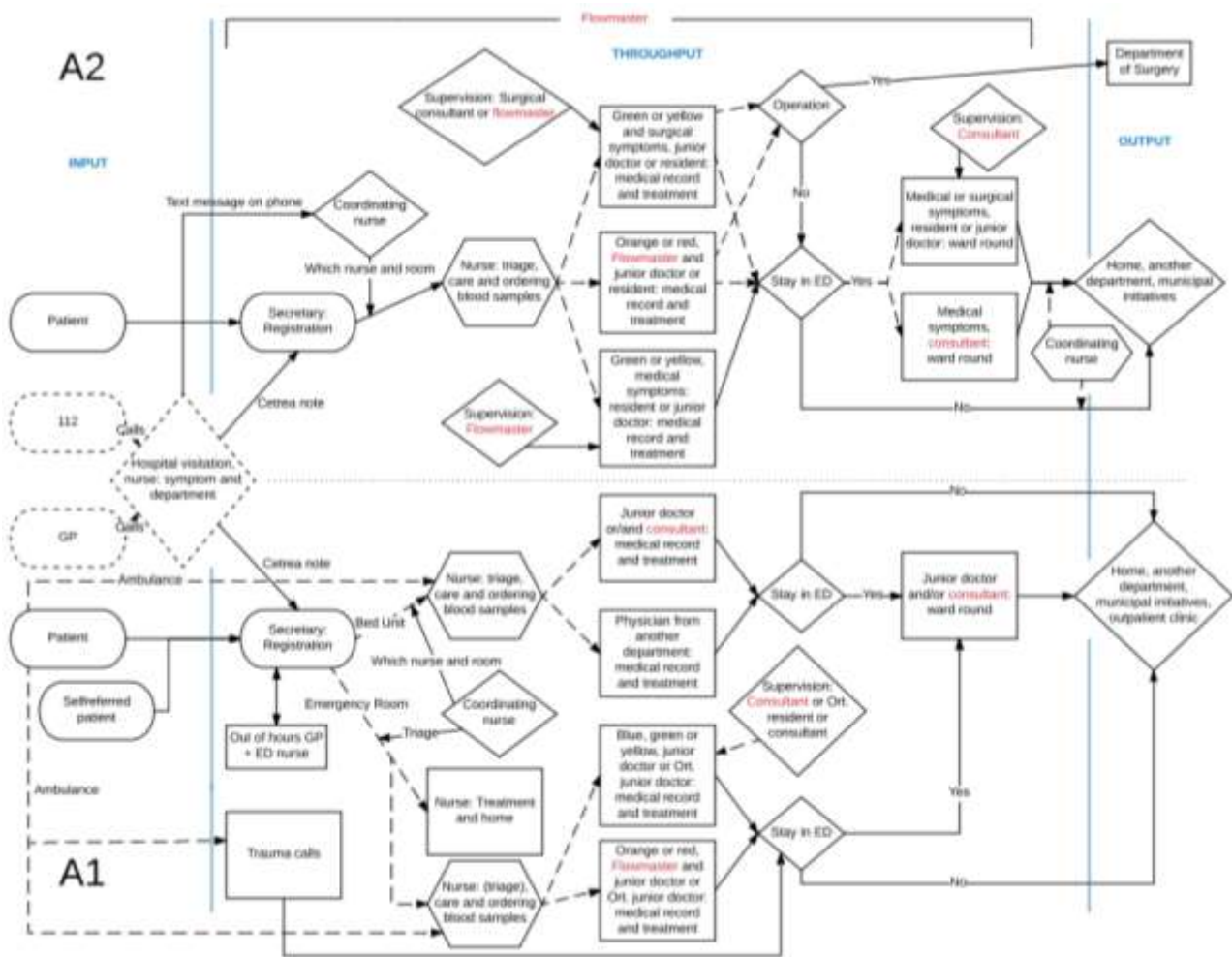
In the emergency department, the patient goes sequentially through different processes (subtasks) in the treatment. These different subtasks are 1) admission, 2) triage, 3) focused care/treatment, and 4) release. The patients are not moved physically, but different employees solve and are responsible for each subtask (see Figure 5.2).

When the patient arrives in the department, a secretary does the registrations. Ideally, the coordinating nurse decides which room and bed the patient will have during the stay within the department and calls the nurse she wants to take care of the patient. This nurse does the initial triage. Triage is the process of determining the priority of patients' treatments based on the severity of their conditions.

However, if the patient is going to be treated in the emergency room, the coordinating nurse will do the initial triage before the patient is sent to the waiting room. The nurse puts on the triage color on the screen and writes it in the electronic patient journal (EPJ). Hereafter the nurse orders basic blood tests and other kinds of tests. A bioanalyst arrives and takes blood tests and an ECG. Depending on the triage color and the symptoms the patient arrives with, a physician performs the initial examinations to diagnose and treat the patient. Physicians from other departments are consulted if necessary. During a shift, the same nurse or a team of two nurses take care of the patient. The physician writes a short plan in the EPJ and dictates the plan for treatment of the patient. Hereafter a secretary writes it in the EPJ. After stabilizing the patient or attending to the patient's basic needs, the physician either refers patients to a specialist, such as an orthopedic surgeon, as necessary or the patient is transferred to a relevant department. If the emergency physician believes that the emergency department is able to treat and discharge the patient within two days, patients can stay within the department. A junior physician (supervised by an emergency physician), a resident, or an emergency physician performs the ward rounds.

These sequential processes are visualized in Figure 5.2. The processes can be divided into three interdependent components: 1) input, 2) throughput, and 3) output (Asplin et al. 2003). The different capacities (e.g., physicians available for solving the tasks) are illustrated too. The sequential process requires not only skills of those solving and responsible for the individual subtasks but also coordination. The organization processes information to coordinate and control its activities. The figure shows some of the information flow, such as notes from the clinical logistic system Cetrea, and coordination mechanisms, such as a coordinating nurse and a hospital visitation, the emergency department has created in order to permit coordinated action across a number of interdependent subtasks. The coordination mechanisms will be elaborated upon later in the article.

**Figure 5.2:** The sequential work processes within the emergency department



In a multitude of ways, the employees are dependent upon another to perform their individual subtasks, in order to get the patient through the treatment system. Nurses wait for the coordinating nurse’s decision about which nurses will take care of newly arrived patients. The nurses cannot note down the triage values in the EPJ before the secretary has registered the patient, and the registration may be delayed if the patient arrives with ambulance to the emergency room. The nurses wait for plans for the patient in order to know what the physicians expect them to do, and physicians wait for the test results in order to make the initial plan. At decision making, junior physicians wait for

supervision from more experienced physicians. To coordinate the transfer of the patients from the emergency department to other departments, the coordinating nurse wait for the physicians to make a decision about whether the patients can stay within the emergency department or not.

Moreover, those employees who are receiving new patients within the emergency department are dependent on those who are taking care of the patients, who have stayed within the department. As the entrance to the hospital, the emergency department receives all acute patients. They either treat the patients or decide which department would be the most suitable to treat the patients due to the patients' needs. When the hospital visitation announces new patients, the emergency department must have beds available for these new patients, and must therefore either discharge some of the patients or transfer the patients to other departments.

As described, the tasks within the emergency department are co-solved, and the employees are highly dependent upon another to perform their individual subtasks, in order to get the patient sequentially through the treatment system. If the complexity is high (i.e., if the tasks are more difficult to solve, such as because the patient is seriously ill or has coexisting diseases), then even more employees are involved in the treatment, more tests are ordered, and the patient's stay within the department may be longer. This co-solving design makes the task interdependence within the emergency department high. A breakdown in any small subtask can shut down the process. Hence, the process requires not only skills of those solving and responsible for the individual subtasks but also coordination, joint decision making, and joint task solving. It involves greater uncertainty and therefore increased information processing (Burton et al. 2015). The fact that the emergency department employs most of the employees eases the collaboration within the department and the process of co-solving. The task interdependence within the emergency department is high both weekdays and weekends.

## 2) *Subunit task environment*

All organizations have boundaries. Some individuals and activities are inside, and others are outside. The outside is called the environment and it affects the way the organization operates (Burton & Obel 2004). The emergency department's environment, which consists of factors such as cooperating municipalities, the region, and the patients, is dynamic and changing, which increases the uncertainty.

One factor that makes the task complexity high, but also makes the environment dynamic, is that the emergency department cannot predict the arrival of patients or what symptoms the patients have. The volume of patients who need acute care varies, and the department must always be prepared to care for various numbers of more or less acutely ill patients with different symptoms. This factor has a substantial impact on workflow patterns, as the emergency department and the health professionals have to adapt to a rapidly changing environment that requires dynamic shifting of resources to meet patients' needs.

Another factor that affects the way the emergency department operates is the decisions made by the management of the hospital, the region, or the Danish Board of Health. Due to the reorganization of acute patient care, the various decision makers are focusing on and interested in how the newly developed emergency departments are organized. The managers of the department mentioned this in an interview: *“Usually, the department management makes the decisions. Now, with the emergency department, many stakeholders have to be heard, there are many opinions, there are many consensus solutions to be found along the way. Both internally at the hospital, but also externally with the primary care and general practitioners. Everyone we collaborate with (...) many have something to say about how the emergency department should manage patient pathways. So we are really watched, and we are evaluated all the time, in everything we do”* (Interview, April 2016).

Moreover, these decisions increase the uncertainty facing the emergency department. As the managers of the department said: *“Sometimes you also just have to jump off the diving board and see what happens. Sometimes we are commanded to start up with something where we have not been quite ready, but then you somehow become ready”* (Interview, April 2016). One example is a decision, made by the region, that a senior physician should be present in the emergency department 24/7. At that time, the emergency department did not have enough emergency physicians, and a poor environment (i.e., a general lack of emergency physicians) makes it difficult to hire more physicians (Chitale et al. 2013). The strategy chosen by the emergency department was to outsource the work, and they made an external agreement with a group of temporary physicians who could help cover the shifts (Burton et al. 2015). The temporary physicians, all highly skilled within medicine specialties, come either from the medical department within the hospital or from the nearby Silkeborg Hospital. These physicians from another department or hospital are another important factor defined as the task environment, because they are working within the emergency department as external actors, who attend to by what Tushman and Nadler have called “organizational members” (1977:616). Due to the emergency department’s lack of control over these external actors, they are potentially unstable and seen as a source of uncertainty that the department has to manage (Tushman & Nadler 1977).

Because of their daily work in medical departments, the temporary physicians mainly work in the emergency department on weekends, so this source of uncertainty increases on weekends. In 2015, the temporary physicians covered 0.6 percent of the daytime shifts and 17 percent of the evening/night shifts on weekdays. However, on the weekends, the temporary physicians covered 61 percent of the daytime shifts 53 percent of the evening/night shifts (calculated from work schedules). Due to the general lack of emergency physicians, only one emergency physician is on duty within the emergency department during evenings, nights, and weekends. Hence, when the temporary physician is taking a shift within the department, he or she is the only senior physician on duty, which reduces the

emergency department's ability to control their way of solving tasks, and the uncertainty increases (Tushman & Nadler 1977).

Moreover, the temporary physicians are not used to working/trained within the emergency department, which affects the way the emergency department operates. On average, each of them cover 1.4 shifts per month. When they only occasionally takes a shift, it takes a lot of time and teaching by old hands on the ward to learn all the rules and routines within the emergency department. Hence, as the coordinating nurses said their workload increases. Normally the emergency physician and coordinating nurse collaborate to manage tasks and resources, but when a temporary physician covers the shift, the coordinating nurse must do a lot of coordination by herself and answer the physician's questions about his tasks. The information processing requirements increase.

The changing and dynamic environment means an increased uncertainty facing the emergency department especially on weekends, when an external actor often take the position as the only "emergency physician" on duty. The competences of the temporary physicians are elaborated further when the information processing capacities are analyzed.

### *3) Inter-unit task interdependence*

Being outside the boundaries, the other departments at the hospital are also a part of the emergency department's environment (Burton et al. 2015). However, in order to provide sufficient care and treatment for in coming patients, emergency departments are highly dependent on other subunits (the other departments at the hospital). Therefore, the collaboration between the emergency department and other departments is analyzed as inter-unit task interdependence, which is the third source of work-related uncertainty. Tushman and Nadler describe inter-unit task interdependence as an uncertainty with even broader structural implications is the degree to which a subunit is dependent

upon other subunits in order to perform its task effectively. The amount of task interdependence that exists between differentiated subunits is associated with the need for effective coordination and joint problem solving (1977:616).

In numerous ways, the emergency department is highly dependent on the other departments at the hospital. Physicians from other departments are on call, many patients are transferred to more specialized departments after initial treatment in the emergency department, and tests are performed by other departments (i.e., the clinical laboratory and the radiology department). Moreover, physicians from other departments solve various tasks within the emergency department on a daily basis. Every day a medical consultant does ward rounds. Two residents, one each from the medical and the surgical department, receive patients 24/7 within the emergency department. The surgical resident is in fact the only one (supervised by a surgical consultant) who can decide whether patients are going to have surgical operations. In daytime, one junior physician from the department of orthopedic surgery treats patients within the emergency room. These physicians from other departments are involved in the treatment, and the emergency department is dependent on how and when these physician processes information.

*An example: The coordinating nurse within the emergency room says that maybe they should call the resident from the department of orthopedic surgery again and ask if he will be here soon. Five patients are now waiting for him. Soon after, the resident shows up. The coordinating nurse says with a smile “Now he is here, just overthrow him”. The junior physician tells the resident that five patients are waiting for him. The resident is surprised. He says that they have been operating for a long time and in the meantime, more and more patients are waiting for them. He apologizes for the waiting time (Observation, junior physician, afternoon shift, Monday, January 2016).*



This field note shows how the capacities, i.e., the physicians from other departments, are associated with lots of uncertainty. One of the reasons for this high level of uncertainty is the physicians' lack of priority for the tasks within the emergency department. One resident from the surgical department said: *"We do plan our own tasks. We solve tasks in the operating theater and participate in the X-ray conferences, and the rest of the time, we solve tasks within the emergency department. We try to be within the emergency department at the times we have agreed, but if the X-ray conference is taking longer than usual, then we will come later, instead of leaving the X-ray conference"* (Interview, October 2015). Due to the current incentive system where physicians are rewarded and have a career path within their own specialty, the physicians from the other departments do not have an incentive to make decisions and take actions that fit well with the needs of the emergency department. As the resident from the surgical department told, he obviously preferred to operate, and the work within the emergency department was just something they had to do. Consequently, the emergency department does not know when these physicians will show up or what level of experience the physicians who show up will have.

The following field note shows that the unknown level of experience is subject to uncertainties: *The coordinating nurse tells the emergency physician that the patient the resident from the medical department is seeing is orange (critically ill). The triage color is yet not on the board, and therefore invisible to the emergency physician. The emergency physician finds out where the patient the nurse is talking about is by looking at the board and walks out to find the room where the patient is. The emergency physician enters the room, says hello, and begins asking questions. The patient addresses the emergency physician, and the resident takes a step backward and watches while the emergency physician takes over (...)* Later, when we are on the way back to the board, the emergency physician says, *that she is a little worried about the new physician from the medical department. She does not know the physician or the physician's level of experience* (Observation, flow master, day shift, Friday,

October 2015). The emergency physician's action is guided by uncertainty. The physician is concerned about the skills of the resident and the level of treatment the patient gets. The result of this concern is that two physicians solve one subtask, and the information processing demands increases.

Another factor that increases the uncertainty is the transfer of patients to more specialized departments. The nurses in the emergency department experienced difficulty agreeing with the other departments that patients from the emergency department should be moved to the specialized department. They explained that it was often a struggle. One said: *"You must argue for each patient you need to transfer"* (Focus group, experienced nurses from A2, May 2016). For one month, the coordinating nurses were asked, as part of this study, to note the response from the other departments when patients had to be transferred. Reactions as *"But then we are crowded"* or *"Can it wait until..."* were found to be normal. As a result, the emergency department was forced to keep the patients until the other departments were ready to receive the patient, reducing the emergency department's capacity to care for new patients.

On weekends, when the emergency department uses external actors as "emergency physicians" the inter-unit task interdependences and thus the uncertainty increases further.

*The junior physician cannot reset a dislocated shoulder. He has tried several times. He leaves the patient to call the consultant from the department of orthopedic surgery. He tells me that maybe we are so lucky that he is sleeping at the hospital and not at home. On the phone, he explains the situation for the consultant and asks him what to do. The consultant says that he will come, but asks the junior physician, did he call the emergency physician before calling him. The junior physician answer that no, he did not. He (the external actor) is a pulmonary medicine specialist and he will not be able to answer this question. Asking if he should call him. No, the consultant will come. After the phone call, the junior physician explains that they are supposed to call the emergency physician first, but when*

*he knows that the emergency physician cannot help him, it is waste of time. You must call one who can make a decision about the patient, he says* (Observation, junior physician, night shift, Saturday, February 2016).

