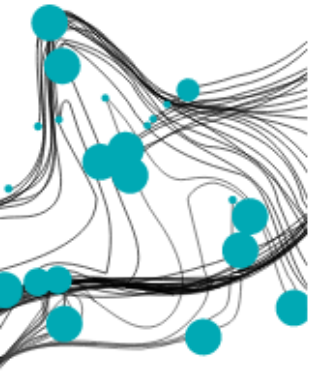


UNIVERSITY OF TWENTE.

Faculty of Science and Technology
Health Sciences

Workload performance measuring in an emergency department

M. L. Kip
M.Sc. Thesis
January 2021

Supervisors:
prof. dr. ir. E. W. Hans,
dr. ir. A. G. Maan-Leeftink
Faculty of Behavioural,
Management and Social Sciences
University of Twente
P.O. Box 217
7500 AE Enschede

A. Houwers-Buunk
Integral Capacity Office
Slingeland Ziekenhuis
P.O. Box 169
7000 AD Doetinchem

Management Summary

Background

There is an increasing pressure on quality and accessibility of emergency care due to excessive crowds on emergency departments (ED). A nationwide research among nineteen Dutch hospitals shows that workload at EDs is high, which means there is insufficient time to deliver proper care to patients. This is also being felt within *Slingeland hospital* (SZ). Several projects contributing to optimisation of the ED have been completed in recent years, but due to experiencing fluctuating workloads and a knowledge gap in optimising nurse staffing, we composed the following research objective:

To develop a formalised approach for measuring workload-related performance in the ED, and to perform a zero-measurement in Slingeland hospital.

Approach

To gain insight into workload-related performance in the ED, we performed a context analysis that showed that workload-related performance is not fully measured in the ED of SZ. Subsequently, we conducted a literature review in which nursing workload is conceptualised and multiple methods for measuring nursing workload were compared. The most suitable method, the *Jones Dependency Tool* (JDT), is chosen for use as a zero-measurement in the ED of SZ. For this purpose, an implementation process was developed, to operationalise the JDT within the hospital's information system HiX. Several stakeholders were involved to make the implementation successful. After implementation in the ED of SZ, workload-related performance was measured, and the perceived workload was compared to the actual workload.

Results

Since September 14, the actual workload has been measured in the ED with the JDT. Simultaneously, nurses have rated their perceived workload. Figure 1 shows that the average total dependency of patients in the ED varies during the day, with similar patterns for the weekdays, however, with differing intensities.

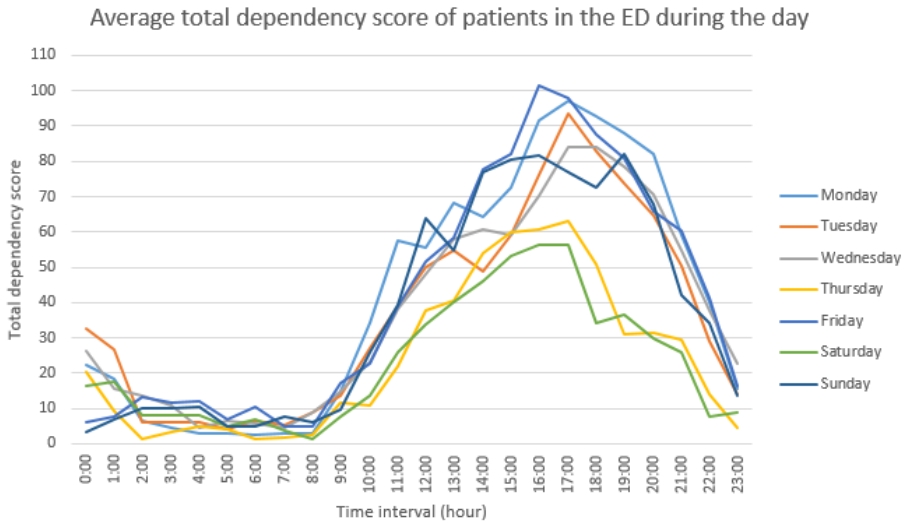


Figure 1: Average total dependency of patients in the ED during the day (n = 1,276, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

The ED strives for a maximum length of stay of three hours for patients in the ED. In total, 65.4% of all ED arrivals between September 14 and October 15 left the ED within three hours. Table 1 shows the length of stay of ED arrivals divided in patient dependency.

Table 1: Length of stay of ED arrivals by dependency group (n = 1,276, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Patient dependency	**<3 hours**	**Total amount**	**Percentage <3 hours**
Low	533	707	75.4%
Moderate	254	491	51.7%
High	26	54	48.1%
Total	17	24	70.8%

In total, 80.7% rated their perceived nursing workload, in which 52.1% corresponds with the actual workload. 8.5% rated their perceived workload higher than the actual workload, and 39.4% rated their perceived workload lower than the actual workload. Figure 2 shows the deviation of perceived workload compared to the actual workload classified by patient dependency group.

Conclusion and recommendations

This research has resulted in the implementation of the Jones Dependency Tool in the ED of SZ. By collaborating with stakeholders, the JDT has been implemented in HiX in the ED of SZ, by which the nursing workload can now be measured in the ED. While a crowding protocol is available, it is currently unknown at what times this protocol should be initiated. We recommend to connect the protocol with set moments in the JDT. Although nurse staffing is the same every weekday, data analysis has shown that the number of ED arrivals vary through the week and through the day. These variations contribute to variations in nursing workloads. Especially on Mondays and Fridays more patients were treated in the ED, in contrary to Thursdays and Saturdays where the least patients were treated. These variations

Figure 2: Degree of deviation of perceived workload (T = 14-09-2020 - 15-10-2020, source: Perceived nursing workload measurements)

contribute to higher nursing workloads on Mondays and Fridays, and lower nursing workloads on Thursdays and Saturdays. However, due to a limited period of workload measurement, the degree of variation in ED arrivals through the week is uncertain. Based on the numbers of ED arrivals in 2019, we expect that the number of ED arrivals on Mondays and Fridays will be higher, but not significantly lower on Thursdays and Saturdays. Therefore, continuation of the JDT is desired, since better predictions can be made by measuring workload for a longer period of time, which consequently will contribute to better resource planning and nurse staffing, where nurse staffing levels can be adjusted on nursing workload during the day, week, and year. By measuring workload for a longer period of time, nurse staffing levels can be adjusted on nursing workload during the day, week, and year. Further, we recommend to organise ED-referrals and ED-appointments elsewhere, since these patients disturb the processes in the ED related to acute patients.

Contents

List of Acronyms

AAZ	Physician acute care: Non-specialised physician, specialist in training, or physician assistant; working under supervision of an ED-physician
AMU	Acute Medical Unit
BIC	Integral Capacity Office
CCU	Cardiac Care Unit
ED	Emergency Department
EHH	First Heart Aid
GP	General Practitioner
GPS	General Practice Station
HIS	Health Information System
ICM	Integral Capacity Management
ICU	Intensive Care Unit
LOS	Length of stay
NPR	Nurse-to-patient ratio
PA	Physician assistant
PCS	Patient Classification System
SZ	Slingeland hospital

Chapter 1

Introduction

This chapter provides insight into the research context (Section 1.1), the perceived problem (Section 1.2), and the research objective with related research questions (Section 1.3).

1.1 Research context

This section provides insight into the research context: Slingeland hospital (Section 1.1.1) and the emergency department of Slingeland hospital (Section 1.1.2).

1.1.1 Slingeland Hospital

Slingeland Hospital (SZ) originated in 1991 from the merger of the general Wilhelmina hospital and the Catholic Sint Jozef hospital, and is named after the Achterhoekse river 'Slinge'. SZ is a general regional hospital, located in Doetinchem [1]. February 2016, *integral capacity management* (ICM) was project-based introduced into the organisation. With the mission to become the best regional hospital in the Netherlands, the hospital strives to organise excellent medical specialist and nursing care, close to home. One of their ambitions is that waiting times in SZ are equal to, or shorter than waiting times in surrounding hospitals. Among other things, ICM is introduced to realise this ambition, because it is important to optimise internal processes, and ensure integral control of patient flows. July 2020, the board of directors decided to give ICM a formal position within the organisation, in the form of the *Integral Capacity Office* (BIC). This research is performed from within the Integral Capacity Office, and focuses on the Emergency department.

1.1.2 Emergency department

Last year, around 15,500 patients visited the Emergency Department (ED) of SZ. These arrivals have been referred by a GP(S), by their medical specialist within the hospital, arrive by ambulance, or are self-referrals [2]. The ED is open for 24 hours per day, 7 days per week. The ED-employees consist of ED-physicians, non-specialised physicians and specialists in training (AAZ), physician assistants (PA), co-assistants, ED-nurses, and the secretary. The activities and facilities are tuned to first care taking, examination, and treatment. The

ED-employees strive to help the most urgent emergencies as fast as possible, and to provide the best care to everyone. The time within which a patient needs to be seen by a physician is determined based on patient acuity, varying from acute to non-urgent.

1.2 Perceived problem

This section describes nationwide trends regarding EDs (Section 1.2.1), and the related challenges for SZ (Section 1.2.2).

1.2.1 Nationwide trends

Stricter standards have partly contributed that Dutch hospitals gradually reduce the number of emergency services. In 2003, 103 posts were still open 24 hours a day; last year there were 83. One in three emergency patients in Dutch hospitals have an age of 65 years or older. In total, more than 800 thousand elderly visit the ED each year. This number is increasing every year, and the conditions with which these patients arrive to the ED are also becoming increasingly complex. Due to the increase in complexity of patients and stricter quality requirements, costs will increase and logistic problems will arise [3, 4].

Besides the increase of frail elderly patients, there is also an increase in *Alternate Level of Care* (ALC) patients occupying hospital beds while they no longer require treatment. These patients are not recuperated enough to go home, and due to waiting lists for nursing homes, outflow in hospitals is stagnating. This increase of so-called 'bed blocking' is caused by aging of the population and capacity problems such as budget cuts, staff shortages, and waiting lists [5, 6]. ALC patients are problematic for hospitals: elderly patients often weaken in hospitals, other patients have to wait longer before they can receive care, planned surgeries will be delayed, and the ED has to refer patients to hospitals in other regions. Besides all this, it is a societal problem since hospital care is by far the most expensive type of care [6].

Due to capacity problems and high input in EDs, patients are at risk and complications can occur. To solve this, more often EDs are temporarily closed [7]. According to ED-physician Menno Gaakeer, the increasing pressure on quality and accessibility of emergency care due to excessive crowds on EDs is caused by insufficient integral approach. The number of EDs being available 24 hours per day and 7 days per week has decreased, while the number of ED-patients only decreases to a limited extent. Fewer patients come to the ED on their own initiative, while the number of referrals increases. Moreover, the average age of patients is rising and admission to the hospital is needed more often [8, 9].

Research among nineteen Dutch hospitals shows that workload at EDs is high, which may cause that on occasions there is insufficient time to deliver proper care to patients [10]. In the hospital industry, over 50% of the employees experience this high workload, and almost 70% feel that workload has increased in the past year [11]. More than 3 out of 4 ED-employees

experience insufficient staffing levels, and 90% of the ED-employees experience that their mental health is considered less important by higher management than productivity [10]. To improve quality of care in the ED, workload will have to be reduced [9].

1.2.2 Challenges for SZ

The consequences of these nationwide trends are being felt within SZ as well. For example, as shown in Table 1.1, in the proportion of patients aged 65 years and older, which increased with 2% between 2017 and 2019, which in 2018 at 40.2% is even higher than the national average of 33.3% [3], and in a decrease in ED arrivals from 16,862 to 15,693 patients in the past three years, with ratios in patient acuity remaining equivalent, see Figure 1.1. Staffing levels have remained the same these years, which raises the question why the experience of a regularly too high workload remains.

Table 1.1: Division of patients into age categories (n = 48,927, T = 2017-2019, source: HiX SZ)

Age	2017	2018	2019
0-17	2,457	2,161	2,032
18-34	2,362	2,345	2,254
35-49	2,282	2,016	1,932
50-64	3,344	3,276	3,193
65-79	4,031	4,140	3,981
85+	2,386	2,434	2,301
Total	16,862	16,372	15,693

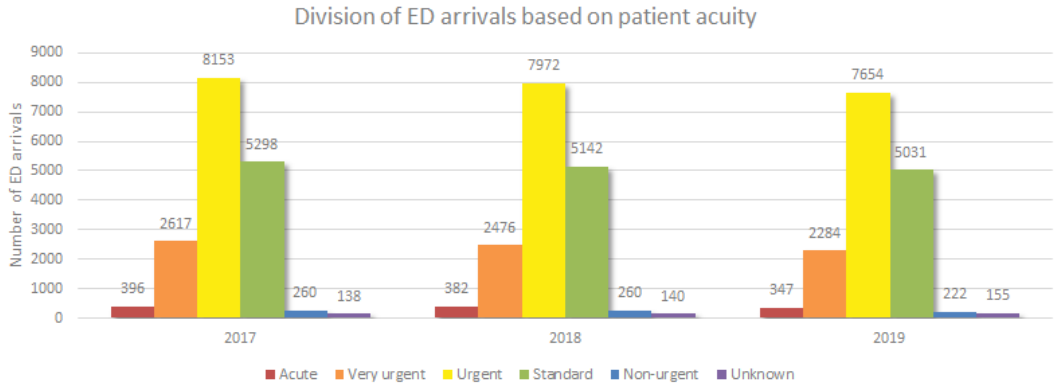


Figure 1.1: Division of patients based on patient acuity (N = 48,927, T = 2017-2019, source: HiX SZ)

Several projects contributing to optimisation of the ED have been completed in recent years, such as the opening of an *Acute Medical Unit* (AMU) to improve ED-output, and a redesign of the ED, by which diagnostics at the ED became possible and a fast track room is established to shorten throughput-times for low-complexity patients.
However, experiencing fluctuating workloads and a knowledge gap in optimising nurse workforce scheduling arose the request by the ED to rearrange the nurse workforce schedule to stabilise the nursing workload. The budgeted number of FTEs has remained unchanged for years, which is also the case for the nursing schedule.

For safe and cost-effective care, SZ uses a *patient classification system* (PCS) to calculate *nurse-to-patient ratios* (NPR) to match the required number of nurses to the number of patients in inpatient wards. However, this method is not suitable for the ED, since patient acuity and the number of ED arrivals - which are very diverse - are not known in advance [12].

Although the fluctuating workload has been experienced for a long time, the actual workload has never been objectively identified. Therefore, this research focuses on how workload can be measured properly, and how the organisation of the ED can be aligned to this.

1.3 Research objective and research questions

This section presents the research objective (Section 1.3.1) and the research questions (Section 1.3.2).

1.3.1 Research objective

The research objective is to develop a formalised approach for measuring workload-related performance in the ED, and to perform a zero-measurement in Slingeland hospital.

1.3.2 Research questions

To achieve the research objective, the following four research questions with corresponding methodology are set up.

1. *How can nursing workload be measured in the ED?*
   In order to answer to this research question, patient processes and resources will be exposed in Chapter 2, and a literature research will be conducted in Chapter 3 to determine how workload can be measured, and we analyse advantages and disadvantages of existing approaches.

2. *How can a workload measurement tool be implemented in the ED of SZ?*
   The second research question will be answered in Chapter 4, where the implementation process of the workload measurement tool will be discussed.

3. *What is the current workload related performance of the hospital's ED?*
   In Chapter 5 we measure and compare perceived and actual workload.

Chapter 2

Context analysis

This chapter provides insight into organisation in and around the ED of SZ. Section 2.1 describes the patient-related processes in the ED, Section 2.2 describes the planning and control of patients and resources in the ED, and Section 2.3 describes the decisions in quality and safety in the ED.

2.1 Process description

Patients arriving to the ED have been referred by a GP(S), by their medical specialist within the hospital, have been transferred by an ambulance, or are self-referrals [2]. Announced patients are registered by physicians and nurses on the yellow registration paper (Appendix A), after which the secretary registers this in HiX, the *healthcare information system* (HIS) used in SZ.

Figure 2.1 shows the patient flows in the ED, where the process for arrivals by ambulance differs from other ED arrivals. ED arrivals by ambulance are immediately allocated to an ED-bed, in contrary to other ED arrivals. Except in cases of availability of a treatment room and where triage immediately can take place after registration at the secretary desk, the patient does not have to wait in the waiting room and will immediately be allocated to an ED-bed where triage takes will place. However, in case the ED is crowded, patients can be referred to the waiting room after triage has taken place or during the patient is waiting for results of the diagnostics.

