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Discharge Before Noon

A study in a medical emergency ward

Master's thesis in Quality and Operations Management

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Anton Karling

Kar-Wai Tang

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Abstract

Introduction
Overcrowding is an issue in hospitals all over Sweden. It contributes to unsafe patient conditions, which has resulted in the death of a patient. A way to address overcrowding is to increase care bed availability by enabling earlier discharges. For this reason, the concept of *Discharge Before Noon* has gained attention. However, research on the topic is still limited.

Purpose
To identify possible ways of increasing *discharges before noon*.

Method
An abductive approach was used for this case study. Data collection was conducted through interviews, observations, shadowing and extractions from databases.

Setting
A general medical emergency ward with 20 care beds.

Result
A strategy was formulated to increase discharge before noon by identifying and addressing root causes which prevented earlier discharges. Several factors were analysed in relation to discharge hours. Attempts to establish correlation did not succeed. However, data revealed that younger patients with one diagnosis were more likely to be discharged earlier.

Discussion
Gathered data suggested that afternoon discharges were a consequence of other tasks occupying time prior to noon. A comparison of interventions in existing literature revealed that similar situations were described and successfully addressed with process redesign. Based on this, a suggestion is put forth on how the medical emergency ward can achieve discharge before noon. The suggestion is centred on identifying next day discharge ready and critical patients during the afternoon ward round, and prioritising these during morning ward rounds.

Keywords: discharge before noon, discharge process, overcrowding, intervention

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Glossary

Healthcare is a specialised context with a number of unique terms. There are several possible translations from Swedish to English. Below are the terms used in this report, included with the Swedish equivalent when applicable.

Assistant Nurse	Unlicensed title not tied to certain education. *Undersköterska*.
Boarding time	The time between the point at which a formal decision is made to admit a patient to an inpatient ward, to the point admission is given.
Careplace coordinator	Name of those who manage bed availability at Sahlgrenska Hospital. *Vårdplatskoordinator*
Care Planning	Activities related to coordinate assistance after discharge to those in need. *Vårdplanering*.
Drug Story	A summary of changes and actions regarding a patient's medication after a hospitalisation. *Läkemedelsberättelse*.
Epicrisis	A clinic summary of a hospitalisation. *Epikris*.
Junior physician	A physician with medical degree pursuing a general licensure. *AT-läkare.*
MAVA	Name for this type of ward, used all over Sweden. Abbreviation of *Medicinsk AkutVårdsAvdelning*.
Nurse	Licensed title tied to a certain education. *Sjuksköterska*.
Occupational Therapist	Profession or title focused on support, maintain or develop daily living skills. *Arbetsterapeut*.
Physiotherapist	Profession or title focused on support, train or improve human mobility. *Fysioterapeut*.
Resident physician	A physician with a general licensure pursuing licensure in a certain field. *ST-läkare*.
Senior physician	Physician with medicinal responsibility at a ward. *Överläkare*.
The National Board of Health and Welfare	Socialstyrelsen
The Swedish Work Environment Authority	Arbetsmiljöverket

1 Introduction

Shortage of care beds is a problem in many hospitals all over Sweden (Sveriges Kommuner och Landsting n.d.). The reason for the bed shortage and the overcrowding this results in is unclear, but the implication for the individual patient may be devastating, since *overcrowding* has been found to contribute to unsafe patient conditions (Cameron, 2006). The National Board of Health and Welfare (2012) states in a report that overcrowding in medical facilities may lead to lack of treatment and mistreatment, which in some cases has resulted in the death of the patient. Though all consequences may not be this severe, the situation is not optimal from either patients or caregivers perspectives. In a report published by The Swedish Work Environment Authority (2012), the issues of overcrowding were highlighted from staffs' perspective, in which it was explained that especially nurses and assistant nurses experienced a stressful work environment.

1.1 Background

Sahlgrenska Hospital in Gothenburg is among the many hospitals within Sweden with overcrowded wards. The hospital is experiencing a shortage of care beds at several wards. One of them is a medical emergency ward. For unclear reasons, patient discharges predominantly occur during afternoons, even though ready earlier. This has numerous consequences. One is increased risk of developing hospital acquired infections, as longer hospital stays has been identified as a possible contributing factor (Clarke, 1996; Donowitz et al., 1982; Girou et al., 1998). Another consequence is prolonged waiting time for patients in the emergency ward (EW) and patient frustration (Bagust, 1999).

A way to address this issue of overcrowding is to increase care bed availability (Cooke et al., 2004). Khanna et al. (2011) found this possible by enabling earlier discharges. For this reason, the concept of *Discharge Before Noon (DBN)* has gained attention. Several interventions have been conducted in order to increase it (e.g. Durvasula et al., 2015). However, Wertheimer et al. (2014) wrote that the existing theory on discharging patients earlier is still limited. Yu (2015) acknowledges that earlier discharges seems to free up care beds, though encourages considering patient pathways in its entirety. The evidence is in any case pointing towards earlier discharges as a solution for increased care bed availability.

1.2 Purpose

The purpose of this study is to identify possible ways of increasing *discharges before noon*.

1.3 Problem Analysis & Research Questions

The underlying reason for discharges not occurring before noon is unclear. To achieve the purpose, the study will use existing research on DBN to look at a case and make an attempt at formulating a feasible solution. For this, the following research questions have been generated:

1: What is the current state of DBN research?
2: What characterises DBN based on the existing data?
3: What can be done to achieve DBN considering the existing constraints?

By understanding the current state of DBN research, the idea is to obtain knowledge concerning what factors that could be preventing earlier discharge hours and also gain a better understanding of how possible solutions could be formulated.

This study has been conducted at *medical emergency ward 91* (MAVA 91) at Sahlgrenska Hospital. This setting was considered appropriate since the ward has been experiencing delayed discharges, which have led to increased waiting time for patients ready to leave the ward, and while doing so, occupied resources such as beds and staff.

1.4 Delimitations

This study does not include any collaboration which MAVA 91 has with other parties, such as with the municipality. Furthermore, processes outside MAVA 91 are not investigated, as well as other processes within the ward, such as *care planning*.

1.5 Thesis Outline

In the introduction, the value and interest of DBN is explained, ending with purpose and research questions. **Chapter 2** presents selected methodology, in which motivation is given to the choices of strategy, design and data gathering tools. In **Chapter 3** the theoretical framework in which the study has been conducted is described. **Chapter 4** includes empirical data presented together with case context. This chapter is structured to reflect the progress of the study, and includes findings and possible solutions. In **Chapter 5**, the purpose and research questions are discussed. A conclusion is then given together with future recommendations.

2 Method

In this chapter, the method for conducting the study is described. The first part presents reasoning behind selected methods, while the last part treats research quality and ethical aspects.

2.1 Research Strategy

This study involves both qualitative and quantitative methods. The selected research approach is abductive, which is an iterative process between theory and empirical data, from which framework, data collection and analysis evolve simultaneously over time (Dubois & Gadde, 2002). This means going back and forth and allowing empirical findings to direct the search for new data. The authors hold an ontological consideration of constructivism, meaning that social phenomena are considered to be a product of social interactions and continuously in change (Dubois & Gadde, 2002).

2.2 Research Design

Yin (2014) describes a case study as an investigation of a single case, such as an organisation or event. A case study design was selected as this study would concern one medical emergency ward. Critique against case studies is the possibility to generalise findings, as only one case has been studied (Yin, 2014). A way to address this is to provide detailed descriptions of the study (Bryman & Bell, 2011).

2.3 Research Method

Below the applied qualitative research methods are presented.

2.3.1 Literature Review

A literature review will be conducted in order to gather relevant articles and generate an understanding of the state of the research field. The main sources are search engines and databases such as Web of Science, Google Scholar and Chalmers University's Library Database. Initiating a study with a thorough literature review is appropriate according Bryman and Bell (2011). To determine current research on DBN as well as to find other relevant theory, structured searches were done on Web of Science, illustrated in **Figure 2**.

2.3.2 Interviews

As the study is conducted through an iterative process, new information and questions will emerge as the study progresses (Dubois & Gadde, 2002). Interviews will therefore be carried out until theoretical saturation has been reached. Qualitative unstructured interviews will be used in the early phases, as this allows for a broader area of information to be gathered and also offers the interview subject flexibility to lead the discussion in different directions, which facilitates insightful information to be gathered (Wilson, 2013). As deeper understanding is gained, interviews of semi-structured type will be used to gather more specific information.

2.3.3 Focus Groups

A focus group is a form of group interview, typically with the aim of investigating a certain topic in-depth (Krueger & Casey, 2009). Such will be held initially in the study, as it allows the authors to develop an understanding of how the topic is perceived by professionals, and serves as an appropriate point of departure. When facilitating a focus group, it important to balance the level of involvement, to allow a free flowing discussion while directing to bring out insights and involve everyone. (ibid)

2.3.4 Observations

Observation can be used as a research method for collection of data. Given the highly specialised context this thesis is conducted in, a Complete Observer-approach will be utilized (Baker, 2006). The researchers are present without interacting or taking part in what is being studied. It has advantages in that the observers stay detached from the group hence minimizing impact on its behaviour. However, a disadvantage is that conversation between group members may be missed.

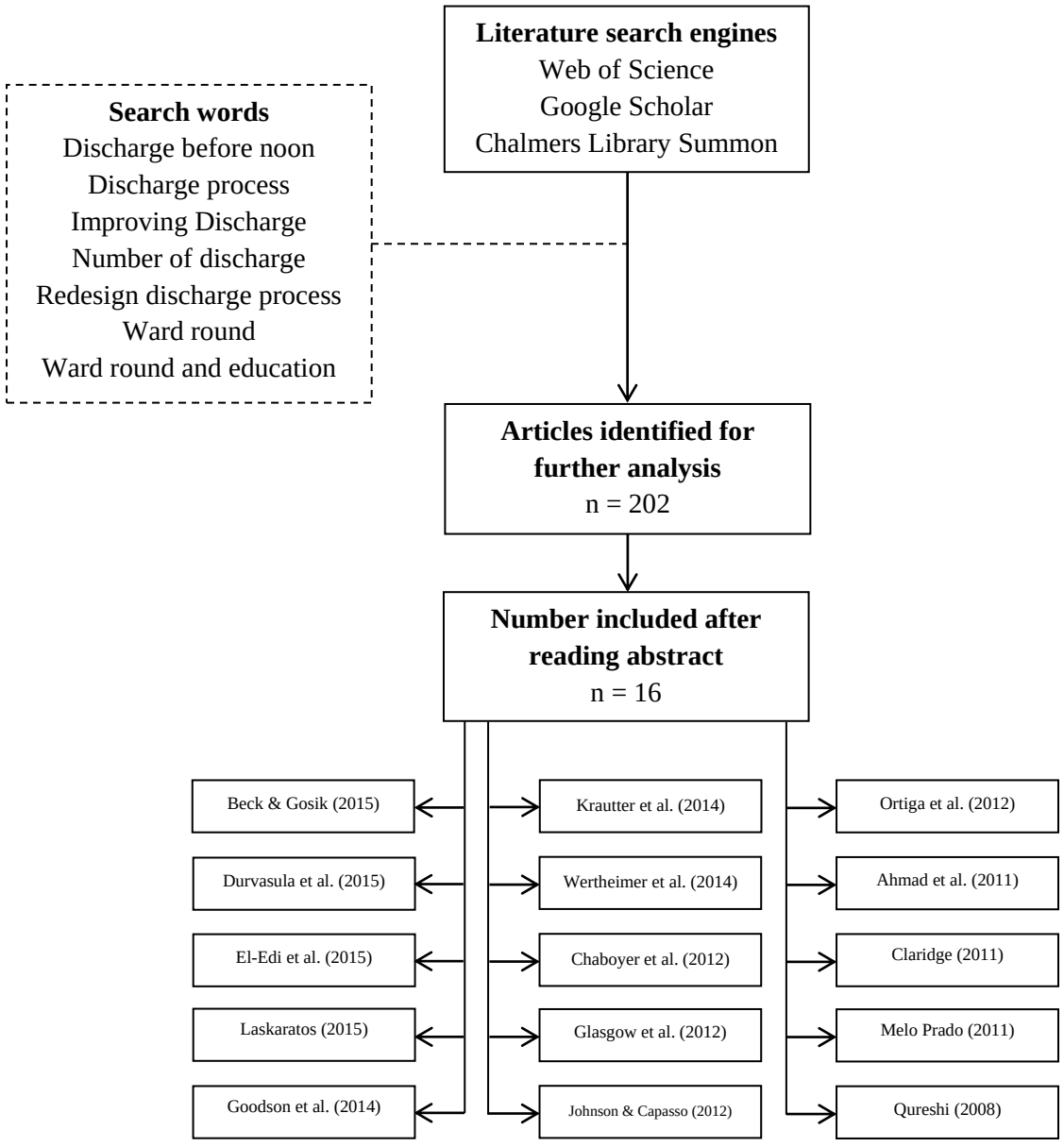

Figure 1. Literature search flow

2.4 Research process

The study was initiated with reviewing existing research on achieving earlier discharge and various quality improvements within healthcare. The patient pathway was mapped to obtain a basic understanding of MAVA 91. An AIM-session was then conducted to gather an overall understanding of why patients at MAVA 91 were not discharged earlier. The information was then structured in collaboration with professionals into a cause-and-effect diagram which was used as the foundation for data collection and analysis. Data was collected for each category in the cause-and-effect diagram through interviews, observations and extraction from IT-systems. In the next step, data was analysed in attempt to obtain information which could aid in the last step of forming a possible solution to achieve DBN based on data and existing research.

2.5 Research Quality and Ethics

Both qualitative and quantitative methods will be adopted in this study. Therefore, quality concerns and criticism have been taken into consideration.

2.5.1 Qualitative

For qualitative research, common criticism is that findings are too subjective, with ambiguousness to how certain areas are chosen instead of others (Neuman, 2011). Qualitative research also tends to be unstructured, making replication of the study difficult. Other criticism concerns problems of generalisability and lack of transparency, due to the difficulty in establishing how conclusions are arrived at (ibid). To manage these points, four criteria are presented by Bryman and Bell (2011). By addressing these, the trustworthiness of the qualitative parts of the study should be increased.

Credibility is about ensuring that research is conducted in accordance to good practice (Bryman & Bell, 2011). Participants will be provided with findings and given opportunity to confirm the accuracy of it. This is called respondent validation and increases credibility by confirming that a correct representations of the participant's intentions have been collected. *Transferability* concerns the degree of generalisability of findings to other contexts and can be increased by producing thick descriptions on details of the culture, which offers a foundation for others to decide how findings can be translated to new settings (Bryman & Bell, 2011). Thus, observed behaviour, interactions and communication will be noted throughout the study. *Dependability* is concerned with the extent to which the authors agree upon observed phenomena and the replicability of the study, and can be addressed by keeping records to allow for inspection of procedures and process (Bryman & Bell, 2011). Therefore, individual notes will be kept of findings to be compared. *Confirmability* deals with the objectivity of the study and is about ensuring that authors' personal values have not influenced the study enough to cause an apparent change in findings (Bryman & Bell, 2011). To the extent which it is possible, personal values will be disregarded from. Focus will be placed on following the findings and using the theoretical foundation to guide reasoning and conclusions.

2.5.2 Quantitative

Some criticism given to quantitative research is that an artificial sense of precision and accuracy can be created from the measurement. It is also criticised for creating an independent static view of social life when analysing relationships (Neuman, 2011). Following categories are generally important to consider for quantitative research.

Reliability concerns whether findings are repeatable (Neuman, 2011). The source and method of collection for data used in the study will be reviewed in order to gauge the reliability of it.

Replicability concerns whether the study is replicable (Neuman, 2011). To facilitate this, procedures and steps taken in the study will be thoroughly described. *Internal validity* concerns whether the results obtained in the study are true (Yin, 2014). Therefore, collected data and findings will be controlled and checked by each researcher. *External validity* concerns whether findings can be generalised to other settings (Yin, 2014). To increase the possibility of this, settings will be described. Furthermore, any generalisations will be made with caution as healthcare is a complex environment. *Construct validity* concerns whether intended concept is measured (Yin, 2014). According to Yin (2014), a way to increase this is by using multiple sources of data and letting key informants review the findings.

2.5.3 Ethics

Ethical principles are concerned with the treatment of participants in the study. The four main principles to take into consideration according to Diener and Crandall (1978) are described below.