The limited skills of the external actors result in increased collaboration with the physicians from the other departments and the inter-unit tasks interdependence increases. A resident from the medical department mentioned another reason why the collaboration with the physicians from the other departments increases on weekends due to the temporary emergency physicians: *“Temporary physicians who do not know the rules and routines, or have the opinion: this is not a task for an emergency physician. That is why you have to work more some weekends”* (Interview, October 2015).

#### Summary of information processing requirements

When looking at the combination of the three sources of uncertainty, the work-related uncertainty facing the emergency department on weekdays and weekends is high and the information processing requirements are extensive. This is due to the task complexity and the level of interdependence between co-solved tasks. A dynamic and changing environment and the emergency department’s interdependence of the other departments at the hospital also affect the uncertainty. When the nature of the task solved by the emergency department is highly uncertain, the need for constant flow of information increases among both the employees and the physicians from other departments solving tasks within the emergency department (Tushman & Nadler 1977). New information becomes important, and adjustment of resources and needs is necessary during the task solving. On weekends, when more tasks are solved by physicians from other departments and external actors take the position as the only “emergency physician” on duty, the uncertainty increases even more and so do the information processing requirements.

## Information Processing Capacities

Effective information processing implies the organization's ability to handle needed information. To handle the information the organization must develop capacities. Two dimensions affect the organization's information processing capacities: the structure, and the kinds of coordination and control mechanisms the organization uses (Tushman & Nadler 1977). These dimensions were analyzed in order to find the information processing capacities on weekdays and weekends, and will now be presented before a summary of the results.

### *1) Structure*

The structure of an organization reflects the division of work (Burton & Obel 2004). It describes how the overall task of providing emergency care is divided into smaller tasks, and how these subtasks are coordinated.

Within the emergency department, the overall task is treatment and care of patients, and nurses and physicians solve these tasks. The nurses operate either alone or in teams of two, and every nurse or team has a number of patients. Depending on the symptoms patients were admitted with, and the degree of illness, physicians with different specialties, experience and department affiliations treat the patient. Mostly, the emergency department's junior physicians (with supervision from an emergency physician) treat the patients. In addition, a number of physicians from other departments solve tasks within the emergency department. Some physicians are called when their skills are needed. The patient's needs are often the controlling element in the treatment carried out within the emergency department, and the agreement with some of the subspecialties is that whenever a patient with symptoms within these specialties shows up in the emergency department, the nurse will receive the patient and, after triage, she call the physician from that specialty. Other physicians show up by

themselves and solve tasks due to collaboration agreements. Every day a medical consultant does ward rounds (every weekday between 3 p.m. and 8 p.m., and on weekends at daytime). Two residents, one from the medical department and one from the surgical department, receive patients within the emergency department 24/7. In daytime, one junior physician from the department of orthopedic surgery treats patients within the emergency room. The tasks (treatment of patients) are solved physically within the emergency department, but physicians from other departments go in and, in cooperation with junior physicians and nurses employed in the emergency department, solve the different tasks. The physicians from the other departments work in the emergency department side by side with the employed physicians. They participate in the organization, but the command structure and incentives are different from the employed physicians. The emergency department has a matrix structure (Burton & Obel 2004, Galbraith 1973) supported by external agreements with the different specialties about how the tasks within every specialty are solved (Burton et al. 2015). The structure of the emergency department is characterized by a dual focus on both specialization and the emergency care process. The degree of focus on specialization is high, because physicians from many different specialties solve tasks within the emergency department, and due to the emergency physicians' and nurses' involvement within and coordination of the tasks, the focus on patient flow is high too. The way the collaboration and division of work are structured provides stability, reduces uncertainty, and ensures quality of patient care.

However, on weekends, when more tasks are “outsourced” to physicians from other departments and the emergency physician is less involved with the patient treatment, the focus on specialization increases and the focus on emergency care processes decreases. Instead of an emergency physician, a consultant from the medical department does ward rounds in the emergency department at daytime. The tasks solved by a physician from one department (the medical department) and a nurse from another department (the emergency department) increases. Looking at who treats the patients within

the emergency department on weekends, the work is divided more by specialized activities: the number of patients with medical symptoms who are treated by a physician from the medical department and the number of patients with surgical symptoms who are treated by a physician from the surgical department increases. This change within the division of work requires more coordination.

In order to be effective, the matrix structure requires managerial skills and coordination (Burton et al. 2015). The coordination mechanism within the emergency department will now be elaborated.

## 2) *Coordination and control mechanism*

An organization's ability to process information is also dependent on its various coordination and control mechanisms, which are different structures used to link or coordinate tasks of interdependent subunits, including rules and procedures, planning and control systems, and coordinating units (Tushman & Nadler 1977). Given the task complexity, task interdependence and their collaboration with other departments, the emergency department uses various strategies in order to coordinate their activities. Inspired by Van de Ven et al. (1976), I distinguish between impersonal and personal coordination and control mechanisms.

### Impersonal coordination and control mechanism

Impersonal coordination (and control mechanism) is coordination by programming such as schedules and formalized rules (Van de Ven 1976). According to Galbraith (1974), the simplest method of coordinating interdependent subtasks is **rules and programs**. Health care organizations, including the emergency department make extensive use of rules and politics, e.g., SOP. Physicians, especially

junior physicians, use these guidelines when facing an unknown task. By using these guidelines, junior physicians can solve more tasks with less supervision.

Another example of how rules apply within the emergency department is the way triage is used to coordinate the interdependent subtasks. Junior physicians (supervised more or less by emergency physicians), medical and surgical residents, and emergency physicians all treat patients within the emergency department, and they cannot all communicate with one another in order to coordinate who should treat which patient. Depending on which triage color and which symptoms the patient arrives with, a physician with a certain level of experience performs the initial examinations to diagnose and treat the patient. They all know the rules of prioritizing and use the clinical logistic system Cetrea to communicate which patients they will treat. This rule helps the physicians to coordinate their subtasks and reduces the need for communication.

*An example: At the computer, Michael (junior physician) logs in to the Cetrea, so he is able to see the list of newly arrived patients, who have not yet been examined by a physician. Five patients are on the list, most of them with a yellow triage, four for surgery and one medical patient. Michael is seeing medical patients today, and he points out to me that only one patient needs to be seen. He finds his notebook in his pocket and on a blank page he writes down the patient's name, CPR number (every Danish citizen is assigned a unique central personal registration number), and the note from the visitation. He goes to the command room and presses with his finger on a pencil on the Cetrea touchscreen. He is now able to manage the board. He presses on his own picture on the board and afterward on the name of the patient such that his picture and name now appears on the patient. The flow master comes, and Michael asks him about another patient is that patient going to be seen? The flow master believes that the patient has already been examined, but will check up on it. He confirms that Michael should see the patient he already has put his name on. Michael press once more on the board and makes a box blue on the board. Now everybody can see that the patient record is going to*

*be done, and that he is the responsible physician* (Observation, junior physician, evening shift, Wednesday, October 2015).

In this example, the junior physician wants a confirmation of which patient he is going to see. However, a lot of the work and procedures in the emergency department is formalized and pre-coordinated with rules such as the one just described, which allows an interdependent set of activities to be performed without the need for communication (Galbraith 1974). In the work schedule, employees can see the role they are going to perform today. A role description is available. On the day described in the field note, Michael treats medical patients. First, he helps with ward rounds. At the morning conference (another coordination mechanism which will be elaborated upon later) he gets a note from the emergency physician, who, according to the schedule, is today responsible for supervising the junior physicians on ward rounds. If possible, all the patients he will see are within one team of nurses, which makes the coordination between the different health professionals easier. After ward rounds, he sees newly admitted medical patients. Here the triage color and then how long, the patient has been in the department, determines whom he sees first. If he needs supervision, the flow master is now responsible for supervision. At an operational level, this formalization helps the junior physicians make their own decisions. Because of the rules, they can do their work without depending on an emergency physician. The rules standardize, reduce variability, decrease uncertainty, and therefore reduce the amount of information to be processed (Galbraith 1974).

Due to formalized and pre-coordinated rules and guidelines, the formalization within the emergency department is high. However, in practice, the rules and guidelines are not always followed, and there is room for the employees to solve the tasks in individual ways. An example is the role description, which includes details of different tasks but not how to solve them. *“The role descriptions are useful if you are new or a temporary physician and you want to know the time for the different conferences. However, the work is so varied and the days are so different that you cannot put the tasks of an*



*emergency physician into a schedule. There are of course some tasks you are responsible for and you are supposed to take care of, but the tasks you solve vary from day to day”* (Interview with an emergency physician, December 2015).

Another coordination mechanism handling the uncertainty is the **external agreements** with the other departments about which physicians will work within the emergency department. These agreements support the matrix structure. With the agreements, the emergency department knows better what to expect from the other departments, thus reducing unpredictability. The emergency department engages individual specialists to work on very specific tasks, to treat patients with certain kinds of symptoms, but they do not know the particular person who will do the work. It is an agreement for an activity (Burton et al. 2015). However, the outsourcing also leads to challenges. As described earlier, the emergency department cannot always control how or when the physicians from the other departments perform the tasks in the emergency department. As one emergency physician said, *“We cannot decide how the surgical resident prioritize his tasks. We cannot say you have to stay here, you cannot leave this department, because of an operation”* (Interview, December 2015).

The dividing of the emergency department into **two different sections** is another coordination strategy. In order to minimize the needs for coordination, the emergency department tries to minimize the diversity of its tasks by having patients with similar diseases on each section: medical and general surgical in A2 and orthopedic surgery and more subspecialized (e.g., urology and gynecology) in A1. The more heterogeneous the patients are, the more varied the requisite kinds of work and the more varied the resources necessary for doing those kinds of work (Strauss et al. 1997). However, the geographical distribution of the department on two different floors also increases the need of coordination (Burton et al. 2015), especially on weekends, where one emergency physician (the flow master) has the overall responsibility for the treatment of the patients within the whole department. This increased need of coordination is solved by using the clinical logistic system Cetrea, which is a

user-driven **electronic information system** (Galbraith 1974) another coordination mechanism mentioned in the example with the junior physician Michael. A clinical logistic system makes it possible for the flow master to get an overview of all patients within the department, even though the department consists of two sections placed on different floors. Moreover, the clinical logistic system makes it possible to communicate the information (e.g., the triage color during the task solving, and the information is available for the other health professionals) much faster, which decreases uncertainty. However, on weekends the clinical logistic system was not used at the same level. Many of the physicians (consultants and residents) from the other departments did not update the clinical logistic system, and the information processing requirements increased. If the flow master would like to know how far the physicians were with the patients they treated, he/she had to call and ask. Hence, on weekends, more personal coordination mechanisms were used.

The more complex the coordination and control mechanism are, the greater the ability to process information, but also more costly in terms of time and resources (Tushman & Nadler 1977). Galbraith suggested a range of different other and more complex coordination and control mechanism. Some reduce the amount of information that is processed, while others increase the capacity to handle information. While the clinical logistic system is a way to increase the department's ability to handle information, **self-contained units** can reduce the amount of information that is processed (Galbraith 1974). The emergency department was using the strategy of self-contained units, dividing the tasks within the department in to sub-units, each managed by an emergency physician. Creating subunits that can initiate and fulfill tasks autonomously without (or with less) coordination with other subunits reduces the need for information processing (Galbraith 1974). This strategy is most evident on weekdays, when the task of treating patients is divided into three different self-contained subgroups:

- 1) The treatment of patients who have just arrived on A2. One flow master (an emergency physician) ensures that every patient is seen by a physician. This emergency physician also has the responsibility

to ensure that the overall task within the emergency department is solved. Hence, the work within the different subgroups is coordinated. 2) The treatment of patients who have been on A2 for a while. Another emergency physician manages the ward rounds and 3) a third emergency physician manages the treatment of patients on A1. Each group works more or less autonomously. However, this strategy is most evident on weekdays. On evenings, nights, and weekends, only two self-contained subgroups exist. The flow master (the only emergency physician on duty) must manage two subgroups, one at each section, while the last subgroup, the ward rounds, is outsourced to a consultant from the department of medicine. As described, this consultant may not inform the flow master about the work within “his” subgroup, and to maintain the inter-unit coordination, the flow master had to call and ask.

The emergency department has increased its ability to preplan by developing a **hospital visitation**, a capacity that handles the information known prior to the admission. Figure 5.2 shows a patient’s way into the department, also called the input. The emergency department knows in advance that a patient will show up. The general practitioner (GP) or paramedic makes a phone call to the hospital visitation, which is staffed by nurses from the emergency department. Using formalized rules (and in collaboration with the GP), the nurse decides where the patient is to be received (e.g., the emergency department, another hospital department, an outpatient clinic, or a municipal offer). The nurse places the information about the patient (e.g., name, age, gender, CPR number, symptoms, and expected specialty), in Cetrea. The coordinating nurse and secretary, who sits up front, can now see on the screen which patients they will receive. The emergency department knows in advance that a patient will arrive and what symptoms the patient has, and are able to plan the admission before the patient’s arrival. This visitation of patients reduces the unpredictability.

However, in order for this to be effective, the emergency department must allocate resources to handle and use the information provided by the visitation (Galbraith 1974). Moreover, the emergency

department does not know the patient's exact arrival time. Moreover, they do not know how ill the patient is, and the description of the symptoms may not match the symptoms the patient has, when the patient arrives, which may lead to changes in resource allocations and priorities. Things, the flow master and the coordinating nurse must act during the actual task, when more information about the patient is known (e.g., by triage). The hospital visitation works in the same way on weekdays and weekends.

#### Personal coordination and control mechanism

In order to be able to make mutual adjustments (e.g., if the pre-known description of the symptoms does not match the symptoms the patient has when the patient arrives, or if a patient's condition deteriorates), personal coordination is another strategy used within the emergency department (Van de Ven et al. 1976). An organization's ability to process information and to coordinate activities relies not only on rules and information systems, but also on the people within the organization. When analyzing the information processing capacity, there are two critical factors: the number of people and their capabilities (Burton et al. 2015). The decision maker's capacity and skills in order to process information is especially important (Galbraith 1974).

In each section, the role of the flow master (an emergency physician) and coordinating nurse are two parallel coordination mechanisms, who secure a lateral flow of information among the sub-units (Galbraith 1974, Burton et al 2015). They are the **matrix managers** and make decisions about how the employees are spending their time based on the priorities of the patients. Based on information (e.g., from the clinical logistic system and the EPJ, as well as informal information from the employees), they keep an eye on the different processes in the patient's treatment to ensure that the

process is kept going (Burton et al. 2015). This coordination mechanism makes it possible to solve problems at the level where the problems occur (Burton et al 2015).

The **coordinating nurses** on A1 and A2 coordinate the overall nurse task. When a patient is admitted to the emergency department, the coordinating nurse decides which patient room and bed the patient will have during the stay within the department and calls the nurse she wants to take care of the patient. The overall nurse task (i.e., taking care of patients), on A2 is divided into smaller subunit tasks. The nurses work in teams of two. Together they care for a number of patients with medical or surgical symptoms. Number one in each team reads about these patients in EPJ, knows the history of each patient, answers phone calls from relatives, participates in the morning conference, collaborates with the physicians, who treat the patients, and coordinates the transfer or discharge of the patients. Number two in each team takes care of the patients and receives new patients. Within each team, they communicate about what they are doing and what they know about the patients. This coordination is central when focusing on effectiveness and quality of care. However, as one nurse said, *“You often do not know what the nurses within the other teams are doing and how many patients they are taking care of”* (Focus group, nurses from A2, May 2016). To ensure that the overall nurse task within the department is solved, the coordinating nurse coordinates these smaller units. The coordinating nurse delegates the tasks each team solves, and every time a task is solved, and the patient is discharged or transferred, the team informs the coordinating nurse either by telephone or in person. The coordinating nurse coordinates the transfer with the other departments at the hospital. The team contacts her if they have any questions or problems, e.g., if they need help or if they cannot receive new patients because of complicated tasks. On A1, the nurses work alone, and the task is divided into even smaller units. Here they solve the tasks on a more ad hoc basis. If a nurse needs help from another nurse (e.g., to move a patient), she just asks the one who is nearest. If a critically ill patient

arrives, the coordinating nurse chooses two nurses to take care of the patient. Again, the coordinating nurse organizes the work to secure that the overall task is solved.

The overall nurse tasks within the emergency department are solved and coordinated in the same way on weekdays and weekends. However, the number of nurses decreases on weekends. Consequently, an individual nurse takes care of more patients and must handle more information. The nurses discussed how this affected the patient care. One nurse said, *“It is more irresponsible, the work we are performing on weekends.”* Another nurse supplemented, *“Sometimes you have to skip things, you would never skip on a weekday, but due to the number of nurses on the weekends, I have to skip it, because I do not have time enough to do it (...) and those weekends where we receive many patients, I do not observe the patients at the same level”* (Focus group, experienced nurses from A2, May 2016). On A1, the experience was the same: *“On weekends, there are not enough nurses to take care of the patients to the extent that we think is necessary for it to be safe. In the morning, you are holding your breath, working as much as possible, and hoping that the time will run, because at 11 a.m. more nurses will come. You are not satisfied with the work you are able to do in these morning hours”* (Focus group, experienced nurses from A1, September 2016).