2.2 Planning and control

This section provides insight in planning and control decisions of the ED based on the framework for healthcare planning and control, see Figure 2.2. The framework consists of four managerial areas, with hierarchical decomposition into four categories. In the managerial areas, a distinction is made between decision-making in medical planning, resource capacity planning, material planning, and financial planning. Decision-making in strategic planning, tactical planning, offline operational planning, and online operational planning relate to the

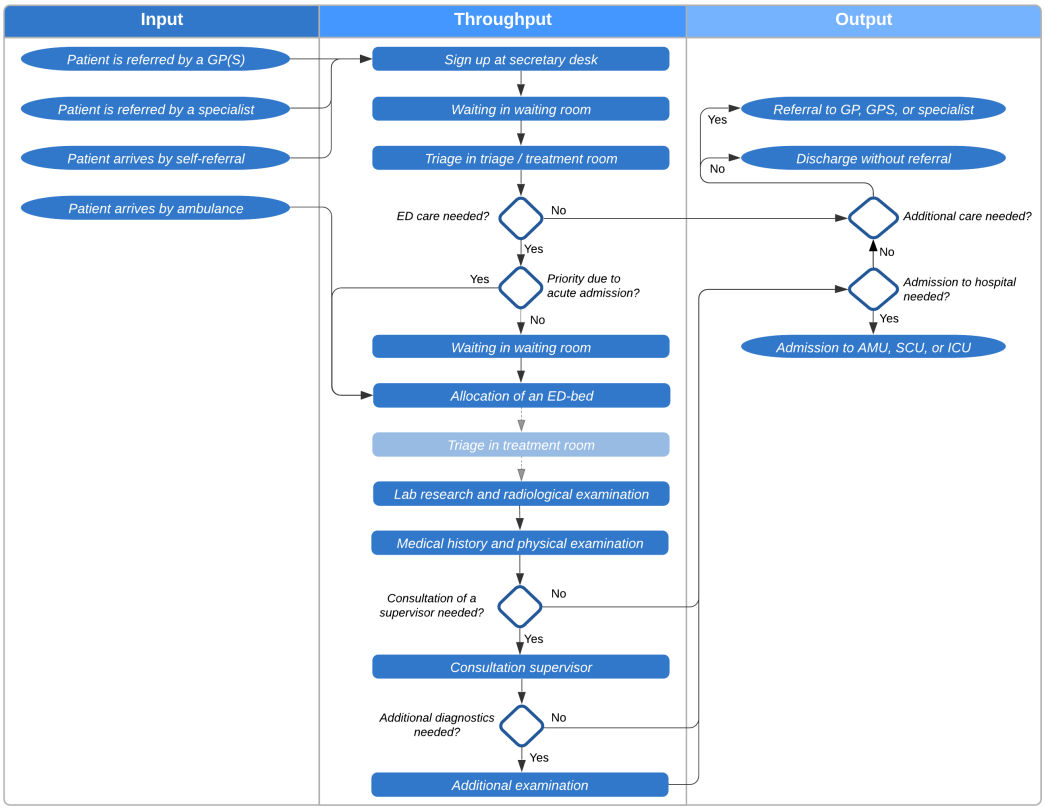


Figure 2.1: Patient flow process in the ED

hierarchical decomposition. Workload related performance is measured at an operational level, while the organisation at higher hierarchical levels influences this as well [13].

	Medical planning	***Resource capacity planning***	***Materials planning***	***Financial planning***
Strategic	Research, development of medical protocols	Case mix planning, capacity dimensioning, workforce planning	Supply chain and warehouse design	Investment plans, contracting with insurance companies
Tactical	Treatment selection, protocol selection	Block planning, staffing, admission planning	Supplier selection, tendering	Budget and cost allocation
Offline operational	Diagnosis and planning of an individual treatment	Appointment scheduling, workforce scheduling	Materials purchasing, determining order sizes	DRG billing, cash flow analysis
Online operational	Triage, diagnosing emergencies and complications	Monitoring, emergency coordination	Rush ordering, inventory replenishing	Billing complications and changes

← managerial areas →

← hierarchical decomposition →

Figure 2.2: Framework for healthcare planning and control [13]

Hierarchical decomposition in decision-making

The management of the ED exists of a cluster manager, a medical cluster manager, and two team managers. Decision-making on strategic and tactical level lies with the cluster manager and medical cluster manager. The team managers of the ED are responsible for offline and

online operational decision-making and are accountable to the cluster manager.

The cluster manager is responsible for business operations, business design, the coherence with the organisation its strategy and goals, and the coherence between customer/market, financial, employees, innovation, and quality/safety. The medical cluster manager is responsible for medical policy, organising and improving operational patient care, and the optimal functioning and cooperation of the specialists. The team manager directly manages the employees of the ED, supervises their activities, and is first point of contact for them. The cluster manager and medical cluster manager are responsible for cluster acute care, among which the ED. Appendix B shows an overview of the organisation of SZ.

2.2.1 Strategic

This sections describes planning and control decisions on strategic level among which the employees, available rooms, and triage system.

Staffing

Table 2.1 provides an overview of the disciplines that work in the ED on a structural basis, and have direct patient contact, with the corresponding quantum and FTEs per discipline. This budgeted number of FTEs has not changed in the past years. Within the ED, nurses are trained to become an ED-nurse or acute care nurse. Acute care nurses can also work in the ICU.

Table 2.1: ED-employees

Discipline	Amount	FTE
Nurse	35	22.7∗
ED-physician	8	5.7
AAZ	24	16.8∗∗
Secretary	8	2.9

∗ *Includes the share of acute care nurses working in the ED.*
∗∗ *Can also be scheduled in the CCU and ICU.*

A total of 35 nurses work in the ED, divided into specific ED-nurses and acute care nurses. These acute care nurses work half the time in the ED and half the time in the ICU.

Available rooms

The ED has eight treatment rooms. One of these rooms, the acute room, is only used for trauma patients who immediately need to receive care. This room has an X-ray facility, extensive monitoring options, and equipment for critically endangered patients. The fast track room is a room with place for three patients with low complex trauma for an accelerated treatment process. The remaining six rooms, of which two are double rooms, are used for all other patients. One of these rooms can be used for extensive wound treatment and as a place for a second trauma patient, and another room is equipped for the treatment of jaw and ear-nose-throat patients. When there is no longer a program in the outpatient operating room, two extra rooms can be used as treatment room in times the ED is crowded and there

is no treatment room available for waiting patients. When no treatment room is available, but patients do need to be treated, waiting patients in the treatment room are temporarily placed in the hallway of the ED. Besides these treatment rooms, the ED has a triage room, X-ray room, and CT-room. Appendix C shows an overview of the ED.

Triage system

The *Manchester Triage System* (MTS) is used in the ED, which means that every patient needs to be seen by a triage nurse within ten minutes after arrival, and thereafter, the time within which a patient needs to be seen by a physician is determined based on patient acuity. The triage codes in Table 2.2 are related to the degree of patient acuity. Figure 2.3 shows the division of ED arrivals per triage code, showing that as age increases, we see an increase in patient acuity relative to the other triage categories.

Table 2.2: Triage codes

Urgency	Triage code	Target time
Acute	Red	0 minutes
Very urgent	Orange	10 minutes
Urgent	Yellow	60 minutes
Standard	Green	120 minutes
Non-urgent	Blue	240 minutes

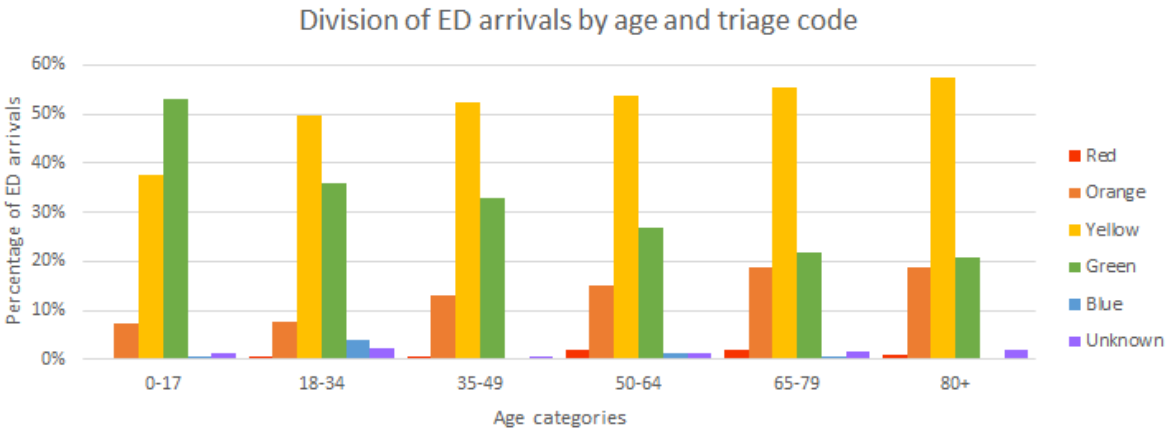


Figure 2.3: Division of ED arrivals by age and triage code (n = 1,293, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Case-mix profile

Data analysis is performed on data from September 14 to October 15. During this period, 1,293 patients arrived to the ED with an average age of 53.5 years. Division in gender was almost equal, namely 50.1% of the ED arrivals are female, and 49.9% are male. Figure 2.4 shows the division in age and gender of these arrivals.

Table 2.3 shows the referral of these patients, where it is clear that the largest share is referred by the GP. ED arrivals via the radiology department have previously been referred by the

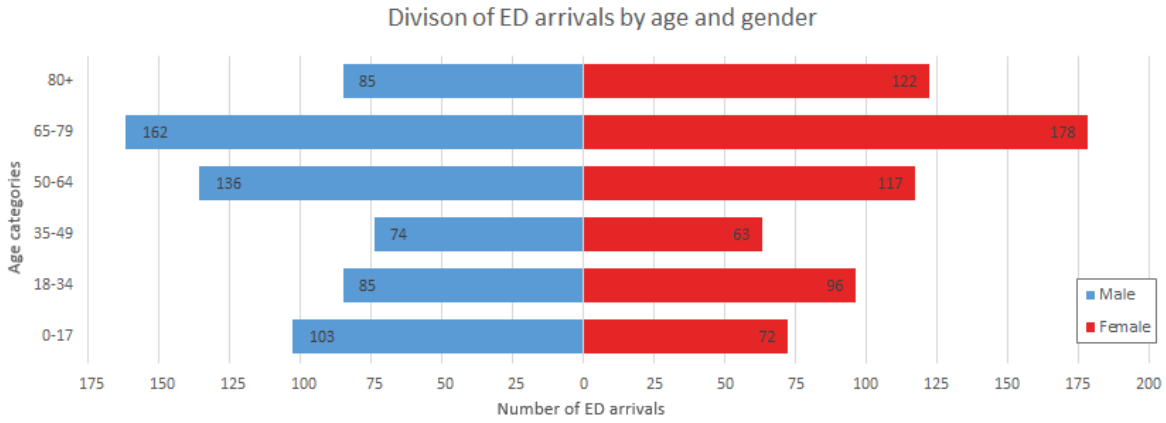


Figure 2.4: Division of ED arrivals by age and gender (n = 1,293, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

GP because of suspected fractures. These patients arrive the radiology department within office hours before they come to the ED. 73.5% of these patients arrive at the ED after 12:00 PM. See Table G.1 in Appendix G for ED referrals by radiology during the day.

Table 2.3: ED arrivals per referrer
(n = 1,293, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Referrer	Number of ED arrivals
GP	414
GPS	238
Specialist	193
Radiology	155
Ambulance	106
Appointment	37
Others	150

The ED-physician is the head practitioner for ED-patients. However, a supervisor can be called for consultation. Specialty of these supervisors can be Anaesthesiology, Cardiology, Dermatology, Gynaecology, Gastroenterology, Internal Medicine, Dental Surgery, Throat-Nose-Ear, Medical Microbiology, Neurology, Ophthalmology, Orthopaedics, Pediatrics, Pulmonology, Rheumatology, Surgery, and Urology. Figure 2.5 shows the division of ED arrivals by specialty based on triage codes, showing that most patients belong to specialty Surgery, with a standard or urgent patient acuity which requires them to be seen by a physician within 60 to 120 minutes.

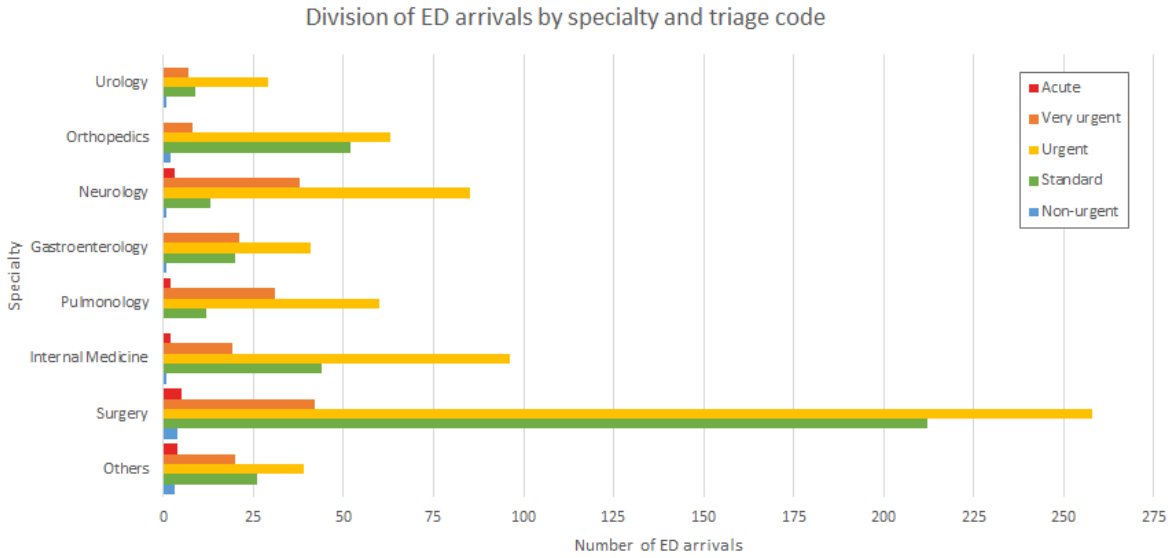


Figure 2.5: Division of ED arrivals by specialty and triage code (n = 1,274, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

2.2.2 Tactical

This section describes planning and control decisions on tactical level among which staffing of physicians, nurses, and secretary.

Staffing

At any given time, at least one ED-physician, is at work in the ED. This is the directing physician. In addition to the ED-physician, non-specialised physicians or physician assistants work in the ED, see Table 2.4. In contrary to physicians, nurses work in more than three different shifts, see Table 2.5. The day and evening shifts make a distinction between (1) regular shift, (2) directing shift, and (3) fast track shift. The secretary is present during the day and evening shifts, see Table 2.6. At night, secretarial duties are responsibility of the nurses.

Table 2.4: Physician staffing

Shift	Amount	Period
Day	3	7:45 - 17:15
Evening	3	15:00 - 23:30
Night	2	23:00 - 8:15

Table 2.5: Nurse staffing

Shift	Amount	Period
Day 1	2	07:30 - 15:30
Day 2	1	09:00 - 17:00
Day 3	1	10:00 - 18:00
Evening 1	3	15:00 - 23:00
Evening 2	1	16:00 - 23:00
Night	2	22:45 - 07:45

Table 2.6: Secretary staffing

Shift	Amount	Period
Day	1	8:00 - 15:30
Evening	1	15:15 - 22:30

2.2.3 Offline operational

This section describes planning and control decisions on offline operational level among which appointment scheduling in the ED.

Figure 2.6 shows for each weekday a boxplot of ED arrivals with corresponding minimum, lower quartile, median, upper quartile, and maximum, in which we see that the number of ED arrivals vary over the weekdays. We can expect higher numbers of ED arrivals on Mondays and Fridays, and lower numbers of ED arrivals on Thursdays and Saturdays. However,

Especially on Mondays and Fridays more patients were treated in the ED, in contrary to Thursdays and Saturdays where the least patients were treated. These variations contribute to higher nursing workloads on Mondays and Fridays, and lower nursing workloads on Thursdays and Saturdays. However, the distribution in the number of ED arrivals is wide, especially on Tuesday, Wednesday, and Thursday, which impedes forecasting the actual number of ED arrivals. Likewise, due to a limited period of workload measurement, the degree of variation in ED arrivals through the week is uncertain. Based on the numbers of ED arrivals in 2019 (See G.1 in Appendix G), we expect that the number of ED arrivals on Mondays and Fridays will be higher, but not significantly lower on Thursdays and Saturdays.

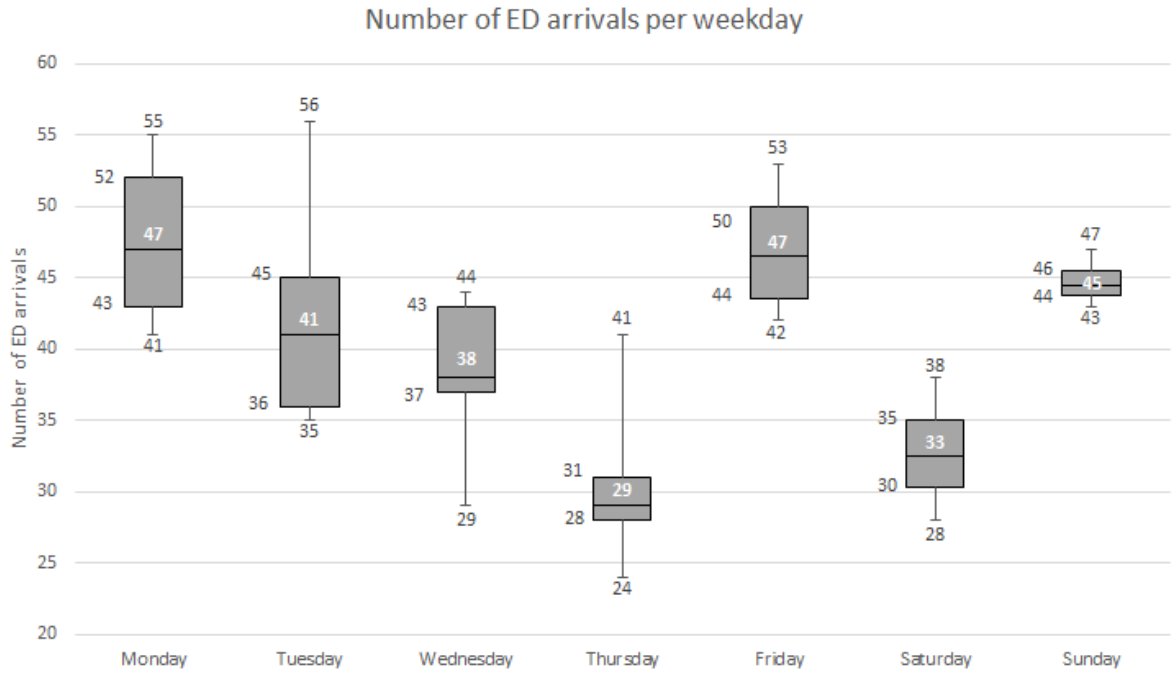


Figure 2.6: Boxplot of ED arrivals per weekday (n = 1,293, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Figure 2.7 shows the average number of patients in the ED during the day, in which we see that, on average, most patients are in the ED at the end of the afternoon. With only 8

regular treatment rooms and place for 3 fast track patients, as mentioned in Section **??**, it shows that a treatment bed is not always available for every patient. In the worst scenario, patients are moved to the hallway.