Harm to participant, in any form, such as physical harm or impeding possibilities of career development. To ensure that no harm is done from this study, full confidentiality and the possibility for anonymity will be offered to each participant, using pseudonyms in documentation to erase any chance of tracing. *Lack of informed consent* highlight the importance of giving participant adequate amount of information to make an informed decision to whether participation is desired or not. Any potential participant in this study will be presented with the purpose of the study, what contribution the participant will give, in what context given information will be used and information on researcher's background. *Invasion of privacy* is a matter of respecting the boundaries of participants. In this study, any participant will be able to withdraw from any activity at any moment. *Deception* is when the research is given a false representation. To avoid deception, adequate description of the study will be given to any participant. For anyone who desires, more information will be given as long as the ethical boundaries are kept. Furthermore, the authors will act with honesty and integrity.

3 Theory

This chapter presents the frame of theory used in the study. Existing literature related to discharge process is presented initially, after which literature on DBN interventions are given together with an overview.

3.1 Discharge Process

The discharge process comprises of the activities conducted to discharge patients. Previous studies have identified patient flow as the main object to focus on when improving the discharge process (Ortiga et. al., 2012; Johnson & Capasso, 2012). Expanding healthcare facilities is not a possible solution, so by focusing on speeding up the patient flow, capacity can be released. Powell et al. (2012) showed through simulation that discharging 75% of the patients before the daily peak of EW demand, could reduce or eliminate boarding time for patients in EW.

Lack of process orientation and focus was identified by Johnson & Capasso (2012) to create delayed discharges. Physicians seemed to concentrate on their task, that is, to cure the patient. They implicitly suggested that their core responsibility ended when a patient was ready to be discharged.

Ortiga et al. (2012) established that an effective discharge process starts at the time of the admission and that having a common discharge protocol was beneficial for hospitalisations which were expected to be less than 72 hours. Starting with the practical preparations the day before, such as collecting the patient's belongings and writing prescriptions, was an effective way of shortening delays in the discharge process, and was considered worthwhile even if 10% of scheduled discharges were cancelled later. Parts of the discharge process can and should be initiated earlier according to Johnson & Capasso (2012), to avoid that nurses turn all their attention to newly admitted patients.

Communication is also an important factor concerning the discharge, but Johnson & Capasso (2012) believe that there is no need for expensive information systems; simple visualisation can be beneficial. Ortiga et al. (2012) based their new design on lean concepts in order to reduce waste and concluded that there is an opportunity to increase bed capacity and productivity at same cost through process reengineering.

Successful studies on redesigning discharge processes have some common factors (Ortiga et al., 2012; Johnson & Capasso 2012; Chaboyer et al., 2012). One is that process focus is important, for which process mapping is shown to be a useful tool. It makes it easier to dissect the process and find the optimal sequence of tasks. Stakeholders ought to be involved in the redesign and implementation. Chaboyer et al. (2012) appointed a senior nurse as change agent with successful outcome. A key is to understand the process from all professions perspective and verify their needs, and later fulfil these with the new design. By doing so quality can be retained.

Another study conducted by Ahmad et al. (2011) introduced a change in consultant ward rounds visits, from twice weekly to twice daily, which resulted in almost doubling the number of discharges and halving the average length of stay without affecting readmission rate or inpatient mortality during the cost neutral intervention. The results were sustained throughout the 12 months intervention period. Ahmad et al. (2011) argue that the results suggest that cultural and behavioural changes can have significant impact on the average length of stay and number of discharges.

Minichiello et al. (2001) investigated staff's perception of reasons for delayed discharges. Findings showed that different professions held different beliefs. Nurses and social workers perceived ward

rounds, conferences and lack of inter-professional communication and pre-discharge planning as causes for delays, and felt that discharge orders were usually not written before noon. Physicians and medical students on the other hand, were more of the opinion that waiting for test result and procedures was the cause. Furthermore, in contrast to the nurses, 60% of the physicians felt that discharge orders were usually written before noon. Furthermore, Minichiello et al. (2001) found that another perceived obstacle for discharges was physician's morning schedules, which were claimed by ward rounds, morning reports and conferences. This made physicians difficult to access and thus led to decisions related to discharges, external support services and daily plans, were pushed later in the day.

3.2 Intervention for Discharge Before Noon

A study was conducted by Durvasula et al. (2015) in an academic medical centre with a medically complex population, with the goal of increasing amount of discharges before 11:00. This led to introducing a new work routine concerning the discharge process. Medical reconciliation was moved to the night before and discharge orders had to be placed before 9:00. The result was an increase to 29.7% discharges before 11:00, with an average of 3 hours earlier discharge. No increase was found concerning length of stay, patient harm or 30-day readmission rate. Durvasula et al. (2015) believe the success largely depended on that the intervention concerned timing of work without adding new tasks. The intervention showed promise in different contexts, which according to them indicated that the intervention could have a broad application. The main hurdle against adopting the intervention was influencing physicians' behaviour and traditional way of working.

El-Eid (2015) conducted a project in which obstacles to discharging patients were identified from different stakeholders' perspective. Some examples were inconsistent information from care providers to patients, no discharge plan and unavailable staff. Many of these were addressed by integrating technology in work routines, such as introducing electronic reports to create more consistent communication to patients. The result was a successful reduction of 22% discharge time, from an average of 2.2 hours to 1.7 hours.

Wertheimer et al. (2014) conducted a study in two acute care inpatient medical units in an academic medical centre, and did not find one specific factor accounting for most delays in discharges. Instead, different factors were found, such as test results not being ready, transportation not arranged, discharge orders coming too late, families not receiving post-discharge education and that some patients simply wanted to stay for lunch. As a way to manage this and create overview, a list of daily responsibilities was introduced, which all staff were involved in the creating process. Interdisciplinary afternoon ward rounds were used to identify next day DBNs and a discharge website was created to facilitate communication. The daily rate of DBN was monitored and communicated. The result was an increase from 11% to 38% DBN over a 13 month intervention period, and 1 hour 30 minutes earlier average discharge time.

Another study was conducted by Mathews et al. (2014) in an EW with inefficient patient flow, strained capacity and increased workload, exacerbated by delayed discharges. This led to an implementation of a system of colour coding patients based on the likelihood of being discharged the following day; green for very likely, yellow for possible, and red for unlikely. The candidates were selected the day before during afternoon ward round. Classification was based on the healthcare professionals' clinical impression, with input from nursing team and care coordination. Green patients were then started with in the morning ward round. The result was an increase in 11:00 discharge from

10.4% to 21.2% over a four year period. Mathews et al. (2014) emphasise that this tool was not finished and would be further developed with involved staff.

In another study presented by Goodson et al. (2014), a standardised discharge process was implemented as a way to achieve an aim of having 70% DBN. A so called discharge brunch was implemented, in which patients, family and staff attended. It served as a group education opportunity concerning the discharge process and post-hospital management. The setting was an inpatient orthopaedic ward for patients who had total hip replacement. The result was 76% DBN for patient who attended the discharge brunch, compared to 36% DBN for the population that did not attend. By implementing discharge brunch, several issues were addressed, such as patient frustration of a slow discharge process, fragmented communication from staff to patients and difficulties to plan for support care providers to be present when instruction were given.

Beck and Gosik (2015) conducted a study which aimed at improving time of discharge by redesigning inpatient paediatric service with Lean Six Sigma. An intervention consisting of three changes was introduced. The first one was altering the composition of rounding teams. Two teams were created who worked independent of each other, sharing equally new, established and dischargeable patients. Another change was creating a standardised ward round structure. The rounds started with addressing patients who could be discharged. All necessary discharge work was completed, with the support of a discharge checklist, before proceeding with next patient. Discharge ready patients were identified in an interdisciplinary meeting the day before. The purpose of the huddle was to discuss anticipated discharges, schedule follow-up appointments and settling necessary prescriptions and arrange home services. Medical teams, social workers and care planners attended the huddle. The result was a decrease in median discharge order to 10:45 from 14:05, and median time of discharge at 14:15 from 15:48. By comparison, respective measures from a control group were 12:56 from 13:13, and 14:45 from 14:50. The result was maintained for at least three following months, with no negative impact on readmission rate or length of stay. Furthermore, a discussion is held by authors that minimising batch sizes in theory would reduce waste, cut work-in-progress patients and allow more time with each patient.

In a review, Yu (2015) concluded that discharging patients before noon seems to create more available beds earlier in the day and thus reduce congestion. It is further explained that DBN seems to work best with an interdisciplinary structure in which candidates for DBN are selected. As a last note, Yu (2015) encourages not to fixate on DBN, and instead view the whole patient pathway as a continuous flow from the EW to discharge, with the aim to reduce patient length of stay and avoid sub-optimisation. Furthermore, Glasgow et al. (2012) argues that complex outcomes such as DBN can be difficult to sustain through a single intervention and argues the value from quality interventions is the knowledge gained from highlighting the topic.

An overview of the interventions is provided in **Table 3**, **Chapter 5.1**. What can be understood from the different cases is that achieving DBN is possible through different ways. The general solution is to start the discharge process earlier, by identifying discharge ready patients during interdisciplinary afternoon meetings. By doing this, tasks are not stacked until later in the process, inevitably delaying the discharge. Discharge ready patients are then addressed first thing during morning ward rounds.

3.3 Ward Round

There is no agreed definition of a medical ward round, but it is described as a complex clinical activity which is critical to providing high quality health safe care (Royal College of Physicians, Royal College of Nursing, 2012). Some of the steps included are: establishing, refining or changing the clinical diagnoses, reviewing patient's progress, formulating discharge arrangements, and communicating with the multidisciplinary team, which is critical for quality of care (O'Leary et al., 2010; Zwarenstein, 2009). Despite playing a central role, ward rounds remain different both in purpose and conduct depending on places (Royal College of Physicians, Royal College of Nursing, 2012).

One purpose of the ward round is to serve as an educational platform (Claridge, 2011; Laskaratos et al., 2015; O'Hare, 2008). Though often used within medical training, research is limited concerning this and done in different contexts with different types of participants (Laskaratos et al., 2015; Melo Prado, 2011). Research shows that ward rounds offer good educational opportunities for skills such as patient management and diagnosis investigations, while not as effective for skills such as physical examination (Laskaratos et al., 2015).

In a study by Claridge (2011), 90% of trainee physicians agreed on that the ward round could be made into a better learning experience, and 36% agreed that a good learning experience was offered. A similar result was found by Qureshi & Swamy (2008), in which 70% of the trainees disagreed or were uncertain that each ward round gave any new learning.

The improvement potential in ward rounds has not gone by unnoticed. Research has been conducted in search for better ways. One such is by Krautter et al. (2014), who tried to increase learning by introducing specially trained supervising physicians who focus on ward round competence. Another is by O'Leary (2010) who introduced an interdisciplinary ward round in attempt to foster effective communication. Powell et al. (2015) developed simulation training as a way to bridge the gap between training and required practical skills. Claridge (2011) proposed simple actions, such as high priority on time management, scheduling rounds in the morning, maintaining a good pace without hurrying and demonstrating passion and enthusiasm for medicine.

4 Empirical Findings

The empirical findings are presented in this chapter. The setting and data collection is first presented, after which MAVA 91 is described. Thereafter findings from each phase of the study are presented, with descriptions of how the result was obtained. Finally, possible solutions based on the findings are provided.

4.1 Setting

Sahlgrenska Hospital is part of Sahlgrenska University Hospital, which consists of several hospitals in the Gothenburg region. Sahlgrenska University Hospital serves the 700.000 inhabitants of the region with basic and emergency care, and the 1.7 million inhabitants of West Sweden with specialised care (Sahlgrenska University Hospital, 2014a).

Sahlgrenska University Hospital employs approximately 16 700 people and has approximately 2000 care beds. It also serves as an educational hospital for medical degrees. The annual turnover is around 13 billion SEK (Sahlgrenska University Hospital, 2014b).

4.2 Data Collection Methodology

Interviews have been held with five nurses, three assistant nurses, four physicians and one business developer of which each lasted 30-60 minutes. Physicians and nurses have been both senior with managerial responsibilities and less experienced mainly involved in operational work. The authors have been present at two ward rounds, one following nurses and one physicians, and one round of discharge dialogues. To not catch attention as outsiders, the same attires as the staff were worn, to avoid the Hawthorne effect in which the observer affects the situation being studied.

Access to all concerned facilities have been given, so the authors have been able to visit the ward without a specific intention anytime, which have made numerous spontaneous discussions and observations possible. Desks in an open office space located in the basement under the ward, where administrative staff and business developers have offices, were made available to the authors. Approximately 320 man hours have been spent at the premises during February 2015 - May 2015. Access to all IT-systems used by clinicians has been granted, though not with full administrative permission. Same applies for business control systems and tools.

4.3 Stage One: Understand Current State

The setting and context are thoroughly presented below.

4.3.1 MAVA 91

MAVA 91 is a general internal medicine ward closely related to the EW. It is a ward in which patients from the EW with need of low intensive surveillance will be hospitalised over at least one night. Many of the patients are elderly. Patients often suffer from more than one diagnosis. However, some are admitted due to drug overdosing or lethal alcohol intoxication. Given these conditions, clinical standardisation is not as effective as in a ward with more homogeneous patients.

A reason MAVA 91 was suitable for this study was due to stable conditions, in aspects such as amount of incoming patients, and that the ward is rather small in size with 20 care beds. For 2014, the ward had approximately 2600 patients, monthly average of 217 patients with a standard deviation of 22. The ward works with three shifts, see **Figure 2**.

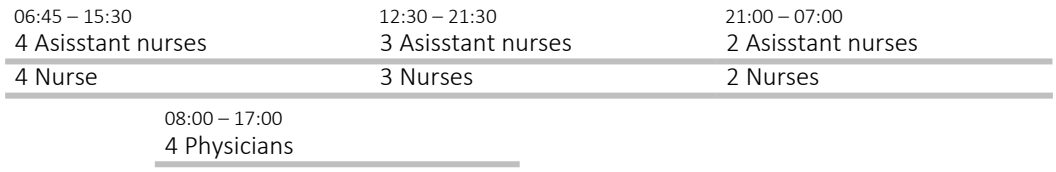

Figure 2. Staff in each shift

Due to MAVA 91's close relationship to the EW, the majority of incoming patients come from there, approximately 92% (**Figure 3**). The remaining 8% of incoming patients are submitted through several different pathways, of which the largest is the *new ward within Sahlgrenska Hospital* at 3%. For patients leaving MAVA 91, most are discharged home. This includes people with and without a need for additional home support. For the former group, there is a need to establish a care plan. Of the remaining patients, 18% are transferred to *other wards within Sahlgrenska Hospital* and 7% are *deceased or had special circumstances*.

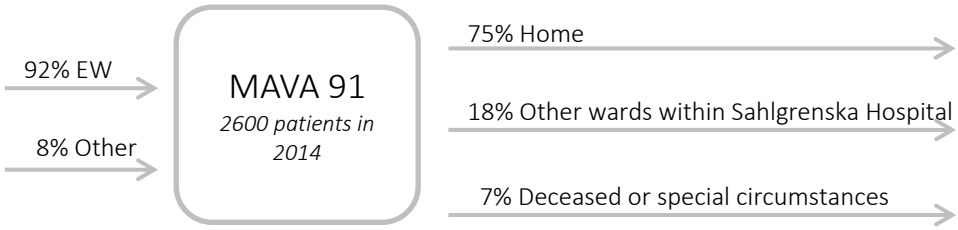

Figure 3. Patient pathways

4.3.2 Patient flow

To gather an understanding of the patient flow in MAVA 91, a process map (**Figure 4**) was created. This provided information on patients' journeys through the ward and the surrounding work performed by staff.

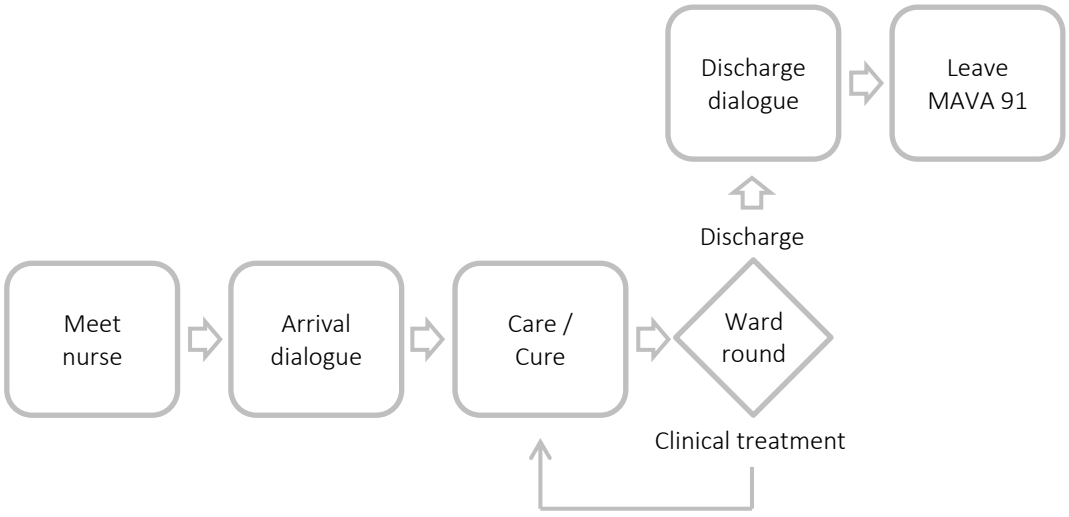

Figure 4. Patient pathway from EW to MAVA 91

Within MAVA 91, the patient is treated clinically. The central component is the *Ward Round*, in which multidisciplinary teams of physicians, nurses and assistant nurses review patients and decide upon measures, which are then followed up in the next ward round. Patients are also reviewed by occupational therapists (OT) and physiotherapists (PT) if needed. The amount of iterations depends on the patient condition. However, from being admitted to MAVA 91 and leaving it, the average length of stay is **3.5 days**.

