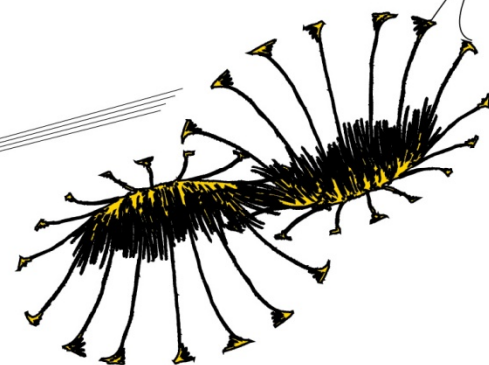


“Intensity of care among patients in the Emergency Department of  
Medisch Spectrum Twente”



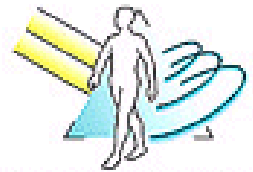
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## Abstract

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*Aim.* This study aimed to develop a score chart that measures the intensity of care and is applicable to the wide variety of patients who visit the emergency department (ED) of the Medisch Spectrum Twente (MST). In the long term the information about the intensity of care per patient should be used for staff planning. The research focused on the following priorities: the indicators that affect the intensity of care, how these indicators are incorporated in a score chart that measures the intensity of care, and the validity and functionality of the score chart.

*Background.* Nowadays there is a growing need to get more insight in the demand of care and patient flow on the ED. These insights provide important information for staff scheduling. Many ED's still base their staffing on patient census alone, but that is only one of many relevant factors. Hence, it is important to analyze and relate the demand of care and patient characteristics in an ED. Patient Classification System's (PCS) have been developed to measure intensity of care, especially nursing care. Studies abroad have shown that there are two types of PCS's, prototype systems (PS-PCS) and factor type systems (FS-PCS). A prototype system is a system, which uses only a few indicators that have been shown to be predictors of the amount of care provided. Patients are then categorized into groups based on whether they demonstrate one or more of these critical indicators. The factor type system identifies a comprehensive list of tasks or procedures performed, with a numerical value given to each task based on the time required to perform them. These values are summed and the category is determined by classifying the number of points. Currently, none of these systems are used in Dutch emergency departments to measure the intensity of care. To investigate which type of PCS is most suitable for application on the ED of the MST the PCS's can be assessed on the guidelines, validity, reliability, simplicity, efficiency, utility, objectivity and acceptability.

*Method.* Literature research, observations of personnel and processes at the ED and semi-structured interviews with ED nurses and ED physicians have been conducted to find critical indicators that affect the intensity of care. Because most of the indicators of the intensity of care can be or are expressed in time, time recordings of all consecutive steps in the care pathway were performed. With the information from the literature, the observations, the interviews and the time measurements, the MST intensity of care score sheet is developed. A pilot study has been executed to test the validity and reliability of the score sheet. The pilot study includes 10 randomly selected patients who have visited the ED of the MST.

*Findings.* Assessing guidelines on the PCS's has showed that prototype PCS's are most suitable for application on the ED. After applying existing prototype PCS's on the ED of the MST it was found that the needs of the ED of the MST were entirely different. A normal prototype PCS categorizes patients into groups based on whether they demonstrate one or more indicators. Because in this research intensity of care is viewed from the perspective of planning, the classification of patients into groups gives too little information about the actual time spent per patient. The prototype PCS has therefore only been used as basis for developing a score chart for the ED of the MST. The critical indicators for measuring the intensity of care at the ED of the MST are communication, movement and transportation, administration, triage, time in the ED, equipment setup, psychological patient characteristics, physical patient characteristics and medical actions. An important question that remained after the determination of the critical indicators was how the various

indicators could be combined. Five of the seven interviews showed that time has to be the connecting factor between the indicators. Therefore measurements of all the indicators that can be expressed in time were undertaken. With the results of the measurements the MST intensity of care score sheet was developed to measure the intensity of care on the ED. In the pilot study the validity and reliability were tested. The score chart is valid when the time spend on the ED is long and many actions are performed on the patient. The validity is less when the time spend on the ED is short and the actions performed on the patient are less numerous. The reliability of the score chart is low because of the fact that in some cases nobody knows what exactly happened to the patient, so that acts were checked on the score sheet, which did not match reality.

*Conclusion.* The MST intensity of care score sheet is well applicable to the ED of the MST. Using the MST intensity of care score sheet, there is a better understanding of the investment of time per patient. In addition, the results from the score sheet give a better understanding of the crowds at the ED than a situation in which only the number of patient is counted. Further assessment of validity and reliability of the score sheet within the ED setting are recommended.