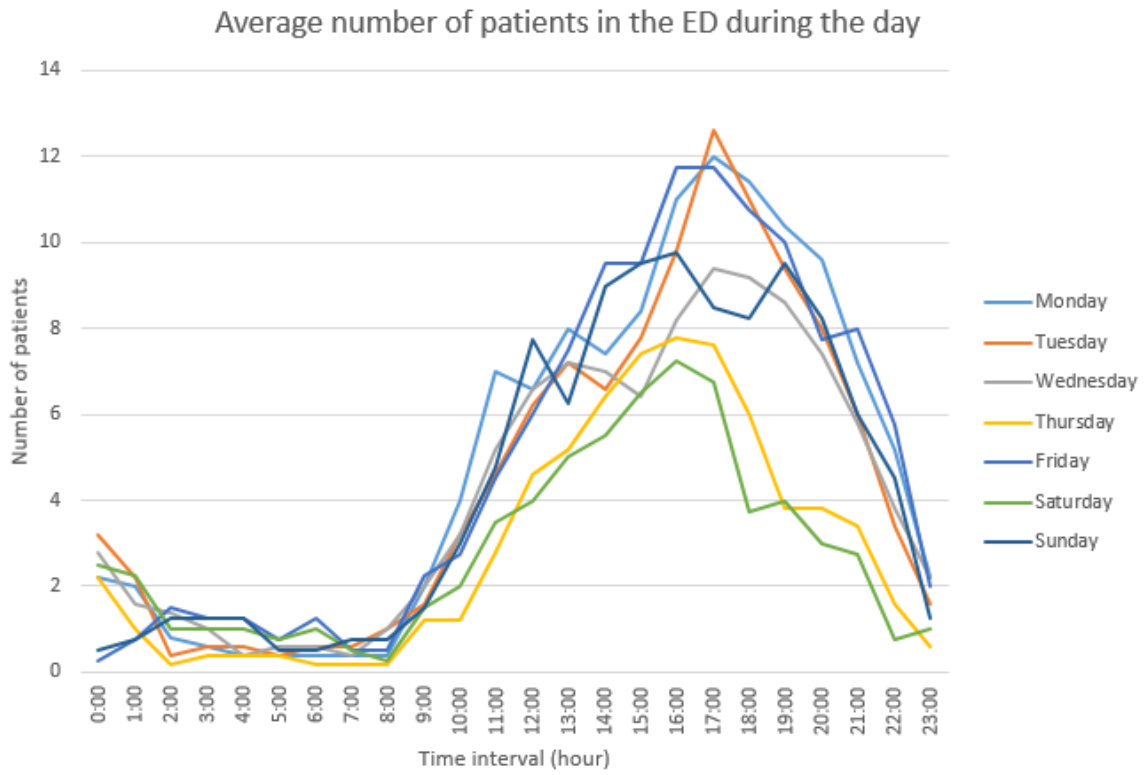


Figure 2.7: Average number of patients in the ED during the day (n = 1,276, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Appointments in the ED

It regularly occurs that patients return to the ED by appointment the next day. Among other things, the appointment is made for reassessment of abdominal complaints or plaster complaints. This patient flow contributes to improper use of the ED. On average, one appointment is scheduled per day, see Table 2.3.z

2.2.4 Online operational

This section describes planning and control decisions on online operational level among which anticipating safety and quality of acute care.

Anticipating on quality and safety

At times when the ED is crowded, the ED-physician can use a protocol to initiate measures to prevent an ED-stop. The aim of the protocol is to guarantee safety and quality of acute care and to get the patient to the right place with the right care as quickly as possible. Table 2.7 describes the protocol containing of 11 measures about which the ED-physician determines which measure(s) is/are most suitable for the current situation.

Table 2.7: Protocol crowding

Measures
A. See patients with less urgency from the GP at a later time in the ED.
B. See patients with less urgency at the outpatient clinic by the specialist.
C. Additional staffing of present and available ED-physician.
D. Additional staffing of a non-specialised physician working in the ICU.
E. Additional staffing of nurses working in the ICU and CCU.
F. Assistance of plaster room.
G. Increasing support services such as laboratory and radiology.
H. ED-physician assesses which specialisms have the highest urgency to assist in the ED.
I. ED-physician sees the patient for the first 10 minutes and, if ABCD are stable, the appropriate specialist will be head practitioner.
J. If possible, transfer patient to *First Heart Aid* (EHH).
K. Request ambulances to spare SZ for patients on the border of the adherence area.

Compliance with the protocol is mandatory, and availability is the responsibility of each department. In case none of the measures provide a solution for the crowded ED, an ED-stop will be announced by the ED-physician for at least two hours so that the quality and safety of care for patients in the ED do not have to be compromised. However, it is not known when the crowding protocol should be started. Depending on insights of the ED-physician, the protocol will be started, in which total workload for patients in the ED is unknown.

2.3 Quality and safety

This section describes the decisions in quality and safety management in the ED of SZ based on their key performance indicators.

Key Performance Indicators

In the ED, there is a screen with multiple throughput-times on it. The purpose of this monitoring is to provide insight into which phase of the care process patients are in, so that individual care needs and throughput-times can be managed. Table 2.8 shows the throughput-times with the target times the ED wants to adhere to, which are based on the patient's arrival time. Actual throughput-times are displayed on the screen in the ED, and when the standard time has elapsed, this time turns red to remind ED-employees that target times are being exceeded. Although most of the throughput-times are registered automatically in HiX, registration of completion of physical examination and consultation of a supervisor has to be performed manually by the ED-physician.

Table 2.8: Target times in the ED

Phase	Regular patient	Fast track patient
1. Triage	$<$ 10 min	$<$ 10 min
2. Lab research and radiological examination	$<$ 30 min	$<$ 30 min
3. Medical history and physical examination	$<$ 60 min	$<$ 30 min
4. Consultation supervisor	$<$ 90 min	$<$ 50 min
5. Additional diagnostics	$<$ 150 min	
6. Outflow	$<$ 180 min	$<$ 70 min

The ED strives for 80% of the triages to be completed within 10 minutes after arrival, and strives to achieve 80% of all patients leaving the ED within three hours. The feasibility of these norms not only depend on resources within the ED. To achieve these goals, a supervisor needs to be available within 20 minutes for consultation, and the nurse of the inpatient nursing ward has to pick up the patients to be admitted within 10 minutes after announcement. Although the ED strives for certain target times, unlike the inpatient nursing wards (as mentioned in Section 1.2.2), nursing workload is not taken into account and it remains unclear how this should be measured.

Table 2.9 shows the KPIs that could be measured, from which it can be concluded that several KPIs cannot be measured. This is due to incomplete and insufficient registration in HiX. The KPIs that have been measured show unsatisfactory results in regard to the aims of the ED.

Table 2.9: Measurement of KPIs (n = 1293, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Phase	Within target time	Total	% within target time
Triage	694	1273	54.5%
Admission to inpatient ward	21	360	5.8%
Discharge	845	1293	65.4%

2.4 Conclusion

Despite the fact that there is insight into the number of patients in the ED during the week and during weekdays, it is unknown how high the workload is at these times, what influences workload, and if staffing levels match with these workloads. This was the main motivation for this research project. In the next Chapter, we conceptualise nursing workload and determine how it can be measured in the ED.

Chapter 3

Theoretical framework

Based on literature review, this chapter provides insight into current knowledge of nursing workload measurement. Appendix D provides information about the execution of the literature review. Section 3.1 provides insight in current knowledge of nursing workload and its influencing factors. Section 3.2 describes what is known about methods to measure nursing workload, and the advantages and disadvantages of different methods are discussed. Section 3.3 describes the most suitable method to measure nursing workload, and Section 3.4 concludes how nursing workload can be measured in the ED of SZ.

3.1 Nursing workload

Nursing workload can broadly be conceptualised as the actual amount of work required to meet the patient's care needs in a given period of time [14, 15]. These needs, also mentioned as 'patient dependency', 'intensity of care', or 'complexity of care' vary among patients in the ED [16]. Workload can be divided into direct patient care, indirect patient care, and other activities related to ward and organisational management [15–18]. Volume of patients, patient dependency, patient acuity, task interruptions, patient turnover, NPR, skill mix of staffing, direct care time, and work flow are influencing factors on nursing workload [18–21].

Crowding in the ED negatively impacts nursing workload, just as the quality of provided care and patient safety [20, 22]. Overcrowding in the ED refers to "the situation where ED function is impeded because the number of patients exceeds either the physical and/or staffing capacity of the ED, whether they are waiting to be seen, undergoing assessment and treatment, or waiting for departure" [23], briefly summarised as the demand for emergency services exceeding its available resources, which can be divided into input, throughput, and output factors [24,25]. Variety in patient acuity and in the number of ED arrivals throughout the day influence crowding based on input. Crowding happens when a patient cannot be admitted to an ED-bed, which subsequently increases waiting times [24]. For throughput, the *length of stay* (LOS) of patients in the ED can influence the crowd. LOS depends on patient dependency and all patient-related processes in the ED, described in Section 2.1. The inability to discharge ED-patients, particularly due to inpatient boarders occupying ED-beds while con-

tinuing to receive appropriate care, pending the availability of inpatient beds, contributes to output-related crowding [22, 24, 26]. These inpatient boarders can subsequently cause longer waiting times for subsequent ED arrivals [26]. Nursing workload comprises of the provision of care to all patients being present in the ED, from new ED arrivals to inpatient boarders, which indicates the direct link between nursing workload and crowding in the ED [22].

High nursing workload contributes to absenteeism, turnover, and job dissatisfaction among nurses [27, 28]. The ability to adapt to high nursing workload is reduced by the frequent exposure to occupational stressors [20], such as high workloads, overcrowding, patient acuity, inter-professional concerns, and staff turnovers [21, 28–30]. Occupational stress impacts both absenteeism and presenteeism, resulting in financial consequences for the employer and productivity losses among the employees who work despite their symptoms of illness, with subsequent an increased risk of adverse patient outcomes [28]. Although positive coping strategies are important in limiting occupational stress [28], research among ED-employees shows that problem-focussed interventions, such as organisational structures and processes, are likely to be more effective to reduce occupational stress than emotional-focussed interventions. Interventions resulting in reduced workload, reduced crowding, and improved staffing levels are related to optimising organisational structures and processes [31, 32].

3.2 Workload measurement methods

This section provides insight into methods to measure nursing workload as described in the literature, and shows an overview of the characteristics of these methods.

Adequate staffing is related to better patient outcomes, decrease in hospital admissions and readmissions, and less burnout symptoms and absenteeism among nurses. In decision-making on a strategic and operational level, forecasting case-mix and volumes of ED arrivals are important for workforce scheduling and resource planning [33, 34], since appropriate workforce scheduling in the ED is hampered by variety in volumes, patient dependency, and LOS among ED arrivals [33, 35]. To improve staffing levels, it is important to measure workload accurately [12,15,27,32]. In addition to forecasting ED arrivals, understanding in characteristics of the ED arrivals and their reasons to visit the ED is important in strategic decision-making [33].

Many nursing activities do not directly contribute to an objectively measurable product, which makes quantifying the nursing workload challenging [36]. Time-and-motion studies are used to analyse the nursing activities required to complete a task, but such systems often require retrospective reporting and are unable to describe the current nursing workload with a resolution of hours or minutes [36]. Health information systems enable to find out the workload and time commitment of nurses. However, it should be taken into account that accurate, comprehensive, and up-to-date documentation must be provided, which can be very difficult during a busy shift [20]. Fishbein et al. [19] categorised workload into four levels to enable the collection of objective workload measures via the HIS, namely, patient-level,

unit-level, task-level, and clinician-level measures. These categories comprise of objective measures related to patient characteristics, work environment, availability of resources, and skill mix of staffing, which should be included in workload measurement [15, 18].

3.2.1 Patient classification systems

Patient classification systems (PCS), also mentioned as 'nursing workload measurement systems', are usually used to measure nursing workload. The classification of the patient is based on factors determining the amount of work required for a patient or a group of patients [15, 37]. *Nurse-to-patient ratios* (NPR) are commonly used in inpatient nursing wards, which presents the number of patients that can be assigned to a nurse [12, 15]. Throughout a shift, nurses in inpatient wards constantly take care for a few patients, while on the other hand, ED-nurses take care for a lot more patient throughout the day for only a short period of time [15]. Likewise, volumes and patient dependency in the ED varies, which is not taken into account in the measurement of the NPR [12].

PCSs can be divided into prototypes and factortypes. Classification based on a prototype system is a subjective manner that focuses on only a few tasks, such as bathing, which are seen as indicators predicting the amount of patient care needed. Patients are divided into groups based on whether or not these tasks are necessary. The factortype system is an objective method to classify patients. All tasks performed to meet the patient's care needs have to be noted on a list, including the time required. Patients will be categorised based on the total time required [37].

Selection of a PCS should be based on validity, reliability, simplicity/efficiency, utility, objectivity, and acceptability. A systematic review of potentially suitable PCSs in the ED describes twelve PCSs, including four prototype and eight factortype systems [37]. The system should be easy to use [15], which is not the case for factortype systems which require comprehensive notation of all nursing tasks. Despite the prototype systems' subjective manner of classification, these systems enable verification of assessments through study replication and validity and reliability testing. Objectivity can be therefore be attained. In addition, the literature review indicates whether the PCSs are prospective and whether direct and indirect nursing time has been included.

The system should be prospective [26], which is the case for all four prototype systems. These prototype systems measure direct nursing time as well. The ED Patient Classification Matrix, Conner's Tool, and Jones Dependency Tool (JDT), which all are prototype systems, where the only three PCSs showing good validity and reliability. Of all PCSs, results for acceptability were only reported for the JDT, which was done through a Delphi study. In the Netherlands, the JDT is already in use in the ED in Dijklander hospital in Hoorn, where it is seen as a reflection of the perceived nursing workload. Table 3.1 shows an overview of

Table 3.1: Patient Classification Systems in the ED [37]

	Validity	Reliability	Simplicity/ efficiency/ utility	Objectivity	Acceptability	Prospective measure	Direct time	Indirect time	Type
Schulmerich (1984)	-	-	-	+	-	-	+	+	Factortype
Butler (1986), *ED Patient Classification Matrix*	+	+	+	-	-	+	+	-	Prototype
Helmer (1988)	-	-	-	+	-	-	+	+	Factortype
Stolley and Hachmann (1989)	-	+	-	+	-	-	+	+	Factortype
Levenstam and Engberg (1993)	-	-	-	+	-	-	+	+	Factortype
Gilbert (1993)	-	-	+	-	-	+	+	-	Prototype
Carr (1994), *GRASP tool*	-	-	-	+	-	-	+	+	Factortype
Nelson (1994)	-	-	-	+	-	-	+	+	Factortype
Conners (1994), *Conner's Tool*	+	+	+	-	-	+	+	-	Prototype
Taylor et al. (1997)	-	-	-	+	-	-	+	+	Factortype
Maxwell (1998)	-	-	-	+	-	-	+	+	Factortype
Crouch and Williams (2006), *Jones Dependency Tool*	+	+	+	-	+	+	+	-	Prototype

the characteristics of the twelve PCSs [37]. More recent studies in the JDT have shown that the degree of nursing intervention, which includes direct and indirect nursing time, correlates with the degree in patient dependency [38]. Therefore, we consider the indirect care missing in Table 3.1 as included in the JDT. See Figure E.1 in Appendix E for additional information in direct and indirect nursing time.

3.3 Measurement tool: Jones Dependency Tool

The Jones Dependency Tool scores six components of patient dependency, namely: communication; airway, breathing and circulation (ABC); mobility; eating, drinking, elimination and personal care; environmental safety, health and social needs; and triage. For each component, the box that is most appropriate for the patient/relative must be ticked, see Figure 3.1 [39]. Each component is rated on a three-point scale, resulting in a score between 6 and 18 [38]. These scores determine the degree of patient dependency, see Table 3.2.