The coordinating nurses collaborates with an emergency physician, who is called a **flow master** and coordinates the overall physician tasks (i.e., treatment of patients). The flow master does have an overview of all the patients within the department, and he or she sits in the coordination room on A2 together with the coordinating nurse. The flow master receives phone calls from outside the hospital, e.g., answering questions from GPs and from the municipal emergency team. He examines all patients who are critically ill (red and orange triage), and he coordinates and supervising the junior physicians and residents, who examine all new patients on A2. Another emergency physician goes on ward rounds and supervises the less experienced physicians. A third emergency physician works on A1. His role is similar to the flow master’s but focuses on the patients on A1. The phone calls he receives

are mostly from the hospital visitation about the visitation of the patients. This emergency physician is mainly sits in the area where subspecialized patients are admitted, but he or she keeps an eye on the emergency room as well.

In the emergency department's everyday clinical practice, the emergency physicians have the overall responsibility of individual patients' treatment. Either they treat patients by themselves or they supervise the less experienced physicians who treat patients. In Denmark, it was decided in the summer of 2017 to make emergency medicine a formally recognized specialty. Hence, the emergency physicians employed within the department are consultants who are specialists in other fields. In addition, they have a supra-specialty within emergency medicine, and have emergency medicine experience within their field of practice. As the manager of the departments said, "*Many of our emergency physicians have worked in the clinic for more than three years. When you are an experienced consultant, and then have been worked in an emergency department for three years, then you are, according to me, a specialist within emergency medicine*" (Interview, April 2016). However, analyzing the emergency physicians as capacities, they have different skills and experiences, and they solve the tasks, collaborate, and process information within the emergency department differently. The other employees noticed these differences: "*It is different what the emergency physicians do and what they can*" (Observation, coordinating nurse, night shift, Sunday, August 2015). Hence, the nurses and junior physicians did not always follow the rules about who to consult about the patients. Despite the formally designed rules, informal processes about who to consult arise. As one junior physician said: "*I sometimes call the resident, and the emergency physician does not know it, and I get a completely different answer about the tests*" (Observation, junior physician, dayshift, Sunday, September 2015). A nurse said something similar: "*Who I consult depends on who is flow master today. If you know who is resident, then I often prefer to consult him instead. I would lie if I said I*

*always consult the flow master, also when that patient is critically ill and is triaged red or orange”* (Focus group with nurses, May 2016).

On weekdays, 3-4 emergency physicians are working within the emergency department. Each one manage a self-contained subgroup. They rotate between the three different subgroups. In one shift they are flow master, and in another shift they manage the ward rounds. Hence, they have the possibility to move resources from one subgroup to another, if needed. They are able to adapt to the situation within an organization where many tasks cannot be pre-planned. Moreover, they often use and complement one another’s competences. *“In daytime, if I have a question about cardiology, then I ask Peter. There are always three emergency physicians at the department, and sometimes four. Therefore, it is piece of cake just to ask one of the others. However, I perform best, when I am working in the emergency room. Here I can solve all the tasks pretty much. I have fun. I am much more relaxed, because I know I have the required skills and knowledge”* (Interview with an emergency physician, February 2017). The emergency physicians act as a team, and because they work together and use one another’s competences, it is the competences of the team that is important. Because of the knowledge exchange between the emergency physicians on an as-needed basis, they increase the amount of information they can process (Burton et al. 2011). However, on weekends, only one emergency physician is on duty, and the competences (e.g., clinical, cooperative and managerial skills) of the single emergency physician become important. *“If I am going on ward rounds, and I have a question, then I will ask one of the other emergency physicians who has the skills I need to answer that particular question (...) When I work as an emergency physician on weekends, I usually ask some of my colleagues (the other emergency physicians), but they are not there. I am the only one at duty”* (Interview with an emergency physician, November 2015). Moreover, when a lot of the emergency physicians’ experience is from their field of practice, it is problematic when a new physician is on duty on weekends.



When only one emergency physician is on duty, the information processing capacity decreases. One emergency physician explains: *“You are doing ward rounds to get people out of the department, therefore you cannot be involved in receiving new patients. You do not have time for both. Then, at night, you will struggle with those things you should have done earlier on (...) It is the worst thing about the weekend and evening/night shifts. You are so damn busy that sometimes you fail to do some things. You simply do not manage to follow up on those things”* (Interview, December 2015). One single senior physician is unable to handle all the information and solve all the tasks he is supposed to solve within the department. The emergency physician has too much work to do. The condition in which there is insufficient time to carry out all expected role functions is also called “role overload” (Moorhead 1981). The strategies used by the emergency physicians to prioritize tasks will be elaborated upon later in the article.

In addition, the junior physicians, who under supervision by an emergency physician treat patients, may have to wait on supervision because their supervisor is too busy. Consequently, they are less supervised, especially those who solve tasks within the emergency room on A1. *“You act a bit like a cowboy you must do what you can do (...) You cross some boundaries you might not have crossed before. In addition, you know that if you have done something that is absolute nonsense, then they will discover it at the conference (an orthopedic consultant reviews all the X-rays), and the patient is called in the next day. You have a safety net, so to speak”* (Interview with a junior physician, January 2016). On weekends, the capacity changes, and it becomes harder to match the capacity (physician) with the task (treatment of the patient). Sometimes the result is “rework”. When junior physicians in the emergency room are solving tasks they do not have the skills to solve, the work failures are discovered the day after the treatment at an X-ray conference and the patient is called in. The failure probability of a work item, here the wrong treatment of a patient, depends on the complexity of the activity and the match between the skill requirement and the responsible physician’s skill level. The

junior physician making a decision he does not have the competences to make will trigger a process of exception report and decision making. Failed work items need rework to maintain the quality, here another treatment (Jin & Levitt 1996).

The emergency physicians accumulate a lot of experience from their field of practice. In addition, they have a supra-specialty within emergency medicine. However, because of a lack of emergency physicians, **external actors** cover more than 50 percent of weekend shifts. During the fieldwork, the differences between the emergency physicians and these temporary physicians became apparent.

The emergency physicians' work consists, in addition to clinical work, of managing, coordinating, and prioritizing the total physician resources within the department. Informants mentioned the temporary physicians' lack of experience of how to coordinate the work within the department *"As coordinating nurse, I often ask our emergency physician, if we can put on the plan for the patients on the Cetrea touchscreen. If I ask the temporary physician about that, they do not know what to do. They are not used to thinking along these lines"* (Focus group, experienced nurses from A2, May 2016).

During one observation, where I was following a nurse, I noticed the temporary physician's answer when a junior physician from the emergency room called the temporary physician for supervision: *"I am a medical consultant. I do not know anything about emergency room tasks"* (Field note, October 2015). This citation illustrate another challenge: the temporary physicians' lack of knowledge about surgery in terms of both treatment and supervision. The junior physicians who could not get the supervision they needed were especially aware of this challenge. *"Because they work as consultants within internal medicine on a daily basis, they never see any orthopedic surgery patients; hence they cannot help us at all. Often they indicate, why should I come? What do you expect from me? It can be frustrating that they will not even try to come and help us, but that they just say that they know*

*nothing about it*” (Interview with a junior physician, December 2015). Consequently, the junior physician tries to consult another physician, e.g., one from the department of orthopedic surgery, or they try to solve the tasks by themselves.

When a temporary physician works as an “emergency physician” on weekends, the professionalization of the workforce, measured by skills, knowledge, and capacity to both generate and process information, is decreasing (Burton et al. 2015:148).

An illustrative example of another coordination mechanism that changes between weekdays and weekends is the morning conference. The morning conference is an example of what Van de Ven et al. (1976) call a “**scheduled group coordination mechanism**”. On weekdays, the emergency physician guided the morning conference. All physicians attended, the nurses and therapists participated too, and the focus was the plan for each patient. On weekends, the medical consultant guided this conference. Only physicians and the coordinating nurse attended, and the focus changed to which physician would see each patient. This change of focus resulted in delayed plans for the patients and lack of information to the coordinating nurse, who could not start preparing for discharge or transfer of patients. During a focus group, the nurses discussed the differences between the weekdays and weekend morning conferences, and a nurse expressed: *“It has indeed impacted the overview. As coordinating nurse, I do not get the information I need for the following conference with the other departments, where I am supposed to know how many patients I expect we will transfer to the various departments”* (Focus group, experienced nurses from A2, May 2016). When the physicians from other departments are solving tasks within the emergency department, they solve the tasks in another way, resulting in a decreased capacity. In the morning conference example, in order to maintain the level of performance, the coordinating nurse had to gather the missing information elsewhere she had to evolve a new strategy. She went to the different nurses who took care of the

various patients. A time-consuming task, and sometimes they could not tell her the plan for their patients, because they did not know it either.

Another scheduled group coordination mechanism used in the emergency department was the capacity conference. At this conference, the coordinating nurses from the emergency department met with the coordinating nurses from the departments, to which the emergency department transferred patients after initial treatment. The goal of this conference was to improve the workflow and make the transfer of patients easier. The nurses said that the conference had helped and that they no longer had nearly as many struggles. However, the other departments did not prioritize the conference on weekends; they often forgot to come, and the lack of communication between the departments impeded the patient flow, a challenge that might affect the patients' length of stay on weekends. The employees noticed this change in the patients' length of stay within the department. *"When I do ward rounds Monday morning, I experience that a lot of tasks have not been done during the weekend. Many patients have stayed within the emergency department for the whole weekend. Patients we normally transfer to other departments within a short time have been here for more than 48 hours"* (Interview with an emergency physician, November 2015). The nurses mentioned this too: *"Often patients stay longer within the department on weekends. When you have a shift Saturday night, you will recognize some of the patients, because they have not been transferred to another department"* (Focus group, experienced nurses, A2).

#### Summary of information processing capacities

The information processing capacities within the emergency department differs on weekdays and weekends. The emergency department has a matrix structure, which can handle much more information than other organizational structures but requires managerial skills and coordination.

Therefore, the emergency department has a flow master and coordinating nurse as matrix managers. However, on weekends, more tasks are outsourced to physicians from the other departments, and this change within the division of work requires more coordination. Furthermore, on weekends, the flow master is the only emergency physician within the department, and he is not able to either process all the information or solve all the tasks within the department. The emergency physician does not have time to act as matrix manager at the same level as on weekdays. When analyzing the information processing capacity within an organization, the number of people and their capabilities is important. Both the number of people able to process information and their capabilities to handle information and make decisions decreases on weekends, when 3-4 emergency physicians are reduced to one, and more than 50 percent of the time, that single one is an external actor, who is not use to work as an emergency physician. The lack of emergency physicians also means that the use of self-contained subgroups decreases on weekends, which means that more information must be processed. Like the use of the self-contained subgroups, many of the emergency department's coordination and control mechanisms decrease or are less effective on weekends. This applies, for example, in the morning conference, the capacity conference, and the use of the clinical logistic system.

When looking at the combination of the structure and the coordination and control mechanisms within the emergency department weekdays and weekends, the information processing capacities within the department are high at weekdays, but lower on weekends.

#### Match or mismatch of information proceeding, weekdays and weekends

The information processing model posits that the fit between the information processing requirements and capacity influences performance (Tushman & Nadler 1977). In many ways, the information processing capacities (i.e., the structure) and coordination and control mechanism that the emergency

department has developed fits with the extensive information processing requirements the department faces due to different types of uncertainty. Table 5.2 shows the match between the uncertainty facing the emergency department and the capacities the emergency department has to cope with these uncertainties. Both the sources of uncertainty and capacities have been described in the article. Moreover, the table also illustrates the differences between weekdays and weekends.

**Table 5.2:** The match of information processing and the differences on weekends

Uncertainty sources		Capacities	Differences on weekends
Task complexity	The admission of various patients regarding symptoms, treatment needs, and stage within their treatment	<ul style="list-style-type: none"> <li>• Matrix structure supported by external agreements and matrix managers</li> <li>• Triage system</li> <li>• Self-contained units (on two floors) managed by emergency physicians</li> <li>• Morning conference</li> <li>• Different roles</li> </ul>	<ul style="list-style-type: none"> <li>• Less effective morning conference, because the conference is managed by a physician from another department</li> <li>• One single emergency physician works on both A1 and A2</li> </ul>
	Different numbers of patients	<ul style="list-style-type: none"> <li>• Flexible self-contained groups</li> <li>• Matrix structure</li> <li>• External agreements about calling physicians from other departments when their skills are needed</li> </ul>	<ul style="list-style-type: none"> <li>• Less flexibility of resources between self-contained units, because only two units exist and one is “outsourced”.</li> </ul>
	Patients with a mix of coexisting conditions	<ul style="list-style-type: none"> <li>• Emergency physicians and nurses with emergency care skills</li> <li>• Flow master to coordinate</li> </ul>	<ul style="list-style-type: none"> <li>• The temporary physicians do have limited skills, e.g., skills within surgery and coordination</li> </ul>
	Lack of knowledge about when the patients will arrive	<ul style="list-style-type: none"> <li>• Hospital visitation</li> </ul>	<ul style="list-style-type: none"> <li>• Less time to use the information provided by the hospital visitation</li> </ul>
	Lack of knowledge about how ill the patients are and which competences are needed	<ul style="list-style-type: none"> <li>• Triage system</li> <li>• Formalized rules and SOP guide less experienced physicians</li> <li>• Supervision</li> </ul>	<ul style="list-style-type: none"> <li>• Less supervision of the less experienced physicians because of the emergency physician’s limited time (and skills if a temporary physician is on duty)</li> </ul>
Task inter-dependence	High degree of co-solving of the tasks, employees are dependent upon one another to perform their individual tasks	<ul style="list-style-type: none"> <li>• Flow master and coordinating nurses coordinate overall tasks</li> <li>• Employees employed in the same department treat most of the patients</li> <li>• Clinical logistic system and EPJ facilitate communication</li> <li>• Triage system and formalized rules to coordinate the subtasks</li> </ul>	<ul style="list-style-type: none"> <li>• The emergency physician has too much to do, leaving a lot of coordination to the coordinating nurse</li> <li>• Less use of the clinical logistic system due to the “outsourcing” of tasks</li> </ul>
Subunit task environment	External actors: temporary physicians are	<ul style="list-style-type: none"> <li>• External agreements</li> <li>• Role description</li> </ul>	<ul style="list-style-type: none"> <li>• Temporary physicians cover more than 50% of the weekend shifts → increasing uncertainty</li> </ul>

	acting “emergency physicians”		<ul style="list-style-type: none"> <li>The temporary physicians do not have the required skills</li> </ul>
Inter-unit task inter-dependence	Dependence on an extensive collaboration with the other departments at the hospital	<ul style="list-style-type: none"> <li>Matrix structure supported by external agreements and matrix managers</li> </ul>	<ul style="list-style-type: none"> <li>More tasks are solved by physicians from other departments on weekends → increased uncertainty, requiring more coordination</li> <li>A lack of coordination changes the focus from the emergency care process to a focus on specialty</li> </ul>
	Transfer of patients from the emergency department to other departments after initial treatment	<ul style="list-style-type: none"> <li>Capacity conference</li> <li>The emergency department has the “visitation rights”</li> </ul>	<ul style="list-style-type: none"> <li>Less effective capacity conference due to the coordinating nurse’s lack of knowledge and the other departments’ lack of prioritizing the conference</li> </ul>

Within the emergency department, there is a fit between the high amount of uncertainty and the choice of a matrix structure and the amount of varied coordination mechanism, but on weekends more tasks are “outsourced” to physicians from other departments, requiring more coordination. However, at the same time the coordination decreases. This is due to the limited number of emergency physicians working on weekends. The emergency physician who is acting matrix manager of both sections has limited time (or skills, if a temporary physician) to coordinate the tasks, because of another task: treatment of critically ill patients. Consequently, the physicians from the other department solve the tasks in their own way. Moreover, these physicians from the other departments often have to prioritize between tasks at their own department, e.g., operations or trauma calls and tasks at the emergency department. As a result, the patient flow in the emergency department is not as fluent on weekends as compared to dayshifts on weekdays, and the patients wait longer to be seen by a competent physician. The structure focuses more on functional specialization and is less service oriented (Burton et al. 2015).

On weekends, there is a misfit between the high tasks complexity and the task interdependence, which requires a high level of competences (i.e., clinical and coordination skills) by the emergency physician, and the number of emergency physicians on duty. One single emergency physician is not

enough to solve all the tasks, and the temporary physician do not have the required skills to solve all the tasks. The risks of breakdowns within the sequential treatment increases on weekends, because the external actors do not have the competences to process the information (fast enough). The capacities do not match the requirements.

More informants mentioned that this mismatch between capacities and requirements affected the patient care. One nurse gave an example: *“One morning a patient with lung cancer had problems with his respiration and sudden deterioration. His triage color was red (seriously ill). An emergency physician, a temporary one, was responsible for the patient care. However, he did not have a good sense of what was required, and the nurse, who was new, did not have much sense of it either. The patient had been within the department for quite a few hours without anything really being done, and in the moment I came, an anesthesiologist came and suggested a special form of treatment. If one of our emergency physicians had been at work, they would immediately have known what to do. The treatment the patients get is very different”* (Focus group, nurses from A2, May 2016). As the nurse said, the level of patient care varies according to the physician at work.