As shown in **Figure 5**, the majority of discharges occur around 14:00. Sample size is 1934 and only patients being discharged home are included (i.e. not to other wards, deceased, etc.).

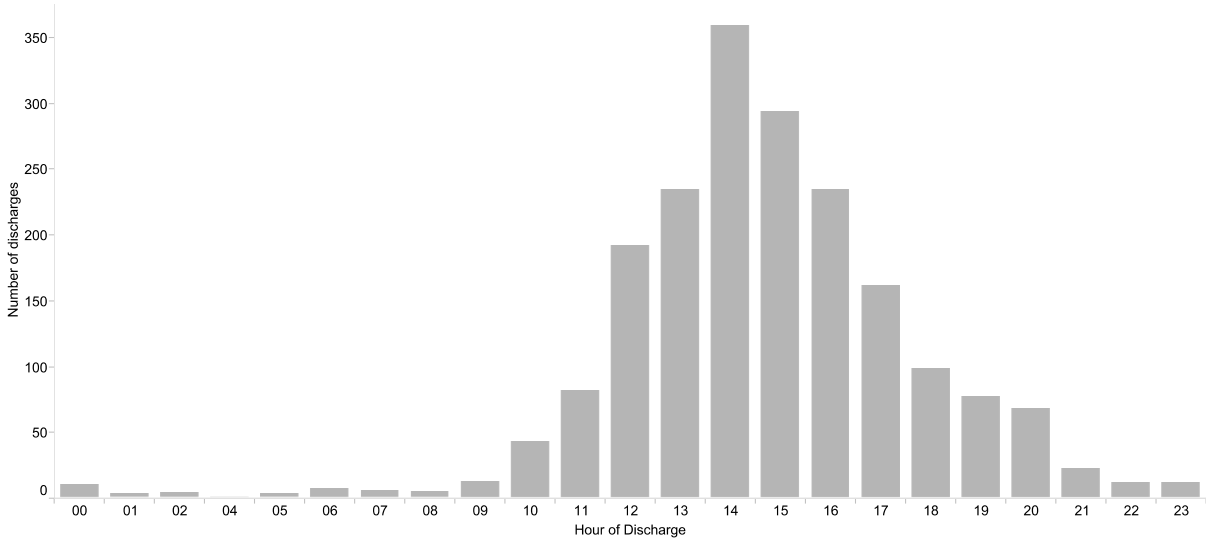

Figure 5. Patient discharge hours from MAVA 91

4.3.3 Voice of the Business (VOB)

To investigate the VOB with regards to discharge before noon, the four metrics proposed by Stahl et al. (2003) were used as guidelines. The metrics are service level, customer satisfaction, clinical excellence and service cost.

The potential benefit for *customer satisfaction* from increased DBN, would be reduced waiting time to access MAVA 91 and thus quicker access to EW for other patients (Durvasula et al., 2015). The nurses at SU also explain that many patients desire to leave when they are ready and express frustration at being kept unnecessarily. Furthermore, as earlier discharges have been found to reduce bed occupancy rates (Khanna et al., 2011), the stressful work environment would decrease for nurses and assistant nurses.

For *clinical excellence*, decreased hospital stay and reduced waiting time would have medical positive impact, as it means a decreased risk of developing hospital acquired diseases and deteriorating health from delayed treatment in wait for admission (Clarke, 1996; Donowitz et al., 1982; Girou et al., 1998).

For *service cost*, the benefit could be more effective use of resources. Care beds would not be occupied by finished patients and staff would not have responsibility for them.

4.3.4 AIM Workshop

An AIM workshop was conducted to gather an initial broad understanding of the problem by gathering knowledgeable people from every profession related to patient discharges. The result provided four categories of possible causes, see **Table 1** for a summary and **Appendix A** for the full result.

Table 1. AIM workshop result for possible causes preventing earlier patient discharge

Question	What prevents patients from being discharged earlier?
Outcome	Inefficient ward round
	High workload Routine and Structure Poor collaboration with municipality } *Highly interrelated*
Participants	Senior Physician, Nurse, Assistant Nurse and Operations developer/former nurse

It emerged that an *inefficient ward round* was felt to be the main cause preventing earlier discharges. It was considered to be time consuming and occupied much resources. All participants agreed that it was caused by a *high workload* and current *routines and structure*, which were highly interrelated and therefore exacerbated issues in one another.

The collected opinion was that routines and structure worked decently as long as the workload was not too demanding. However, the business developer explained that MAVA 91 often is overcrowded, which makes work stressful in general. According to the discussions, a consequence of this was that less time could be spent on preparing for the ward round, and that assistant nurses were too occupied to attend them, causing an information loss. It was also discussed that notes in journals were differently written which resulted in different formats, which hindered efficient information extraction.

4.4 Stage Two: Gather Data

Data gathering methods and sources are presented below.

4.4.1 Data Collection Plan

To gather qualitative data, it was considered necessary to interview all professions involved in MAVA 91. Experienced and less experienced workers were selected for the interview to allow for different point of views. The quantitative data collected was for all patient year 2014. Due to organisational changes, obtaining data for 2013 would be problematic.

To guide the collection of data, a list of possible root causes was generated with a cause-and-effect diagram. For further deciding at which data points to start investigating, control charts would be created to identify points at which hour of discharge had been early or late.

4.4.2 Requirements for the Ward Round

As the ward round had been identified in the AIM workshop as a main contributing factor for preventing earlier patient discharges, it would be further investigated. Semi-structured interviews were held with nurses, assistant nurses and physicians, see **Appendix B** for the questions used.

The nurses considered it important to get clear communication with physicians in matters concerning treatment plans, since this would give them an increased understanding of what tasks to conduct. Furthermore, it was important to be able to raise and discuss questions concerning patients which had arisen during work. It was also important to be able to prepare for the ward round, by gathering an understanding of patient's situations. However, this step was sometimes compromised as time would not suffice for a thorough preparation.

The assistant nurses explained that the ward round offered a chance to understand the reason behind treatment plans and thus understand the patient care in a broader context. The knowledge which assistant nurses bring is information acquired through work. The assistant nurses work most closely with patients and therefore, according to all interviewees, have valuable information about fundamental status of patients.

The physicians felt it was important to be able to discuss patients and raise questions with nurses and assistant nurses. Furthermore, it was explained that an educational value exists with ward rounds. The physicians use it as a learning opportunity, and at times student physicians accompany. In such situation, it becomes important to be more explicit and clear in discussions concerning patients.

To conclude, each profession desire a comprehensive knowledge foundation to base decisions on. This foundation is dependent on the possibility to communicate with other professions as each has different knowledge.

4.4.3 Identification of Possible Root Causes

The purpose with a cause-and-effect diagram is to push beyond symptoms to identify root causes and ensure that an extensive list of ideas are covered in order to not overlook any major root cause (Breyfogle, 2003). Causes to problems can often be identified by using the 7M's; management, man, method, measurement, machine, material and milieu (Bergman & Klefsjö, 2010).

A cause-and-effect diagram was created **(Chapter 4.5, Figure 6),** in which possible causes for preventing earlier discharges were mapped. The 7Ms were used as guidelines when structuring input from the existing literature and AIM workshop. The diagram was then validated through discussions with staff to decrease the risk of missing important causes. The different arrows in the diagram are explained as follows.

Work Routine and Structure

According to the AIM result, the main reason for why discharges mostly occurred in afternoons was the ward round structure. The ward round would therefore be mapped and observed to obtain an understanding of it. Moreover, the result and much of the discussion of the AIM sessions had been related to daily routines and work structure. Other interventions described in existing literature also

focused on rearranging work tasks as a way to achieve earlier discharges, see **Chapter 3.2**. Therefore, morning routines up to patient discharge would be mapped for the different professions.

Workload

According to the participants in the AIM sessions, a high workload was tightly related to issues with routines and structure. It was therefore of interest to see whether there was a connection between hour of discharge and workload. To measure the level of workload, DRG-values would be used. DRG is a value connected to the diagnosis of a patient and is used to calculate the reimbursement which Sahlgrenska receives from Västra Götalands County for treating the patient (The National Board of Health and Welfare, 2014). It is related to the severity and effort of taking care of a patient, thus a useful indicator of workload.

Information Gathering

As revealed in the AIM sessions, the IT-systems had been described as time consuming, inefficient and non-user friendly. It was also understood that information dispersion was prevalent, and therefore of interest to investigate how the interaction with the IT-systems was conducted. Moreover, according to the nurses and physicians, some journals were well structured with information presented clearly. To investigate, these would be compared with journals considered to be less structured.

Control Charts

Control charts are used to visualize a process over time in order to detect special cause variation, create a measurement baseline, and to monitor the process (Breyfogle, 2003). Depending on the type of data generated by a process, continuous or discrete, sub-grouped or individual, the control chart will differ slightly. A control chart was created for weekly discharge hours during 2014, found in **Appendix C**. Another control chart was created to identify trends when DBN were balanced to discharges after noon, which can be found in **Chapter 4.5.2**.

4.5 Stage Three: Study data

Data for each arrow on the cause-and-effect diagram were collected and studied (**Figure 6**). The purpose was to find indication as to what pushed discharge hours to occur during afternoons. To assure reliability of data, different sources were used when possible. The analysis is presented below, organised in accordance to the arrows from the cause-and-effect diagram.

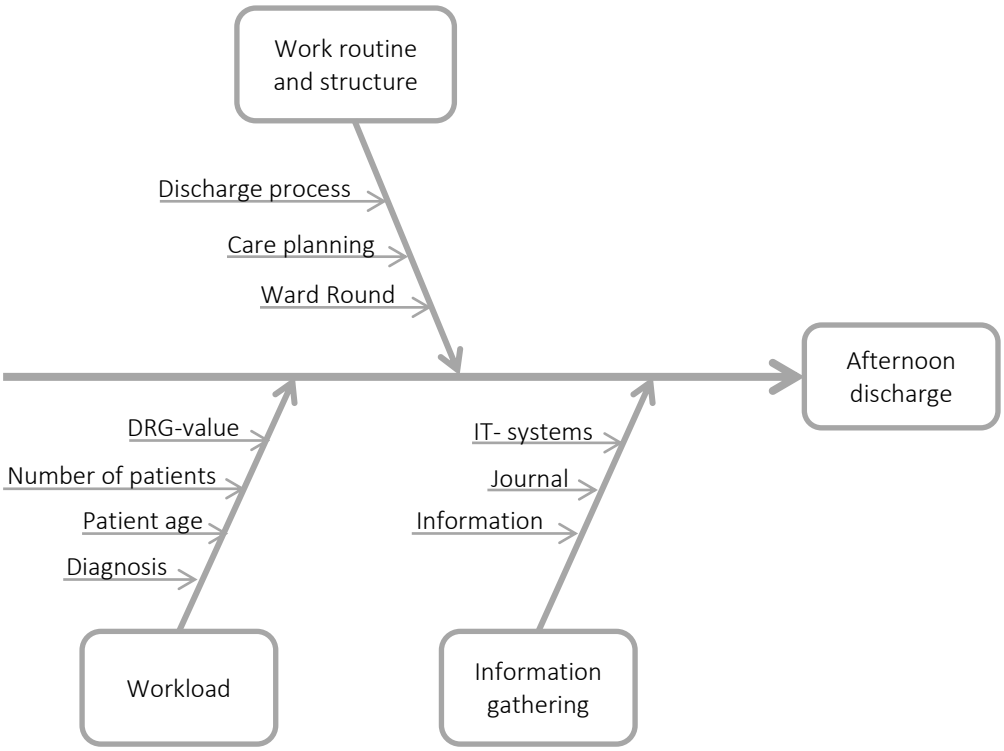

Figure 6. Possible influences on discharge hours

4.5.1 Work Routines and Structure

A process map visually documents a process and provides a foundation for understanding the current situation (Breyfogle, 2003). By providing an overview, problems and opportunities are easier to identify and communication is facilitated. When creating a process map, it is important to only go to a level of detail helpful for the project (ibid). Through interviews and observations, data was gathered to map the different components of daily work for the different professions.

Morning work routine

Process maps were created for morning activities until discharge of patient, for physicians, nurses and assistant nurses. The reason was to better understand what type of work was conducted and how time was spent on different activities.

The nurses' first event during morning shift is a report from night shift, which serves as a briefing on patients' status, see **Figure 7**. This is stated by the nurses to be important as it gives the succeeding nurse an overall understanding of the patient which has been designated to them. Each nurse is responsible for five patients. The morning meeting afterwards is non-patient related, used for discussing concerned topics for nurses and assistant nurses. Thereafter, two groups are created. One reads about patients while the other distributes medicine, and switches after the meeting with PT and OT. To read about patients, different IT systems are accessed.

The combination of reading about patients and distributing medicine, at which the nurses get to meet the patients, allow nurses to obtain an overall understanding of the patient. This knowledge is important for the ward round to be effective and efficient, according to the nurses and physicians. How much time a nurse spends on reading up on patients depends on whether any prior contact had existed. If there had, less time would be spent. Nurses have a scheduled breakfast before the ward

round. The quote below was given by one of the more experienced nurses. Though it may seem trivial, it gives a perception of the high morning workload.

"Breakfast is important to me, I always try to make time for it." – Nurse

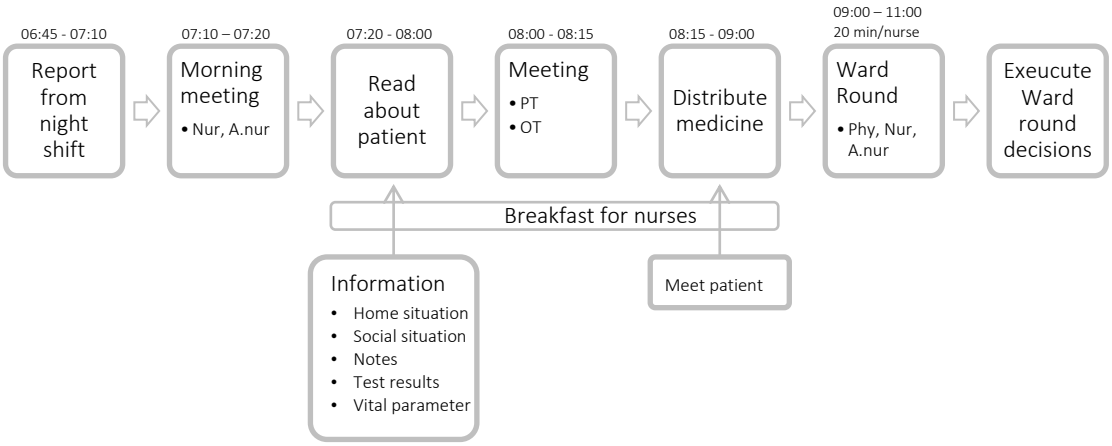

Figure 7. Morning routine for nurses

The morning routine for assistant nurses is presented in **Figure 8**. As can be seen, work is centred on patient care. Assistant nurses provide support with basic activities which patients are incapable of managing themselves. This leads to an accumulated understanding of patients' basic situations, as opposed to nurses and physicians who manage other areas and get patient information through sporadic updates. For assistant nurses who want to attend the ward round, it means leaving work for approximately 20 minutes and continuing afterwards. Each assistant nurse is designated patients, as the nurses. These usually form a team around their patients and have more communication.