*Keywords:* intensity of care, ED, PCS, MST intensity of care score sheet

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## Introduction

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Nowadays there is a growing need to get more insight in the demand of care and patient flow in the Emergency Department (ED). This is important information because the demand and use of care have influence on the type and amount of personnel needed. Personnel costs are the largest part of a hospital's operating budget, so it is important to keep these costs as low as possible [1]. To understand how the demand of care and patient flow interact, it is important to understand the intensity of care in an ED. This is important because it improves the planning process of the labour intensive ED care. With information about the intensity of care a workforce can be formed, that better reflects the supply and demand of care in the ED. A definition of the intensity of care is the amount of care needed for an individual patient. More intensive care for a patient results in a more comprehensive care profile and more time involved by the medical specialists and nurses [2, 3]. However intensity of care is often defined as intensity of nursing care. Intensity of nursing care is the amount of direct and indirect patient care activity required to carry out the nursing function and the factors that have an impact on the level of work required to perform that activity [4]. This latter definition of the intensity of care is used as the basis for this research.

Many ED's still base their staffing on patient census alone, though that is only one of many relevant factors [5]. Staffing should be allocated according to the intensity of nursing care and not necessarily to the degree of illness or the number of patients, as many patients who are not very ill may, at times, generate more nursing care hours than very ill patients [2]. Also, Medisch Spectrum Twente (MST) bases its staffing on patient census alone. Currently, the MST does not have the instruments that take other effects such as medical actions per patient into account. To be able to plan resources a through insight in the demand required, hence this research the focus is on the demand side rather than on the supply-side.

### *Aim of the study and research questions*

This study aimed to develop a score chart to measure the intensity of care which is applicable to all patients who visit the ED of the MST. This is the first time that at the ED of the MST the medical actions performed on patients are included to measure the intensity of care. Additional goal of the study was to make statements about the functionality of the developed score chart for measuring the intensity of care on the ED.

This research is a first step to balance supply and demand, where the supply side and scheduling part should follow the present project.

To achieve this goal a study has been performed based on a research question and several sub-questions.

The main research question is:

*What are the key characteristics required to measure the provided intensity of care at the ED of the MST?*

To answer the main research question, several sub questions were formulated.

1. *Which indicators have effect on the intensity of care from the perspective planning?*
2. *What is the relationship between the different indicators?*

3. *How to combine the different indicators into a score chart that measures the intensity of care?*
4. *What can be concluded about the functionality of the score chart that measures the intensity of care on the ED of the MST?*

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## Patient Classification System's

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Patient Classification System's (PCS) have been developed to measure intensity of nursing care[4]. The purpose of a PCS is to determine the intensity of nursing care for a patient or group of patients[2]. Patient classification generally means that a specific population of patients has predictable or observable characteristics[6]. A PCS is a method of identification and classification of patients into mutually exclusive categories, and the quantification of these categories as a measure of nursing effort required[2]. The ideal patient classification system matches patients' needs with nursing resources [1]. There are two basic types of classification systems, the prototype system and the factor type system.

### *Prototype system*

A prototype system is a system, which uses only a few indicators that have been shown to be predictors of the amount of care provided. Patients are then categorized into groups based on whether they demonstrate one or more of these critical indicators [2]. Advantages of the prototype system with respect to the factor type system are that the prototype system is easier and less expensive to develop and implement. Also, the use of this system requires less time and the system type is better accepted by nurses [7]. A disadvantage of the prototype system is the less accurate ratings because of the use of broad descriptions [1]. This type of classification is said to be subjective [8].

### *Factor type system*

The factor type system identifies a comprehensive list of tasks or procedures performed, with a numerical value given to each task based on the time required to perform them. These values are summed up and the category is determined by the total number of points [8]. Advantages of the factor evaluation system with respect to the prototype system are that the factor type system provides a more precise measurement of the condition of the patient and therefore a more accurate description of the care needed by each patient [1]. This type of classification is more objective than the prototype system [8]. Disadvantages of the factor type system are that the factor type system is more time-consuming and usually involves an extensive checklist of patient care items [1].

A review of the literature has shown that much research has been done, but that there are difficulties in developing a PCS for use in the ED [8]. This is because there is a change in the flow of patients and illness severity of patients in the ED. The usefulness of a classification system depends on the application in the broad case mix of patients coming to the ED. Therefore the validity is determined using a representative population. The literature review has identified 12 PCS's that may be applicable in the ED, yet no evidence was found for a Dutch emergency department using a PCS. All published examples of Emergency department PCS's are found in Australia, the UK, the US and Hawaii [8]. To investigate the quality of the PCS's several guidelines have been established. The PCS are assessed on their validity, reliability, simplicity, efficiency, utility, objectivity and acceptability. The validity of the score chart is considered to be the degree to which an instrument or score chart measures what it is supposed to measure[6]. The reliability of the score chart, is tested by the ability to repeatedly identify the same information[6]. The simplicity and efficiency of the score chart are considered to affect the score chart's utility and it is recommended that a score chart be a permanent part of the patient record[8]. Objectivity is attained with a score chart