The emergency department did make an agreement with a group of temporary physicians to cover shifts within the department. However, they have not been able to create a capacity to deal with the increased uncertainty that such an agreement creates. This organizational misfit exists on both weekdays and weekends. However, the temporary physicians cover more shifts on weekends, which means that the misfit is bigger and have more consequences within weekends.

When analyzing the requirements and capacities within the emergency department, the information processing requirements is extensive at weekdays, but even higher on weekends due to an increased level of work related uncertainty especially within the subunit task environment and inter-unit task interdependence. Moreover, the information capacities within the emergency department are high at



weekdays, but lower on weekdays, because of a decreasing and less effective set of coordination and control mechanisms. Figure 5.3 shows the relation between the needs and capacities.

**Figure 5.3:** Relationship between information processing requirements and capacities within the emergency department, weekdays and weekends (illustration inspired by Figure 3 within Tushman & Nadler 1977:619).

Information Processing Requirements	Information Processing Capacities	
	High	Low
Extensive	Match <b>Weekdays</b>	Mismatch <b>Weekends</b>
Minimal	Mismatch	Match

On weekends, the information processing capacities in the emergency department decrease, and the capacities are therefore not sufficient to deal with the high work-related uncertainty, which is even higher on weekends.

Mismatches in capacities and requirements are associated with lower organizational performance (Tushman & Nadler 1977), and more informants noticed that this mismatch affected the patient care. Due to the mismatch on weekends, the decisions within the emergency department will be made with a less than optimal amount of information, the treatment will be delayed (e.g., patients will wait longer to be seen by the right capacity), and the patients' stay within the department will be extended. Extended length of stay within hospital emergency departments is associated with higher risk of errors and increasing costs (Hoot & Aronsky 2008).

This analysis shows that there is a misfit between the information demands and capacities during the weekends so on weekends, the organization will be less efficient. The misfits may thus explain the

weekend effect. In the next part of the analysis, I will investigate how the employees deal with this mismatch within the department's ability to process information. The employees' behavior may affect the patient care due to a prioritization of some patients over others.

### **5.6 Strategies used to deal with the misfits**

As stated above, the misfits within the organizations ability to process information on weekends may on a macro level be one explanation of the weekend effect. By moving from a macro approach, where the unit of analysis is the emergency department, to a micro approach focusing on how work roles are carried out by employees, I have identified different strategies used by the emergency physicians in an attempt to cope with the mismatch between the information processing requirements and capacities (Moorhead 1981).

Medical work is a collaboration between various health professionals, and within the emergency department, most tasks are co-solved. However, the emergency physician has the overall responsibility for patient treatment within the department. Moreover, one of the reasons for the mismatch between information processing demands and capacities on weekends is due to the fact that only one emergency physician is on duty, and he or she is unable to process all the needed information within the organization. The emergency physician has too much work to do and has to prioritize between which tasks to solve. I will therefore focus primarily on the strategies used by the emergency physicians in this part of the analysis.

On weekends, the main tasks of the emergency physician are to coordinate the tasks within the department, treat seriously ill patients, and (as the only senior physician on duty) supervise less experienced physicians. Often the emergency physician has to prioritize between the tasks. They are trained to do so, but the organizational complexity complicates this maneuver. To be able to prioritize,

the emergency physician needs information. The information available on the clinical logistic system helps the emergency physician to get an overview of the tasks. However, some tasks are not visible on the screen (e.g., adjustments needed due to a deteriorating in a patient's condition). If the emergency physician is not aware of these tasks, they cannot be prioritized. The emergency physician is dependent on the reports from the other health professionals, who spend more time with the patients.

In the empirical material, I identified four different strategies used and developed by emergency physicians in an attempt to cope with the misfits within the organizational design of the emergency department on weekends. The strategies were changing triage color, prioritizing tasks on A2, controlling other physicians, and prioritizing of either clinical or coordinating tasks.

#### Changing triage color

To get information about how urgently patients need to see a physician, a nurse does an initial triage of the patients when they are admitted to the emergency department. According to department rules, the emergency physician has to see the red (triage color) patients immediately and orange patients within 15 minutes. This rule sometimes stresses the emergency physicians, especially if multiple patients are orange and should be prioritized at the same time. Sometimes the emergency physicians choose to down-triage patients by changing the initially determined triage color. An emergency physician explained: *“The emergency physician may decide to down-triage patients when they (nurses) are calling about an orange patient. I may do it too, if they call me from the emergency room, and the patient has an orange triage because of a dislocated shoulder. Then I may say that I do not have time to see the patient, and one of the residents must fix it”* (Interview, December 2015).

If the emergency physician does not have time to see a patient because of prioritizing other tasks, he or she sometimes decides to change the triage color of the patient from orange to yellow. By doing that, the physician does not have to see the patient immediately, and a less skilled physician can do the initial treatment and later be supervised by the emergency physician. This strategy is because the capacity of emergency physicians is not always high enough to follow the formalized rules about how and when to see critically ill patients, and the emergency physician has to actively prioritize between patients, some patients are more orange than others. By changing a patient's triage color from orange to yellow, the emergency physician reduces the requirements of information processing in an attempt to get the requirements to match the available capacities. However, they leave important information processing work to less senior physicians, which may affect the patient care negatively.

The consequence of this strategy is, however, that even though a formalized rule says that the nurses should call the emergency physician every time a patient is triaged red or orange, the nurses did not always call the emergency physician when a patient is triaged orange. The nurses often discussed, whether they should call the emergency physician or not, or they called the physician and said the resident was already here and it was not necessary that the emergency physician show up too. The result of the emergency physicians' strategy of down-triaging patients was that nurses too exercised a considerable degree of judgment in their reporting instead of following the rule. By doing this, the nurses helped the emergency physician to decide which competences would treat the patient. However, the rule was made to secure that a senior physician with the right capacity to process needed information saw the seriously ill patient when the patient was admitted.

The fact that both physicians and nurses did not always follow the rule about when orange patients should be seen by a senior physician, may lead to some patients not being seen by the appropriate capacity, especially on weekends. A capacity who are able to process the needed information and make the right decisions at the right time.

The reason the nurses on A1 did not always call the emergency physician when patients were triaged orange might also be a consequence of another strategy used by the emergency physicians: they often prioritized tasks on A2.

### Prioritizing tasks on A2

On weekends, the emergency physician is the overall responsible physician for both A1 and A2. However, most of the physicians prioritized tasks on A2, leaving A1 without a senior physician most of the time. The emergency physician has a base within the coordination room on A2, and on the clinical logistic system, the information about the patients admitted to the department is available. If the nurses and junior physicians on A1 need his expertise, they have to call him. As one emergency physician said, *“I am very dependent on that the junior physicians and nurses are my ears and eyes and they call me when they receive an orange or red patient (triage color)”* (Interview, December 2016). The emergency physician becomes a “physician on call” and the responsibility moves to the junior physicians and the nurses.

When asking the emergency physicians about how they prioritized the time between the sections, most answered they prioritized tasks on A2. As one emergency physician said, *“Basically, I am probably an A2 physician, also more than I perhaps should be”* (Interview, December 2015). They came up with different explanations: 1) Condition of the patients. The medical patients were often more complex and more critically ill than those patients admitted on A1. 2) Competences. Most of the physicians specialized in medicine, and they believed that they could do much more for the medical patients admitted to A2. 3) Affiliation. Most of the physicians worked at A2 before the section became a part of the emergency department, and because of that, they knew this section and the nurses better than those on A1. One physician explained, *“I feel comfortable when I am working*

on A2, which is the section that I have been a part of since, yes, before it became a part of the emergency department. We have a culture where we talk together and there is a great expectation of reconciliation between physicians and nurses. Everyone knows the tasks, and you do not have to think all the time. When you get down to A1, things do not run in the same way, and sometimes you get irritated. Things are just not as you are used to” (Interview, December 2015). Another emergency physician commented: “There is no doubt, this staircase is sometimes a little higher and a little further than what it really is” (Interview, December 2016). The emergency physicians’ explanations show that the prioritizing of A2 partly is a result of the conditions on which the emergency department was designed. The sections within the emergency department belonged before to two different departments. Some physicians working within these sections became emergency physicians. The longer affiliation to some parts of the department affects their prioritization of tasks. Moreover, a lack of a specialty within emergency medicine means that emergency physicians have backgrounds within other specialties. They are specialized to treat patients with certain symptoms, and therefore they more or less consciously prioritize treating these patients.

The consequence of this strategy, emergency physicians prioritizing tasks on A2, is that the responsibility moves to the junior physicians and nurses. They manage the treatment processes, coordinate the tasks, and call more experienced physicians if needed. They decide who and when to call. This design requires that the junior physicians and nurses have the right competences and experience to make these decisions. However, the uncertainty about the responsibility increases, especially if those physicians the junior physician calls do not have time to come or prioritize other tasks. In the emergency room, the junior physicians sometimes experience that neither the emergency physician nor the consultant from the department of orthopedic surgery take responsibility. The emergency physician may not have the skills to help, and the consultant may not prioritize helping because the emergency room has become a part of the emergency department.

These differences within the organization of the emergency department on weekdays and weekends means that the patients admitted on A1 on weekends may not get the same treatment as if they were admitted on a weekday.

#### Prioritizing clinical tasks or coordinating tasks

On weekends, the emergency physicians often prioritized between coordinating tasks or clinical tasks, e.g., using more time on treating critically ill patients. They had to decide between handling the information in order to coordinate the care of patients within the department (e.g., the information coming from the hospital visitation about expected patients) or using more time to treat seriously ill patients (e.g., get all the information needed themselves instead of leaving this work to other and less experienced physicians).

Some emergency physicians prioritized the clinical tasks. One explained: *“If it is a critically ill patient, then I stay by the patient maybe for 20 minutes or half an hour or so, and finish my task. I cannot leave a patient who is critically ill to go out and take care of the flow. However, I lose the overview (...) (When I come back) I am looking at the clinical logistic system, I am talking to the coordinating nurse and typically there will be some junior physicians waiting for supervision”* (Interview, December 2016). The nurses who sometimes acted as coordinating nurse also mentioned that emergency physicians often prioritized the clinical tasks: *“An emergency physician is often disrupted, especially if it is one of those shifts where many patients turn out to be red or orange (triage color). Then these patients almost take their time completely, and you may experience that when you inform them, that there are no more beds available or what about this patient, could we transfer him to another department, they have too much to think about, and you have to solve it by yourselves”* (Focus group, experienced nurses from A2, May 2016).

However, some of the physicians had another strategy. One explained, *“If we are busy, and we have to transfer some patients to the other departments, then I do not have time to stay by the patient for as long as I prefer (...) In such a situation, you have to prioritize. Because, when a nurse calls me and says you have to, we have to find a solution to this. Then it is difficult to stay with the patient, especially when the junior physician will come later. In most cases, I leave the patient a little earlier”* (Interview, February 2016). Later in the interview, the emergency physician mentioned one of the consequences of emergency physicians not always having time to stay by patients: *“It is the consequence of being so busy. I lose information, because I do not have time to stay at the patient for a longer time. It is just arrive, does he breathe, he does, is he awake, fine, and so forth and then I leave again. For example, we had a patient the other day. I did the right thing. However, I had just been told that she had had a headache since Sunday night and it had been a very bad headache. Since she had had nausea, vomiting, and neck stiffness, we decided to transfer her to Aarhus (university hospital one hour away). If I had used more time with her, I would have been told, as they were in Aarhus, that she had a sore throat the week before. Then I would have thought of meningitis as the first thing. Her treatment was not delayed; there was an hour in difference, so it meant nothing (...) It frustrates me that my own demands for quality are not always met because of the bustle. I am sorry about that. That my questions to the patients are not optimal”* (Interview, February 2016).

As the emergency physician mentioned, when leaving the patients because of coordination tasks, the emergency physician does not have time enough to collect the needed information. He or she may not get the same clinical overview (for definition see Bossen & Jensen 2014), which is crucial in health care in order to make the right decisions. As a result, decisions within the emergency department will be made with a less than optimal amount of information. When prioritizing the coordination tasks, they leave important information processing work to less senior physicians, which may affect the patient care negatively.



## Controlling other physicians

On weekends, physicians from other departments solved more tasks within the emergency department increasing the inter-unit task interdependence. Cooperation agreements were made with the various departments to ensure that the physicians solved the tasks within the emergency department. The emergency department knew how many physicians were present within the emergency department and when. Hence, the agreements provided stability, reduced the uncertainty, ensured the quality, and released some resources. However, how these physicians solved the tasks was not specified in the agreement, and as illustrated there was still a high degree of uncertainty in the collaboration due to the emergency department's dependence on these physicians.

Some of the emergency physicians tried to minimize this uncertainty by trying to control which tasks the physicians from the other department solved and when. *"In my shift, I delegate the tasks, and they solve these tasks"*, as one emergency physician said (Interview, December 2015). By telling the physicians from the other departments what to do, the emergency physician tries to influence the activities of the physicians. Another emergency physician called the physicians to board meetings. They met in front of the touchscreen, where they could see all patients within the emergency department and talk about what they needed to do in order to treat the various patients. By inviting the physicians from the other departments to participate in these discussions about what to do, the emergency physician tries to create an incentive and thereby influence the activities: the physicians themselves can help to determine which patients are transferred to the other departments. However, this delegating and discussion of tasks takes time. Other emergency physicians let the physicians solve the tasks in their own way, and "trusted" the way the physicians solved the tasks. They said that they did neither always know how the other emergency physicians solved their tasks, and that physicians are used to solving tasks by their own it is a part of being a senior physician. Other physicians mentioned that they had to be nice to these physicians from the other departments because

of the emergency department's dependence on their task solving. As shown, the emergency physicians tried to find a balance between decreasing the uncertainty by controlling the processes, and accepting their dependence on these physicians in order to treat all the patients in order to reach the goal of the organization. It may also be an acceptance of the missing capacities, and that the emergency physicians do not have time to solve this task. They should prioritize other tasks.

#### Summary of employees' strategies

On a micro level, the emergency physicians use different strategies in an attempt to cope with the mismatch between the information processing requirements and capacities on weekends. Three of the strategies (changing triage color, prioritizing tasks on A2, and prioritizing of either clinical or coordinating tasks) were about prioritizing between tasks, while the emergency physicians tried to compensate for the information processing misfits with the last strategy (controlling other physicians).

The emergency physician on duty cannot solve all the tasks he or she is supposed to solve and has to prioritize which tasks to solve. When prioritizing between the tasks, the emergency physician often prioritizes paying more attention to the treatment of some patients rather than others (e.g., the patients on A2 rather than patients on A1, or some orange patients rather than other orange patients). As a result, some information may not be processed at all or not at the right time, and the risk of something being overseen or errors occurring increases. Consequently, treatment levels between patients may vary between weekends and weekdays, where more emergency physicians are on duty. This competition among patients for available resources is a well-known problem within the organization of the medical work (Strauss et al. 1997).

Some of the emergency physicians used another strategy. As described, more physicians from other departments were solving tasks within the emergency department on weekends, which increased uncertainty. The emergency physicians tried to minimize increased uncertainty by trying to control, which tasks these physicians from the other department solved and when. By trying to control the physicians from other departments, the emergency physicians compensated for the information processing misfits. This strategy might affect the quality of care of some patients and thus diminish the effect of the information processing misfits.

The different strategies the employees develop and use and the consequences of these strategies shows that the misfit between the information processing demands and information processing capacities have an effect on what can be done, and how it can be done. It affects the quality of the work performed in the emergency department.

## **5.7 Discussion and conclusion**

Patients should be able to expect the same standard of emergency care, whatever day of the week they are admitted. However, more than 100 studies have demonstrated that patients admitted to hospitals on weekends experience worse outcomes compared with patients admitted during the week, and emergency patients seems to be most affected (Lilford & Chen 2015, Wise 2016). Despite the “weekend effect” being well documented, the causes of this effect are unclear (Bray & Steventon 2016).

This study shows that the information processing requirements within the emergency department are extensive at weekdays and on weekends. This is due to the high level of uncertainty caused by 1) task complexity, i.e., acute ill patients with various symptoms admitted at times that cannot be predicted, 2) the level of interdependence between tasks, which are co-solved, 3) a dynamic and changing

environment, and 4) the emergency department's interdependence with other departments at the hospital. On weekends, physicians from other departments solve more tasks within the emergency department, and temporary physicians are acting emergency physicians, which makes the information processing requirements even higher. The extensive information processing requirements match the matrix structure of the emergency department, which are able to handle much more information than other organizational structures and the amount of varied coordination mechanisms within the emergency department. However, the information processing capacities within the emergency department differs between weekdays and weekends, due to a lower level of coordination and control mechanisms on weekends. On weekends, 3-4 emergency physicians are reduced to one, and more than 50 percent of the time, that single one is an external actor. Hence, both the number of people and their skills to process information are reduced. Furthermore, more coordination mechanisms (e.g., the self-contained groups, the morning and capacity conferences, and the use of the clinical logistic system) decreases or are less effective on weekends. As a result, the now increased number of physicians from the other departments solving tasks within the emergency department do so in their own way, without central coordination, and patients are waiting longer to be seen by a physician, who often also is less competent due to the reduced number of senior physicians on duty. This mismatch between the information processing demands and capacities affects the patient care.