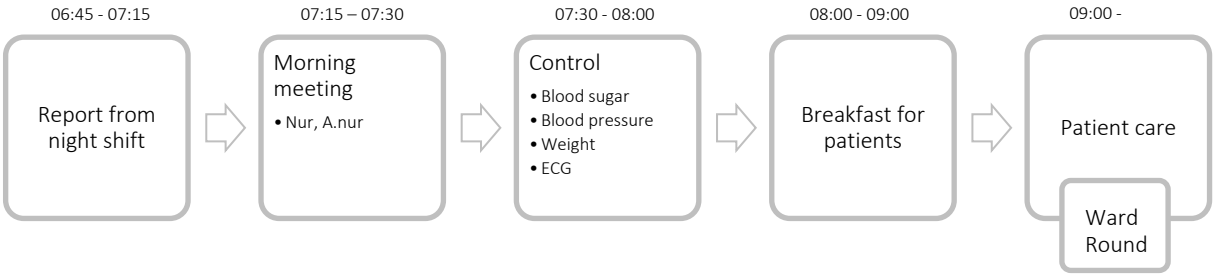

Figure 8. Morning routine for assistant nurses

Physicians have the medicinal responsibility for patients. Their ward round preparation consists of gathering information about the patient background and medicinal status, such as test results or following up on treatments, see **Figure 9**. However, test results are not always ready, which delays decisions concerning patients. To gather information, different IT systems are accessed. It was explained that reading up on patients also depended on whether there had been any prior contact

between physician and patient during the stay, with more required time if none pre-existed. Furthermore, the ward rounds serve an educational purpose, with medicinal students taking part occasionally.

"*The ward round is important from an educational aspect, but if no students are present I will proceed much faster."* - Senior physician

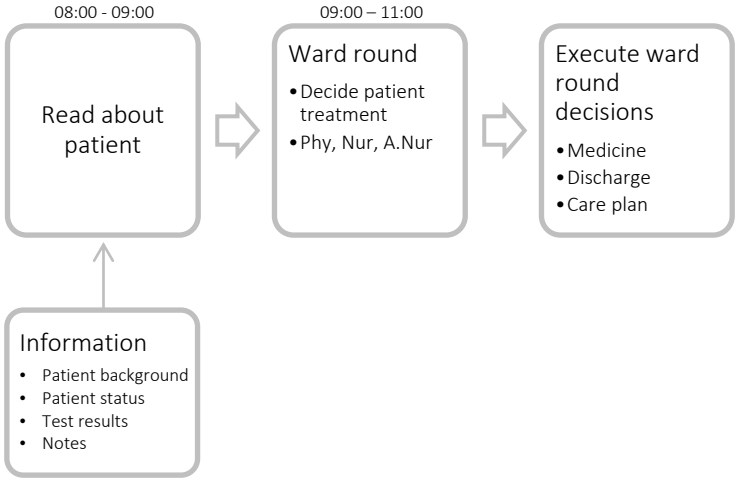

Figure 9. Morning routines for physicians

As can be seen, the time prior to ward rounds are scheduled with activities for all professions. To introduce more activities during the morning is therefore not possible as this would be at the cost of ward round preparation, which is crucial for the treatment of patients.

Ward Round

The ward round consists of two phases, a sitting and walking part, **Figure 10**. The *sitting part* is carried out as an interdisciplinary meeting in which physicians, nurses and assistant nurses gather to share knowledge to make informed decisions about treatments for each patient. The patients are addressed in an order from 1 to 20. Following that order, the respective responsible nurse and assistant nurse join the physicians. Each profession is responsible for bringing certain information. The *walking part* is when physicians meet each patient to inform about treatment and decisions.

The work structure of the ward round is a batch flow, in which patients are first discussed in the sitting ward round before the walking round begins. In both the sitting and walking round, patients are addressed from patient 1 to 20. The sitting ward round takes approximately 120 minutes. Approximately 80 minutes are spent on discussing patients with nurses and assistant nurses. The remaining time was spent on discussing patients within the physician group, and waiting and advising other specialists. There are usually four physicians attending; a senior, a resident and two intern physicians. In addition, student physicians sometimes attend.

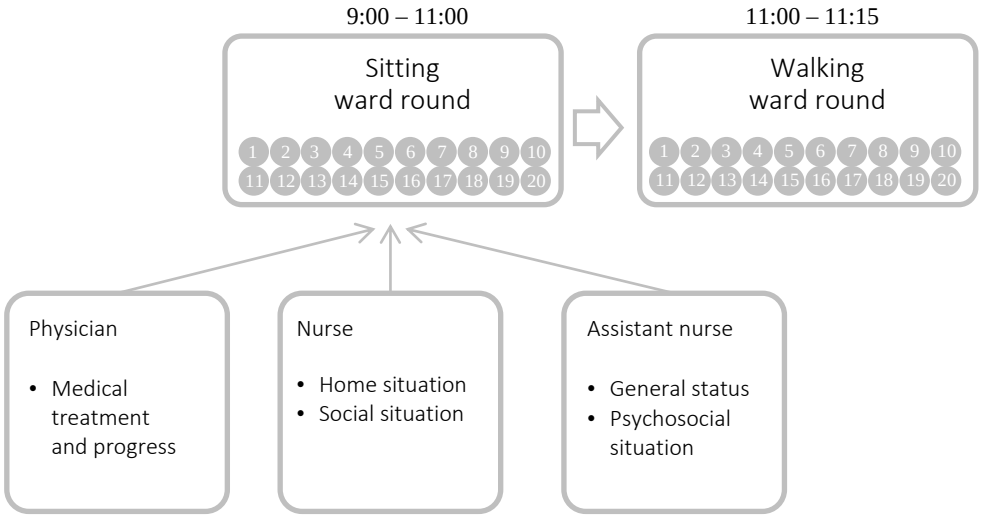

Figure 10. Ward round

Different inputs from different professions are brought into the ward round. **Table 2** presents an overview of this.

Table 2. SIPOC for the ward round

Supplier	Input	Process	Output	Customer
	Patient background	Ward round	Treatment plan	Nurse
Nurse	Social situation			Assistant nurse
	Home situation			Physician
	Vital parameters			Patient
Assistant nurse	General status			Care planner
	Psychosocial situation			
Physician	Test results			
	Medication list			

Nurses are responsible for having knowledge about patient's home and social situation. Home situation concerns if the home situation allows for a decent living, generally only affecting people of higher age. This is the basis for deciding whether a *care plan* is necessary to accommodate for the new health status. Social situation concerns managing contacts, such as with kin and nursing homes.

"*I try to judge if the patient will be able to take care of themselves at home, it can be hard to know if a patient is fully honest when only asking, elderly often like to think they are fully independent."* - Nurse

Assistant nurses have knowledge about a patient's general and psychosocial situation, which concerns things such as mobility, appetite and mood. Working closely with patients allows assistant nurses to

continuously observe patients health development and converse with them. Although having valuable information, assistant nurses do not always attend ward rounds, due to lack of time or interest since the ward round is not mandatory and traditionally has not been attended by assistant nurses. According to nurses and physicians, the absence of this profession leads to a diminished understanding of patient situation.

"*I like to take part in the sitting ward round as it gives me the possibility to learn more about the medicinal and clinical perspective."* - Assistant Nurse

Physicians are responsible for the medicinal aspect of treating a patient. The focus lies on understanding the ailments and finding appropriate cures. It is important to be able to prepare for the ward round by e.g. checking test results and follow up on effects of treatments. Furthermore, it was explained that understanding the basic patient condition was important.

"*First of all I want to know how the patient generally feel, if they are able to eat, walk and take care of themselves. This is especially important if I have not met the patient before."* - Senior Physician

As can be seen, the outcome of the ward round depends on the information each professions brings. In other words, a critical aspect is the possibility for each profession to prepare for the ward round.

Discharge Dialogue

When a patient is considered ready to leave, a discharge dialogue will be held with the patient. The discharge dialogue serves as a final point where physicians meet patients to describe what the patient has been treated with during the visit and offer patients a chance to ask questions. According to physicians and observations, the dialogue takes approximately four minutes. There are several activities necessary when discharging patients. Some need to be conducted before the actual discharge dialogue, while most can be conducted afterwards. The activities fall into three categories; review, plan and follow up.

The *review part* is about writing an epicrisis and drug story. The *plan part* is about organising for the patient's self-managed treatment, e.g. daily medicine dispensation or physical exercises, and needs to be prepared before the discharge dialogue. The *follow up part* is about the patient's long term medical treatment, such as writing referrals and setting up revisits for monitoring health progress.

Care Planning

Many elderly and fragile patients are being hospitalised at the ward and often need some level of assistance at home. Hospitalisation might change the need for home assistance. In order to coordinate the patient's needs with the municipality, a meeting called *care planning* is conducted at hospital premises. When staff at the ward know the needs of a patient will change, the municipality is contacted through a dedicated IT-system. Four people are generally involved in the care plan meeting; the patient, a relative to the patient, a nurse, and someone from the municipality. From the day that the municipality is informed, five days are given to set up proper services. If the limit is passed, a fee is paid to the ward per each overdue day. While interviewing nurses and physicians, it became clear that care planning is an activity which takes up much time and creates frustration as it is not connected to the professional's core activities.

4.5.2 Workload

Scatter plots is a simple tool for visualising and identifying correlation in data (Breyfogle, 2003). By conventions, the independent variable (X) is plotted on the horizontal axis and the dependent on the

vertical (Ys). It is important to notice that correlation does not necessarily imply causation. If a scatter plot suggests that correlation exists, designed experiments should be used for verification (Montgomery, 2005). Furthermore, if a plot suggests no correlation, it does mean that any correlation can be ruled out.

In **Appendix D,** the *discharge hour* is plotted against *DRG-value*. The independent variables are DRG and age of the patient. Based on the data, no correlation could be identified between any of the variables. Furthermore *length of stay* to *discharge hour* were plotted stratified on diagnoses, with seven most common diagnoses included, see **Appendix E**. Only patients being discharged home are included. No linear correlation could be identified. However, shorter length of stay seems to be associated with DBN. **Appendix F** includes a table with descriptive statistics on discharge hours stratified on diagnosis. In **Appendix G,** discharge hours are plotted separated in weekdays. Based on the data, no linear correlation can be identified between discharge weekday and hour of discharge. Data were obtained from a system used by the business controllers.

AM/PM discharges

A way to classify discharges is to divide them into discharges that occur *before noon* and *after noon*, which better represents the ward's goals. **Figure 11** illustrates proportions of pre- and post-noon discharges, plotted in regards to age and number of diagnoses assigned to a patient, with the actual numbers presented in **Appendix H**. Patients are assigned one main diagnosis, up to 5 additional ones. Only patients being discharged to home are included.

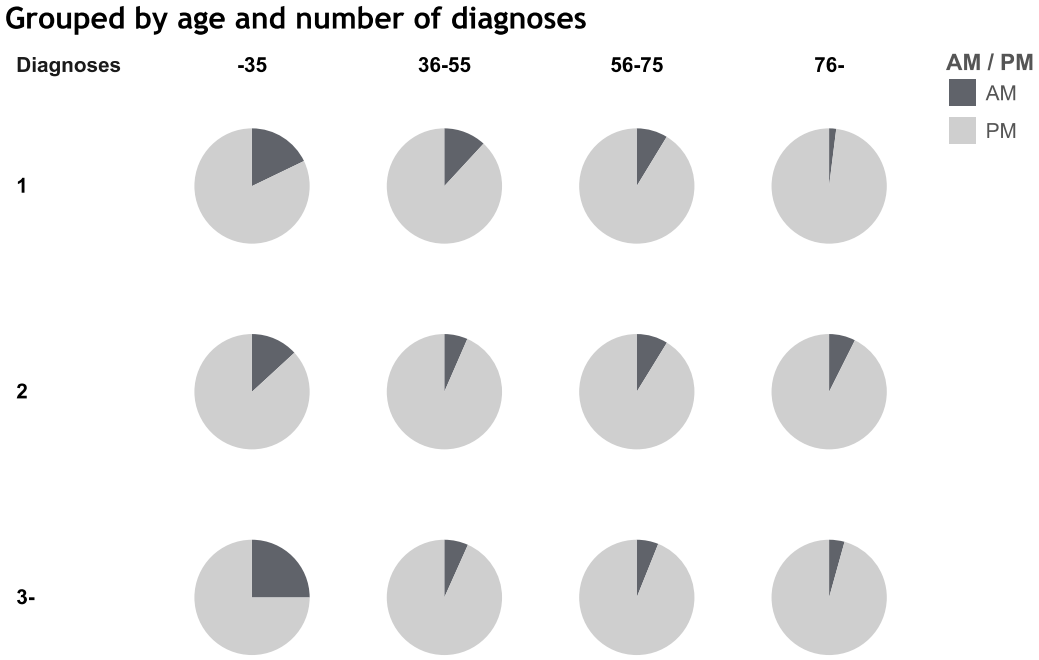

Figure 11. Pre- and post-noon discharges, in regards to age and number of diagnoses

The ward's output is fairly stable over time and over the week, which can be seen when plotted over months (**Figure 12, Appendix I**) and weekdays (**Figure 13, Appendix J**), respectively. Younger people with only one diagnosis tend to be discharged earlier. Reasons for this might be that they unlikely require care planning and are able to travel from the hospital by themselves.

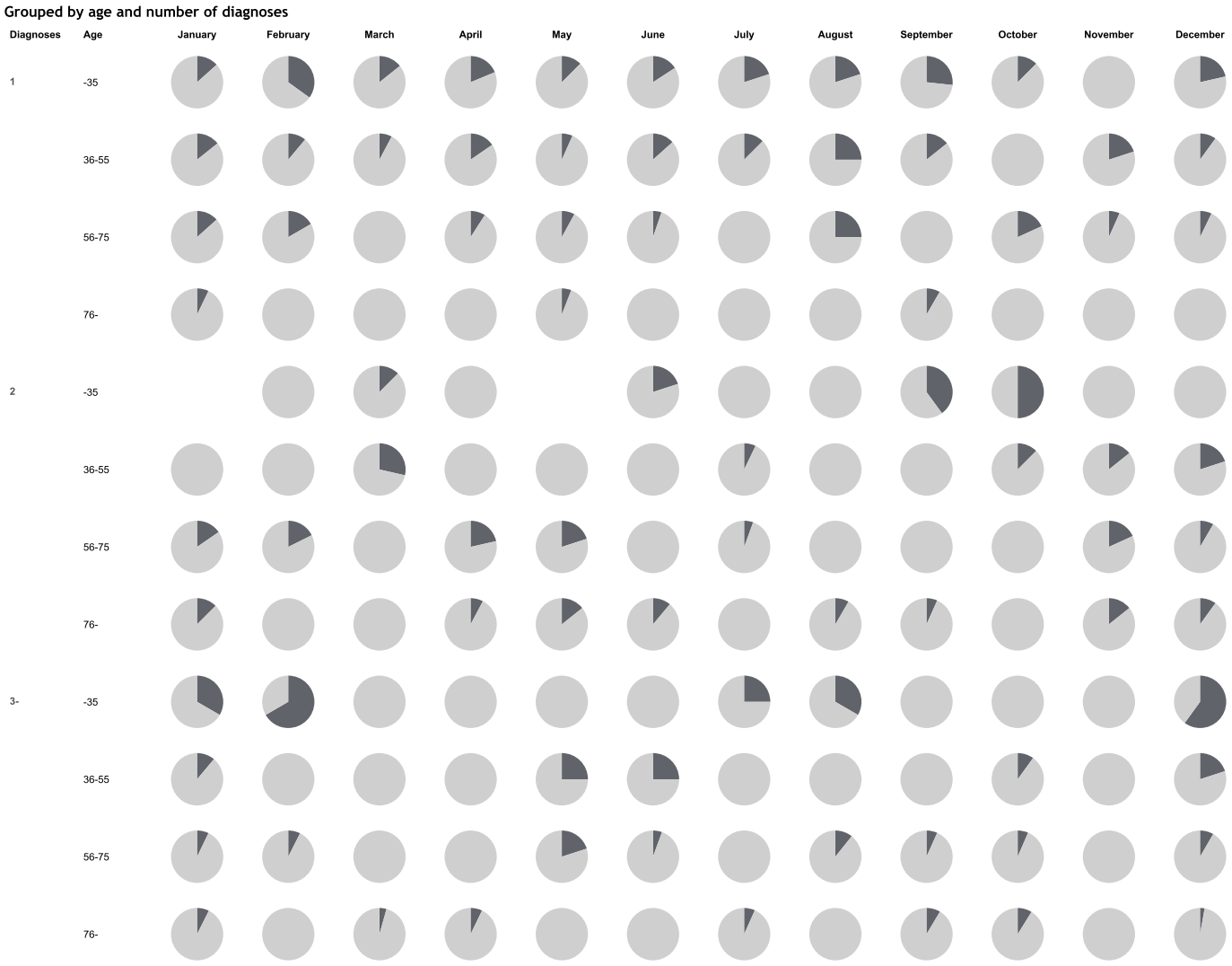

Figure 12. Pre- and post-noon discharges, in regards to age, number of diagnoses and month