Table 3.2: Patient dependency rating scale [38]

Rating	Dependency
6-7	Low
8-12	Moderate
13-15	High
16-18	Total

Component	3 points	2 points	1 point	Rating
Communication	▸ Complete impairment due to loss of one or more senses. ▸ Pain being at the higher range of the visual analogue scale. ▸ Unresponsive. ▸ Language barrier. ▸ Extensive behavioural problems.	▸ Impairment or potential for impairment of one or more senses. ▸ Pain at the mid-range of the visual analogue scale. ▸ Responding only to verbal and/or pain stimulation. ▸ Difficulty due to language barrier. ▸ Anxious, tearful and/or distressed.	▸ Able to communicate through all senses. ▸ Pain at the lower range of the visual analogue scale. ▸ Alert. ▸ No language barrier. ▸ Co-operative and/or relaxed.	
Airway, breathing and circulation (ABC)	▸ Cardiac and/or respiratory arrest, or risk of arrest. ▸ Complete impairment of ABC or shock.	▸ Risk of impairment to ABC (potential for shock due to condition).	▸ No ABC problems. ▸ Minor wounds.	
Mobility	▸ Total immobility.	▸ Partial mobility loss; patient requires trolley and/or wheelchair.	▸ Fully mobile. ▸ Minor limb problem.	
Eating, drinking, elimination and personal care	▸ Total loss of bowel and/or bladder function and/or hyperemesis. ▸ Total loss of independent self-care.	▸ Partial loss of bowel and/or bladder function and/or vomiting. ▸ Partial loss of independent self-care.	▸ Normal bowel and/or bladder control. No vomiting. ▸ Able to maintain independent self-care.	
Environmental safety, health and social needs	▸ Demonstrates danger to self or others. ▸ Appears to require extensive social support.	▸ Appears unable to fully understand risks. ▸ Appears to require some social support.	▸ Shows total ability to fully understand risks. ▸ Does not appear to require social support.	
Triage	▸ Red or orange.	▸ Yellow.	▸ Green or blue.	

Glossary of terms
Complete impairment = complete loss; impairment = some degree of loss; senses = any one of the five senses especially sight, hearing, touch; language barrier = inability to speak or speaks different language to nurse; behavioural problems = psychological or drug related; total loss = total inability to control own functions (may be ongoing); social support = co-ordination of relatives, environment and/or service provision; shock = hypovolaemic, cardiogenic, obstructive or distributive, requiring immediate intervention; partial mobility loss = has some ability to move limbs, but may require help with sitting and/or standing.

Figure 3.1: Jones Dependency Tool [38]

3.4 Conclusion

Although the complex and varying nature in the ED impedes predicting the demand for nursing care [20,37], a tool that provides insight into workload can still be useful for signalling trends, and visible peaks in workload can be used to identify and resolve managerial problems [20]. We agree with the assigned capabilities of the Jones Dependency Tool in validity, reliability, simplicity, acceptability, and the ability to prospective measure direct time [26, 37, 40]. Subsequently, we have confidence in the capabilities for objectivity and the ability to measure indirect time. In addition to identifying patterns in volumes and LOS of ED arrivals, the Jones Dependency Tool is chosen to gain insight in patient dependency and to measure nursing workload in the ED of SZ.

Chapter 4

Implementation process

The JDT is already available in HiX, which enables digital data collection via the HIS when this function is set up in SZ. This chapter describes the implementation process preceded to be able to use the JDT via HiX within SZ. Section 4.1 describes which stakeholders were involved in the implementation, Section 4.2 describes how the implementation is prepared, Section 4.3 describes which additional actions were required, Section 4.4 describes how the measurement weeks were organised, and Section 4.5 describes how measurement can be automated for future repetition.

4.1 Implementation team

To be able to set up the JDT in the HIS of SZ, the information analyst had to make adjustments in HiX. Therefore, we approached the information analyst of the ED to investigate and align the possibility of setting up the JDT in HiX. After confirmation that set up of the tool was possible, we had a meeting with the team manager of the ED, and consultation by phone with Dijklander hospital. Contact with Dijklander hospital was made via the network of the involved ED-physician in SZ. The JDT is already in use within the ED of Dijklander hospital. Therefore, we have been able to discuss experiences and problems they have encountered and to gain insight into matters that required extra effort to successfully implement the tool. During the meeting with the team manager, we aligned how ED-employees could be involved in the implementation. The team manager referred to the LEAN-team of the ED, which consists of two nurses and one secretary, who were expected to act as early adopters.

4.2 Preparation

Prior to aligning with the nurses of the LEAN-team, we designed a flyer to convince them of the relative advantage of the JDT. The flyer consisted of figures based on data analyses, see Figure 4.1. In addition to the flyer, we discussed the required commitment of the nurses, and obtained advice on how to approach ED-employees to successfully implement the JDT in the ED. The nurses were enthusiastic yet sceptical about the extra action required. We discussed questions that were asked with the information analyst and ED-physician of

Dijklander hospital.

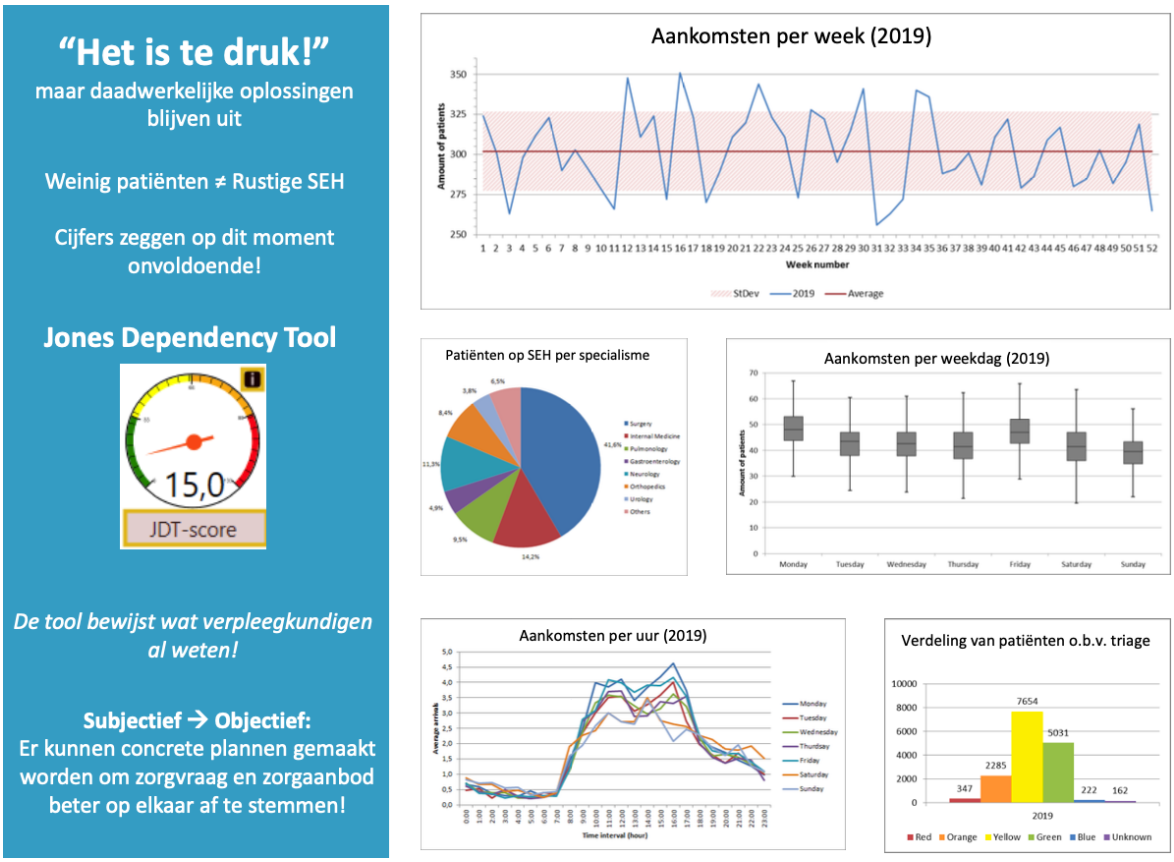


Figure 4.1: Flyer for convincing nurses of the relative advantage of the JDT

For the nurses, the importance of the study had to be clear, so that they would be willing to participate in the measurements. In order to create support among nurses, so that they would be motivated to actively participate in the study, the implementation of the tool has been announced in the weekly newsletter, emphasising the importance of the study for the nurses themselves, see Appendix F. The week prior to the start of the implementation, we were regularly present at the ED so that alignment could take place with as many different nurses as possible.

4.3 Additional actions required

Based on literature [38] and ED-stops in Dijklander hospital, HiX assumes that a nurse can carry a maximum workload of 30 points to guarantee safety and quality of care, which enables to exhibit the current nursing workload in the ED through a barometer. In addition to the questionnaire to be completed for each patient, the barometer must be adjusted to the current level of nurses present in the ED. Any time a nurse leaves or an extra nurse starts working should be adjusted in HiX. According to the two nurses and team manager, this is an undesirable extra administrative burden. Therefore, with the help of the information analyst, a system has been built in which standard nurse staffing levels, as mentioned in Section 2.2.2, are set during the day, with the possibility to deviate from this. To validate the workload

measured by the JDT, nurses have been asked to rate their perceived workload two times per shift by the use of an ordinal rating scale, see Table 4.1. The researcher designed a format on which the perceived workload could be noted, see Figure 4.2.

Table 4.1: Rating scale for the perceived workload

Colour	Perceived workload
Green	Low
Yellow	Moderate
Orange	High
Red	Too high

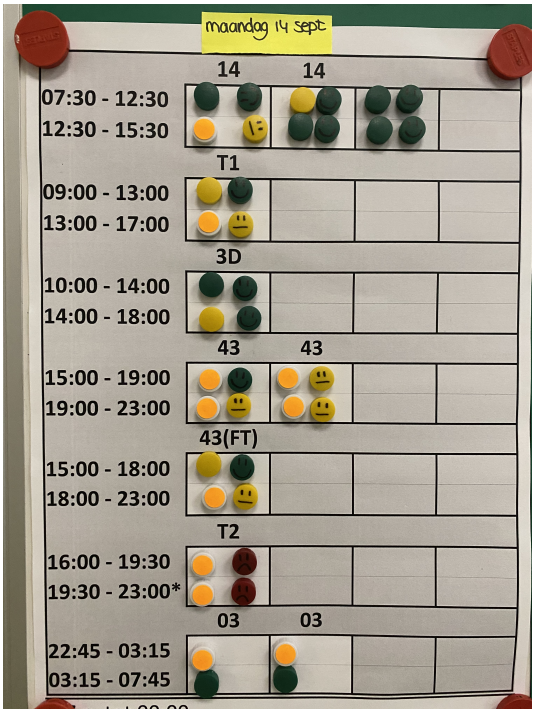


Figure 4.2: Rating format for the perceived workload

4.4 Measurement weeks

The tool was put in use from September 14, 2020. The researcher had planned to be present at the ED as much as possible during the two measurement weeks to support the nurses in the use of the JDT. The first day, final comments and questions were discussed during the pre-shift briefings. The following days, experiences of the tool were added to this. September 14, the researcher has been present at the ED during the whole day, to support the nurses working in the day, evening, and night shift as well as possible. The following days, the researcher was present during the day shift, and stayed at the ED until the evening shift's directing nurse was present, to align whether support was desirable. After the first week, it became clear that intensive support was no longer necessary, after which it was decided to only be present during the pre-shift briefings. During the measurement weeks, there was a varying degree of desired support and acceptance of the tool. The question why the tool had

to be implemented to measure what they are already experiencing resulted in a dialogue in which it was discussed that the JDT can demonstrate the actual workload on the basis of figures, against which improvement initiatives can be adjusted.

4.5 Future repetition

Prior to the implementation, we argued the desirability of continuing the use of the tool after the two measurement weeks in order to continue to generate data, and thus be able to recognise possible changes in nursing workload in seasonal patterns. During the second measurement week, a team meeting took place where we discussed experiences of the tool, we showed the first results, and we discussed that the use of the JDT would be continued. Continuation of the JDT is desired, since better predictions can be made by measuring workload for a longer period of time, which consequently will contribute to better resource planning and nurse staffing, where nurse staffing levels can be adjusted on nursing workload during the day, week, and year. Data regarding the JDT can easily be obtained from HiX, which simplifies future repetition.

Chapter 5

Workload measurement

This chapter shows the results of the zero-measurement in Section 5.1, the insights into differences between perceived and measured workload in Section 5.2, and conclusion in Section 5.3.

5.1 Workload related performance analysis

This section provides insight in the data analysis conducted, to wit, ED arrivals and the related performance metrics, the workload measured with the JDT, and the perceived workload of the nurses in the ED.

Table 5.1 shows the division of ED arrivals by age categories and dependency groups, in which we see that on average, patient dependency is higher at higher age, and more than half of the ED arrivals have a low dependency.

Table 5.1: Division of ED arrivals by age and dependency group (n = 1,276, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Age	Low	Moderate	High	Total
0-17	78.5%	18.6%	2.3%	0.6%
18-34	79.7%	18.6%	1.7%	0.0%
35-49	63.5%	32.1%	2.9%	1.5%
50-64	61.9%	32.8%	3.6%	1.6%
65-79	44.4%	50.5%	4.2%	0.9%
80+	26.0%	63.0%	10.0%	1.0%
Total	56.6%	38.2%	4.3%	0.9%

Figure 5.1 shows that the average total dependency of patients in the ED varies during the day, with similar patterns for the weekdays, however, with differing intensities.

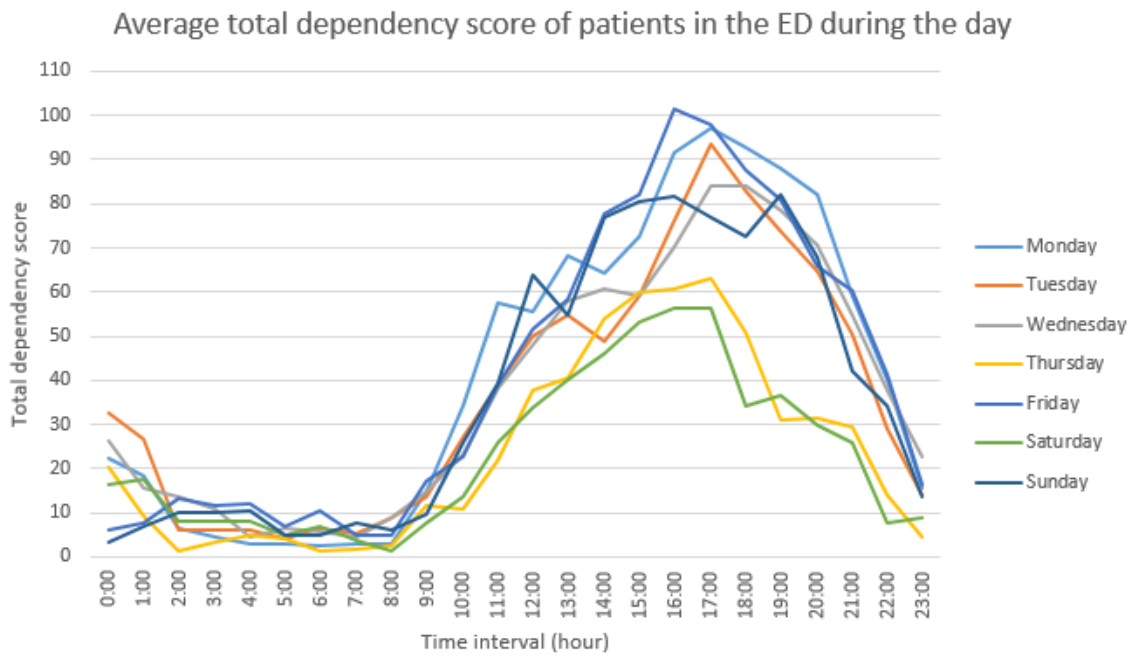


Figure 5.1: Average total dependency of patients in the ED during the day (n = 1,276, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Figure 5.2 shows the division in patient dependency in the ED on Mondays during the day. We see that the largest proportion of patients have a low dependency. See Figure G.2 in Appendix G for other weekdays.

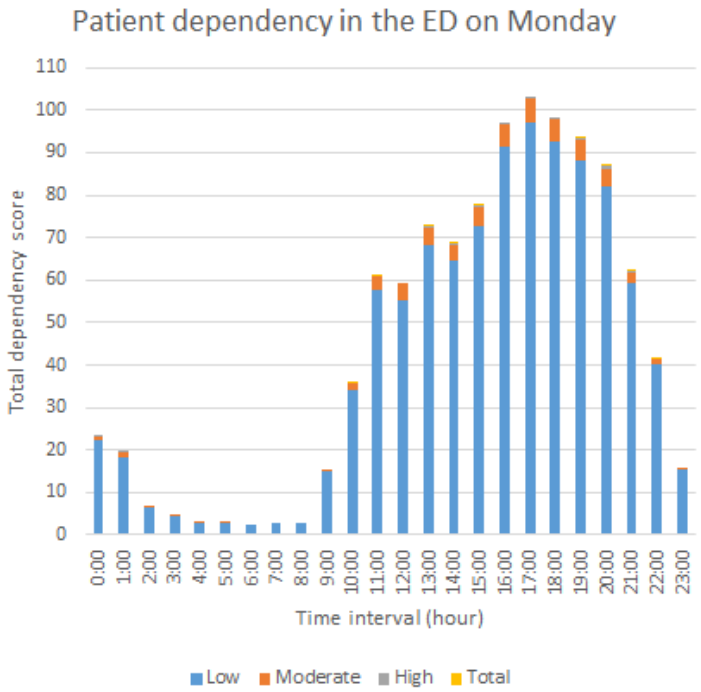


Figure 5.2: Patient dependency in the ED on Mondays (n = 236, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Throughput-times of patients in the ED is on average more than an hour longer in case

they need hospital admission, namely 3:20 hours compared to 2:04 hours when a patient is discharged. The average time for patients waiting to be admitted is 0:37 hours. The average duration of patients who will be admitted to a nursing home is 5:25 hours.