Furthermore, in order to cope with this mismatch, employees developed different strategies. In this study, four emergency physicians' strategies have been identified. Three of the strategies (changing triage color, prioritizing tasks on A2, and prioritizing either clinical or coordination tasks) were about prioritizing tasks due to the fact that the emergency physician was unable to solve all the tasks he or she was supposed to solve. As a result, the emergency physician prioritized some patients rather than others, and those patients whose treatment was not prioritized might not get the same level of treatment as if they were admitted on a weekday. They might have to wait longer, and the emergency

physician was less involved within their treatment. Consequently, some information might not be processed at the right time or not at all, and the risks of errors occur increases. With the last strategy, the emergency physicians tried to minimize uncertainty by controlling how the physicians from the other departments solved the tasks within the emergency department. This strategy might affect the quality of care of some patients and thus diminish the effect of the information processing misfits.

I found the theoretical approach of information processing useful for the investigation of possible explanations of the weekend effect within the setting of a Danish emergency department. To our knowledge, the information processing model has not been used to analyze an empirical case within the setting of health care on this detailed level before. By building on the contingency theory, the information processing model provides a conceptual framework for analyzing complex organizational challenges (Tushman & Nadler 1977). However, due to the simplicity, the model does not specify a direct way for incorporating social practices into organizational analysis, social practices that might influence or be influenced by the misfit identified by using the model. The information processing model thus offers only a partial account of reality. To gain a more comprehensive understanding of a dynamic organization and the differences between weekdays and weekends, I combine different perspectives (Astley & Van de Ven 1983). By combining the information processing perspective and ethnography, I am able to investigate both the formal organization and the strategies developed by the employees in able to cope with the misfits found in the initial analysis (Scott & Davis 2013).

The suggestions mentioned in the existing studies as to why the weekend effect exists focused on individual parts of the organization such as competences, number of employees, or access to the service departments (Aylin et al. 2010, Barba et al. 2006, Bell & Redelmeier 2001, James et al. 2010). These explanations do not encompass contextual organizational dimensions. By combining an information processing perspective and ethnography, I found that the “weekend effect” emerges in a

complex interplay between many different organizational elements, which furthermore affect the social practices. On a macro level, the various misfits within the organization's ability to process information affect both the patient care offered by the emergency department and the employees' behavior on a micro level. By using different strategies, they had to prioritize between different tasks, which too affect the patient care delivered by the emergency department on weekends. The increased competition among patients for available resources during weekends is a consequence of the misfits between information processing demands and capacities on weekends.

The combination of an information processing perspective and the use of ethnography provides a new perspective on the causes of the weekend effect, by investigating the setting in which the patient care is delivered, and how it varies within different organizational circumstances on weekdays and weekends.

The identification of the strategies, developed and used by the emergency physicians, shows how the employees within the emergency department tries to adapt to the misfit between information processing demands and information processing capacities. Another possibility is to fix the misfit by changing the organizational design. If the organization of the emergency department was rearranged so that the information processing capacities matched the demands, then the patient care offered on weekdays and weekends would be more similar, and the weekend effect would be minimized. Some of the misfits within the emergency department's ability to process information could be solved by increasing the capacities, e.g., by hiring more emergency physicians. It may eventually be possible, due to the decision of the Danish Board of Health to create a specialty within emergency medicine. Hiring more emergency physicians who actually had a specialty within emergency medicine would increase the skills within the emergency department and decrease the uncertainty (e.g., their dependence on the other departments and their use of external actors as "emergency physicians"). Moreover, the patient care on weekends would no longer be dependent on a single senior physician's

skills but on a team as in weekdays, and the emergency physicians would be able to handle clinical, coordination, and supervision tasks. Until these new emergency physicians are ready to staff the emergency department, more physicians would be interested to staff emergency departments.

Another solution is to decrease the uncertainty, which occurs in connection with the emergency department's dependence on the other departments by changing the incentives. Today, the physicians from other departments do not have any incentives to solve the tasks within the emergency department, and therefore they do not prioritize these tasks. Furthermore, they do not have any incentives to solve the tasks in ways that would fit more with the process focus within the emergency department. Both solutions, hiring more emergency physicians or changing the incentives, could increase the quality of patient care and decrease patients' lengths of stay within the emergency department.

The main strength of this study is the use of qualitative methods. The observation of and interviews with both management and employees about how the emergency department is organized and how the tasks are coordinated and solved by different employees on both weekdays and weekends gives a detailed and in-depth picture of not only the formal organization but also the social practices. The qualitative methods make it possible to capture the complexity of patient care and thus provide insights into possible reasons of the weekend effect. Although longitudinal field research seems particularly well suited to studies of organizational changes in emergency departments on weekdays and weekends, like all studies, this also suffers from limitations. This study is based on a fieldwork, which took place in one of the 21 Danish emergency departments, and the emergency department's strategy about solving shortage by outsourcing shifts to a group of temporary physicians, who acts "emergency physicians" once a month, is unique for this case. However, the challenges described within this study (e.g., the physicians from other departments lack of incentives to solve tasks within the emergency department and the limited number of emergency physicians on duty during evenings,

nights, and weekends) are observed in more Danish emergency departments (Duvald et al. 2015, Duvald et al. 2016a, Duvald et al. 2016b, Duvald et al. 2016c, Møllekær et al. 2017). The emergency departments in Denmark are new and still under development, some of the variation in the organization on weekdays and weekends exists because of a managerial focus on getting the organization to work in daytime at weekdays. Moreover, it has just been decided to establish a specialty within emergency medicine in Denmark. A register-based study of the patients admitted to the emergency department used in this study has not been done. The weekend effect has been explored in more than 100 studies, which confirm that the weekend effect is a common finding at the hospital-wide level. Replicating this further would seem to fulfill no useful purpose. However, a register-based study could show differences in case mix between patients admitted on weekdays and weekends, differences that may affect the information processing requirements on weekdays and weekends.

#### Acknowledgements

I would like to thank the employees and managers in the emergency department at Viborg Regional Hospital, Regional Hospital Central Jutland, for enabling me to visit their department to observe their daily operations.



## **Chapter 6: Concluding discussion**

---

This chapter brings together the findings from the three papers included in this thesis. First, I look back at the research questions presented in the introductory chapter and answering them based on the results from the three individually papers. Then I will discuss further how the results from the three papers are connected, before offering an overview of the thesis's limitations and contributions. After presenting some suggestions for future research, the thesis will ends with some concluding remarks.

### **6.1 Answering the research questions**

The first research question, “Is there a weekend effect in the emergency department (when looking at mortality rate, length of stay, and number of adverse events), and if it exists, what characterizes the weekend effect?” is addressed in papers I and II, which constitute chapter 3 and 4. To answer the research question, I will summarize the findings from the two papers.

The first paper, “Day of the week of admission, patient characteristics and patient outcomes: a study of the weekend effect in an emergency department” explores parts of the first research question by examining the association between time of admission and 30-day mortality rates and length of stay within the emergency department. Findings showed that a higher percentage of patients had a stay of more than 24 hours within the emergency department on weekends. Furthermore, patients with a high disease severity admitted on weekends had an increased risk of dying within 30 days when comparing with patients admitted on weekdays. The mortality rate is particularly high for critically ill patients with an orange triage score admitted at nighttime and for patients with a red triage score admitted on evenings at weekends. The weekend effect within the emergency department is characterized by critically ill patients who are admitted on weekends having an increased risk of a longer stay within

the emergency department, but also of dying within 30 days, when compared with patients attending the emergency department on weekdays. Once you have past the problem of understanding just what is happening, it is natural to ask the question of why things happen. Patient characteristics, including the severity of disease, were investigated in order to consider if changes in patient characteristics could be a possible explanation of the weekend effect, as suggested by previous studies. Findings showed that more patients admitted on weekends have a high disease severity (triage orange or red), and more patients were transferred to the ICU on weekends. These differences indicate that patients admitted on weekends were more critically ill than patients admitted to the emergency department on weekdays. Thus, differences in disease severity may be one of the explanations of the weekend effect.

In the second paper, “Adverse events in an emergency department weekdays and weekends - a critical study of registration practices,” I tried to illuminate the sub-question about adverse events. I investigated the number and types of adverse events that occurred in the emergency department on weekdays and weekends by using data from the mandatory and national electronic self-reporting system. Findings showed that most adverse events happen on weekdays (0.13 per shift) when compared to weekends (0.07 per shift). However, the greatest time of risk for having an adverse event is in the night between Saturday and Sunday. Different types of adverse events happen on weekdays and weekends. Most of the adverse events happen on weekdays are related to 1) samples, patient examination, and test results and 2) medication. Adverse events related to 3) treatment and nurse care and 4) information handover, patient responsibility, and documentation happen more often on weekends. However, the findings of the explorative phase building on interviews and a questionnaire showed that even though employees perceive reported adverse events as a tool to optimize work processes and quality of patient care provided in the emergency department, they did not report all adverse events due to barriers both on an organizational and a practice level. When only some adverse events are reported to the national reporting system, this study indicated problems in registration

practices, and the usefulness of the data for research in general (and of the weekend effect) has been discussed.

Once past the problem of understanding what is happening, it is natural to ask why things happen. In the first two papers, I examined whether there was a weekend effect in a Danish emergency department and what characterized this weekend effect. Several studies have asked about the existence of the weekend effect. However, they did not continue to investigate why the weekend effect exists. I did that in my thesis with the second research question: “How is the emergency department organized, i.e., what characterizes the structure, the employees, the work processes and the coordination in the emergency department respectively, weekday and weekend, and can the differences within the organization be a possible explanation of the weekend effect?,” which is addressed in paper III. I chose to search for explanations of the weekend effect within the emergency department’s organization and social practices.

Based on a longitudinal ethnographic fieldwork and by using an information processing model as the theoretical framework, I made a thorough analysis of the organization of the emergency department on weekdays and on weekends. Due to a changing number of employees and their competences, as well as changed work processes and coordination and control mechanism, I found differences within the emergency department’s capacities to process information on weekdays and on weekends. The differences within the organization meant that the information processing requirements and capacities match on weekdays, but on weekends, there was a mismatch between the high requirements and low capacities. This mismatch appears to be one explanation to why the quality of the patient care differs on weekdays and weekends. Furthermore, I identified strategies developed by the employees to cope with or to compensate for this mismatch. These strategies, which were used to prioritize between the patients, and thus may affect the quality of care of some patients. These identified changes within the

setting in which the patient care is delivered provide a new perspective on the causes of the weekend effect.

## **6.2 Connecting results from the three individual papers**

The quantitative data used and presented in papers I and II is from 2014-2015, and most of the qualitative data presented in papers II and III was collected during fall 2015. However, the data collection has been a developing process, and focus groups and the questionnaire (most used in paper II) were added in 2016. Thus, all data used in the thesis was collected in the same time period, which make the findings from the various studies connectable. In this subsection, I will connect findings from papers II and III by looking at the occurrence of the adverse events and the design of the organization. Furthermore, I will elaborate upon the connection between the findings from papers I and III.

Most adverse events occurred between 2:00 p.m. and 3:59 p.m.

When analyzing the data about the adverse events reported to the mandatory and national electronic system, I found an additional finding, which has not been presented in paper II. It is the result of a time analysis of when the reported adverse events occurred. Time of day was unknown for 76 adverse events, leaving 153 adverse events (67%, 153/229) in the time analysis. Table 6.1 shows what time of the day the adverse events happened.

**Table 6.1:** Time of day for adverse events

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total number	Percent
00:00 - 1:59 a.m.	1	1	1	1	1	2	2	9	6
2:00 a.m. - 3:59 a.m.	2	0	1	0	0	2	2	7	5
4:00 a.m. - 5:59 a.m.	0	1	1	1	0	1	0	4	3
6:00 a.m. - 7:59 a.m.	0	1	2	2	1	0	3	9	6
8:00 a.m. - 9:59 a.m.	0	6	3	1	2	0	1	13	8
10:00 a.m. - 11:59 a.m.	2	4	1	2	0	1	0	10	7
12:00 p.m. - 1:59 p.m.	3	3	6	2	4	1	0	19	12
2:00 p.m. - 3:59 p.m.	2	3	4	8	6	3	2	<b>28</b>	<b>18</b>
4:00 p.m. - 5:59 p.m.	0	3	1	6	1	1	1	13	8
6:00 p.m. - 7:59 p.m.	2	1	2	0	1	2	2	10	7
8:00 p.m. - 9:59 p.m.	1	1	2	3	2	4	0	13	8
10:00 p.m. - 11:59 p.m.	2	1	2	4	1	2	1	13	8

The result shows that most adverse events (18%, 28/153) happened between 2:00 p.m. and 3.59 p.m. The need for 24-hour emergency care requires emergency department employees to work in shifts. The emergency department operates with three shifts, and during the time window between 2:00 p.m. and 3.59 p.m., the day shift, which is running from 7:00 a.m. to 3:00 p.m., ends, and the evening shift, which starts at 3:00 p.m. and runs until 11:00 p.m. (or until morning for physicians), starts. This result was validated by the questionnaire. When asking the employees when they thought the majority of the adverse events in the emergency department happened, 17% of the employees answered “in the shift changes.” Intuitively, the result is not very surprising. Shift changes have long been viewed as dangerous times and especially within emergency care, failures in communication and transfer of critical information or treatment responsibility can result in adverse events (Wears et al. 2003).

Despite this knowledge, the findings from the ethnographic fieldwork showed that the emergency physicians' handovers at shift changes were limited. If existing, only short, one-on-one conversations about the most critically ill patients took place.

However, the time window between 2:00 p.m. and 3:00 p.m. becomes even more interesting if adding the findings from the study of the organization of the emergency department, which showed that the emergency department's design changes between the day shift and the evening shift. The findings were already identified in Møllekær et al.'s (2017) study. However, because the differences between the organization in day shifts and in evening/night shifts are similar to the differences between the organization of the emergency department on weekdays and on weekends, paper III presents a detailed analysis of these differences. The knowledge about how many differences happen in this short time window and result in a change of the organizational design of the emergency department highlights the risk of adverse events happening in this specific period and helps us to understand the increased number of adverse events found in the second study.

However, the findings from paper II that not all adverse events are reported by the employees showed that when examining the existence of the weekend effect and why this effect exists, it may due to registration practices be difficult to focus on adverse events and examine the actual number of adverse events happening on weekdays and on weekends. Thus, it may be more fruitful to examine other performance goals or outcomes, such as mortality rates and length of stay, as I did in paper I, or how patient care are organized on weekdays and weekends, as I did in paper III.

#### The organization that handles more critically ill patients

When investigating the reasons of the existence of the weekend effect, mortality may not be the best outcome to use, and other outcomes may be more important to investigate (Wise 2016). The focus of

this thesis has been the differences within the organization of the emergency department on weekdays and on weekends, and thus the setting in which the patient care take place. However, the epidemiological study presented in paper I showed a difference within length of stay and mortality rate between critically ill patients attending the department on weekdays and on weekends. Thus, the weekend effect within the emergency department is not just driven by the health care providers' anecdotal experiences. Moreover, the findings showed that in total fewer patients are attending the emergency department during the weekend, but a higher percentage of those patients are critically ill, when compared to the patients admitted on weekdays.

This is an important fact to consider when examine the organization of the emergency department on weekdays and on weekends. The emergency department should be designed in a way that make the department able to handle the changing characteristics of patients attending on weekdays and on weekends. However, the thorough analysis of the organization of the emergency department presented in paper III showed that the information processing capacities of the emergency department were decreasing on weekends, e.g., the number of emergency physicians on duty decreased from four to one. This may fit with the decreasing number of patients admitted to the emergency department on weekends. However, when a higher percentage of the patients admitted on weekends are critically ill (triaged red or orange), compared with the patients admitted on weekdays, the information processing requirements are increased and so are the needs of information processing capacities. The higher percentage of patients with a high disease severity (triaged orange or red) admitted to the emergency department explains the findings of the different strategies developed and used by the emergency physicians to prioritize between the patients. This prioritizing happens on a micro level, which can explain why some patients may not get the same level of treatment as if they were admitted on a weekday.

### **6.3 Limitations and contributions**

By mixing both quantitative and qualitative approaches within my thesis, I was able to generate a better understanding of the weekend effect within a Danish emergency department as well as to explore several possible explanations for why patient care differs on weekdays and on weekends. By searching on a patient level, I found with my epidemiological study presented in paper I that disease severity may be an explanation of the weekend effect. The patients attending the emergency department during weekends tended to be more critically ill than the patients attending the emergency department on weekdays. Moreover, by combining ethnographic methods and an information processing perspective, I found explanations for why the patient care differs on weekdays and weekends on both an organizational level and an employee level. The emergency department's ability to process information was low on weekends, and due to the mismatch between the information processing requirements and capacities, the employees developed different strategies to prioritize between the patients.