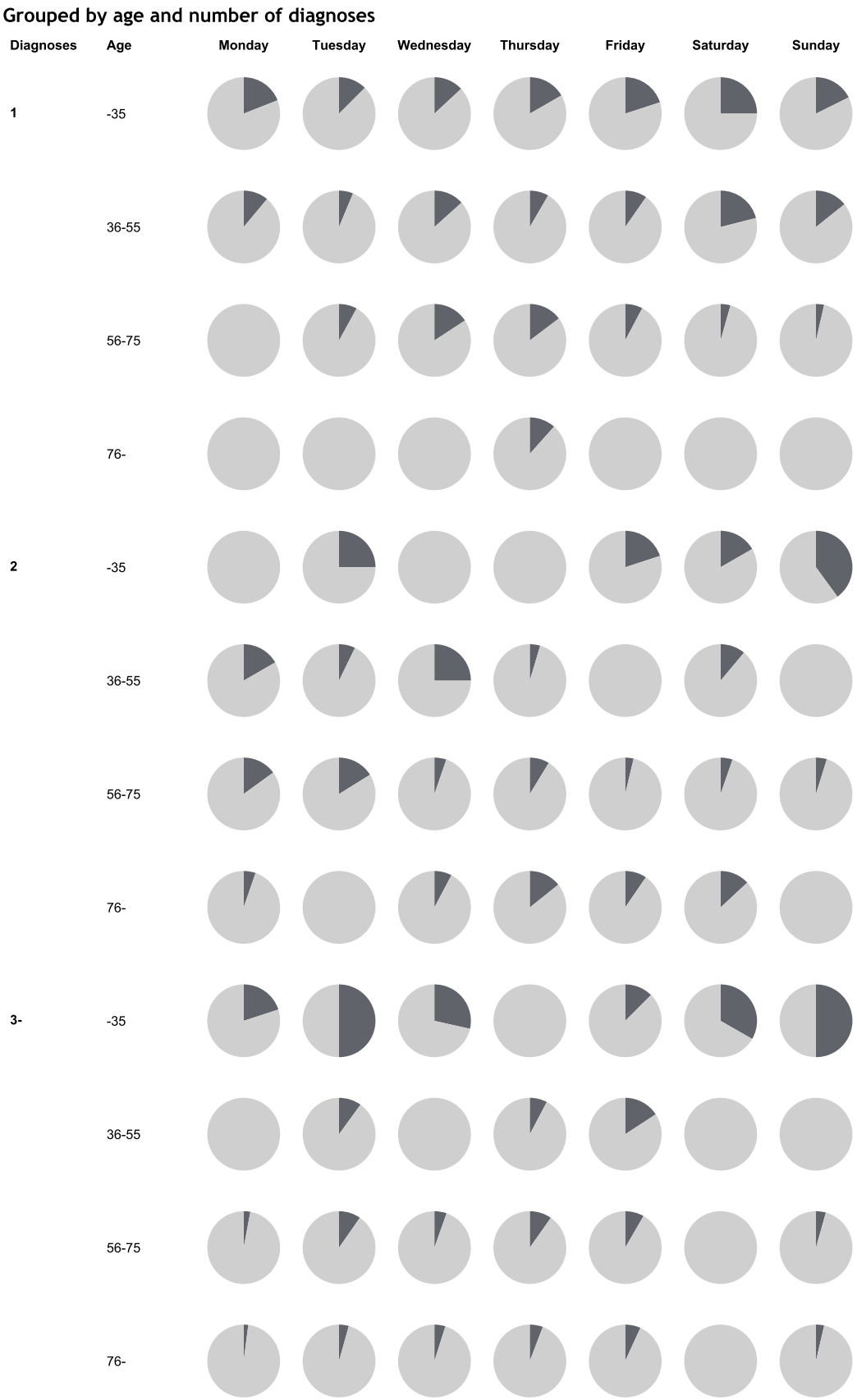

Figure 13. Pre- and post-noon discharges, in regards to age, number of diagnoses and weekday

There are a number of outliers in all cases above. Given the large number of factors which might be related to the patient, efforts to further stratify does not seem to lead to further findings at this stage. Factors could be external, such as family conditions or time when transport is available. It could also be related to patient's attitude to the ward and healthcare in general, some patients just want to go home whereas some want to stay. This is where the healthcare professionals' judgement comes into use. It becomes evident why their experience, education and vast knowledge are needed in a context such as this.

The g-chart in **Figure 14,** with corresponding table in **Appendix K**, describes the number of days between days where 50% or more of the discharges occurred before noon. Out of the 361 days on which discharges occurred, there are nine days which qualifies as such. G-charts are used to monitor processes where the studied events seldom occur, as in this case (Benneyan, 2001). An event above the upper control limit suggests non-systematic causes and should be identified and acted upon. Benneyan (2001) states that just studying points outside the control limit is not sufficient, and that one should see nine concurring points below the central limit as an indicator for systematic change, which in this case is not possible. Furthermore, a number of zero-points in a row call for a further testing. The table describes the number of patients and percentage of DBN those days. Given the small sample, it is hard to draw any conclusions to whether a trend is coincidental or real. Of the nine days, seven have a below average total number of discharges, which might affect the DBN-rate. The upper control limit is outside of the pictured chart's range.

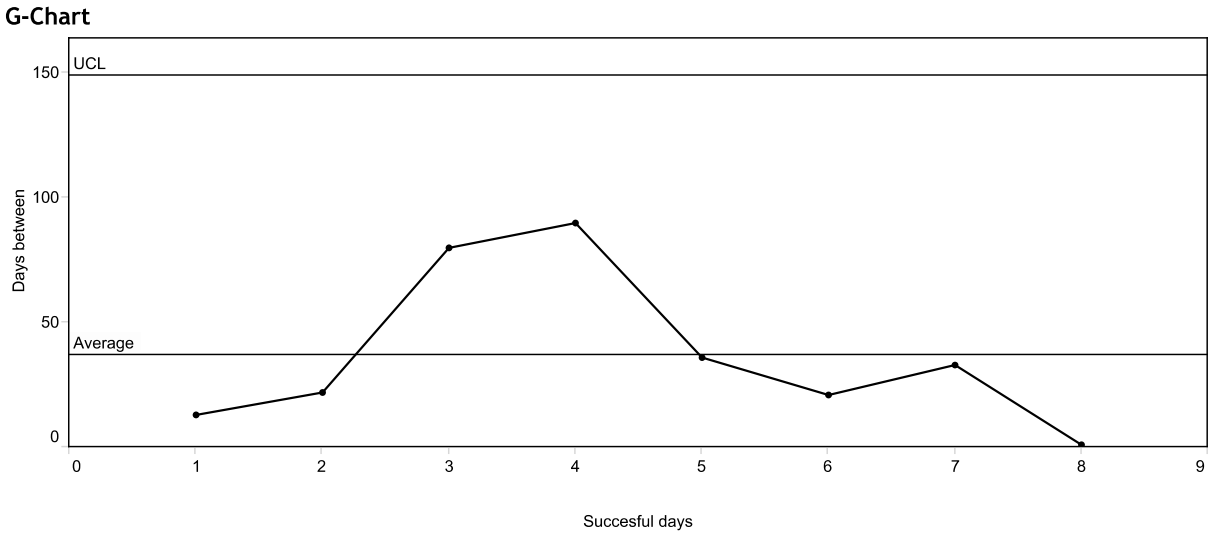

Figure 14. DBN trend on days in-between with DBN ≧ 50%

4.5.3 Information Gathering

Having compared journals considered well-structured and less well-structured, minor differences were found. Besides structure, there was a difference in level of detail and what type of information included. The selection of journals was based on recommendation from nurses. These were read by the authors in attempts to identify differences or similarities in terms of structure and content. Due to the amount of text not being very extensive, spanning from a sentence to ten sentences, the potential time saving obtained from a different structure, would likely have limited impact on the hour of discharge. A similar result was found when looking into patient information such as patient

background, test results and home situation. The information was written in short sentences in marked fields, easily understood.

"It requires so much clicking and browsing around in Melior[1] to find all necessary information you are looking for." - Senior Nurse

Both physicians and nurses had described a lack of overview and information dispersion when gathering patient information, which was noted through observations. Gathering information about a patient was cumbersome as it required collection from different pages. Understanding the content was of small concern; accessing it was the time consuming part, which was apparent when shadowing the nurses.

4.5.4 Conclusions from studying data

Based on the collected data, it seems that patients with younger age and fewer diagnoses have a higher likelihood of having DBN. Correlation between discharge hour and several other factors was not successfully found. It was understood that possible reasons to why DBNs were not achieved were due to causes which hindered the discharge process to start earlier and thereby allowing patients to leave earlier. One cause was that other prioritised activities prior to lunch pushed discharge related tasks later into the day. This points to the structural design of tasks and routines as the area to be addressed, which is similar to findings in the existing literature.

4.6 Stage Four: Formulate Solutions

As concluded from studying data, restructuring task and routines seems to be a feasible way to generate a positive impact on discharge hours. Possible ways of addressing these have been generated. The solutions have taken every professions needs into consideration.

4.6.1 Categorisation through Prioritisation

During the ward round, patients are discussed in an order of 1 - 20. If patients would be addressed through categorisation instead, such as *discharge ready and critical* patients first, earlier actions would be enabled. As done in several interventions, see **Chapter 3.2**, categorising patients would be conducted in the afternoon ward. In the ward round next morning, these patients would be first served and immediately discharged.

Required changes

Introducing additional activities during mornings is not possible due to lack of time. As explained in **Chapter 4.5.1** some activities need to be conducted before a discharge dialogue, such as medication reconciliation. Thus, for earlier discharges to be possible, these activities are suggested to be conducted the day or evening before. This was successful done by e.g. Durvasula et al. (2015), in which medication reconciliation was moved to the night before, and the discharge order came before 9:00.

[1] Melior is the Patient Journal system.

[2] http://npe.skl.se/Oversikt.aspx?ActiveView=3

Cause and Benefits

The current way of managing patients from 1 - 20 prevents timely patient admissions to MAVA 91 and the EW. It might also delay treatment of some patients as these might be placed in the end numbers. To categorise patients, would enable targeted actions towards smaller groups of patients.

One benefit would be quicker access to care for patients both in MAVA 91 and EW. It would also mean more timely discharges, which means reduced risk developing hospital acquired infections as duration of stay is related to this (Clarke, 1996; Donowitz et al., 1982; Girou et al., 1998). In literature, earlier patient admission creates a more even flow and workload in the patient pathway. Benefits which are more difficult to specify is the more effective resource usage of care beds and staff.

Fulfilling the CTQs

The requirements for the ward round mentioned in **Chapter 4.4.2** are fulfilled with the proposed solution. Critical patients are prioritised together with discharge ready patients, meaning patients in need of attention are not overlooked. The educational aspect is largely kept intact, although there might be a slight loss for the physician conducting the discharge. However as found in research, the effectiveness of the traditional education in ward round has been questioned. The possibility to discuss and raise question remains.

Risks and Cautions

Two important aspects need to be considered; the safety and treatment of other patients, and the educational aspect. In this solution, a physician discharges a patient during the ward round. If same physician holds important information on a different patient, the absence would be at the cost of patient safety. Therefore, the discharging physician should be conducted by a physician who can afford to leave. Another consequence is a potential loss of educational opportunities for the discharging physician.

The average daily discharge is seven patients. If all were to be discharged in the morning, the effective time spent on discharge dialogues would be around 28 minutes (based on 4 minutes for each patient, see **Chapter 4.5.1**). A suggestion is to limit discharges. The goal would be to find a balance between amount discharges and absence from ward round.

By moving the discharge preparation to the night before, e.g. medication reconciliation, there is a chance that work is conducted unnecessarily in case a patient situation changes. A similar concern was discussed in a study by Ortiga et al. (2012), which concluded that such cases accounted for less than 10% of all cases, and thus felt the benefits outweighed that cost.

Summary of Proposed Solution

Preparation and categorisation are the two main pillars of the solution, which could be implemented without any larger investments and likely without great interruption on deliverance ability.

"*I believe this solution is worth a try, it's only a matter of convincing the physicians."* - Business Developer

One of the key points with the solution, is that no additional work added, just rearranged, as have been found to be enough for a positive impact on discharges (e.g. Beck and Gosik, 2015; Durvasula et al., 2015; Mathews et al., 2014). The main argument for the proposition is that it takes all the professions' needs into consideration while increasing the operational efficiency.

To visualise the proposed solution, an illustration is given in **Figure 15**. In the present situation, patients are treated from 1-20. Little distinction is made between critical and discharge ready patients. The average daily number of discharges is seven patients, and occurs on average at 14:00.

With the proposed change, *critical* and *discharge ready* patients are distinguished for purposes of prioritisation. The idea is to enable discharge ready patients to leave as early as possible and allow admission to new patients in order to reduce congestion in EW. Conducting the average seven daily discharges during morning is unlikely at this point, which is why three beds are used in the illustration. The remaining four can be discharged post-noon as usual

4.6.2 Divide Ward Round

The ward next door, MAVA 90, has until very recently worked in a similar way to MAVA 91. Changes in the physical layout and routines have been implemented to enable constant supervision for a small number of beds.

The most relevant focus for this study are the changes concerning the ward round system, which is now split in two groups. This means that physicians are responsible for only 10 patients hence the sitting ward round is faster. Since this structure has been utilised for only one month, no formal data on differences and possible improvements have been collected. Most of the staff working at these two wards rotate between them though, and therefore they have been able to compare experiences from both settings. Nurses and assistant nurses first impressions have mainly been positive to the changes; it is a calmer atmosphere, they are able to spend more time with patients, and the ward round is faster. A negative input was that if you the day before worked with the 10 patients, it will be a lot of new information to process if one is to work with the other 10 patients. A senior physician at MAVA 91, who has not yet experienced the new way of working, believes that it will be more difficult to get an overview over the hospitalised patients when only meeting half of them.

When designing the discharge process to reach the desired goal of DBN, splitting the ward round can be one possible solution to look into. As data is yet to be collected it is uncertain whether the changes offer improvements or not. If the management team decide to implement the solutions at both wards, it will likely not interfere with the proposed ideas in this report.

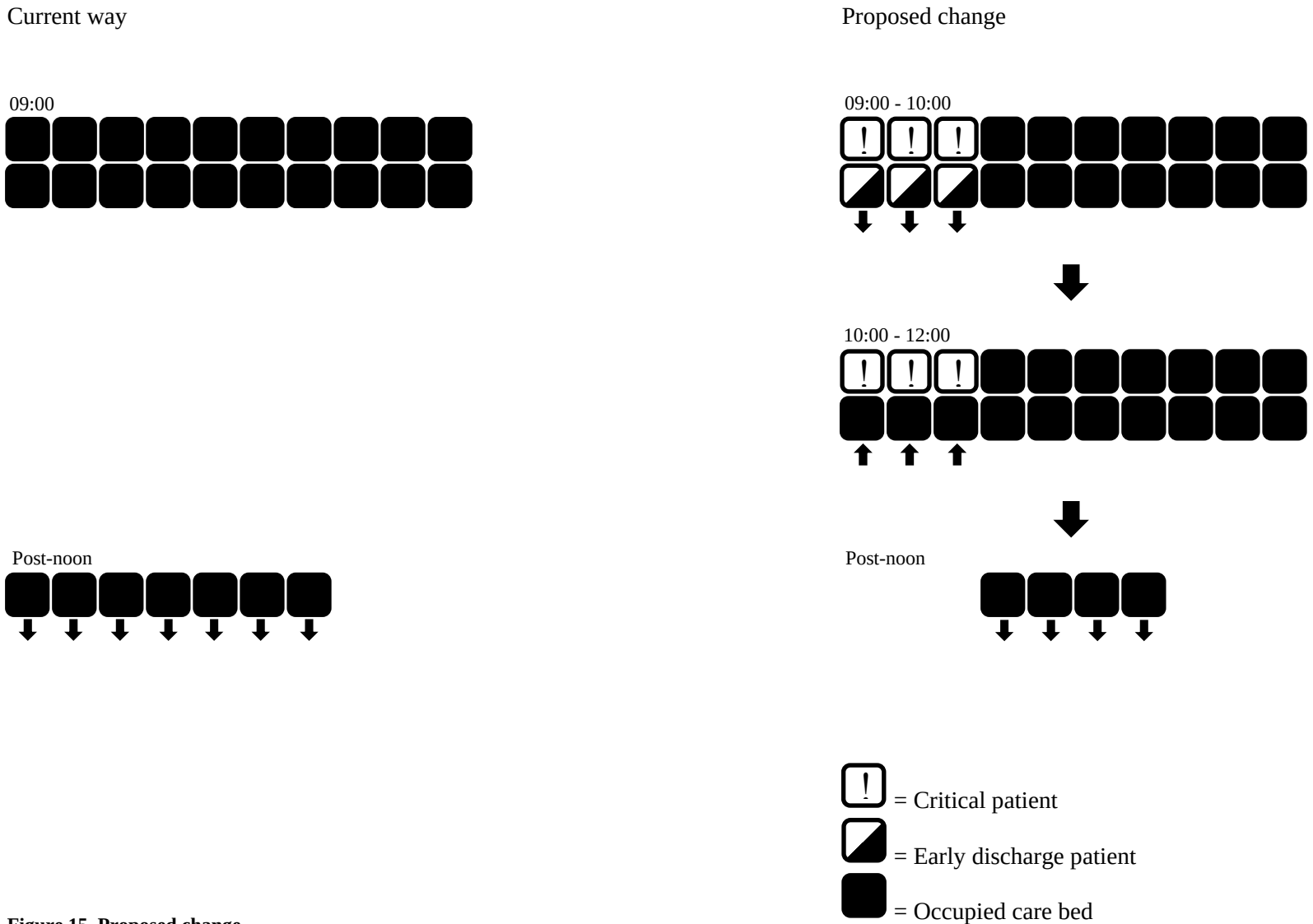

Figure 15. Proposed change

5 Discussion

This chapter treats the research questions, which are answered and elaborated on, through the lens of theory and perspective of the authors.