5.2 Measured and perceived workload

Table 5.2 shows the number of ratings given per shift. Regular shifts are shifts where nurses do not work in the fast track room and do not have a directing role.

Table 5.2: Completed ratings of the perceived workload

Shift	Expected	Completed	Percentage rated
Regular	654	575	87,9%
Directing	196	176	89,8%
Fast track	182	151	83,0%
Total	1006	902	89,7%

Figure 5.3 shows the measured nursing workload based on staffing levels and the assumption of a maximum workload of 30 points per nurse. JDT-scores of patients are included from arrival to discharge, since nurses in the ED take care for all these patients. Figure 5.4 shows the perceived nursing workload between September 14 and October 15.

		0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
Monday	14-09-20	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	14%	52%	33%	54%	74%	58%	60%	92%	103%	108%	104%	80%	54%	22%
Tuesday	15-09-20	87%	70%	22%	33%	12%	0%	20%	20%	33%	29%	28%	66%	53%	49%	41%	51%	45%	56%	84%	49%	48%	39%	36%	43%
Wednesday	16-09-20	18%	0%	0%	0%	0%	0%	0%	0%	0%	7%	16%	35%	45%	40%	52%	46%	37%	76%	98%	106%	88%	64%	30%	20%
Thursday	17-09-20	0%	10%	10%	10%	0%	12%	12%	13%	0%	0%	0%	23%	28%	28%	38%	71%	54%	51%	93%	63%	40%	53%	37%	28%
Friday	18-09-20	32%	10%	22%	22%	22%	20%	20%	20%	20%	20%	12%	30%	45%	53%	70%	83%	80%	99%	99%	77%	48%	53%	52%	12%
Saturday	19-09-20	40%	27%	0%	0%	0%	0%	15%	15%	0%	7%	10%	10%	30%	31%	52%	75%	70%	77%	21%	39%	48%	8%	16%	48%
Sunday	20-09-20	0%	0%	0%	30%	30%	20%	20%	20%	10%	8%	13%	40%	39%	39%	53%	46%	57%	105%	94%	97%	70%	48%	24%	23%
Monday	21-09-20	50%	25%	10%	10%	10%	10%	10%	0%	0%	13%	24%	65%	73%	77%	69%	76%	84%	94%	116%	101%	72%	56%	49%	35%
Tuesday	22-09-20	37%	35%	0%	0%	0%	12%	12%	0%	0%	8%	11%	18%	38%	49%	50%	69%	75%	112%	166%	132%	110%	82%	48%	35%
Wednesday	23-09-20	152%	92%	92%	77%	37%	55%	37%	37%	37%	29%	33%	31%	15%	78%	74%	108%	75%	109%	118%	113%	111%	110%	66%	37%
Thursday	24-09-20	32%	17%	0%	18%	18%	0%	0%	0%	20%	13%	7%	18%	33%	34%	68%	83%	52%	82%	46%	9%	10%	10%	7%	10%
Friday	25-09-20	0%	32%	32%	17%	17%	0%	10%	0%	0%	27%	30%	38%	30%	71%	82%	88%	81%	66%	63%	98%	68%	51%	44%	12%
Saturday	26-09-20	27%	58%	32%	32%	32%	0%	0%	0%	0%	7%	9%	19%	25%	22%	35%	23%	37%	66%	64%	57%	43%	37%	0%	0%
Sunday	27-09-20	0%	0%	0%	0%	15%	0%	12%	12%	12%	13%	15%	27%	73%	48%	73%	78%	63%	56%	64%	109%	76%	58%	43%	42%
Monday	28-09-20	63%	50%	15%	15%	15%	15%	0%	0%	0%	17%	30%	46%	51%	65%	51%	71%	77%	90%	151%	118%	117%	64%	41%	40%
Tuesday	29-09-20	43%	17%	0%	17%	17%	0%	0%	0%	15%	32%	50%	36%	38%	45%	23%	21%	17%	38%	41%	60%	43%	44%	24%	25%
Wednesday	30-09-20	30%	25%	10%	0%	0%	0%	0%	0%	10%	7%	5%	17%	24%	47%	50%	26%	52%	68%	121%	111%	100%	66%	43%	65%
Thursday	01-10-20	88%	32%	0%	0%	23%	23%	0%	0%	0%	34%	20%	26%	27%	32%	22%	23%	27%	23%	54%	33%	43%	27%	0%	0%
Friday	02-10-20	10%	10%	35%	40%	42%	12%	25%	13%	13%	9%	18%	32%	65%	47%	43%	37%	58%	91%	120%	120%	118%	100%	40%	35%
Saturday	03-10-20	0%	0%	0%	0%	0%	10%	20%	10%	10%	7%	16%	31%	23%	23%	13%	25%	10%	25%	59%	47%	30%	32%	0%	0%
Sunday	04-10-20	10%	15%	37%	12%	12%	0%	0%	20%	20%	22%	42%	37%	52%	37%	65%	65%	25%	22%	59%	70%	73%	40%	24%	0%
Monday	05-10-20	47%	42%	30%	12%	0%	0%	12%	12%	12%	8%	38%	43%	26%	28%	17%	32%	46%	82%	100%	104%	89%	78%	50%	32%
Tuesday	06-10-20	85%	88%	30%	0%	22%	22%	22%	12%	12%	7%	6%	6%	18%	23%	17%	30%	43%	73%	97%	114%	104%	72%	20%	0%
Wednesday	07-10-20	20%	13%	13%	13%	0%	0%	0%	0%	0%	14%	23%	41%	52%	38%	37%	21%	30%	23%	46%	31%	0%	8%	16%	23%
Thursday	08-10-20	0%	0%	0%	0%	0%	0%	0%	0%	0%	18%	18%	18%	44%	43%	58%	52%	48%	60%	28%	36%	39%	31%	16%	0%
Friday	09-10-20	0%	0%	0%	0%	0%	15%	15%	0%	0%	21%	17%	30%	32%	24%	64%	68%	52%	70%	107%	66%	60%	63%	48%	50%
Saturday	10-10-20	43%	32%	22%	23%	23%	23%	12%	0%	0%	14%	11%	26%	35%	58%	53%	53%	34%	21%	8%	21%	12%	39%	18%	10%
Sunday	11-10-20	12%	32%	32%	27%	13%	13%	0%	0%	0%	0%	18%	28%	49%	58%	65%	80%	73%	73%	106%	90%	83%	42%	60%	27%
Monday	12-10-20	27%	37%	0%	0%	0%	0%	0%	12%	12%	46%	35%	34%	49%	60%	58%	66%	38%	48%	44%	59%	73%	51%	29%	0%
Tuesday	13-10-20	22%	12%	0%	0%	0%	0%	0%	13%	13%	0%	18%	37%	62%	62%	73%	75%	73%	111%	73%	53%	54%	43%	34%	13%
Wednesday	14-10-20	0%	0%	0%	0%	0%	0%	12%	0%	27%	26%	19%	36%	64%	38%	40%	46%	41%	73%	86%	76%	93%	57%	56%	43%
Thursday	15-10-20	48%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	25%	32%	38%	22%	21%	47%	62%	32%	43%	42%	20%	0%

Figure 5.3: Nursing workload in the ED (n = 1,276, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

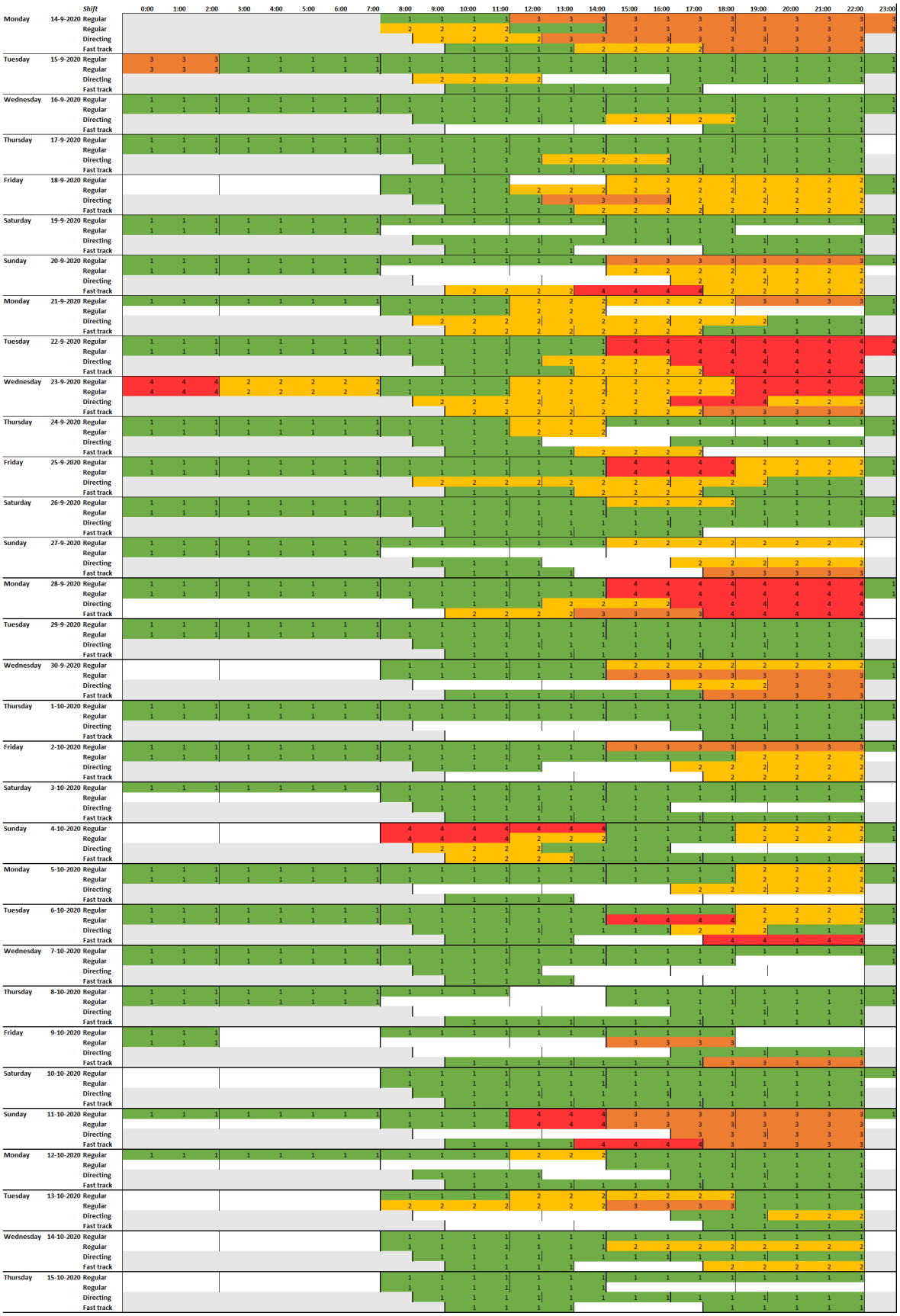


Figure 5.4: Perceived nursing workload in the ED (n = 1,923, T = 14-09-2020 - 15-09-2020, source: Perceived nursing workload measurements)

Between September 14 and October 15, ED-stops were announced on September 22, 17:50-19:50; September 25, 15:30-17:30; and September 28, 17:30-19:30. On days when ED-stops were announced, the JDT score increases further in advance. For September 22 and September 28, Figure 5.3 shows the highest measured nursing workloads. However, September 25 does not relate to this. Due to the coronavirus, this exceptional situation occurred where COVID-19 patients were accountable for the ED-stop by occupying ED-beds.

Table 5.3: Share of deviation in the perceived workload compared to the measured workload (T = 14-09-2020 - 15-10-2020, source: Perceived nursing workload measurements)

	Low	**Moderate**	**High**	**Too high**	**Total**
Number of deviations	50	538	235	95	918
Share of deviation	5.4%	58.6%	25.6%	10.3%	100.0%

Because the measurement of perceived workload is tuned to categories in the barometer, perceived workload can be compared to the measured workload based on low, moderate, high, and too high workload. Table 5.4 shows the degree of higher, equal or lower perceived workload compared to the measured workload. At times when the measured workload is low, a higher workload was perceived in 5.4% of the cases. For a moderate workload, 58.6% of the perceived workload deviated, and this was 25.6% when measured workload was high, and 10.3% when the workload was measured as too high. Deviations in perceived workload compared to the measured workload can largely be classified as a lower perceived workload compared to the measured workload. Among the nurses who worked in the fast track shift, in 51.4% of all measurements, the perceived workload was lower than the measured workload.

Table 5.4: Percentage of deviating perceived workload compared to the measured workload (T = 14-09-2020 - 15-10-2020, source: Perceived nursing workload measurements)

Shift	**Higher**	**Equal**	**Lower**
Regular	8.0%	58.3%	33.7%
Directing	8.8%	42.4%	48.8%
Fast track	10.3%	38.4%	51.4%
Total	8.5%	52.1%	39.4%

By measuring the average deviation of the perceived workload compared to the measured workload, Figure 5.5 shows the percentages of deviation of the measured workload during the day. The figure shows that when a moderate workload is measured, this is perceived differently in most cases, namely 69% of all deviations.

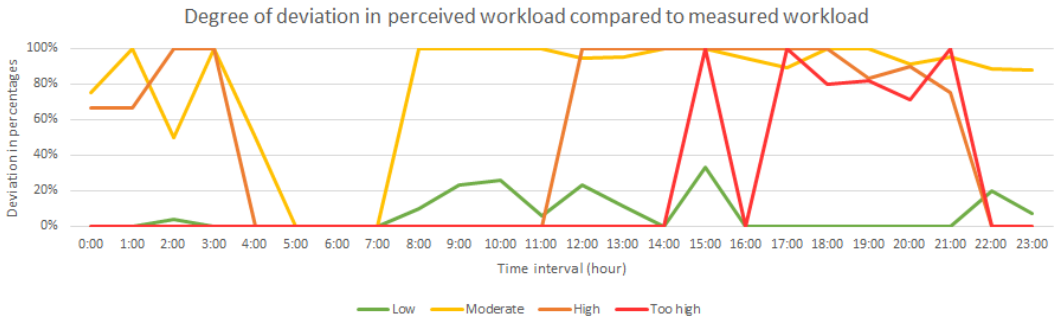


Figure 5.5: Degree of deviation of perceived workload among nurses in the ED (T = 14-09-2020 - 15-09-2020, source: Perceived nursing workload measurements)

In total, 80.7% rated their perceived nursing workload, in which 52.1% corresponds with the actual workload. 8.5% rated their perceived workload higher than the actual workload, and 39.4% rated their perceived workload lower than the actual workload. Figure 5.6 shows the deviation of perceived workload compared to the actual workload classified by patient dependency group.

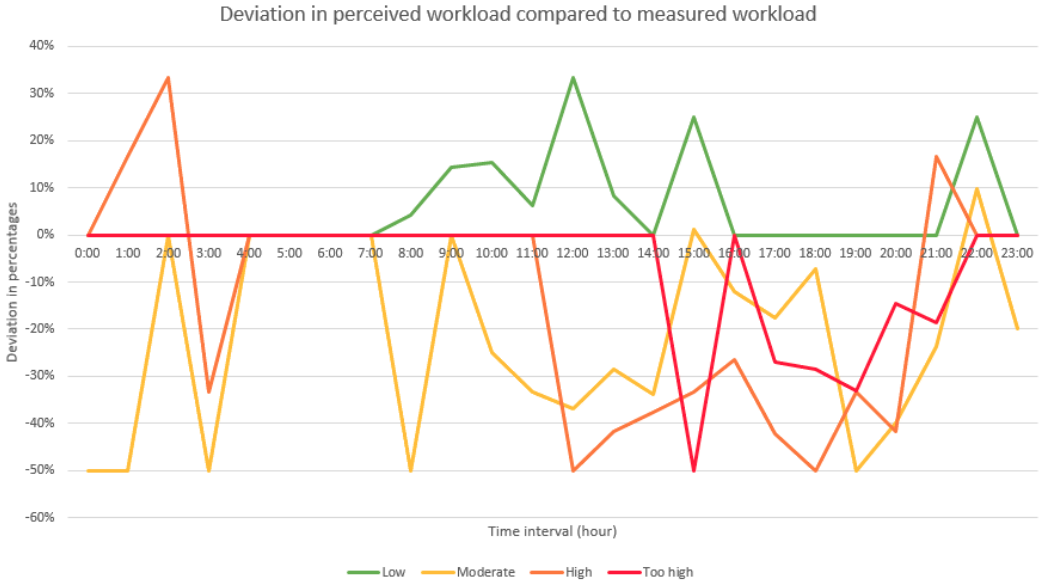


Figure 5.6: Deviation of the perceived workload compared to measured workload among nurses in the ED (T = 14-09-2020 - 15-09-2020, source: Perceived nursing workload measurements)

5.3 Conclusion

The perceived nursing workload does not always match with the measured nursing workload. Especially when the JDT represents a moderate workload, nurses often indicate that the workload is low. In observations and interviews with nurses it has clarified that, despite the perceived low workload, the nurses postponed their lunch break due to patient care. Even though the perceived nursing workload does not always match with the measured nursing workload, it is possible that due to the unpredictable atmosphere in the ED, nurses are used to varying and high workloads, by which means a lower workload is perceived.