One limitation of mixed methods is that it can be a challenge to learn and master multiple methods (Johnson & Onwuegbuzie 2004). To avoid this limitation, I collaborated in my first study with two physicians who know about epidemiology, and in my second study, a statistician advised me. Moreover, the potential for providing more complete knowledge and stronger conclusions through convergence and corroboration of findings, and the possibility to find various potential explanations of the weekend effect, outweigh the disadvantages of mixed methods.

My choices of methodological approaches for each study made it possible to contribute in various ways. In the first study, presented in paper I, I used data from EPR, which made it possible to investigate not only the existence of the weekend effect (mortality and length of stay) but also the



disease severity by using the triage score as an indicator. Disease severity has been suggested as a possible explanation of the weekend effect but has hardly been investigated.

In the second study, presented in paper II, I investigate numbers and types of adverse events in the emergency department on weekdays and on weekends. Moreover, I discuss the usefulness of data on adverse events registered to the national database in research investigating adverse events. By adding an explorative phase using focus groups and a questionnaire, I show that only some adverse events are registered. Moreover, I identify different explanations for why not all adverse events are reported. In this study, instead of using the data from the national reporting system, I could have done an observational study of adverse events like previous studies, but then I would not be able to question and discuss the possibility of using the data collected through the database, data that other studies have used.

In the third study, presented in paper III, I combine an ethnographic field study with the information processing perspective in order to investigate both the formal organization and the social practices within the emergency department. This combination of different methodological approaches made it possible to investigate how changes within the organizations on both a macro and a micro level may be an explanation to why the quality of care changes from weekdays to weekends. My study describes a process to estimate the information processing requirements and capacities using this theoretical model. To my knowledge, the information processing model has not been used on a detailed level within an health care context.

The choice of doing a single case study enable me to investigate the weekend effect in depth to provide rich and detailed descriptions and understanding of both the existence of the weekend effect and different possible explanations to why the weekend effect exists in this setting. In addition, I was able to capture and highlight the complexity of the weekend effect. Due to an examination of all the

emergency departments in Denmark (Møllekær et al. 2017), the particular emergency department used in this thesis was chosen based on detailed insights.

Even though the thesis is based on an in-depth study of a single emergency department, the results are relevant for other emergency departments. First, the results found in the epidemiological study, presented in paper I, confirm the findings from a study investigating the existence of the weekend effect in another Danish emergency department (Biering et al. 2016). Second, it has been estimated that the 21 Danish emergency departments were organized in different ways (Danish Ministry of Health and Prevention 2014). However, a nationwide study, identifying three organizational models by investigating organizational differences and similarities between the Danish emergency departments, found that the majority of the emergency departments including the emergency department at Viborg Regional Hospital, Regional Hospital Central Jutland changed from one model to another over a 24-hour period, and between weekdays and weekends (Møllekær et al. 2017). The results of the in-depth study of the organizational changes within the emergency department on weekdays and weekends, presented in paper III, provides detailed insights of the organizational changes identified in the nationwide study. These organizational changes may explain why the patient care differs on weekdays and weekends.

#### **6.4 Future research**

In the introduction of this thesis, other potential explanations for the existence of the weekend effect were offered, including the visitation of the patients. The results of the epidemiological study presented in paper I substantiate this proposal. In total, general practitioners referred 75.7% of the patients admitted to the emergency department. To my knowledge, differences within the visitation of patients have not been examined in the search for possible explanations for the weekend effect.

When investigating organizational changes within hospital departments in order to find possible explanation to why the weekend effect exists, the emergency department is an important place to start, because of its role as “gatekeeper.” All patients with a few exceptions (e.g., patients with serious heart-related events) enter the hospital through the emergency department, and many patients are discharged from the emergency department without further admission. Thus, changes within the organization of the emergency department on weekdays and weekends would affect many patients. However, after initial treatment within the emergency department, many patients, and often the most critically ill patients, are transferred to other hospital departments. In paper I, I examine the 30-day mortality rate for patients admitted through the emergency department. The organizational changes within the emergency department on weekdays and weekends may affect the quality of the patients’ initial treatment, and the initial treatment is an important stage within the treatment process, but organizational changes within the other departments on weekdays and weekends may too be an explanation of the existence of the weekend effect. One possible way to investigate these differences using a qualitative approach is to observe/follow individual patients and their treatment across the department boundaries to discover more about the collaboration between the departments, including handovers, and the organizational changes within more hospital departments on weekdays and weekends. The method, where the ethnographer follow people, is known within anthropology as multi-sited ethnography (Marcus 1995).

During my ethnographic field study in the emergency department, I observed more organizational differences between weekdays and weekends. Those differences are not presented within the three papers but might highlight more explanations of the weekend effect and therefore could be interesting to investigate in future research. One of those differences I want to highlight here was the presence, or rather lack of presence, of different types of health professionals on weekends. On weekends, neither the therapists nor the pharmacists were present in the emergency department. A systematic

review concludes that there is limited published research about the effect of additional physiotherapy to hospital inpatients outside of regular business hours, defined as Monday to Friday, 9:00 a.m. to 5:00 p.m. (Brusco & Paratz 2006).

Another observation was differences within the emergency department's collaboration with the service departments. The service departments did not provide all services on weekends. The patient might be transported to Aarhus University Hospital (a one-hour drive), if he or she was critically ill, but if not and it was something that could wait, it was done Monday. Access to services from the service departments is an explanation of the weekend effect that has been suggested by previous studies (e.g., Schilling et al. 2010).

In paper III, I have been focused on the physicians in my analysis of differences between the organization of and social practices within the emergency department on weekdays and weekends. I found differences within the number of physicians, differences within the competences of the emergency physicians hired by the department and the external physicians "playing" emergency physician on weekends, and different strategies used by physicians to cope with the mismatch within the department's ability to process information. Only to a limited extent did I examine the differences of the nurses. In the paper, I address some of the nurses' reactions on the physicians' strategies. However, future research into possible explanations of the weekend effect within emergency departments could investigate differences within the number and skills of the nurses and their different strategies. One previous study of a French ICU shows that the patient-to-nurse ratio is important in terms of weekend mortality (Neuraz et al. 2015).

## 6.5 Concluding remarks

In the last decades, studies have demonstrated the existence of the weekend effect in various settings, both internationally and nationally. Calls have gone out for research investigating the reasons of the existence of the weekend effect. However, this is not a simple task. The weekend effect is a complex phenomenon, and there may be more or different explanations for why this effect exists. With my thesis, I have contributed to an understanding of why the weekend effect exists in the setting of a Danish emergency department. I cannot come up with “the” explanation of the weekend effect but more explanations that are possible. Only by acknowledging the existence of the weekend effect and by expanding the knowledge about why the patient care differs on weekdays and weekends can we do something meaningful to mitigate the weekend effect in the future.

I will conclude my thesis by citing Miles and Huberman: *“Until recently, the dominant view was that field studies should busy themselves with description and leave the explanations to people with large quantitative data bases. Or perhaps field researchers, as is now widely believed, can provide “exploratory” explanations - which still need to be quantitatively verified. Much recent research supports a claim that we wish to make here: that field research is far better than solely quantified approaches at developing explanations of what we call local causality - the actual events and processes that led to specific outcomes”* (Maxwell 2004b).

## References

---

- Andersen PO, Maaløe R, Andersen HB. (2010). Critical incidents related to cardiac arrests reported to the Danish Patient Safety Database. *Resuscitation* 81:312-316.
- Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Camargo CA Jr. (2003). A conceptual model of emergency department crowding. *Ann Emerg Med* 42(2):173-180.
- Astley WG, Van de Ven AH. (1983). Central perspectives and debates in organization theory. *Admin Sci Quart* 28:245-273.
- Aylin PP, Yunus A, Bottle A, Majeed A, Bell MD. (2010). Weekend mortality for emergency admissions. A large, multicentre study. *Qual Saf Health Care* 19:213-217.
- Baker GR, Norton PG, Flintoft V, et al. (2004). The Canadian adverse events study: the incidence of adverse events among hospital patients in Canada. *JAMC* 170(11):1678-1686.
- Barach P, Small SD. (2000). Reporting and preventing medical mishaps: lessons from non-medical near miss reporting systems. *BMJ* 320:759-763.
- Barba R, Losa JE, Velasco M, Guijarro C, García de Casasola G, Zapatero A. (2006). Mortality among adult patients admitted to the hospital on weekends. *Eur Journal of Inter Med* 17(5):322-324.
- Barnett MT, Kaboli PT, Sirio CA, Rosenthal GE. (2002). Day of the week of intensive care admission and patient outcomes: A multisite regional evaluation. *Medical Care* 40(6):530-539.
- Becker DJ. (2008). Weekend hospitalization and mortality: a critical review. *Expert Rev. Pharm Out Res.* 8(1):23-26.

Bell CM, Redelmeier DA. (2001). Mortality among patients admitted to hospitals on weekends compared with weekdays. *N Engl J Med* 345(9):663-668.

Bell CM, Redelmeier DA. (2004). Waiting for urgent procedures on the weekend among emergently hospitalized patients. *Am J Med.* 117(3):175-181.

Bernard HR. (2011). *Research methods in anthropology: qualitative and quantitative approaches*, 5th edn. Altamira Press, Lanham.

Biering K, Nielsen RF, Pérez N. (2016). Admission-time-dependent variation in mortality in a Danish emergency department. *Dan Med J* 63(1):1-6.

Bossen C, Jensen LG. (2014). How physicians ‘achieve overview’: a case-based study in a hospital ward. In: Paper proceedings of the 17th ACM conference on computer-supported cooperative work & social computing, Baltimore, MD, USA, 257-268.

Brennan TA, Leape LL, Laird NM et al. (1991). Incidence of Adverse Events and Negligence in Hospitalized Patients — Results of the Harvard Medical Practice Study I. *N Engl J Med.* 324:370-376.

Bray BD, Steventon A. (2016). What have we learnt after 15 years of research into the ‘weekend effect’? *BMJ Qual & Saf* 0:1-4.

Brubacher JR, Hunte GS, Hamilton L, Taylor A. (2011). Barriers to and incentives for Safety Event Reporting in Emergency Departments. *Healthc Q.* 14(3):57-65.

Brusco NK, Paratz J. (2006). The effect of additional physiotherapy to hospital inpatients outside of regular business hours: a systematic review. *Physiotherapy theory and practice* 22(6):291-307.

Buckley D, Bulger D. (2012). Trends and weekly and seasonal cycles in the rate of errors in the clinical management of hospitalized patients. *Chronobiology International* 29(7):947-954.

Burton RM, Obel B. (2004). *Strategic organizational diagnosis and design: the dynamics of fit*, 3rd edn. Kluwer Academic Publishers, Boston.

Burton RM, Obel B, DeSanctis. (2011). *Organizational design: a step-by-step approach*, 2nd edn. Cambridge University Press.

Burton RM, Obel B, Håkonsson DD. (2015). *Organizational design: a step-by-step approach*, 3rd edn. Cambridge University Press.

Chitale AK, Mohanty RP, Dubey NR. (2013). *Organizational behavior: text and cases*. PHI Learning, Delhi.

Christ M, Grossmann F, Winter D, Bingisser R, Platz E. (2010). Modern triage in the emergency department. *Dtsch Arztebl Int.* 107(50):892-898.

Christensen MB, Olesen F. (1998). Out of hours service in Denmark: evaluation five years after reform. *BMJ* 316:1502-1505.

Cram P, Hillis SL, Barnett M, Rosenthal GE. (2004). Effects of weekend admission and hospital teaching status on in-hospital mortality. *Am J Med* 117(1):151-157.

Creswell JW. (2014). *Research design. Qualitative, quantitative & mixed methods approaches*. 4th ed. Sage.

Danish Ministry of Health and Prevention. (2014). *Faglig gennemgang af akutmodtagelserne. (Evaluation of Danish emergency departments)*. Copenhagen. (In Danish)



Danish National Board of Health. (2007). Styrket akutberedskab, planlægningsgrundlag for det regionale sundhedsvæsen (Strengthen emergency care preparedness, a planning basis for the regional health care system). Copenhagen. (In Danish)

Danish National Board of Health. (2016). De danske akutmodtagelser, status 2016 (The Danish hospital emergency departments, a status 2016). Copenhagen. (In Danish)

De Cordova PB, Phibbs CS, Bartel AP, Stone PW. (2012). Twenty-four/seven: a mixed-method systematic review of the off-shift literature. *J Adv Nurs*:1454-1468.

De Vries EN, Ramrattan MA, Smorenburg SM, Gouma DJ, Boermeester MA. (2008). The incidence and nature of in-hospital adverse events: a systematic review. *Qual Saf Health Care* 17:216-223.

Donaldson L. (1987). Strategy and structural adjustment to regain fit and performance: in defense of contingency theory. *J Manage Stud* 24(1):1-24.

Donaldson L. (2006). The contingency theory of organizational design: challenges and opportunities. In Burton RM, Eriksen B, Håkonsson DD, Snow CC (ed.): *Organization design. The evolving state-of-the-art*. Springer. p. 19-40.

Duvald I. (2017). Fits and misfits between the information processing requirements and capacities: the weekend effect in a hospital emergency department. 2017. Working paper.

Duvald I, Kirkegaard H. (2014). Prøvehandling som metode i organisationsudvikling. (Trial acts as a method of organizational development). *Tidsskrift for Dansk Sundhedsvæsen* 90(7): (In Danish)

Duvald I, Møllekær A, Boysen MA, Vest-Hansen B. (2018). Day of the week of admission, patient characteristics and patient outcomes: a study of the weekend effect in an emergency department. Working paper.

Duvald I, Møllekær AB, Kirkegaard H, Obel B. (2015). Organiseringen af akutmodtagelserne i Region Nordjylland – en rapport fra DESIGN-EM (The organization of the emergency department in the North Denmark Region – a report from DESIGN-EM). Aarhus. (In Danish)

Duvald I, Møllekær AB, Kirkegaard H, Obel B. (2016a). Organiseringen af akutmodtagelserne i Region Sjælland – en rapport fra DESIGN-EM (The organization of the emergency department in Region Zealand – a report from DESIGN-EM). Aarhus. (In Danish)

Duvald I, Møllekær AB, Kirkegaard H, Obel B. (2016b). Organiseringen af akutmodtagelserne i Region Syddanmark – en rapport fra DESIGN-EM (The organization of the emergency department in the Region of Southern Denmark – a report from DESIGN-EM). Aarhus. (In Danish)

Duvald I, Møllekær AB, Kirkegaard H, Obel B. (2016c). Organiseringen af akutmodtagelserne i Region Hovedstaden – en rapport fra DESIGN-EM (The organization of the emergency department in the Capital Region of Denmark – a report from DESIGN-EM). Aarhus. (In Danish)

Dyer WG, Wilkins AL. (1991). Better stories, not better constructs, to generate better theory: a rejoinder to Eisenhardt. *Academy of Management Review* 16(3):613-619.

Earnest A, Chen MIC, Seow E. (2006). Exploring if day and time of admission is associated with average length of stay among inpatients from a tertiary hospital in Singapore: an analytic study based on routine admission data. *BMC Health Services Research* 6(6).

Eisenhardt KM. (1989). Building theories from case study research. *Acad Manage Rev* 14(4):532-550.

Emerson RM, Fretz RI, Shaw LL. (1995). *Writing ethnographic fieldnotes*. University of Chicago Press.

- Evans SM, Berry JG, Smith BJ et al. (2006). Attitudes and barriers to incident reporting: a collaborative hospital study. *BMJ Quality & Safety* 15(1):39-43.
- Flyvbjerg B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry* 12(2):219-245.
- Fordyce J, Blank FSJ, Pekow P et al. (2003). Errors in a busy emergency department. *Ann Emerg Med* 42(3):324-333.
- Galbraith J. (1973). *Designing complex organizations*. Addison-Wesley Publishing Company, Reading, Massachusetts.
- Galbraith J. (1974). Organization design: an information processing view. *Interfaces* 4(3):28-36.
- Gill R, Barbour J, Dean M. (2014). Shadowing in/as work: ten recommendations for shadowing fieldwork practice. *Qualitative Research in Organizations and Management: An International Journal* 9(1):69-89.
- Goddard AF, Lees P. (2012). Higher senior staffing levels at weekends and reduced mortality. *BMJ*:1-2.
- Graversen DS. (2015). Out-of-hours telephone triage by nurses and doctors in Danish acute care settings. A study of quality focusing on communication, safety and efficiency. Project description prepared at the Research unit for general practice Aarhus.
- Gulløv E, Højlund S. (2003). Konteksten. Feltens sammenhæng. In Hastrup K (ed.): *Ind i verden. En grundbog i antropologisk metode*. Hans Reitzels Forlag. p. 343-362. (In Danish)
- Hafner JW, Belknap SM, Squillante MD, Bucheit KA. (2002). Adverse drug events in emergency department patients. *Annals of Emergency Medicine* 39(3):258-267.