5.1 What is the current state of DBN research?

The state of the current DBN research is still limited. A comparison of existing DBN interventions are presented in **Table 3**. All interventions were related to process focus, changes in work structure and organisation.

Many of the interventions focus on starting the discharge process earlier, so that patient can leave as soon as possible and starting with discharge ready patients in the morning, e.g. Durvasula et al. (2015), Wertheimer et al. (2014) and Beck and Gosik (2015). However, descriptions or explanations to which issues these interventions addressed were lacking except for in El-Eid (2015). What can be concluded is that achieving DBN seems to be possible through different ways. Furthermore, the settings in which the interventions are conducted are various. Interventions took place in both general wards with a wide range of medicinally different patients, and in specialised wards with a homogenous patient group.

Merely introducing standardised routines seems enough to give an efficiency boost, as described by Wertheimer et al. (2014) and Goodson et al. (2014). The fact that most interventions were restructuring and standardisation of work, would suggest that these were cost efficient. Moreover, the fact that limited changes could produce positive impact, can provide comfort in that much is not required to achieve noticeable improvements in healthcare. It can also be seen as proof of low hanging fruits and the potential for the field of quality improvement within healthcare to expand. It is worth highlighting that no negative impact on readmission rate or length of stay was found in the different interventions.

Some tendencies toward integrating IT as way of achieving efficiency can be found. Mainly El-Eid (2015) turns towards IT-systems when addressing obstacles to early discharges. It can also be seen in Wertheimer et al. (2014), who introduced a DBN website to centralise information related to discharge ready patients, such as an overview to track task completion. From a technical point of view, the effort required is small. The difficulty probably lies in understanding how technology should be integrated to support healthcare practitioners, without adding work, and with a low learning threshold.

The premise for DBN is that by discharging patients earlier, beds become available and overcrowding is reduced. Even though other interventions describe successful results in DBN with no negative impact on readmission rates or length of stay, measures were missing on whether the freed up beds were utilised quickly by new patients. The possibility exists that administrative processes hinder quick and efficient patient admission.

Table 3. Review of DBN intervention

Authors	Purpose of the study	Setting	Methodology	Intervention	Outcome
Beck and Gosik (2015)	To assess the impact of Lean/Six Sigma on advancing times of placement of discharge and patient discharge.	Academic medical center with 133 beds with 4100 admissions per year. Located in Pennsylvania, United States.	6-monts pre-intervention data was compared to 6-months post-intervention data.	**Creation of discharge checklist** - to facilitate discharges **Daily interdisciplinary pre-discharge planning** - identify next day discharge - discuss and plan anticipated discharges **Introduced standard rounding workflow** - to expedite patient discharge - start rounds with discharge patients **Staff reallocation** - to round with smaller teams on fewer patients to achieve more balance workload for physicians	Time of order entry decreased from 14:05 to 10:45 (200 min), and for time of discharge from 15:48 to 14:15. No negative impact on readmission rate or length of stay. A post-intervention survey showed that 75% of the nurses and 100% of members of the division were in favour to continue with the intervention.
Durvasula et al. 2015	To determine if an interdisciplinary approach to scheduled discharge order could increase percentage of discharges before 11:00 and improve overall discharge time.	An academic hospital with 450 beds with 18000 inpatient admission each year. Located in Seattle, United States.	Data from pilot study conducted over a 3-month period was compared to baseline data collected for the 4 months prior the intervention.	**Creation of a checklist** - to facilitate earlier start of discharge process - to eliminate last-minute requests to coordinate services and home health needs **Completion of medication reconciliation and discharge order form before the day before discharge** - enable early morning discharge	Patient discharged before 11:00 increased to 29.7%, compared to 0.5% in control group. Average 3 hour earlier discharge time. No impact on length of stay. 30-day readmission rate improved from 13.8% to 10.3%.
El-Eid 2015	To assess the effectiveness of Six Sigma methods for improving the discharge process.	A tertiary care teaching hospital with 386 beds and 35 000 inpatients yearly. Located in Beirut, Lebanon.	5-months quantitative data pre-intervention was compared to 5-months quantitative data post-intervention.	**Incorporated IT-system in discharge process** - improve care provider availability - reduce wait - improve communication concerning planning of discharge and between professionals - streamline several processes which support the discharge process	Decreased discharge time with 22%, from 2.2 hours to 1.7 hours. Length of stay decreased from 3.4 to 3.1 days.

Authors	Purpose of the study	Setting	Methodology	Intervention	Outcome
Goodson et al. 2014	To determine whether the implementation of a discharge brunch could lead to earlier discharge hour.	24-bed orthopaedic unit in a 176-bed community hospital in Mid-Atlantic region of the United States.	Compared data between intervention and control group.	**Discharge Brunch with group discharge instructions** - Improved communication	76% DBN for patients attending discharge brunch. 39% DBN for patients without discharge brunch.
Mathews et al. 2014	To evaluate the usefulness of a color discharge tool, which was supposed to enhance communication and trigger earlier discharge steps.	A 1571-bed general medical and surgical community and teaching hospital in New Haven, United States.	Data was compared between baseline and period of using the discharge tool.	**Red/Yellow/Green Discharge Tool** - Earlier start of discharge process - Improved communication - Prioritisation of discharge patient	Discharge before 11:00 increased from 10.4% to 21.2% between four years. No negative impact on readmission rate.
Wertheimer et al. 2014	To sustainably achieve DBN rate of 30% and evaluate the effect of the intervention.	Two acute care inpatient medical units with 32-beds each, in an academic medical center. Located in New York, United States.	Pre-/post-intervention retrospective analysis.	**Checklist of daily responsibilities** - standardisation **Identify next day DBN in afternoon ward round** - Earlier start of discharge process - Prioritisation of discharge patient **Discharge Website** - enhanced communication	DBN increased from 11% to 38% during 13 months. 1 h 30 min earlier average discharge time. 30-day readmission rate declined from 14.3% to 13.1%.

5.2 What characterises DBN based on the existing data?

A possible strategy to understand the characteristics of DBN is through clustering patients based on different factors, in order to decide which patients are more likely to be subject to earlier discharge. These factors could be both directly related to the patient and circumstances. To find the factors with the most impact, several were studied, including weekdays, age, gender and diagnosis. Given the diversity of the patients the data naturally included a lot of noise.

Based on the data, patterns were found which indicate that age could impact the hour of discharge. It was seen that young patients (≤35) had a higher likelihood of being discharged before noon. A possible explanation to these findings is that young patients are more eager to leave the ward as soon as possible, and that physicians tend to feel more comfortable with discharging young patients quicker as these might be considered to have a stronger general health. In line with this, data shows that elder patients (76≤) are less likely to be discharged before noon (4%). Furthermore, fewer diagnoses indicated a slight increase in likelihood for DBN. Fewer diagnoses might mean a decreased medical complexity which facilitates confident decision-making as the necessity to control for different possible health risks is lower.

Activities in the morning delayed discharge related tasks, which was also found by Minichiello et al. (2001). In several interventions, the focus is placed on restructuring and streamlining the discharge process, in order to achieve earlier discharge hours, e.g. Durvasula (2015), Wertheimer et al. (2014). Thus, based on existing literature and collected qualitative data, it seemed as a feasible option to restructure the discharge process to obtain earlier patient discharges. El-Eid (2015) is a good example which shows that a more effective discharge process and statistical control is obtainable through making several smaller adjustments to streamline work.

5.3 What can be done to achieve DBN considering the existing constraints?

Based on historical data, in the past when there was no systematic way of treating patients, findings show a pattern that young patients are more likely to be discharged before noon. Based on this observation, the authors would like to suggest the organisation to make a more deliberate action towards DBN by attempting to treat these patients first or earlier.

A suggestion is to put forth that MAVA 91 introduces a prioritised patient work order by categorising patients during afternoon ward round. By such an introduction, discharge ready patients, e.g. younger patients, could be allowed to leave earlier and critical patients receive early attention.

A constraint with discharging patients early is that the physician conducting the discharge dialogues cannot contribute or take part of the ward round. As stated by all professions, see **Chapter 4.4.2**, communication across professions is an important requirement for the ward round. Therefore, as stated in **Chapter 4.6.1**, it might be necessary to initially set a maximum amount of DBN, in order to limit the time which the discharging physicians is absent from the ward round.

However, it should be remembered that postponed delays in discharges leads to later admittance, meaning higher risk for deteriorating health for patients in the already crowded EW (e.g. Girou et al. 1998). As emphasised in the literature, viewing the whole patient pathway as a continuous flow, from the EW to discharge, is important to reduce patient length of stay and avoid sub-optimisation (Bergman & Klefsjö, 2010; Yu, 2015). If changes are introduced, the authors recommend monitoring

length of stay and readmission rates, which decreases the risk of postponing an afternoon discharge to the next morning in order to increase the DBN rate.

Furthermore, for DBN to reduce overcrowding in EW, free beds should be utilised as quickly as possible. Former ways of working in the EW and MAVA 91 might need to be adapted to fit the new circumstances. Moreover, it has to be mentioned that approximately 5% of EW patients are transferred to MAVA 91. If a serious change is desired in the EW, addressing other pathways is required. However, MAVA 91 can serve as an initial test for the other pathways.

Another aspect is the dependency on others actors to discharge patients. Out of the discharged patients, 75% are sent home, some of which require a care plan. Unfortunately, the number of patients with care plans cannot be isolated. However, what is clear is that the transfer between hospital and municipality leaves much to be wanted. The underlying cause has not been investigated in this study, but doing so could result in widespread impact and large gains, see **Chapter 5.6**.

5.4 Data Quality and Accessibility

During the study, to find and process data have been time consuming. Existing data have been hard to obtain. Most data can be found within the county's IT system *Cognos* but few people possess knowledge on how to extract it. During analysis it became evident that the quality of the data can be questioned. It seems as if little control exists in some cases as to which information can be entered into the system. The first step if one wants to have a data-driven organisation would therefore be to focus on improving data quality and increase accessibility.

5.5 Process Thinking

As stated by e.g. Berwick (2003) and Bohmer (2010), the health care sector has made huge clinical advancements, however not operational. A consequence of this is that approaching improvement work through a data driven approach, becomes more difficult. Although a lot of medical data is stored, there are still many operational aspects for which no data is collected, e.g. the time from when a patient is determined to be discharged until actually leaving. It is therefore the authors' opinion that it could be beneficial to lay the foundation for operational improvement work by implementing basic process thinking and terminology into health care.

5.6 Collaboration with Municipality

It is obvious from reported statistics that the collaboration concerning transfer of patient is worth improving; 137 care beds were occupied by medically finished patient during the first quarter of 2015 (Västra Götalandsregionen, 2015). This equals 7% of all care beds in Sahlgrenska University Hospital. In industrial terms, this would be analogous to storing finished products, and would be considered waste. Moreover, from interviews with nurses and physicians, it has been explained that the collaboration does not work efficiently. From the perspective of the hospital, the potential gains are immense as each occupied bed also occupies other resources.

5.7 IT systems

The overall goal of improvement efforts should be to decrease the time spent on tasks which is not directly related to treatment of patient, in this case mainly administrative tasks. As it was found when

studying information gathering in the ward, the time needed for administration causes frustration as many different pages are required to enter and cumbersome to allocate. Nevertheless, administration and documentation are important and necessary to be able to deliver quality healthcare. Focus on this area should be to shave down the complexity and streamline the information flow while ensuring that no crucial data is lost. Factors to avoid include redundancy, in content and creation of information. In the current way of working, both nurses and physicians save data that in some cases tell the same story. This leads not only to excessive and unnecessary work but also contributes to a perceived information flooding.

There are two possible but not mutually exclusive solutions to address this problem. First revolves around the idea to establish structures and routines over whose responsibility it is to register certain information, while the second concerns the IT systems. Much effort is spent on going through a patient's file to find all information regarding home situation, test results, previous visits, medications and other type of necessary data.

Even though Sahlgrenska have systems which are almost fully developed by them, and owns an extensive IT-organisation, the influence the ward have over systems improvement is low. The most used system for patient care documentation, *Melior*, should be designed to allow other counties and caregivers access to information. In the near future, it is planned that primary care centres in the region will merge care documentation system with Sahlgrenska.

The amount and variety of stakeholders within Sahlgrenska obviously present an immense challenge in designing a system which satisfies all. It would probably be a complex, time consuming, and expensive effort, with satisfying results far from guaranteed. Initiatives on a local scale, mainly concerning information related to routines, should be manageable with higher likelihood of succeeding. It should be identified what kind of information that is crucial to the staff and in what form this should be standardised into. According to interviewees some physicians use a simple and comprehensive way of documenting, which hints that some fundamentals exist to build on.

5.8 Limitations

A limitation in this study was that patient satisfaction was not included. From a quality perspective, this is an important aspect. The reason for not including it was due to the sensitive nature of hospitals, where certain legal approvals would have to be granted before involving patients. However, the study did not reach a point in which collecting the patient views were deemed crucial. Neither was any cost analysis completed. Furthermore, the lack of formal routine description and the complex environment made basic work such as mapping patient pathways and workflows much more cumbersome which slowed down the project progress.

5.9 Managerial Implications

For healthcare practitioners at MAVA 91, one takeaway from this study is having an overview of work routines through the process maps. The general value from having these is the possibility of visual communication and a common point to base improvements and discussions on. Another value from the study is the understanding of different professions perspective and needs, which could aid in mitigating the isolation between the professions.

6 Conclusion

The purpose of this study was to identify possible ways of increasing *discharges before noon*. By studying existing literature it was understood that DBN could be achieved through interventions related to the structural design of the discharge process. Interventions described in literature were found to be similar in design and targeted areas.

Efforts were made to understand what factors influenced discharges, by trying to identify root causes which prevented DBN. Attempts to establish correlation between any of the various factors and discharge hours were unsuccessful. However, a finding from the data was that younger patients with one diagnosis were more likely to be discharged earlier.

It was suggested, based on studying data collected from interviews and observations, that delayed discharges was a consequence of other activities prior to lunch, which postponed discharge related tasks. Other studies had identified a similar pattern and introduced interventions with successful outcomes with no negative impact on length of stay and readmission rate.

Recurring themes in these interventions were earlier identification of next day discharge ready patient and prioritisation of discharge ready patients during morning ward rounds. This allowed discharge related activities to begin earlier, while also establishing an urgency to discharge patients as soon as ready. While such interventions were successful in increasing bed availability, the capability of utilising the liberated capacity must exist for DBN to reduce overcrowding.

6.1 Future Recommendations

Future actions and recommendations are presented below.

6.1.1 Implementing the Solution

The proposed solution in **Chapter 4.6** is based on existing research. The case at MAVA 91 has similarities with those described in research. Therefore, the solution is considered appropriate. As done in other interventions, it is recommended to monitor *readmission rate* and *length of stay* to monitor for any negative impact.

6.1.2 Identify number of Patients with Care Plan

The number of patients sent home with a care plan could not be identified. Being able to do so would give evidence to how the collaboration with the municipality affected the ward.

7 Researcher's observations from a quality perspective

This chapter presents observations made during the project which does not have a natural belonging to other parts of the report. The observations are categorised as easy implementation or important quality dimensions.