Chapter 6

Conclusion and discussion

Section 6.1 presents the conclusions on the research with corresponding recommendations, and Section 6.2 presents discussions about the research conducted.

6.1 Conclusion

This section presents the most interesting findings from the previous chapters, namely the answers to the research questions presented in Section 1.3, by which the research objective has been achieved. The research objective was:

To develop a formalised approach for measuring workload-related performance in the ED, and to perform a zero-measurement in Slingeland hospital.

How can nursing workload be measured in the ED?
By gaining insight in the organisation's healthcare planning and control with the use of the healthcare framework [13] and gaining knowledge in measurement of nursing workload, it became clear that patient dependency - better known as 'intensity of care' - which strongly affects nursing workload, was not measured in the ED of SZ. To find a suitable way to measure patient dependency, we conducted a literature review in which multiple methods for measuring nursing workload were compared. Based on the literature review, the Jones Dependency Tool was found to be the most suitable method for a zero-measurement in the ED of SZ.

How can a workload measurement tool be implemented in the ED of SZ?
To implement the Jones Dependency Tool in the ED of SZ, an implementation process was developed, to operationalise the JDT within HiX. Several stakeholders were involved to make the implementation successful, among which the team manager, information analyst, ED-physician, two ED-nurses, and an ED-physician of Dijklander hospital where the JDT was already in use. By involving more and more people in a controlled and step-by-step way, keeping focus on the relative advantage for the nurses, and by thinking in advance about possible questions and critical notes, the implementation in the ED was without major set-backs. During a team meeting, desirability of continuation of the JDT is discussed, since

better predictions can be made by measuring the workload for a longer period of time, which consequently will contribute to better resource planning and nurse staffing.

What is the current workload related performance of the hospital's ED?
Although nurse staffing is the same every weekday, data analysis has shown that arrival patterns in the ED vary through the week and through the day. Especially on Mondays and Fridays more patients were treated in the ED, in contrary to Thursdays and Saturdays where the least patients were treated. These variations contribute to higher nursing workloads on Mondays and Fridays, and lower nursing workloads on Thursdays and Saturdays. However, due to a limited period of workload measurement, the degree of variation in ED arrivals through the week is uncertain. Therefore, continuation of the JDT is desired, since better predictions can be made by measuring workload for a longer period of time, which consequently will contribute to better resource planning and nurse staffing, where nurse staffing levels can be adjusted on nursing workload during the day, week, and year. At times when the measured workload is low, a higher workload was perceived in 5.4% of the cases. For a moderate workload, 58.6% of the perceived workload deviated, and this was 25.6% when measured workload was high, and 10.3% when the workload was measured as too high. Deviations in perceived workload compared to the measured workload can largely be classified as a lower perceived workload compared to the measured workload. Among the nurses who worked in the fast track shift, in 51.4% of all measurements, the perceived workload was lower than the measured workload.

To translate the results in the study into interventions, recommendations are discussed in the following section.

6.1.1 Recommendations

Based on the insights obtained through this research, this section describes interventions that can contribute to improvement of workload related performance in the ED.

Agreements in the crowding protocol
The crowding protocol is established without measurable starting points. Therefore, the ED-physician puts the protocol in operation on his own discretion. The JDT provides insight into the current nursing workload, and data analysis has shown that when an ED-stop is announced, nursing workload has been visibly increasing for a longer period of time. Changing from reactive to pro-active behaviour will contribute to the prevention of excessive workloads. To implement agreements in the crowding protocol, a flow chart should be connected to the current protocol, whereby the current JDT-score is leading in the already existing protocol.

Rearrange and improve registrations in HiX
Since not all KPIs can be measured, the ED is unable to monitor their performances. This can negatively impact the outcome of these unmeasured KPIs, since adjustment cannot take place. Subsequently, due to free input fields, the reason why patients come to the ED,

and whether they arrive by ambulance or with their own transport is often unclear. This complicates data analysis in ED arrivals. For these reasons, it is desired to rearrange and improve registrations in HiX.

Reorganise ED-referrals

More than 10% of all ED arrivals are referred by their GP to radiology because of suspected fractures. These patients arrive at the radiology department within office hours before they come to the ED. The pattern of occupation of the ED by these patients is similar to the other patient groups, which can lead to an additional increasing workload. If these patients no longer come to the ED, but can receive further care in the plaster room or at the outpatient clinic, the chance of an additional increase in the nursing workload will be reduced.
To reorganise ED-referrals, these patients should be included in the annual plans for the outpatient clinic, so that semi-urgent planning in the outpatient clinic is taken into account.

Reorganise appointments

The purpose of the ED is to treat emergency patients. Patients who have been in the ED for plaster in the previous days and shows up with plaster complaints or patients with abdominal complaints who return to the ED by appointment the next day for reassessment are no longer emergency patients. To avoid appointments in the ED, semi-urgent reassessment of abdominal complaints should be scheduled in the outpatient clinic and plaster complaints should be scheduled in the plaster room.

Staffing

During the week, the amount of ED arrivals varies widely. Continuation of the JDT is desired, since better predictions can be made by measuring workload for a longer period of time, which consequently will contribute to better resource planning and nurse staffing, where nurse staffing levels can be adjusted on nursing workload during the day, week, and year.

6.2 Discussion

Despite the presence of the coronavirus, we have chosen not to focus on this. However, this may have had an impact on reliability and results such as higher psycho-social workload and increase in absenteeism. Due to the coronavirus, a lot of processes in the hospital have changed. Among which the arrival of cardiac patients. Cardiac patients normally arrive in the First Heart Aid (EHH), but due to the coronavirus, reorganisation and relocation of care within the whole hospital was necessary, whereby cardiac patients were relocated to the ED from October 16. Since this is an unusual situation, data included in the data analysis is limited to October 15.

The perceived workload was not always registered, but when this is compared with the measured workload, it appears to have been at times when the workload was mainly not high. Further registrations show that nurses like to note when the perceived workload has

been too high, while registrations are more often forgotten at quieter times. This corresponds to the fact that it is very human to forget normal things and remember incidents.

References

[1] P. Meerdink, "Stichting 'Doetinchemse Ziekenhuizen'," 2015. [Online]. Available: https://www.archivesportaleurope.net/ead-display/-/ead/pl/aicode/NL-DtcSARA/type/fa/id/0465

[2] Slingeland Ziekenhuis, "Spoedeisende hulp (SEH)," February 2020. [Online]. Available: https://www.slingeland.nl/website/spoedeisende-hulp/579

[3] M. van der Geest, "Ziekenhuizen: eisen aan spoedzorg voor ouderen te hoog, kosten dreigen uit de hand te lopen," *Volkskrant*, May 2019.

[4] Federatie Medisch Specialisten, "Kwaliteitskader Spoedzorgketen aangeboden," April 2019. [Online]. Available: https://www.demedischspecialist.nl/nieuws/kwaliteitskader-spoedzorgketen-aangeboden

[5] C. van Soelen and D. de Clerck, "Zorginfarct: elke dag minstens 560 ziekenhuisbedden onnodig bezet," *RTL nieuws*, February 2020.

[6] F. Weeda, "Het ziekenhuis raakt verstopt door ouderen die er niet horen," *NRC*, February 2020.

[7] M. Effting, "Nieuwsuur: 'Patiëntveiligheid op Spoedeisende Hulp in gevaar bij LUMC'," *NRC*, June 2020.

[8] M. Gaakeer, "Emergency Departments in the Netherlands: an exploration of characteristics and operational standards for the purpose of future optimization," 2019. [Online]. Available: https://www.eur.nl/sites/corporate/files/2019-12/proefschrift-menno-gakeer.pdf

[9] Skipr, "Concentratiebeleid SEH's is te eenzijdig en contraproductief," December 2019. [Online]. Available: https://www.skipr.nl/nieuws/concentratiebeleid-sehs-is-te-eenzijdig-en-contraproductief/

[10] IZZ, "Hoge werkdruk op SEH," 2018. [Online]. Available: https://www.izz.nl/thema/gezond-werken/psychische-belasting/artikelen/hoge-werkdruk-op-seh

[11] CBS, "Uitkomsten werknemersenquête AZW 1e meting 2019," 2019. [Online]. Available: https://www.cbs.nl/-/media/_excel/2019/40/eerste-uitkomsten-werknemers-2019.xlsx

[12] L. A. Wolf, C. Perhats, A. M. Delao, P. R. Clark, and M. D. Moon, "On the Threshold of Safety: A Qualitative Exploration of Nurses' Perceptions of Factors Involved in Safe Staffing Levels in Emergency Departments," *Journal of Emergency Nursing*, vol. 43, no. 2, pp. 150–157, November 2016.

[13] E. Hans, M. V. Houdenhoven, and P. J. H. Hulshof, "A framework for health care planning and control," *Memorandum (Institute of Pacific Relations, American Council)*, 2011.

[14] D. Hesselink, "Met een stopwatch op de SEH," *Inzage 2013*, pp. 29–30, 2013. [Online]. Available: https://www.netwerkacutezorg.nl/wp-content/uploads/Inzage-2013.pdf

[15] P. Swiger, D. Vance, and P. Patrician, "Nursing Workload in the Acute Care Setting: A Concept Analysis of Nursing Workload," *Nursing Outlook*, vol. 64, 2016.

[16] M. G. Alghamdi, "Nursing workload: a concept analysis," *Journal of Nursing Management*, vol. 24, no. 4, pp. 449–457, May 2016.

[17] S. Iordache, M. Elseviers, R. De Cock, and B. Van Rompaey, "Development and validation of an assessment tool for nursing workload in emergency departments," *Journal of Clinical Nursing*, vol. 29, no. 5-6, pp. 794–809, 2019.

[18] D. Myny, D. De Bacquer, A. Van Hecke, D. Beeckman, S. Verhaeghe, and D. Van Goubergen, "Validation of standard times and influencing factors during the development of the Workload Indicator for Nursing," *Journal of Advanced Nursing*, vol. 70, no. 3, pp. 674–686, mar 2014.

[19] D. Fishbein, S. Nambiar, K. McKenzie, M. Mayorga, K. Miller, K. Tran, L. Schubel, J. Agor, T. Kim, and M. Capan, "Objective measures of workload in healthcare: a narrative review," pp. 1–17, December 2019.

[20] H. Ead, "Change Fatigue in Health Care Professionals—An Issue of Workload or Human Factors Engineering?" *Journal of PeriAnesthesia Nursing*, vol. 30, no. 6, pp. 504–515, 2015.

[21] C. L. Enns and J. A. V. Sawatzky, "Emergency Nurses' Perspectives: Factors Affecting Caring," *Journal of Emergency Nursing*, vol. 42, no. 3, pp. 240–245, May 2016.

[22] P. W. Crane, Y. Zhou, Y. Sun, L. Lin, and S. M. Schneider, "Entropy: A conceptual approach to measuring situation-level workload within emergency care and its relationship to emergency department crowding," *Journal of Emergency Medicine*, vol. 46, no. 4, pp. 551–559, 2014.

[23] Australasian College for Emergency Medicine, "Policy on Standard Terminology," Tech. Rep., June 2019. [Online]. Available: https://acem.org.au/getmedia/e5cf7ac4-dae5-4193-be9a-6746b0d85009/P02{_}Standard{_}Terminology{_}Dec-14.aspx

[24] B. R. Asplin, D. J. Magid, K. V. Rhodes, L. I. Solberg, N. Lurie, and C. A. Camargo, "A conceptual model of emergency department crowding," *Annals of Emergency Medicine*, vol. 42, no. 2, pp. 173–180, 2003.

[25] R. Calegari, F. S. Fogliatto, F. R. Lucini, J. Neyeloff, R. S. Kuchenbecker, and B. D. Schaan, "Forecasting Daily Volume and Acuity of Patients in the Emergency Department," *Computational and Mathematical Methods in Medicine*, vol. 2016, 2016.

[26] W. Varndell, E. Ryan, A. Jeffers, and N. Marquez-Hunt, "Emergency nursing workload and patient dependency in the ambulance bay: A prospective study," *Australasian Emergency Nursing Journal*, vol. 19, no. 4, pp. 210–216, November 2016.

[27] L. Berry and P. Curry, *Nursing Workload and Patient Care: Understanding the Value of Nurses, the Effects of Excessive Workload, and How Nurse-Patient Ratios and Dynamic Staffing Models Can Help*, 1st ed. Ottowa, Ontario: The Canadian Federation of Nurses Unions, 2012.

[28] E. Elder, A. N. Johnston, M. Wallis, J. H. Greenslade, and J. Crilly, *International Emergency Nursing*, July, pages = 17–24, pmid = 31053392, publisher = Elsevier Ltd, title = Emergency clinician perceptions of occupational stressors and coping strategies: A multi-site study, volume = 45, year = 2019.

[29] J. Crilly, J. H. Greenslade, A. Johnston, E. Carlström, O. Thom, L. Abraham, D. Mills, and M. Wallis, "Staff perceptions of the emergency department working environment: An international cross-sectional survey," *EMA - Emergency Medicine Australasia*, vol. 31, no. 6, pp. 1082–1091, December 2019.

[30] H. G. Xu, A. N. Johnston, J. H. Greenslade, M. Wallis, E. Elder, L. Abraham, O. Thom, E. Carlström, and J. Crilly, "Stressors and coping strategies of emergency department nurses and doctors: A cross-sectional study," *Australasian Emergency Care*, vol. 22, no. 3, pp. 180–186, September 2019.

[31] E. Elder, A. N. Johnston, M. Wallis, and J. Crilly, "The demoralisation of nurses and medical doctors working in the emergency department: A qualitative descriptive study," *International Emergency Nursing*, vol. 52, p. 100841, September 2020.

[32] M. F. Hellín Gil, M. J. López Montesinos, A. M. Seva Llor, M. P. Ferrer Bas, and M. L. Maciá Soler, "Assessing the adequacy of workload measurement tools using a quality-based methodology," *Revista Brasileira de Enfermagem*, vol. 70, pp. 39–46, January 2017.

[33] F. Zaerpour, D. P. Bischak, M. B. Menezes, A. McRae, and E. S. Lang, "Patient classification based on volume and case-mix in the emergency department and their association with performance," *Health Care Management Science*, vol. 23, no. 3, pp. 387–400, September 2020.

[34] M. Afilal, F. Yalaoui, F. Dugardin, L. Amodeo, D. Laplanche, and P. Blua, "Forecasting the Emergency Department Patients Flow," *Journal of Medical Systems*, vol. 40, no. 7, July 2016.

[35] L. T. Wundavalli, P. Kumar, and S. Dutta, "Workload Indicators of Staffing Need as a tool to determine nurse staffing for a high volume academic Emergency Department: An observational study," *International Emergency Nursing*, vol. 46, September 2019.

[36] E. L. Clopton and E. K. Hyrkäs, "Modeling emergency department nursing workload in real time: An exploratory study," *International Emergency Nursing*, vol. 48, January 2020.

[37] S. Williams and R. Crouch, "Emergency department patient classification systems: A systematic review," pp. 160–170, July 2006.

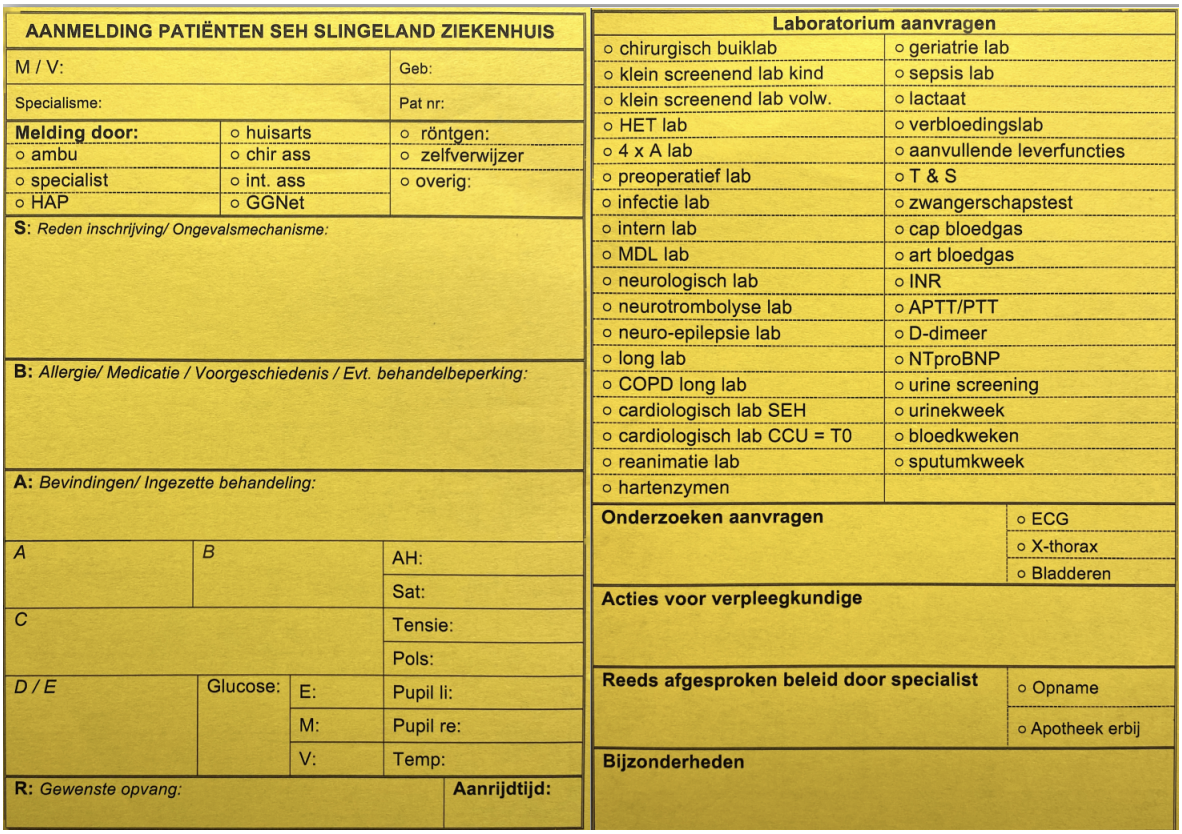
[38] G. Jones, "Measuring patient dependency in the emergency department," *Nursing standard (Royal College of Nursing (Great Britain) : 1987)*, vol. 30, no. 2, pp. 38–43, September 2015.