- Hakimzada AF, Green RA, Sayan OR, Zhang J, Patel VL. (2008). The nature and occurrence of registration errors in the emergency department. *Int J Med Inform* 76:169-175.
- Hamilton P, Mathur S, Gemeinhardt G, Eschiti V, Campbell M. (2010). Expanding What We Know About Off-peak Mortality in Hospitals. *JONA* 40(3):124-128.
- Hammersley M, Atkinson P. (2007). *Ethnography: principles in practice*, 3rd. Routledge, London and New York.
- Handel AE, Patel SV, Skingsley A, Bramley K, Sobieski R, Ramagopalan SV. (2012). Weekend admissions as an independent predictor of mortality: an analysis of Scottish hospital admissions. *BMJ Open* 2(6).
- Hart GK, Baldwin I, Gutteridge G, Ford J. (1994). Adverse incident reporting in intensive care. *Anaesthesia and intensive care* 22(5):556-561.
- Hemmingsen MA. (2014). Hospital tilbageviser øget dødelighed i weekender og ferier. (Hospital refutes increased mortality on weekends and holidays) *Dagens Medicin*. (In Danish)
- Hoff TJ, Sutcliffe KM, Young GJ. (2016). *The healthcare professional workforce: understanding human capital in a changing industry*. Oxford University Press.
- Hoot NR, Aronsky D. (2008). Systematic review of emergency department crowding: causes, effects, and solutions. *Ann Emerg Med* 52(2):126-136.
- Huibers L, Moth G, Carlsen AH, Christensen MB, Vedsted P. (2016). Telephone triage by GPs in out-of-hours primary care in Denmark: a prospective observational study of efficiency and relevance. *Br J Gen Pract* 66(650):e667-e673.

- James MT, Wald R, Bell CM, Tonelli M, Hemmelgarn BR, Waiker SS, Chertow GM. (2010). Weekend hospital admission, acute kidney injury, and mortality. *J Am Soc Nephrol* 21:845-851.
- Jin Y, Levitt RE. (1996). The virtual design team: a computational model of project organizations. *Comput Math Organ Th* 2(3):171-196.
- Johnson RB, Onwuegbuzie AJ. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher* 33(7):14-26.
- Johnson RB, Onwuegbuzie AJ, Turner LA. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research* 1(2):112-133.
- Kirkwood BR, Sterne JAC. (2003). *Essential medical statistics*. 2nd ed. Malden, Ma: Blackwell Science. p. 264-267.
- Kohn LT, Corrigan JM, Donaldson MS. (2000). *To err is human: building a safer health system*. Institute of Medicine. National Academy Press.
- Kristiansen NS, Kristensen PK, Nørgård BM, Mainz J, Johnsen SP. (2016). Off-hours admission and quality of hip fracture care: a nationwide cohort study of performance measures and 30-day mortality. *Int J Qual Health C* 28(3):324-331.
- Kurland L, Graham C. (2014). Emergency medicine development in the Nordic countries. *European Journal of Emergency Medicine* 21(3):163.
- Kusenbach M. (2003). Street phenomenology: the go-along as ethnographic research tool. *Ethnography* 4(3):455-485.
- Kvale S, Brinkmann S. (2006). *InterViews: Learning the Craft of Qualitative Research Interviewing*. Sage.

- Leape LL, Brennan TA, Laird NM et al. (1991). The Nature of Adverse Events in Hospitalized Patients - Results of the Harvard Medical Practice Study II. *N Engl J Med.* 324(6):377-384.
- Leape LL. (2002). Reporting of adverse events. *N Engl J Med.* 347(20):1633-1638.
- Leeuw ED, Hox JJ. (2008). Self-administered questionnaires; mail surveys and other applications. In: Leeuw ED, Hox JJ, Dillman DA (ed.): *International handbook of survey methodology.* Lawrence Erlbaum Associates. p. 239-263.
- Lilford RJ, Chen Y. (2015). The ubiquitous weekend effect: moving past proving it exists to clarifying what causes it. *BMJ Qual Saf* 0:1-3.
- Long D, Hunter C, Van der Geest S. (2008). When the field is a ward or a clinic: hospital ethnography. *Anthropol Med* 15(2):71-78.
- Madsen F, Ladelund S, Linneberg A. (2014). High levels of bed occupancy associated with increased impatient and thirty-day hospital mortality in Denmark. *Health Affairs* 33(7).
- Maggs F, Mallet M. (2010). Mortality in out-of-hours emergency medical admissions – more than just a weekend effect. *J R Coll Physicians Edinb* 40(2):115-118.
- Manfredini R, De Giorgi A, Fabbian F. (2017). Acute diseases, emergency admissions and mortality during weekends: should we be worried? *J Thorac Dis.* 9(9):2723–2727.
- Marcus GE. (1995). Ethnography in/of the world system: The emergence of multi-sited ethnography. *Annu. Rev. Anthropol.* 24:95-117.
- Mattsson MS, Jørsboe H. (2014). Danske studier af akutte patientforløb efter opstart af fælles akutmodtagelser. (Danish studies of acute treatment after initiation of emergency departments). *Ugeskr Laeger.* 15:1396-1398. (In Danish)

- Maxwell JA. (2004a). Causal explanation, qualitative research, and scientific inquiry in education. *Educational Researcher* 33(2):3-11.
- Maxwell JA. (2004b). Using Qualitative Methods for Causal Explanation. *Field Methods* 16(3): 243-264.
- Maxwell JA. (2012). The importance of qualitative research for causal explanation in education. *Qualitative Inquiry* 18(8):655-661.
- McDonald, S. (2005). Studying actions in context: a qualitative shadowing method for organizational research. *Qual Res* 5(4):455-473.
- McKee M. (2016). The weekend effect: now you see it, now you don't. *BMJ*:353.
- Mikulich O, Callaly E, Bannett K, O'Riordan D, Silke B. (2011). The increased mortality associated with a weekend emergency admission is due to increased illness severity and altered case-mix. *Acute Med.* 10(4):182-187.
- Milch CE, Salem DN, Pauker SG, Lundquist TG, Kumar S, Chen J. (2006). Voluntary electronic reporting of medical errors and adverse events. An analysis of 92,547 reports from 26 acute care hospitals. *J GEN INTERN MED* 21:165-170.
- Mintzberg H. (1970). Structured observation as a method to study managerial work. *Journal of Management Studies* 7(1):87-104.
- Morgan DL. (1996). Focus groups. *Annu Rev Sociol* 22:129-152.
- Møllekær AB, Duvald I, Kirkegaard H, Sørensen PD, Eskildsen JK, Obel B. (2014). Organisationsdesign af de fælles akutmodtagelser (Organizational design of the emergency

departments). In: Pedersen KM, Petersen NC (eds.) Fremtidens Hospital (The hospital of the future). Munksgaard. (In Danish). p. 251-265

Møllekær A. (2016). The organization of the emergency departments and the 7-day mortality risk. Oral presentation at the DESIGN-EM conference 12th of May 2016. [http://mgmt.au.dk/fileadmin/user\\_upload/ANDERS\\_MOELLEKAER\\_DESIGN-EM\\_KONFERENCE\\_12.05.16.pdf](http://mgmt.au.dk/fileadmin/user_upload/ANDERS_MOELLEKAER_DESIGN-EM_KONFERENCE_12.05.16.pdf) (In Danish). Accessed 7 June 2016.

Møllekær AB, Duvald I, Eskildsen JK, Obel B, Madsen B, Kirkegaard H. (2017). The organisation of Danish emergency departments. Working paper.

National Board of Health. (2007). Danish Patient Safety Database. Report published in July.

Neuraz A, Guérin C, Payet C, Polazzi S, Aubrun F, Dailler F, Lehot J, Piriou V, Neidecker J, Rimmelé T, Schott A, Duclos A. (2015). Patient mortality is associated with staff resources and workload in the ICU: A multicenter observational study. *Critical Care Medicine* 43(8):1587-1594.

Nielsen KJ, Pedersen AH, Rasmussen K, Pape L, Mikkelsen K. (2013). Work-related stressors and occurrence of adverse events in an ED. *Am J Emerg Med* 31:504-508.

O'Donnell CA. (2000). Variation in GP referral rates: what can we learn from the literature? *Family Practice* 17(6):462-471.

Otto, T. (1997). Informed participation and participating informants. *Canberra Anthropology* 20:1-2.

Ozdemir BA, Sinha S, Karthikesalingam A, Poloniecki JD, Pearse RM, Grocott MPW, Thompson MM, Holt PJE. (2016). Mortality of emergency general surgical patients and associations with hospital structures and processes. *British Journal of Anaesthesia*, 116(1):54-62.



Patient Safety Board. (2016). Dansk Patientsikkerhedsdatabase. Årsberetning 2015. (Danish Patient Safety Database. Annual Report 2015.) Report published in April. (In Danish).

Pauls LA, Johnson-Paben R, McGready J, Murphy JD, Pronovost PJ, Wu CL. (2017). The weekend effect in hospitalized patients: a meta-analysis. *Journal of Hospital Medicine* 12(9):760-766.

Payne G, Payne J. (2004). *Key concepts in social research*. Sage, London.

Pedersen KM, Andersen JS, Søndergaard J. (2012). General practice and primary health care in Denmark. *The Journal of the American Board of Family Medicine* 25:34-38.

Redelmeier DA, Bell CM. (2007). Weekend worriers. *N Engl J Med*:1164-1165.

Rossdale M, Kemple T, Payne S, Calnan M, Greenwood R. (2007). An observational study of variation in GPs' out-of-hours emergency referrals. *British Journal of General Practice* 57:152-154.

Ruiz M, Bottle A, Aylin PP. (2015). The Global Comparators project: international comparison of 30-day in-hospital mortality by day of the week. *BMJ Qual Saf* 0:1-13.

Sanjek R. (1990). On ethnographic validity. In: *Fieldnotes. The makings of ethnography*. p. 385-418.

Schiøler T, Lipczak H, Pedersen BL et al. (2001). Forekomsten af utilsigtede hændelser på sygehus. En retrospektiv gennemgang af journaler (Incidence of adverse events in hospitals. A retrospective study of medical records). *Ugeskr Læger* 163:5370-5378. (In Danish, summary in English).

Schmidt M, Pedersen L, Sørensen HT. (2014). The Danish Civil Registration System as a tool in epidemiology. *Eur J Epidemiol*. 29:541-549.

Scott RW, Davis GF. (2014). *Organizations and organizing rational, natural and open systems perspectives*. Pearson

Schilling PL, Campbell Jr DA, Englesbe MJ, Davis MM. (2010). A comparison of in-hospital mortality risk conferred by high hospital occupancy, differences in nurse staffing levels, weekend admission, and seasonal influenza. *Medical care* 48(3):224-232.

Sharp AL, Choi HJ, Hayward RA. (2013). Don't get sick on the weekend: an evaluation of the weekend effect on mortality for patients visiting US EDs. *Am J Emerg Med* 31:835-837.

Smith AF, Goodwin D, Mort M, Pope C. (2006). Adverse events in anaesthetic practice: qualitative study of definition, discussion and reporting. *Br J Anaesth* 96(6):715-721.

Soop M, Fryksmark U, Köster M, Haglund B. (2009). The incidence of adverse events in Swedish hospitals: a retrospective medical record review study. *Int J Qual Health C* 21(4):285-291.

Spradley JP. (1980). *Participant Observation*. Wadsworth.

Stang AS, Wingert AS, Hartling L, Plint AC. (2013). Adverse Events Related to Emergency Department Care: A Systematic Review. *PLoS ONE* 8(9):1-7.

Stanhope N, Crowley-Murphy M, Vincent C, O'Connor AM, Taylor-Adams SE. (1999). An evaluation of adverse incident reporting. *Journal of Evaluation in Clinical Practice* 5(1):5-12.

Steenberger A. (2013). Fejl hænger sammen med stress og indberettes sjældent. (Incidents are associated with stress and are rarely reported) *Ugeskrift for læger*. Marts 27. (In Danish).

Steenberger A, Heissel A. (2017). Sundhedsminister siger god for nyt speciale i akutmedicin. (Health Minister announce a new speciality in emergency medicine). *Ugeskrift for læger* 12. (In Danish).

Strauss AL, Fagerhaugh S, Suczek B, Wiener C. (1997). *Social organization of medical work*. Transaction Publishers, New Brunswick.

- Suter RE. (2012). Emergency medicine in the United States: a systemic review. *World J Emerg Med* 3(1):5-10.
- Sørup CM, Jacobsen P, Forberg JL. (2013). Evaluation of emergency department performance – a systematic review on recommended performance and quality-in-care measures. *SJTREM*. 21(1):62.
- Tchijevitch OA, Nielsen LP, Lisby M. (2017). Life-threatening and fatal adverse drug events in a Danish university hospital. *Journal of Patient Safety* 00:1-6
- Thompson JD. (1967). *Organizations in actions*. Oxford University Press.
- Tighe CM, Woloshynowych M, Brown R, Wears B, Vincent C. (2006). Incident reporting in one UK accident and emergency department. *Accident and Emergency Nursing* 14:27-37.
- Tushman ML, Nadler DA. (1977). Information processing as an integrating concept in organizational design. *Acad Manage Rev*:613-624.
- Van de Ven AH, Delbecq AL, Koenig R. (1976). Determinants of coordination modes within organizations. *Am Sociol Rev* 41(2):322-338.
- Van der Geest S, Finkler K. (2004). Hospital ethnography: An introduction. *Social Science & Medicine* 59(10):1995-2001.
- Vest-Hansen B, Riis AH, Sørensen HT, Christiansen CF. (2014). Acute admissions to medical departments in Denmark: Diagnoses and patient characteristics. *European Journal of Internal Medicine* 25:639-645.
- Vest-Hansen B, Riis AH, Sørensen HT, Christiansen CF. (2015). Out-of-hours and weekend admissions to Danish medical departments: admission rates and 30-day mortality for 20 common medical conditions. *BMJ Open* 5:1-10.

Vibjerg T. (2013). Læger og sygeplejersker tier for det meste. (Physicians and nurses are quiet for most of the time). Jyllandsposten, July 3 (In Danish). Accessed September 29, 2016.

Vincent C, Stanhope N, Crowley-Murphy M. (1999). Reasons for not reporting adverse incidents: an empirical study. *Journal of Evaluation in Clinical Practice* 5(1):13-21.

Viskum B, Granhof AJ, Pedersen I, Stæhr MD. (2011). Behov for nytænkning i arbejdet med utilsigtede hændelser. (Needs for innovation in the work of adverse events). *Ugeskr læger*, May. (In Danish).

Wadel C. (1991). Feltarbeid i egen kultur. En innføring i kvalitativt orientret samfunnsforskning. (Fieldwork in own culture. An introduction to qualitatively oriented social research). Flekkefjord: Hegland Trykkeri. (In Norwegian).

Walker AS, Mason A, Quan TP, Fawcett NJ, Watkinson P, Llewelyn M, Stoesser N, Finney J, Davies J, Wyllie DH, Crook DW, Peto TEA. (2017). Mortality risks associated with emergency admissions during weekends and public holidays: an analysis of electronic health records. *Lancet* 390:62-72.

Walsham G. (1995). Interpretive case studies in IS research: nature and method. *Eur J Inform Syst* 4(2):74-81.

Webb M. (2011). The weekend effect: a rapid review of the literature. Web site. <http://www2.nphs.wales.nhs.uk:8080/healthserviceqtdtdocs.nsf/Main%20Frameset?OpenFrameSet&Frame=Right&Src=%2Fhealthserviceqtdtdocs.nsf%2F61c1e930f9121fd080256f2a004937ed%2F7f113a4146140de1802578b1002d7781%3FOpenDocument%26AutoFramed>. Accessed September 30, 2017.

Wears RL, Perry SJ, Shapiro M, Beach C, Croskerry P, Behara R. (2003). Shift changes among emergency physicians: best of times, worst of times. *Proceedings of the human factors and ergonomics society 47th annual meeting*: 1420-1423.

Wen LS, Anderson PD, Stagelund S, Sullivan AF, Camargo CA. (2013). National survey of emergency departments in Denmark. *European Journal of Emergency Medicine* 20(3):205-209.

Wind G. (2008). Negotiated interactive observation: Doing fieldwork in hospital settings. *Anthropology & Medicine* 15(2):79-89.

Wise J. (2016). The weekend effect – how strong is the evidence? *BMJ*:1-5.

Whittaker W, Anselmi L, Kristensen SR, Lau Y, Bailey S, Bower P, Checkland K, Elvey R, Rothwell K, Stokes J, Hodgson D. (2016). Associations between extending access to primary care and emergency department visits: a difference-in-differences analysis. *PLoS Med* 13(9):1-19.

Wolff B, Knodel J, Sittitrai W. (1993). Focus Groups and Surveys as Complementary Research Methods. A case example. In Morgan D. (ed.): *Successful Focus Groups: Advancing the State of the Art*. Sage, London. p. 118–136.