7.1 Easy Implementation

Sahlgrenska have several systems to extract operational data from but the most important is *Cognos*. The knowledge on how to manage this system is limited, which makes data collection time consuming. In order for a business developer at MAVA 91 to acquire data, it must be ordered from a central function instead of extracting by own means. From a quality perspective, this is an obstacle to basing decisions on fact. Systems ought to be set up to measure performance objectives, however as it is now, these measures are only sequentially evaluated. Moreover, measures that in real time assess whether operational objectives are met, such as waiting time, is missing. Educating concerned staff in how to take advantage of the systems would make the process of extracting data faster, hence increase control over the operations and guide instant actions when necessary.

7.2 Important Quality Dimensions

The overarching goal of healthcare services is to cure patients. Thus, it seems strange that MAVA 91 do not have systematic way of following up if treatments have been successful. This is easier said than done, as many of the hospitalised patients, especially at a general medicine ward such as MAVA 91, suffer from more than one diagnosis. Readmission rate is likely to be the most appropriate measure. The county of Västra Götaland have created an action plan where an explicit goal to decrease the readmission rate can be found (Västra Götaland, n.d.), but initiatives on a local level seems to be missing. Therefore it would be desirable to develop a metric that better measure success rate and guide actions, either according to their own metric or to the regional goal.

Along with clinical success, patient satisfaction should be measured. Surveys are done biannually by Sveriges Kommuner and Landsting (SKL) to establish patients experience from a quality perspective and the results are made publicly available[2]. However, according to the business developer at MAVA 91, little to no action is conducted upon these results. Historically, quality improvement has not been important within healthcare, but it will likely become a crucial aspect in the future. This transformation seems to be rather slow, and the current top down approach may not be fully sufficient. Developing an own way of measuring patient satisfaction may make it easier to guide actions on a local level. Furthermore, initiatives on a local level can make it easier to motivate changes and improvements.

Another aspect is how to manage, promote, and secure the quality of information shared face-to-face between professionals. As mentioned, there are numerous points of interaction between and within different professions.

"*I like to take part in the sitting ward round as it gives me the possibility to learn more about the medicinal and clinical perspective."* - Assistant Nurse

[2] http://npe.skl.se/Oversikt.aspx?ActiveView=3

As physicians, nurses, and assistant nurses consider meeting each other a valuable asset, there is an opportunity to launch improvements in this field. According to interviews, lack of time is the main hinder to communication, which is why this issue is heavily related to the routine related issues. During these interviews it was furthermore revealed that learning is important, both nurses and assistant nurses consider collaboration and communication as way to learn more about the medicinal aspect of work. Considering this, it is important not to mismanage meetings between the professions by governing too strictly what information is important for the different parts. An organisation in which continuous learning is supported, is one of the Baldrige quality criteria (Health Care Criteria Category and Item Commentary, n.d.).

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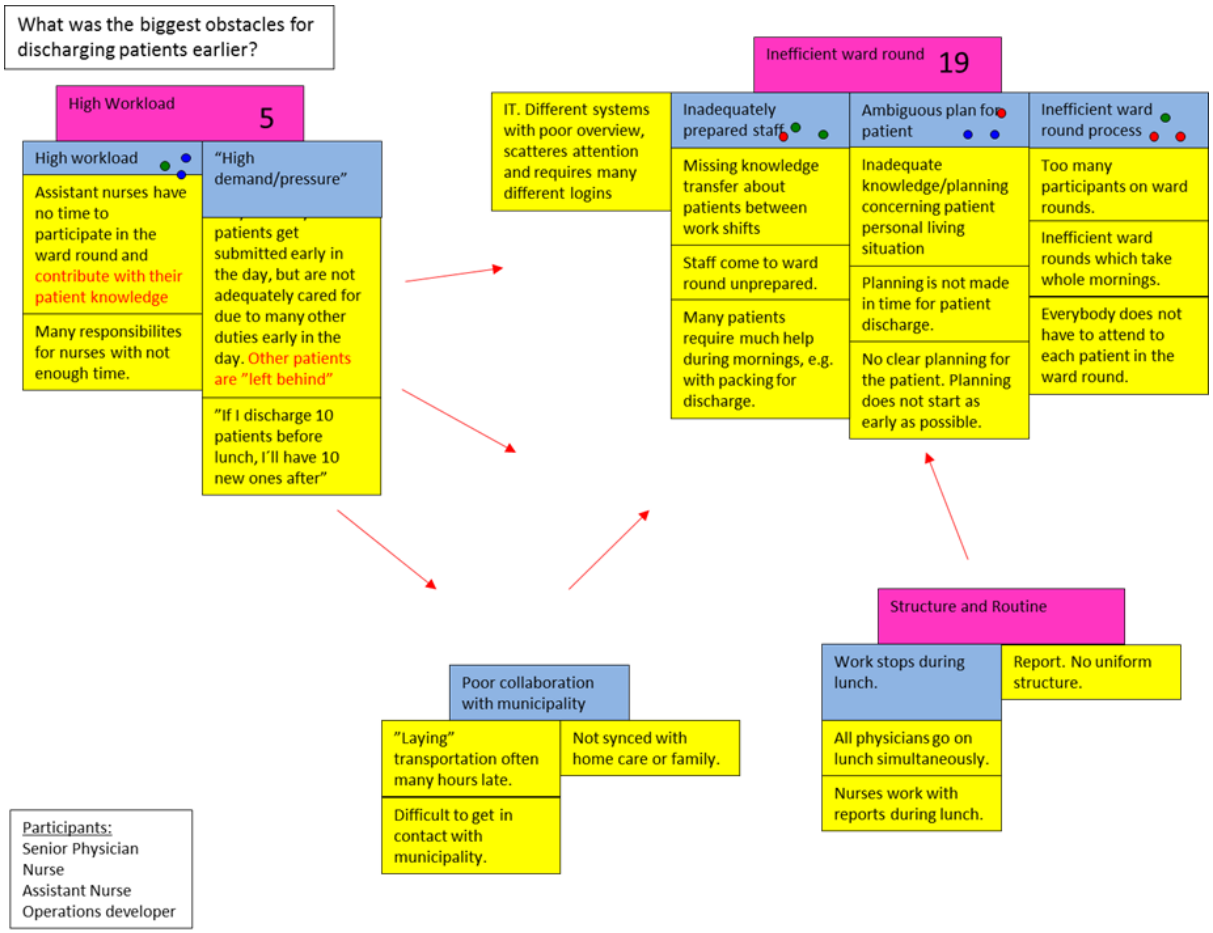
Appendix

Appendix A: AIM workshop results



Appendix B: Interview Ward Round

- What are the inputs to the Ward Round?
- Which IT-systems are utilised?
- Are there any key questions/factors that are always investigated?
- What type of information is usually requested during Ward Rounds?
- What information do you perceive as most time-consuming to collect?
- Do you perceive differences in the understandability of information in in journals and other material?
- How does each senior physician run the Ward Round? What are the similarities and differences?
- What is your output from the Ward Round? (Result you bring out from the Ward Round)
- What activities are conducted in a pre-noon shift? How are the activities conducted?
- Can you describe a typical pre-noon shift?
- What change/s would facilitate your Ward Round preparation work?

Appendix C: Control Chart Discharge Hour

Xbar&S-charts should be used when sample sizes are large enough to calculate a reliable standard deviation within the sub groups, sample sizes can be considered large when $n > 10$. This chart consists of two separate graphs displayed together, in the Xbar-part are the mean of subgroups plotted over time and above it the S-part, which is the standard deviation of the subgroups. Montgomery (2005) further advice using Xbar&S-charts when sample size varies and the procedure for calculating centre lines and control limits varies if size of sub groups is the same or not. In this case are weighted averages used, below are the formulas:

$$\bar{\bar{x}} = \frac{\sum_{i=1}^{m} n_i \bar{x}}{\sum_{i=1}^{m} n_i}$$

$$\bar{s} = \left[\frac{\sum_{i=1}^{m}(n_i - 1)\, s_i^2}{\sum_{i=1}^{m} n_i - m}\right]^{\frac{1}{2}}$$

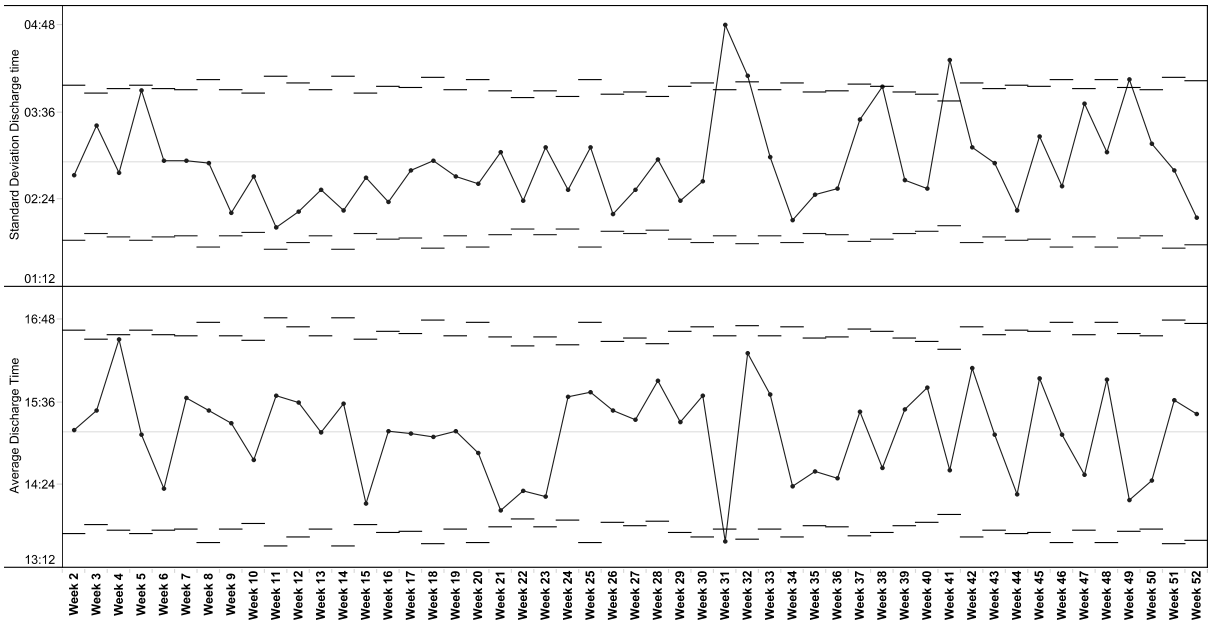
Control limits for the Xbar-chart are calculated according to:

$$UCL = \bar{\bar{x}} + A_3\bar{s}$$
$$LCL = \bar{\bar{x}} - A_3\bar{s}$$

And for the s-chart:

$$UCL = B_4\bar{s}$$
$$LCL = B_3\bar{s}$$

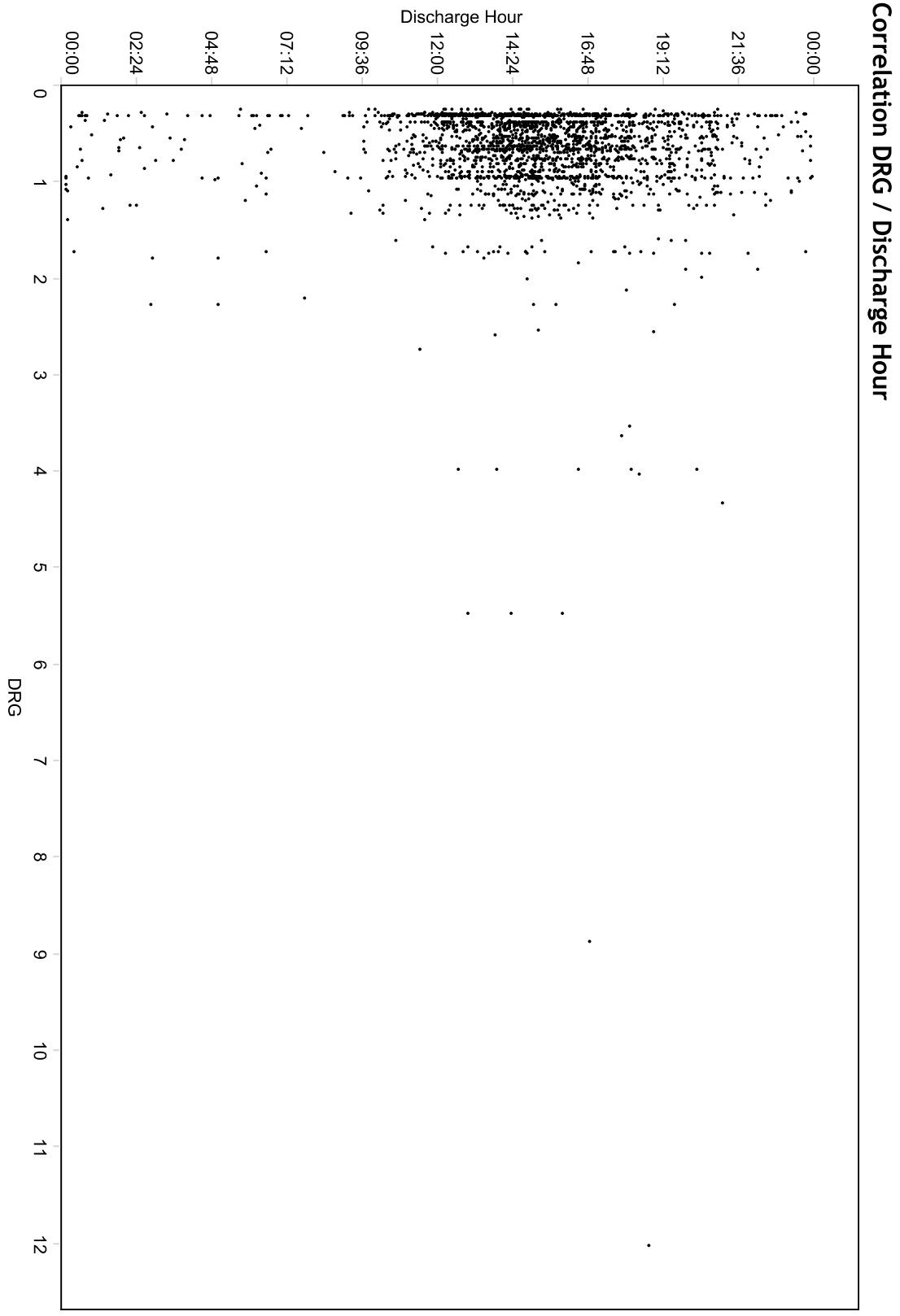
Time is calculated using Excel conventions where time is represented by number of minutes after midnight divided by total minutes during 24 hours. The visualisation software is then used to convert this fraction to corresponding time of day. In the following chart the discharge hours from MAVA 91, sub-grouped in weeks 2 - 52 year 2014 are examined. As the number of patients visiting the ward varies so does the subgroup sizes. Control limits varying according to sample sizes.



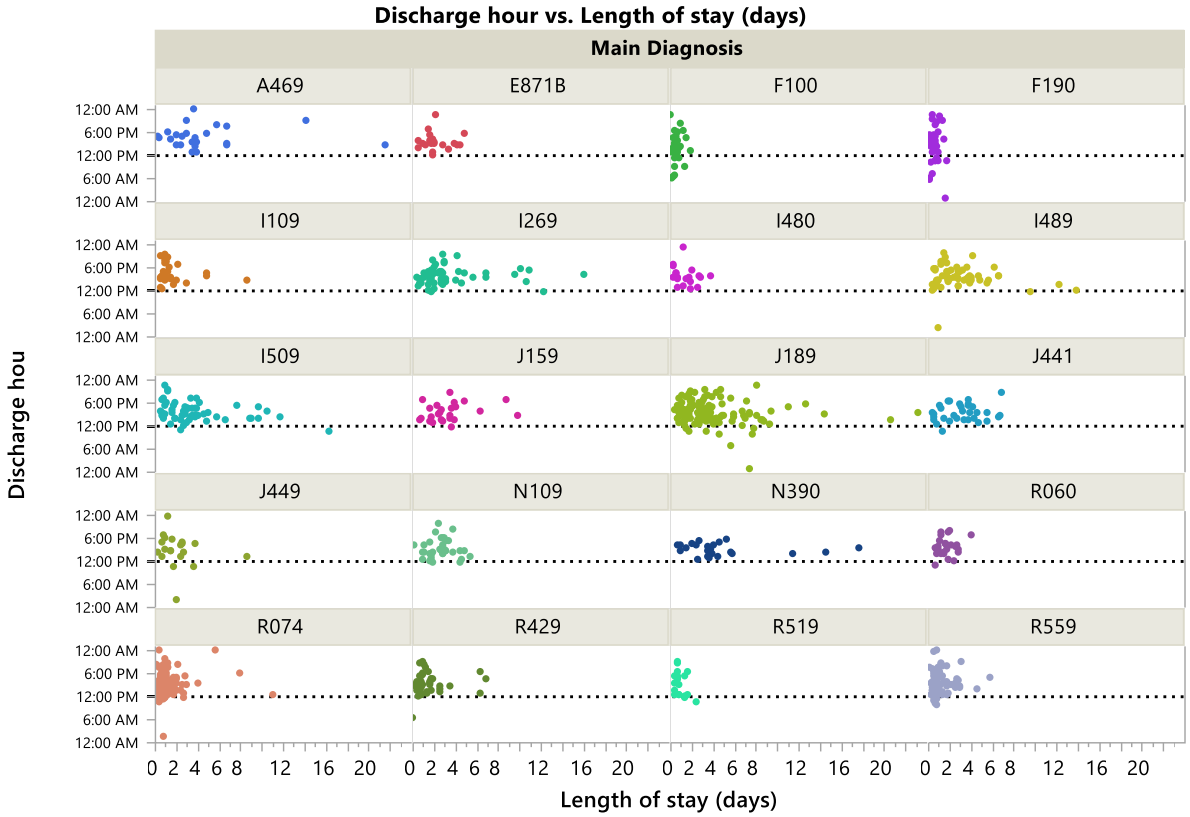
As one can see there are a number of interesting points; week 31, 32, 41 and 49. Week 31, and 32 are during summer vacation hence parts of staff are temporary which may have an impact on daily work.