constructed in such a way that the rating can be verified. Part of the acceptability of the score chart comes from the subjective assessment of how valid the score chart appears to the nurse[8]. Besides this, it is checked that the PCS'-s are able to provide a predictive value for direct nursing time, indirect nursing time and unavailable nursing time. Direct nursing time is required for those activities that take place in the presence of patient and/or family. Indirect nursing time is time required for those activities and tasks performed away from the patient and/ or family. Unavailable for patient care time includes activities of personnel that are not directed toward individual patient care. In table 1: Emergency department patient classification systems, the PCS'-s are listed with the guidelines to which a PCS should adhere [8]. The conclusion that can be drawn from the table is that prototype PCS'-s are better suited for application at the ED than factor type PCS'-s. This is because prototype PCS'-s score significantly better on validity, reliability, simplicity, efficiency and utility. Factor type PCS'-s score only better on objectivity.

	Validity	Reliability	simplicity/ efficiency/ utility	Objectivity	Acceptability	Prospective measures	Direct nursing time	Indirect nursing time	Unavailable nursing time
<b>Factor type</b>									
Schulmerich 1984	-	-	-	+	-	-	+	+	-
Stolley and Hachmann 1989	-	+	-	+	-	-	+	+	-
Nelson 1994	-	-	-	+	-	-	+	+	-
Carr 1994 (GRASP tool)	-	-	-	+	-	-	+	+	-
Taylor et al. 1997	-	-	-	+	-	-	+	+	-
Maxwell 1998	-	-	-	+	-	-	+	+	-
Helmer 1988	-	-	-	+	-	-	+	+	-
Levenstam and Engberg 1993	-	-	-	+	-	-	+	+	-
<b>Prototype</b>									
Gilbert 1993	-	-	+	-	-	+	+	-	-
Crouch and Williams 2006 (Jones Dependency Tool)	+	+	+	-	+	+	+	-	-
Butler 1986 (ED patient classification Matrix)	+	+	+	-	-	+	+	-	-
Conners 1994 (Conner's tool)	+	+	+	-	-	+	+	-	-

Table 1: Emergency department patient classification systems [8]

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## Method

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### *Study overview*

A non-experimental, explorative research method is used. Data obtained from the observations, the interviews and the measurements are gathered from the ED of the MST. The MST is one of the largest non-academic hospitals in the Netherlands and is located in Enschede [9]. The hospital provides basic care, top clinical and top referral care. In addition, the MST is one of the eleven trauma centres in the Netherlands with its own helipad [9]. In the ED of the MST there is a team of about 43 nurses. In addition, there are a number of physicians from the surgical discipline and depending on the symptoms of a patient other physicians are required for consultation. The way people work in the ED of the MST is affected by some typical conditions. For example, the ED of the MST uses an ECG service, employees of the laboratory visit the ED for blood sampling, employees of the X-ray visit the ED to make pictures and there is no CT-scanner in the department. Access to staff members included in this study is approved by the senior management (team leader). Oral consent is obtained from the staff involved. A description of the study, the assurance of confidentiality and the possible value of the findings of the study in advancing the service and care provided to patients is outlined to each participant.

The steps taken:

1. A search in the literature is conducted to find indicators that can measure the intensity of care from the perspective of planning and possible existing prototype PCS'-s to measure intensity of care in a hospital setting, and more specifically in the ED.
2. Observations of the processes on the ED and the nurses are made to understand what's going on at the ED and to gain insight into the possible indicators for the intensity of care on the ED.
3. Semi-structured Interviews are held with nurses and ED physicians. Presenting the findings from the literature study and observations to the nurses and physicians of the ED leads to the indicators that affect the intensity of care on the ED of the MST. In addition, the relationship between the different indicators is studied.
4. The next step is to do time measurements of all the indicators of the intensity of care, which can expressed in time, on the ED to get an idea of the workload of the patient in the ward. With these measurements, a better picture of the intensity of care of the patient in the ward is obtained.
5. Construction of the score chart. With the information from the literature, the observations, the interviews and the time measurements the score chart in the form of a score sheet is developed.
6. A pilot study is done to test whether the developed score chart can measure the intensity of care correctly. In the pilot study the score chart is tested on his validity and reliability.

Figure 1 contains a flowchart of the steps completed during the research.