Yin RK. (2004). *Case study research: design and methods*, 5th ed. Sage, Los Angeles.

Zhou Y, Li W, Herath C, Xia J, Hu B, Song F, Cao S, Lu Z. (2016). Off-hour admission and mortality risk for 28 specific diseases: a systematic review and meta-analysis of 251 cohorts. *J Am Heart Assoc.* 5(3).



# Appendix

---

## Appendix I: Questionnaire

### Spørgeskema omkring utilsigtede hændelser (UTH'er) i akutafdelingen

Formålet med spørgeskemaet er, at undersøge jer medarbejders indblik i og holdning til registrering af utilsigtede hændelser samt jeres registreringspraksis. Undersøgelsen er en del af Iben Duvalds ph.d.-projekt omkring organiseringen af akutafdelingen og forskellene på hverdag og weekend.

Det er frivilligt at deltage i undersøgelsen og anonymitet garanteres.

Skemaet har spørgsmål, hvor der skal sættes kryds  i den boks, der svarer til det rigtige svar. Hvis du efterfølgende vil ændre dit svar, fyldes kassen ud  og der sættes kryds i den boks, hvor du hellere vil svare. Læs alle svarmulighederne grundigt igennem, inden du vælger dit svar.

Andre spørgsmål er åbne. Her har du mulighed for selv at forfatte dine holdninger. Er der for lidt plads, markerer du sidst i svaret med en \* og skriver videre bag på siden.

For at undersøgelsens resultat bliver så retvisende som muligt, bedes du besvare spørgeskemaet uden hjælp fra andre. Det tager ca. 10 minutter at besvare skemaet. Det udfyldte skema afleveres til Iben.

#### Lidt spørgsmål om dig

1. Angiv din alder: \_\_\_\_\_ år
2. Angiv dit køn:    Mand     Kvinde
3. Hvor mange år har du været ansat i akutafdelingen: \_\_\_\_\_ år
4. Angiv din faggruppe: Sygeplejerske  Sekretær  Yngre læge  Akutlæge  Andet: \_\_\_\_\_
5. Hvor er du ansat (kun sygeplejersker og sekretærer): A1                     A2

#### Definition af utilsigtet hændelse (UTH)

6. Ved du, hvad en utilsigtet hændelse er?                    JA                     ER I TVIVL                     NEJ
7. Hvordan vil du definere, hvad en UTH er (skriv med dine egne ord)?

#### Introduktion af UTH og arbejdet med UTH'er i afdelingen

8. Er du blevet introduceret for, hvordan der arbejdes med UTH'er i afdelingen?  
JA     NEJ     VED IKKE

Hvis **ja**, hvordan er du blevet introduceret for det?



9. Ved du, hvordan man rapporterer en UTH? JA  ER I TVIVL  NEJ

10. Ved du, hvilke UTH'er, du forventes at rapportere? JA  ER I TVIVL  NEJ

Hvis **ja**, hvilke UTH'er forventes det, at du rapporterer?

11. Hvem er ansvarlig for arbejdet med UTH'erne, der hvor du er ansat (navn): \_\_\_\_\_

12. Hvordan arbejdes der med UTH'er, der hvor du er ansat – fx hvordan får du besked om dem, der er sket?

13. Hvordan synes du afdelingens/afsnittets arbejde med UTH'er fungerer?

### Den seneste UTH, du har forårsaget eller observeret en anden forårsage

14. Har du forårsaget en UTH eller observeret en anden forårsage en UTH? JA  NEJ  VED IKKE

15. Den seneste UTH, du har forårsaget eller du har observeret en anden forårsage, hvad omhandlede den?

16. Hvornår skete denne UTH (dato samt dag/aften/nattevagt, hvis du kan huske det): \_\_\_\_\_

17. Forårsagede du eller en anden denne UTH? Jeg  En anden

18. Blev UTH'en rapporteret? JA  NEJ  VED IKKE

Hvis **ja**, hvem rapporterede den? Vedkommende selv  En anden

Hvis **nej**, hvorfor blev den ikke registreret?

### Dine rapporteringer af UTH'er

19. Har du rapporteret en UTH? JA  NEJ

Hvis **nej**, spring til spørgsmål 27, side 5. Hvis **ja**, hvornår rapporterede du sidst en UTH: \_\_\_\_\_

20. Hvor mange UTH'er har du rapporteret, mens du har arbejdet i akutafdelingen?

1-5

6-10

11-20

Over 20

21. Hvor mange af de UTH'er, du forårsager, rapporter du?

Ingen (0%)

Enkelte (10%)

En del (30%)

Halvdelen (50%)

Mange (80%)

Alle (100%)

22. Hvad var de væsentligste årsager til, at du rapporterede UTH'erne?

23. Hvor indrapporterer du UTH'erne? Hjemme  På arbejde

Hvis **hjemme**, hvorfor?

Hvis du indrapporter dem på arbejde, hvornår rapporter du dem (du må gerne sætte flere krydser)?

Umiddelbart efter UTH'en var sket

I vagten

Efter arbejdstid

I en vagt en anden dag

24. Hvad er de væsentligste årsager til, hvis du ikke altid indrapporterer UTH'er – sæt max 4 krydser?

- Manglende tid
- Jeg har ikke lyst til at indrapporter nogle UTH'er, som mine kollegaer har lavet
- Det er besværligt at rapportere
- Nervøs for det efterfølgende forløb
- Jeg forventede, en anden ville indrapportere den
- Jeg vidste ikke, hvordan man indrapporterer
- Jeg glemte det
- Hændelsen vurderede jeg til at være ubetydelig
- Der sker alligevel ikke noget efterfølgende med de indrapporterede UTH'er
- Jeg prioriterede andre (og vigtigere) arbejdsopgaver
- Jeg vil ikke bruge min fritid på det
- Jeg var usikker på, hvem der skulle indberette den
- Der er ikke fokus på det i afdelingen
- Jeg vil ikke have at UTH'en bliver brugt som eksempel
- Vi dokumenterer nok i forvejen – jeg orker ikke at dokumentere dem
- Jeg tænker, der er en bedre måde at arbejde med UTH'erne på i stedet for at indrapportere dem

Andre årsager – skriv gerne:

### Det elektroniske indrapporteringsystem

25. Hvordan synes du det elektroniske indrapporteringsystem virker?

Kaotisk       Tager for lang tid/besværligt       Pædagogisk /nemt       Fint

Andet:

26. Hvordan kunne systemet forbedres, således at du synes det er nemmere at indrapportere en UTH?

### Fremtidigt arbejde med UTH'er

27. Hvad kunne få dig til at indrapportere flere UTH'er?

Mere fokus på indrapportering i afdelingen

Jeg fandt en rytme i det

Et mere simpelt indrapporteringssystem

Andre ting:

28. Hvordan kunne afdelingen forbedre arbejdet med UTH'er?

### UTH'er, som andre forårsager

29. Ville/har du indberettet UTH'er, som andre har forårsaget? JA  MÅSKE  NEJ

Hvorfor/hvorfor ikke?

Hvis **nej**, hvad gør du så?

Snakker med vedkommende

Jeg blander mig ikke

Jeg forventer vedkommende selv rapportere den

Andet:

### UTH'er på forskellige tidspunkter

30. Har du en oplevelse af, at der sker flere UTH'er på nogle tidspunkter? JA  NEJ  VED IKKE

Hvis **ja**, hvornår?

I dagvagter

I aftenvagter

I nattevagter

I weekenderne

I vagtskifte

Andet:

31. Hvorfor tænker du, der sker flere UTH'er på dette/disse tidspunkter?

### Din personlige holdning til registrering af UTH'er

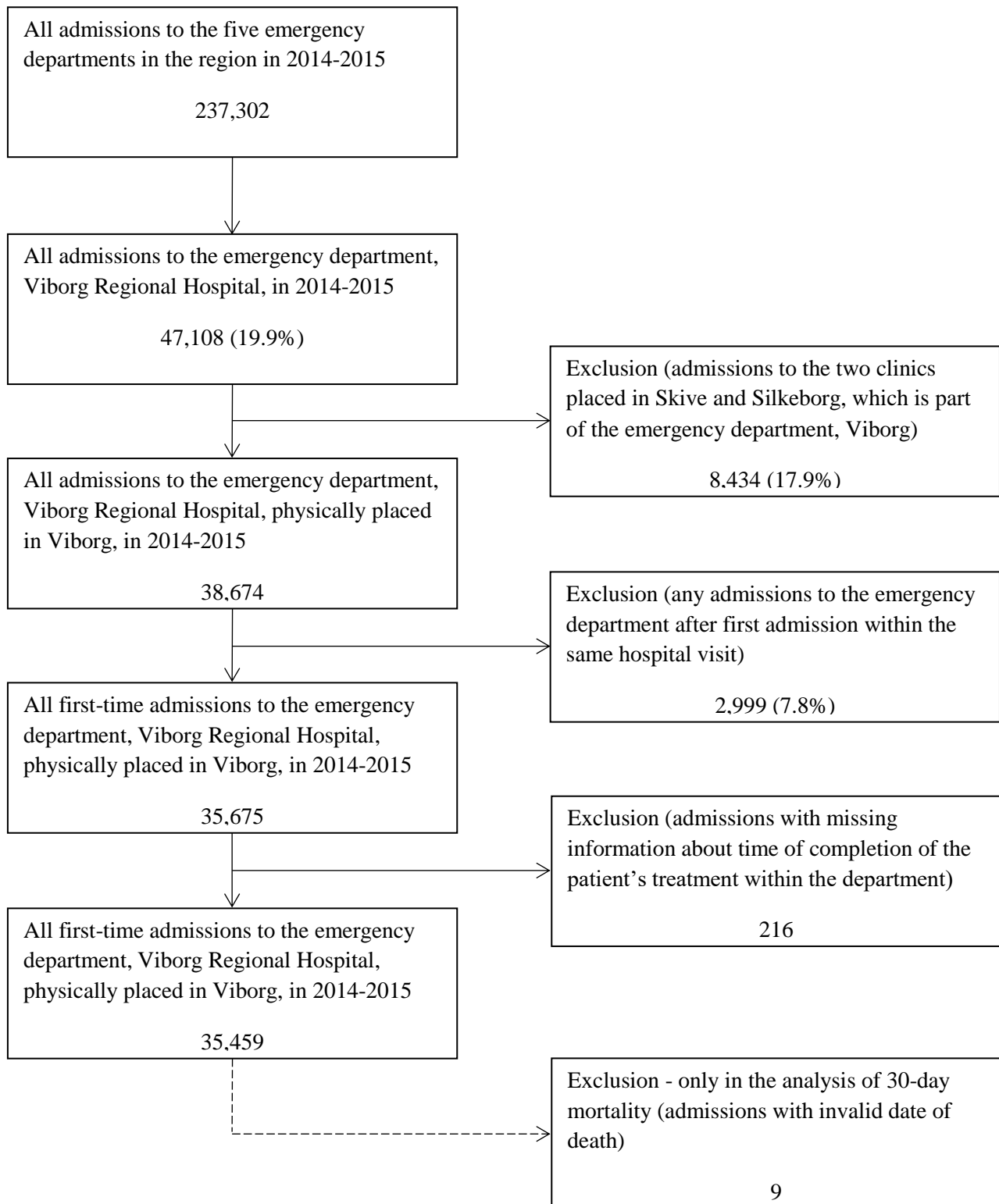
32. Synes du, det er vigtigt at UTH'erne bliver registreret? JA  NEJ  VED IKKE

Hvorfor/hvorfor ikke?

**MANGE TAK FOR DIN HJÆLP!**

Hvis du har spørgsmål til undersøgelsen, er du velkommen til at kontakte Iben: [idp@btech.au.dk](mailto:idp@btech.au.dk)

**Appendix II: Flowchart for all patient-visits to the emergency department in 2014-2015**



### Appendix III: ICD-10 codes of each primary diagnostic group

Disease category	ICD-10
Infectious diseases	A00-B99
• Infections of the blood-forming organs	D73.3
• Infections of the endocrine organs	E06.0, E06.9, E32.1
• CNS infections	G00-G02, G04-G07
• Infections of the eye, ear, and adnexa	H00, H01.0, H03-1, H04.0, H04.3, H05.0, H06.1, H10, H13.0-1, H15.0, H.19.1-2, H22.0, H32.0, H44.0-1, H60.0-1, H60.3, H62.0-3, H65.0-1, H66.0-4, H66.9, H67.1, H67.8, H68.0, H70.2, H73.0, H75.0, H94.0
• Heart infections	I00-02, I30.1, I32.0-1, I33.0, I38, I39.8, I40.0, I41, I43.0, I52.0-1, I68.1, I98.1
• Respiratory tract infections	J00-J06, J09-J18, J20-J22, J34.0, J36, J38.3D, J38.7G, J39.8A, J44.0, J85.1-3, J86
• Infections of the digestive system	K04.0, K04.6-7, K05.2, K11.2-3, K12.2, K13.0A, K14.0A, K20.9A, K23.0-1, K35, K37, K57.0, K57.2, K57.4, K57.8, K61, K63.0, K65.0, K65.8I, K67, K75.0-1, K77.0, K80.0, K80.3-4, K81.0, K83.0, K85.9, K93.0-1
• Skin and subcutaneous infections	L00-03, L05-08, L88
• Infections of the musculo-skeletal system and connective tissue	M00-01, M46.1-5, M49.0-3, M60.0, M60.8, M63.0-2, M65.0-1, M68.0, M71.0-1, M86.0-2, M86.9, M90.0-2
• Urinary tract infections	N10, N12, N13.6, N15.1, N16.0, N20.0I, N29.1, N30.0, N33.0, N34.0-1, N39.0
• Male genital infections	N41, N43.1, N45.0, N45.9, N48.1-2, N49
• Female genital infections	N61, N70-N77
• Obstetrical infections	O23, O26.4, O41.1, O75.3, O85, O86, O88.3, O91, O98
• Infectious complications of procedure, catheters etc.	T80.2, T81.4, T82.6-7, T83.5-6, T84.5-7, T85.7, T88.0, T89.9
Neoplasms (Chapter II)	C00-D48
Diseases of the blood and blood-forming organs and certain disorders involved in the immune system (Chapter III)*	D50-D89
Endocrine, nutritional and metabolic disorders (Chapter IV)*	E00-E90
Mental and behavioral disorders (Chapter V)	F00-F99
Diseases of the nervous system (Chapter VI)*	G00-G99
Diseases of the circulatory system (Chapter IX)*	I00-I99
Diseases of the respiratory system (Chapter X)*	J00-J99
Diseases of the digestive system (Chapter XI)*	K00-K93
Diseases of the musculoskeletal system and connective tissue (Chapter XIII)	M00-M99
Diseases of the genitourinary system (Chapter XIV)*	N00-N99
Injury, poisoning and certain other consequences of external causes (Chapter XIX)*	S00-T98
Factors influencing health status and contact with health services (Chapter XXI)	Z00-Z99
Symptoms and abnormal findings, not elsewhere classified (Chapter XVIII)	R00-R99
Other* i.e., diseases of the eye and adnexa (Chapter VII)*, diseases of the ear and mastoid process (Chapter VIII)*, diseases of the skin and subcutaneous tissue (Chapter XII)*, diseases associated with pregnancy, childbirth and puerperium (Chapter XV)*, diseases originating in the perinatal period (Chapter XVI) and congenital malformations (Chapter XVII)	H00-H95, L00-L99, O00-O99, P00-P99, T00-T99

\*except infectious diseases within the chapter



**Declaration of co-authorship\***

Full name of the PhD student: Iben Duvald Pedersen

This declaration concerns the following article/manuscript:

Title:	Day of the week of admission, patient characteristics and patient outcomes: a study of the weekend effect in an emergency department
Authors:	Iben Duvald, Anders B. Møllekær, Mathias A. Boysen, Betina Vest-Hansen

The article/manuscript is: Published  Accepted  Submitted  In preparation

If published, state full reference:

If accepted or submitted, state journal: Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine

Has the article/manuscript previously been used in other PhD or doctoral dissertations?

No  Yes  If yes, give details:

The PhD student has contributed to the elements of this article/manuscript as follows:

- A. Has essentially done all the work
- B. Major contribution
- C. Equal contribution
- D. Minor contribution
- E. Not relevant

Element	Extent (A-E)
1. Formulation/identification of the scientific problem	A
2. Planning of the experiments/methodology design and development	C
3. Involvement in the experimental work/clinical studies/data collection	C
4. Interpretation of the results	B
5. Writing of the first draft of the manuscript	A
6. Finalization of the manuscript and submission	A

**Signatures of the co-authors**

Date	Name	Signature
23/1-18	Anders B. Møllekær	<i>Anders Møllekær</i>
23/1-18	Mathias A. Boysen	<i>Mathias A. Boysen</i>
14/1-18	Betina Vest-Hansen	<i>Betina Vest-Hansen</i>

In case of further co-authors please attach appendix

Date: 24/1-18

*Iben Duvald*

Signature of the PhD student

\*As per policy the co-author statement will be published with the dissertation.