During week 41 and 49 a number of patients have for unclear reasons been discharged at close to midnight which increase the standard deviation. Why discharges have occurred at this odd time has not been confirmed, but it is possible that patients have left the ward on their own initiative. Generally the process can be considered fairly stable but what is concerning is that the average discharge time is never close to the desired goal

Appendix D: DRG/Discharge Hour



Appendix E: LOS/Discharge

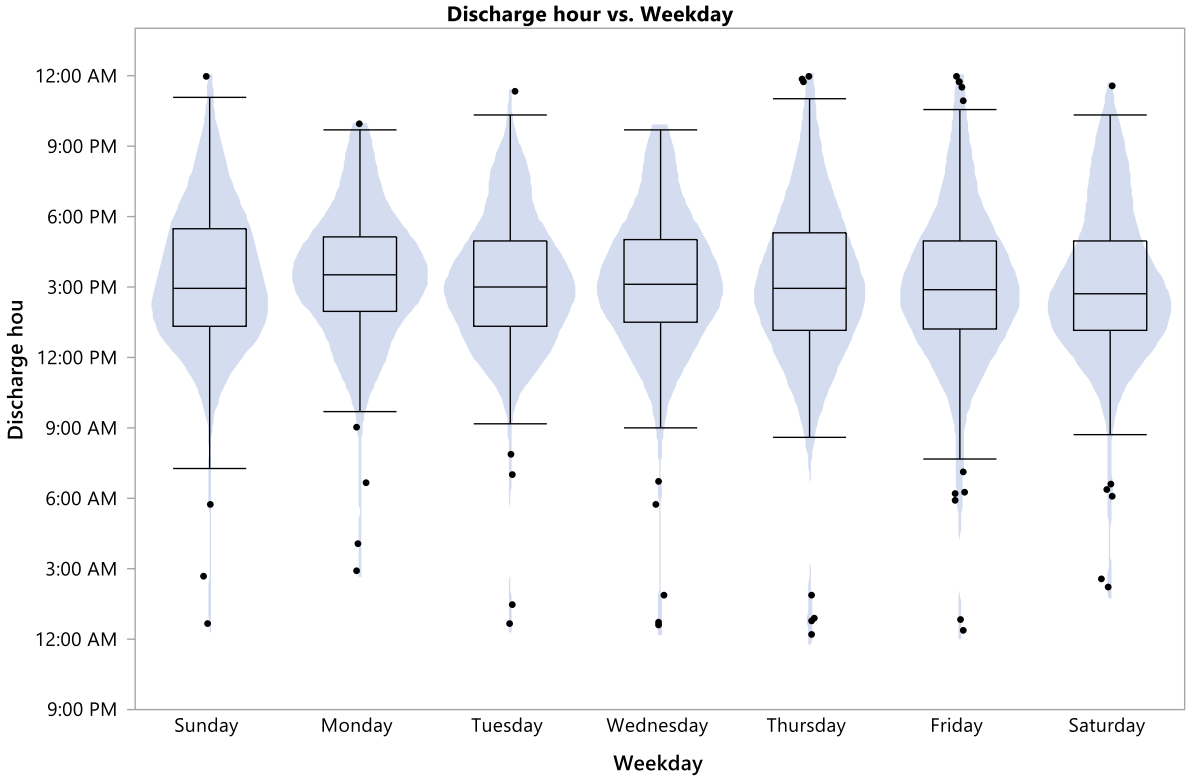


R074 is the most common diagnosis, with 155 cases during 2014. The diagnosis is given to patients experiencing chest pain. During 2014 were there 2335 patients with registered diagnoses. J189 is the second most common diagnosis, with 152 cases during 2014. The diagnosis is given to patients with unspecified pneumonia. The chart above includes the 20 most common diagnoses.

Appendix F: Discharge Hour by Diagnosis (min 10 diagnoses)

	Count	Average	Median	Std. Dev.	1st quartile	3rd quartile
R074	163	14:46	14:24	03:08	12:44	16:44
J189	134	15:18	15:08	02:53	13:44	16:49
R559	94	15:10	14:51	02:42	13:19	16:35
I489	67	15:14	14:55	02:41	13:54	16:50
I509	65	15:32	14:57	02:23	13:58	16:39
I269	56	15:40	15:31	02:04	14:29	16:35
R429	45	15:10	14:46	02:38	13:25	16:33
F190	36	13:38	14:25	05:20	10:28	17:07
N109	36	15:06	14:35	02:23	13:41	16:15
F100	35	13:31	13:20	03:36	12:13	15:19
J441	32	15:16	15:04	02:10	13:39	16:58
R060	32	15:36	15:24	02:11	14:12	16:37
I109	28	16:21	15:41	02:27	14:48	18:01
A469	26	16:35	16:30	02:40	14:33	17:25
J159	26	15:28	15:04	02:17	13:35	17:09
N390	24	14:55	14:57	01:27	13:56	16:00
J449	23	15:08	15:24	04:11	13:42	17:18
E871B	21	15:32	14:59	02:19	14:35	16:12
I480	21	15:33	15:18	02:24	14:20	16:18
R519	21	15:22	16:25	03:02	12:16	17:10
F130	18	12:08	13:10	06:07	09:30	15:42
D649	15	15:12	15:13	02:19	13:40	16:52
G459	15	15:45	15:44	02:05	14:45	16:56
A419	14	15:49	15:42	02:11	14:12	16:38
D509	14	16:40	16:12	02:51	14:56	18:03
N390X	14	14:27	14:31	01:15	13:26	14:58
Z036	14	12:16	12:28	05:53	10:28	14:33
I209	13	15:08	15:13	03:10	12:19	16:30
G409	12	15:17	15:02	02:05	14:21	16:05
I500	12	14:36	16:19	05:10	13:10	17:29
Z039	11	14:29	14:03	03:12	12:28	16:37
F109	10	14:34	12:59	03:27	12:28	15:27
I259	10	16:04	15:54	02:20	14:09	18:08
J069	10	15:23	15:35	01:58	13:54	16:57
R568X	10	15:31	15:47	03:35	14:23	17:55

Appendix G: Weekday/Discharge Hour



Discharge hour separated in weekdays with average and 1 standard deviation.

	Count	Avg.	Median	Std. Dev.	1st quartile	3rd quartile
Monday	375	15:35	15:43	03:32	14:02	17:45
Tuesday	393	15:01	15:05	03:18	13:35	16:55
Wednesday	409	15:26	15:18	03:22	13:53	17:19
Thursday	418	15:11	15:03	03:29	13:39	17:11
Friday	449	15:04	15:05	03:42	13:21	17:08
Saturday	305	14:59	14:52	03:39	13:13	16:55
Sunday	288	15:17	15:21	03:41	13:24	17:36

Count	Average	Median	Std. Dev.	1st quartile	3rd quartile
2 637	15:13	15:10	03:32	13:31	17:10

Appendix H: Pre- and post-noon discharges, in regards to age and number of diagnoses

Age	Diagnoses		AM	PM
-35	1	%	17,84%	82,16%
		Count	33,00	152,00
	2	%	13,16%	86,84%
		Count	5,00	33,00
	3-	%	25,00%	75,00%
		Count	8,00	24,00
36-55	1	%	11,84%	88,16%
		Count	18,00	134,00
	2	%	6,52%	93,48%
		Count	6,00	86,00
	3-	%	6,67%	93,33%
		Count	5,00	70,00
56-75	1	%	8,67%	91,33%
		Count	17,00	179,00
	2	%	8,75%	91,25%
		Count	14,00	146,00
	3-	%	6,05%	93,95%
		Count	15,00	233,00
76-	1	%	1,95%	98,05%
		Count	3,00	151,00
	2	%	7,35%	92,65%
		Count	10,00	126,00
	3-	%	4,26%	95,74%
		Count	13,00	292,00

Age		AM	PM
-35	%	18,04%	81,96%
	Count	46,00	209,00
36-55	%	9,09%	90,91%
	Count	29,00	290,00
56-75	%	7,62%	92,38%
	Count	46,00	558,00
76-	%	4,37%	95,63%
	Count	26,00	569,00

Diagnoses		AM	PM
1	%	10,33%	89,67%
	Count	71,00	616,00
2	%	8,22%	91,78%
	Count	35,00	391,00
3-	%	6,21%	93,79%
	Count	41,00	619,00

Appendix I: Pre- and post-noon discharges, in regards to age, number of diagnoses and month

Diagnoses	Age			January	February	March	April	May	June	July	August	September	October	November	December
1	-35	AM	%	13%	35%	14%	19%	13%	16%	20%	20%	27%	13%		21%
			Count	2	7	2	3	2	3	2	3	4	2		3
		PM	%	87%	65%	86%	81%	88%	84%	80%	80%	73%	88%	100%	79%
			Count	13	13	12	13	14	16	8	12	11	14	15	11
	36-55	AM	%	14%	11%	8%	15%	7%	13%	13%	25%	14%		20%	10%
			Count	2	1	1	2	1	2	2	2	2		2	1
		PM	%	86%	89%	92%	85%	93%	87%	88%	75%	86%	100%	80%	90%
			Count	12	8	12	11	14	13	14	6	12	15	8	9
	56-75	AM	%	13%	17%		9%	8%	5%		25%		18%	7%	7%
			Count	2	2		2	2	1		4		2	1	1
		PM	%	87%	83%	100%	91%	92%	95%	100%	75%	100%	82%	93%	93%
			Count	13	10	16	20	23	18	17	12	14	9	14	13
	76-	AM	%	7%				6%				8%			
			Count	1				1				1			
		PM	%	93%	100%	100%	100%	94%	100%	100%	100%	92%	100%	100%	100%
			Count	13	6	20	16	16	16	15	17	11	12	6	3
2	-35	AM	%			13%			20%			40%	50%		
			Count			1			1			2	1		
		PM	%		100%	88%	100%		80%	100%	100%	60%	50%	100%	100%
			Count		1	7	5		4	4	4	3	1	2	2
	36-55	AM	%			29%				7%			13%	14%	20%
			Count			2				1			1	1	1
		PM	%	100%	100%	71%	100%	100%	100%	93%	100%	100%	88%	86%	80%
			Count	5	9	5	5	8	12	13	3	9	7	6	4
	56-75	AM	%	15%	18%		21%	20%		6%				18%	8%
			Count	2	3		3	2		1				2	1
		PM	%	85%	82%	100%	79%	80%	100%	94%	100%	100%	100%	82%	92%
			Count	11	14	4	11	8	20	17	9	16	16	9	11
	76-	AM	%	13%			8%	14%	11%		8%	7%		14%	10%
			Count	1			1	1	2		1	1		2	1
		PM	%	88%	100%	100%	92%	86%	89%	100%	92%	93%	100%	86%	90%
			Count	7	6	8	12	6	16	13	11	14	12	12	9
3-	-35	AM	%	33%	67%					25%	33%				60%
			Count	1	2					1	1				3
		PM	%	67%	33%	100%	100%	100%	100%	75%	67%	100%	100%	100%	40%
			Count	2	1	3	1	3	2	3	2	2	2	1	2
	36-55	AM	%	11%				25%	25%				10%		20%
			Count	1				1	1				1		1
		PM	%	89%	100%	100%	100%	75%	75%	100%	100%	100%	90%	100%	80%
			Count	8	8	4	5	3	3	8	10	4	9	4	4
	56-75	AM	%	7%	7%			20%	6%		11%	7%	6%		8%
			Count	1	2			3	1		3	1	2		2
		PM	%	93%	93%	100%	100%	80%	94%	100%	89%	93%	94%	100%	92%
			Count	13	25	22	22	12	17	16	25	14	29	16	22
	76-	AM	%	7%		4%	7%			7%		9%	9%		3%
			Count	2		1	1			2		3	3		1
		PM	%	93%	100%	96%	93%	100%	100%	93%	100%	91%	91%	100%	97%
			Count	25	23	22	13	23	14	28	23	32	31	23	35

Appendix J: Pre- and post-noon discharges, in regards to age, number of diagnoses and weekday

Diagnoses	Age	AM / PM		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	-35	AM	%	19%	13%	13%	17%	20%	25%	18%
			Count	4	3	3	4	7	6	6
		PM	%	81%	88%	87%	83%	80%	75%	82%
			Count	17	21	20	20	28	18	28
	36-55	AM	%	11%	6%	13%	8%	10%	21%	14%
			Count	2	1	4	2	3	4	2
		PM	%	89%	94%	87%	92%	90%	79%	86%
			Count	16	15	26	22	28	15	12
	56-75	AM	%		8%	16%	15%	8%	4%	4%
			Count		2	6	5	2	1	1
		PM	%	100%	92%	84%	85%	92%	96%	96%
			Count	22	23	32	29	24	22	27
	76-	AM	%				12%			
			Count				3			
		PM	%	100%	100%	100%	88%	100%	100%	100%
			Count	25	31	19	23	27	7	19
2	-35	AM	%		25%			20%	17%	40%
			Count		1			1	1	2
		PM	%	100%	75%	100%	100%	80%	83%	60%
			Count	7	3	6	5	4	5	3
	36-55	AM	%	17%	7%	25%	5%		11%	
			Count	1	1	1	1		2	
		PM	%	83%	93%	75%	95%	100%	89%	100%
			Count	5	13	3	21	19	16	9
	56-75	AM	%	15%	16%	5%	9%	4%	5%	5%
			Count	3	5	1	2	1	1	1
		PM	%	85%	84%	95%	91%	96%	95%	95%
			Count	17	26	18	21	26	18	20
	76-	AM	%	5%		8%	14%	10%	13%	
			Count	1		1	3	2	3	
		PM	%	95%	100%	92%	86%	90%	87%	100%
			Count	18	22	12	18	19	20	17
3-	-35	AM	%	20%	50%	29%		13%	33%	50%
			Count	1	2	2		1	1	1
		PM	%	80%	50%	71%	100%	88%	67%	50%
			Count	4	2	5	3	7	2	1
	36-55	AM	%		10%		8%	16%		
			Count		1		1	3		
		PM	%	100%	90%	100%	92%	84%	100%	100%
			Count	4	9	13	12	16	11	5
	56-75	AM	%	3%	10%	5%	10%	8%		4%
			Count	1	3	2	4	4		1
		PM	%	97%	90%	95%	90%	92%	100%	96%
			Count	33	28	35	37	44	34	22
	76-	AM	%	2%	4%	5%	6%	7%		4%
			Count	1	2	3	3	3		1
		PM	%	98%	96%	95%	94%	93%	100%	96%
			Count	49	45	59	49	41	22	27

Appendix K: DBN trend on days between with DBN ≧ 50%

			AM	PM
January	2	%	50%	50%
		Count	1	1
	16	%	50%	50%
		Count	4,0	4,0
February	8	%	50%	50%
		Count	2,0	2,0
May	1	%	67%	33%
		Count	2	1
August	1	%	50%	50%
		Count	4,0	4,0
September	7	%	100%	
		Count	1	
	29	%	50%	50%
		Count	2	2
November	2	%	50%	50%
		Count	1	1
	4	%	50%	50%
		Count	1	1