[39] R. Crouch and S. Williams, "Patient dependency in the emergency department (ED): Reliability and validity of the Jones Dependency Tool (JDT)," *Accident and Emergency Nursing*, vol. 14, no. 4, pp. 219–229, October 2006.

[40] W. Varndell, C. MacGregor, R. Gallagher, and M. Fry, "Measuring patient dependency-performance of the Jones dependency tool in an Australian emergency department," *Australasian Emergency Nursing Journal*, vol. 16, no. 2, pp. 64–72, May 2013.

Appendix A

Registration paper



AANMELDING PATIËNTEN SEH SLINGELAND ZIEKENHUIS

M / V:		Geb:
Specialisme:		Pat nr:
Melding door:	○ huisarts	○ röntgen:
○ ambu	○ chir ass	○ zelfverwijzer
○ specialist	○ int. ass	○ overig:
○ HAP	○ GGNet	

S: *Reden inschrijving/ Ongevalsmechanisme:*

B: *Allergie/ Medicatie / Voorgeschiedenis / Evt. behandelbeperking:*

A: *Bevindingen/ Ingezette behandeling:*

A	*B*		AH:
			Sat:
C			Tensie:
			Pols:
D / E	Glucose:	E:	Pupil li:
		M:	Pupil re:
		V:	Temp:

R: *Gewenste opvang:* **Aanrijdtijd:**

Laboratorium aanvragen

○ chirurgisch buiklab	○ geriatrie lab
○ klein screenend lab kind	○ sepsis lab
○ klein screenend lab volw.	○ lactaat
○ HET lab	○ verbloedingslab
○ 4 x A lab	○ aanvullende leverfuncties
○ preoperatief lab	○ T & S
○ infectie lab	○ zwangerschapstest
○ intern lab	○ cap bloedgas
○ MDL lab	○ art bloedgas
○ neurologisch lab	○ INR
○ neurotrombolyse lab	○ APTT/PTT
○ neuro-epilepsie lab	○ D-dimeer
○ long lab	○ NTproBNP
○ COPD long lab	○ urine screening
○ cardiologisch lab SEH	○ urinekweek
○ cardiologisch lab CCU = T0	○ bloedkweken
○ reanimatie lab	○ sputumkweek
○ hartenzymen	

Onderzoeken aanvragen	○ ECG
	○ X-thorax
	○ Bladderen

Acties voor verpleegkundige

Reeds afgesproken beleid door specialist	○ Opname
	○ Apotheek erbij

Bijzonderheden

Appendix B

Organisational chart

Figure B.1 gives an overview of the organisation of SZ. The five blue clusters are managed by three cluster managers, mentioned as cluster manager care. Cluster acute care includes all acute departments and its corresponding disciplines, namely: the ED, the AMU, the ICU, and the SCU/CCU/EHH.

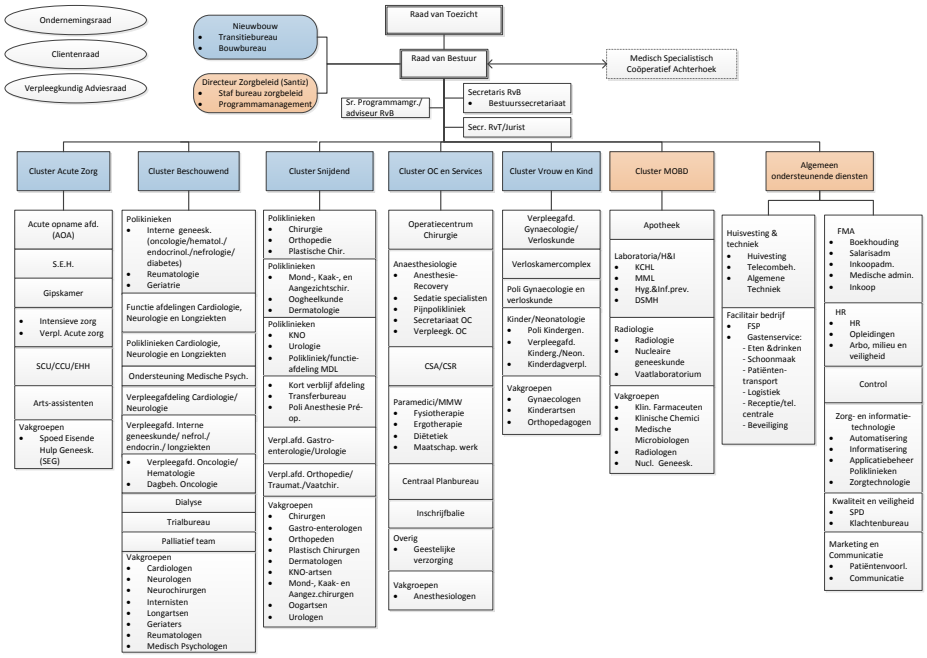
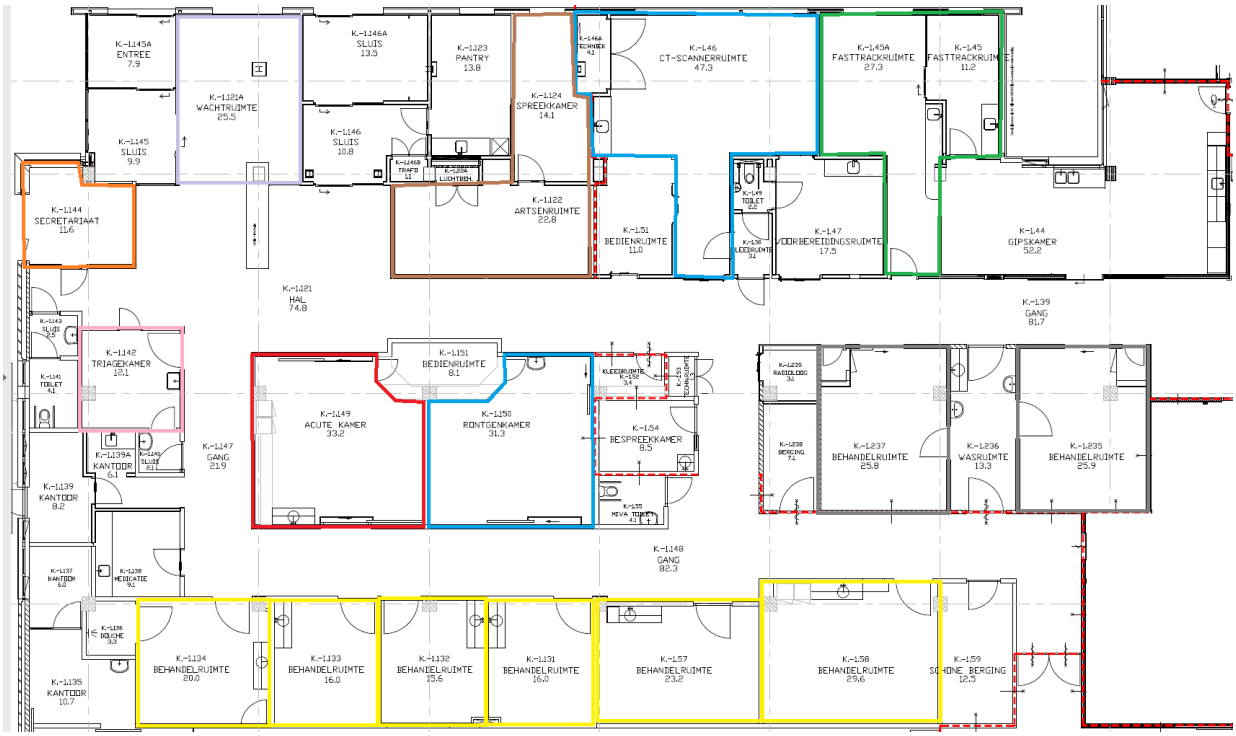


Figure B.1: Organisational chart of Slingeland hospital

Appendix C

Overview of the ED

- Orange = Secretary desk
- Pink = Triage room
- Purple = Waiting room
- Red = Acute treatment room
- Yellow = Treatment room
- Green = Fasttrack room
- Blue = Diagnostics rooms
- Brown = Staff room
- Grey = Outpatient operating rooms



Appendix D

Literature review

With searching terms *"workload measurement"*(26), *factors* AND "nursing* workload" AND "emergency department"*(40), *varying emergency nurse* workload*(17), and *"patient classification" emergency department*(16), PubMed gave, in total, 99 hits for articles published within the last 5 years. In total, 18 articles were directly included, and based on snowballing, 10 more relevant articles were included, see Figure D.1.

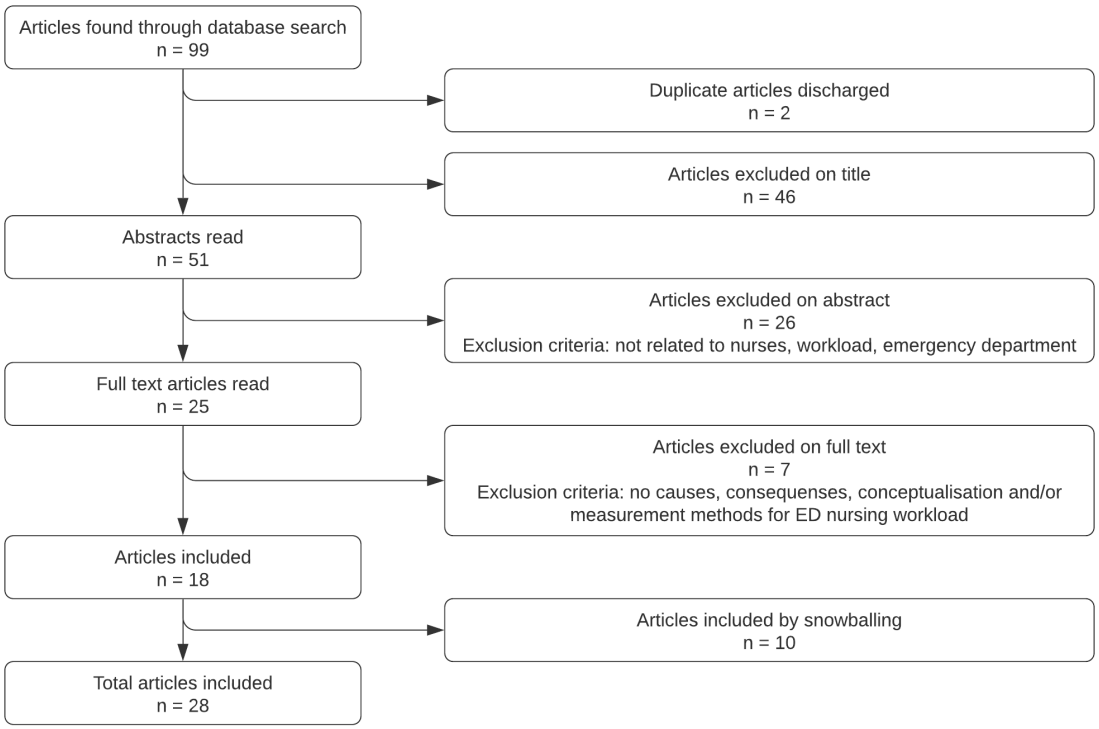


Figure D.1: Literature search flow chart

Appendix E

Direct and indirect care

Component	Total dependency	High dependency	Moderate dependency	Low dependency
Communication	▸ Nurse present at all times (one-to-one) (direct care (D)/ indirect care (I)). ▸ Constant attention due to behavioural problems and/or a need for psychological support (D). ▸ Constant support and/or frequent contact with relatives (I). ▸ May require intramuscular or intravenous analgesia.	▸ Constant observation (but not requiring one-to-one) (D/I). ▸ Frequent attention due to behavioural problems and/or a need for psychological support (D). ▸ Frequent support and/or contact of relatives and/or friends due to severity and/or death of patient (I). ▸ May require intramuscular or intravenous analgesia.	▸ Nurse available in calling distance (D/I). ▸ Reassurance and/or psychological support (D). ▸ May require relatives to be informed and/or explanation (I). ▸ May require intramuscular or intravenous analgesia.	▸ Nurse available in the department (D/I). ▸ Reassurance (D).
Airway, breathing and circulation (ABC)	▸ Frequent (15 minutes) vital signs (D). ▸ Constant airway and/or breathing attention (D). ▸ Resuscitation (D). ▸ Rapid intravenous fluids (D). ▸ Extensive or time-consuming interventions and/or tests (D/I).	▸ Vital signs (30 minutes-1 hour) (D). ▸ Observation and/or intervention with airway and/or breathing (oxygen administration) (D). ▸ Frequent intravenous fluids (D). ▸ Require various blood tests (D/I).	▸ Vital signs (2-4 hours) (D). ▸ Intravenous fluids (D).	▸ Vital signs once only (D). ▸ Minimal wound care (D).
Mobility	▸ Frequent pressure area care (D). ▸ Constant elimination support (D). ▸ Extensive or time-consuming interventions and/or tests (D/I).	▸ Pressure area care (1-2 hours) (D). ▸ Require X-rays and/or scans (D/I).	▸ Pressure area care (4-6 hours) (D).	▸ Nil specific.
Eating, drinking, elimination and personal care	▸ Requires constant attention to care.	▸ Assistance with bedpans and/or urinals (D).	▸ Assistance with toiletry, commode and/or walking to the toilet (D).	▸ Nil specific.
Environmental safety, health and social needs	▸ Constant attention due to behavioural problems (D). ▸ If discharged will require complex discharge arrangements involving more than one service provider (I). ▸ Admission planning (I). ▸ Will require escorting to wards and/or departments (D). ▸ Extensive, time-consuming health promotion and/or self-care advice required (D).	▸ Frequent attention due to behavioural problems (D). ▸ If discharged will require complex discharge arrangements involving more than one service provider (I). ▸ May require admission planning (I). ▸ Will require escorting to wards and/or departments (D). ▸ More extensive health promotion and/or self-care advice required (D).	▸ May require some discharge planning linked with one service provider (I). ▸ May require admission planning (I). ▸ May require escorting to wards and/or departments (D). ▸ Requires some health promotion and/or self-care guidance (D).	▸ Discharge planning is uncomplicated (I). ▸ Some health promotion and/or self-care may be required (D).

Once the dependency score has been obtained using the JDT, possible nursing workload could include: (D) = direct care (I) = indirect care.
Individual patients will vary in the workload generated, but in most cases one or more activities in each component section will be required.
Total dependency = overall score of 3
Patients require total nursing care and a one-to-one input.
High dependency = overall score of 2
Patients require a high level of nursing intervention, but less than that required by a totally dependent patient.
Moderate dependency = overall score of 1
Patients require moderate levels of nursing intervention and are encouraged to become independent.
Low dependency = overall score of 0
Patients require a minimal level of nursing intervention. May require some first aid at triage and wound care.

Figure E.1: Overview of direct and indirect care according to the Jones Dependency Tool

Appendix F

Information for ED-employees

At the beginning of the research period, there has been an introduction about the research added into the weekly newsletter (Appendix F.1.) Four weeks before the measurement period took place, ED-employees were informed via the newsletter about the measurement method and the period of measuring (Appendix F.2). Two weeks before the measurement period took place, ED-employees were informed via the newsletter how the JDT works and how it looks like in HiX (Appendix F.3).

F.1 First newsletter

Hallo allemaal,

Mijn naam is Lonneke Kip en ik ben 10 februari gestart met mijn afstudeeronderzoek binnen het Slingeland Ziekenhuis. Ik studeer Gezondheidswetenschappen aan de Universiteit Twente en ik heb binnen de studie gekozen voor de specialisatie 'optimaliseren van zorgprocessen'. Voor ik hier aan begonnen ben heb ik Gezondheid & Technologie (studierichting van de HBO-V) gestudeerd en heb ik aansluitend een jaar gewerkt binnen het MTH-team in de thuiszorg van Marga Klompé.
De komende 20 weken ga ik mij richten op de instroom en doorstroom op de SEH. Om een goed beeld te krijgen zal ik enkele (niet-aansluitende) dagen mee komen kijken en zal ik je mogelijk benaderen om te interviewen. Het doel van mijn onderzoek is het kaart brengen van problemen die zich voordoen (gericht op patiëntenstroom en werkdruk), onderliggende oorzaken en daar bij passende verbetermogelijkheden.
Als je vragen, ideeën en/of opmerkingen hebt, dan hoor ik dat graag! Mailen kan naar l.kip@slingeland.nl.

Groeten Lonneke

F.2 Second newsletter

Hallo allemaal,

Mijn naam is Lonneke Kip en momenteel ben ik vanuit mijn opleiding Gezondheidswetenschappen bezig met mijn afstudeeropdracht gericht op de Spoedeisende Hulp. Hiervoor heb ik gewerkt als verpleegkundige. Sommigen van jullie hebben mij voor corona al gezien, maar heel veel van jullie ken ik nog niet.

Het doel van mijn afstudeeronderzoek is om aanbevelingen te doen waarmee de werkdrukverdeling van verpleegkundigen op de SEH verbeterd kan worden.
Omdat de zorgzwaarte van patiënten op de SEH erg wisselend is en op dit moment onvoldoende inzichtelijk is hoe dit verdeeld is over de dag en week, zal hiervoor gedurende 2 weken een werklastmeting plaats gaan vinden. Hiermee wordt drukte meetbaar, waardoor verbeteringen mogelijk worden.

Tijdens deze meetperiode zal de Jones Dependency Tool (JDT) gebruikt worden. Dit is een patiëntgebonden vragenlijst met 6 onderdelen, waar op ieder onderdeel 1, 2 of 3 punten gescoord kunnen worden. Dit kun je zien als een onderdeel van de triage. Daarnaast zal er van jullie gevraagd worden om na de dienst de ervaren werkdruk te noteren. Dit zal nodig zijn om de daadwerkelijke drukte op de SEH te kunnen berekenen en te visualiseren en uiteindelijk te analyseren wat hier invloed op heeft. Ervaring in een ander ziekenhuis wijst uit dat de ervaren werkdruk vrijwel volledig overeen komt met de gemeten werkdruk.

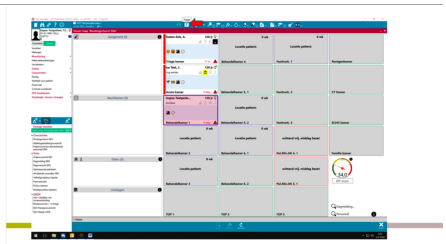
De meetperiode zal plaatsvinden tussen 14 en 27 september. Voorafgaand zullen de laatste afstemmingen plaatsvinden met Esther Brinke, Monique Teunissen en Lisette Lieferink en ontvangen jullie in week 36 extra informatie over de JDT er hoe het er uit ziet binnen HiX.

Tijdens de meetperiode zal ik zoveel mogelijk aanwezig zijn op de SEH om jullie vragen te beantwoorden en indien gewenst te helpen bij het gebruik van de tool. Mocht je nu al vragen en/of opmerkingen hebben, dan hoor ik het graag! Hoe beter de JDT afgestemd wordt op de SEH, hoe meer inzicht we kunnen krijgen hoe de werkdruk beter verdeeld zou kunnen worden.

Tussen 19 en 26 augustus ben ik afwezig. Voor dringende vragen kun je op dat moment bij Esther of het Lean team terecht. Verder ben ik bereikbaar via l.kip@slingeland.nl en telefoonnummer 9179.

Groeten Lonneke

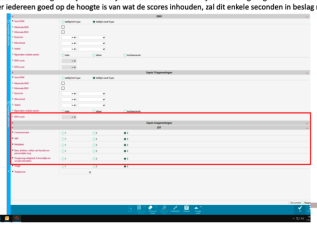
F.3 Third newsletter



Waarom een tool implementeren?

- Het aantal aanwezige patiënten staat niet gelijk aan de drukte op de SEH.
- Op dit moment kunnen pieken in de werklast op de SEH onvoldoende inzichtelijk gemaakt worden. Hiervoor ontbreekt benodigde informatie over de zorgzwaarte van patiënten.
- Het inzichtelijk maken van deze pieken en de factoren die hier invloed op hebben biedt mogelijkheden om hier daadwerkelijke actiepunten op in te zetten.

Onder aan de triage vind je de scorelijst van de JDT. Deze dient tijdens de triage ingevuld te worden.
Wanneer iedereen goed op de hoogte is van wat de scores inhouden, zal dit enkele seconden in beslag nemen.

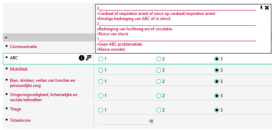


Jones Dependency Tool

- De JDT maakt de zorgzwaarte van SEH-patiënten inzichtelijk.
- Bij invoering van de JDT geeft de barometer continu inzicht in de werklast. Hiermee kunnen opnamestops beter voorspeld en mogelijk voorkomen worden.

- Daarnaast worden metingen opgeslagen waardoor na verloop van tijd geanalyseerd kan worden waar verbetermogelijkheden zitten.
- Mogelijke verbeterpunten kunnen bijvoorbeeld het aanpassen van het dienstrooster en patiëntenstromen en het verschuiven van taken/verantwoordelijkheden zijn.

Door op de naam van de categorie te klikken wordt meer informatie zichtbaar over de te scoren punten.



Implementatie

- Iedere implementatie brengt tijdelijk extra tijd en werk met zich mee. Daarom is het zaak om vanaf begin van de invoering al goed voorbereid te zijn.
- De vragenlijst, bestaande uit 6 categorieën met elk 3 antwoordmogelijkheden, wordt verderop uitgelegd. Deze lijst komt op het whiteboard van de dagstart te hangen.
- Op de volgende dia's zie je hoe het er binnen Hix uit komt te zien.

Dit is een overzicht van alle punten waar op gescoord wordt.
Per categorie kijk je welke optie (1, 2 of 3) het beste aansluit bij de patiënt.
Dit overzicht zal ik alvast op het whiteboard hangen.

	1 punt	2 punten	3 punten
Communicatie	• Volledige communicatie mogelijk • Geeft pijn aan in het lagere deel van de NRS (0-3) • Is alert • Geen taalbarrière • Is coöperatief/vrolijk	• Bedreiging of potentiele bedreiging van een of meer zintuigen • Geeft pijn aan volgens het middelste deel van de NRS (4-7) • Reageert slechts op verbale stimulatie of een pijnprikkel • Moeilijkheden veroorzaakt door taalbarrière • Angstig, verdrietig, gestrest	• Onvermogen tot communicatie door uitval van een of meerdere zintuigen • Geeft pijn aan in het hoogste deel van de NRS (8-10) • Reageert niet, op zowel verbale stimulatie als op pijnprikkels • Taalbarrière • Ernstige gedragsproblemen
ABC	• Geen ABC problematiek • Kleine wonden	• Bedreiging van luchtweg en/of circulatie • Risico van shock	• Cardiaal of respiratoir arrest of risico op cardiaal/respiratoir arrest • Ernstige bedreiging van ABC of in shock
Mobiliteit	• Volledig mobiel • Lichte extremiteitsproblemen	• Deels immobiel • Patiënt is afhankelijk van looprek of rolstoel	• Totaal immobiel
Etan, drinken, verlies van functies en persoonlijke zorg	• Geen problemen met darm/blaas functie, niet braken • Volledig ADL zelfstandig	• Beperkt verlies van darm/blaas functie en/of overgeven • ADL zelfstandigheid beperkt	• Totaal verlies van darm/blaas functie en/of doorlopend braken • Totaal verlies van ADL zelfstandigheid
Omgevingsvreemdheid, tichamelijke en sociale behoeften	• Is volledig in staat risico's in te schatten • Heeft geen sociale ondersteuning nodig	• Is niet volledig in staat risico's in te schatten • Heeft sociale ondersteuning nodig	• Toont een gevaar voor zichzelf of voor anderen te zijn • Heeft intensieve sociale ondersteuning nodig
Triage Totaalscore	• Groen of blauw	• Geel	• Rood of oranje

Rechts onder in beeld is de barometer zichtbaar.

Dagstart

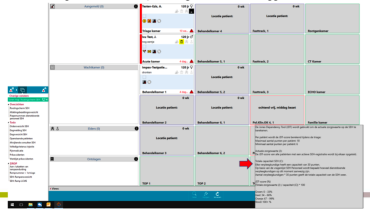
- Iedere dag zal tijdens de dag- en late dienst de dagstart plaatsvinden. Naast de lopende zaken zal de JDT besproken worden.
- Rechts zie je een format voor de meting van de ervaren werklast. Dit format komt links onder op het whiteboard van de dagstart te hangen.
- Aan het eind van je dienst plaats je 4 gekleurde magneetjes op het format, passend bij hoe je de werklast en je werkplezier hebt ervaren (tijdens de 1e en 2e helft van je dienst).
- Iedere dag blikken we even terug op hoe het de dag ervoor gegaan is.

Hier vind je extra informatie over de werking van de barometer

Aanwezigheid en aanspreekpunten

- Maandag 14 september zal ik de hele dag aanwezig zijn om de dagdienst, late dienst en nachtdienst op gang te helpen met de tool.
  - Rond 9:00 uur zal de dagstart plaatsvinden en vanaf 10:00 uur gaan we beginnen met de JDT.
- De overige dagen zal ik aanwezig zijn tussen 7:30 en 18:00 uur.
- Monique Teunissen, Lisette Lieferink, Michiel Tebbes en Esther Brinke zijn betrokken bij invoering van de JDT. Voor vragen kunnen ook zij benaderd worden.
- Dinsdag 8, woensdag 9 en donderdag 10 september zal ik om 9:00 aanwezig zijn bij de dagstart om eventuele vragen te bespreken en de omkwikselomgeving te bekijken.
- Mocht je vragen hebben, stel ze gerust! M: i.kip@slingeland.nl T: 9179

De punten die toegekend worden aan de verpleegkundige capaciteit zijn gebaseerd op validatie binnen het Dijklander ziekenhuis.
Dit zal aardig overeen komen met SZ, maar is nog niet definitief en zal nog gevalideerd moeten worden.



Evaluatie

- Donderdag 24 september zal ik aansluiten bij het teamoverleg om de volgende punten te bespreken:
  - Ervaringen
  - Verbeterpunten
  - Verantwoordelijkheden
  - Vervolg
- Na de eerste 2 meetweken ga ik mij bezig houden met de analyse van de geregistreerde metingen. Vervolgens zullen jullie op de hoogte worden gehouden van mijn bevindingen.
- Verdere evaluatiemomenten zullen later ingepland worden.

Appendix G

Additional results

This chapter shows additional results on data analyses.

Table G.1: ED referrals by radiology (n = 155, T = 14-09-2020 - 15-10-2020, source: HiX SZ)

Time	Number of ED arrivals
8:00 AM	2
9:00 AM	9
10:00 AM	12
11:00 AM	18
12:00 PM	22
13:00 PM	10
14:00 PM	21
15:00 PM	21
16:00 PM	33
17:00 PM	7

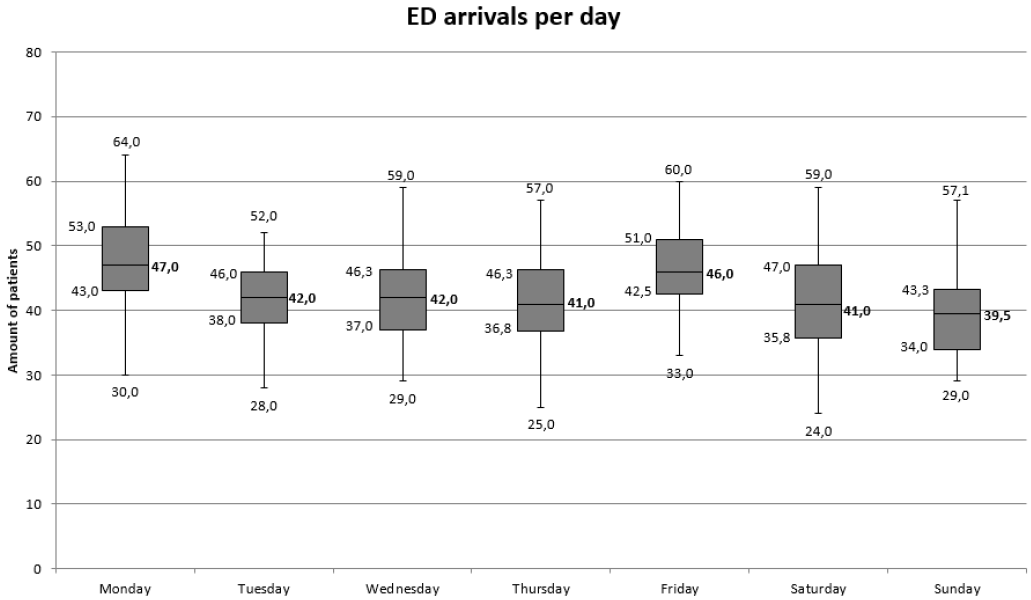


Figure G.1: Average amount of ED arrivals per time of arrival (n = 15,693, T = 14/09/2020 - 15/10/2020, source: HiX SZ)

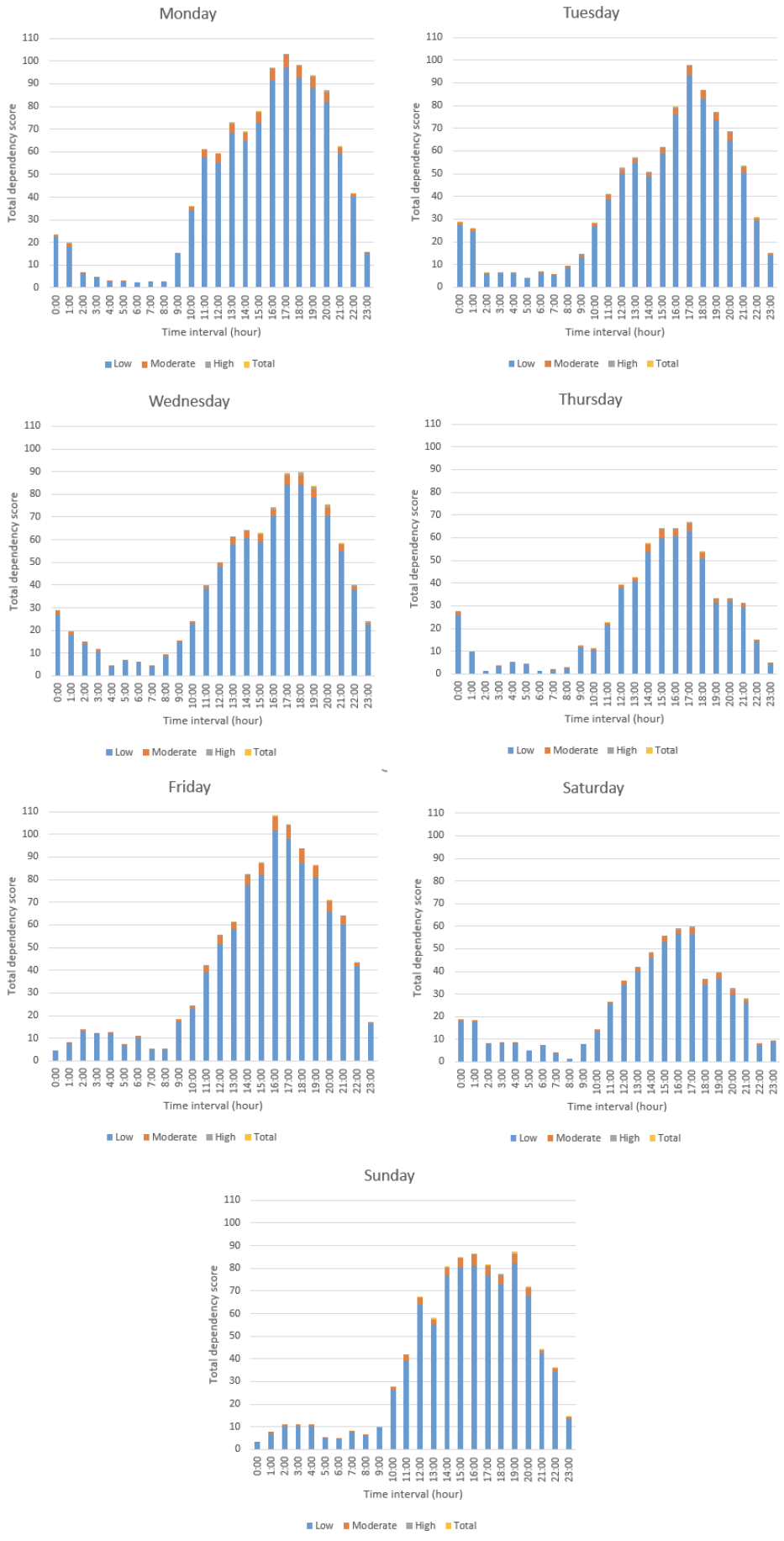


Figure G.2: Patient dependency in the ED per weekday (n = 1,276, T = 14-09-2020 - 15-10-2020, source: HiX SZ)