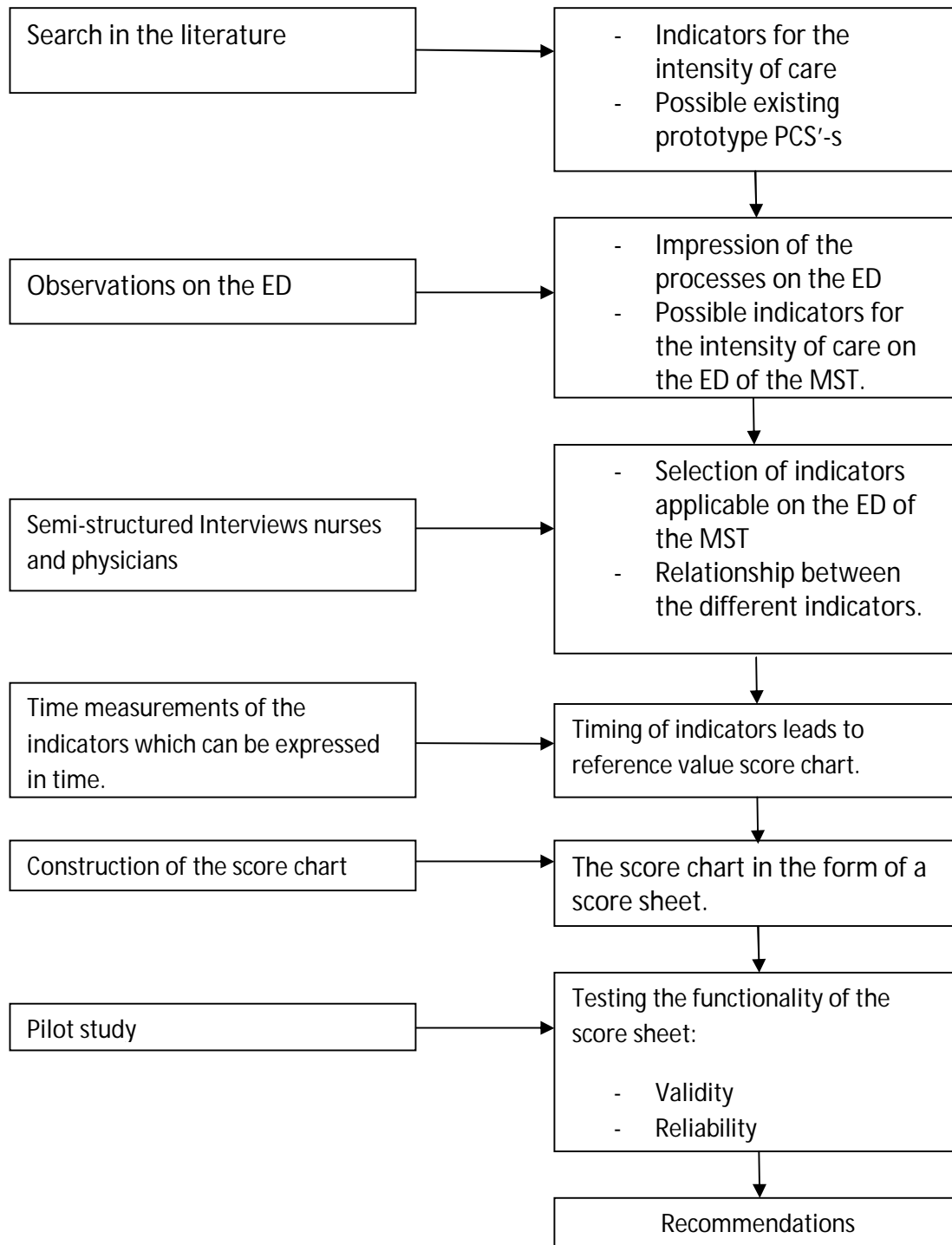


Figure 1: Flowchart research intensity of care on the ED of the MST

### 1,2,3 Identification of relevant indicators – literature, observations and interviews

To investigate which indicators represent the intensity of care a literature research on the relevant indicators is done. The search is done in computerized databases like Science Direct and Pubmed, using the terms 'intensity of care', 'demand on the emergency department', 'patient classification system' and 'patient classification systems + emergency department'. In addition, this study used references of useful articles. Other sources of information are

found on other sites like Google Scholar, using the same terms as in the computerized databases.

Four days of observations are performed to obtain insight in the possible indicators that may have influence on the intensity of care and to obtain insight in the processes within the ED.

The observations and the literature study appeared supportive for the interview survey (Appendix 1: Semigestructureerd interview - Verpleegkundige). The indicators found in the literature and during the observations are presented to the nurses and physicians to determine whether these indicators are also relevant in practice. An interview approach is used to obtain the view of staff. The interviews include open and closed questions. The four ED nurses who were interviewed are selected by the team leader ED and an ED physician. The three ED physicians who are interviewed come from existing contacts of the MST. They are physicians who are working in similar ED's elsewhere in the Netherlands.

#### *4. Time measurements to classify tasks*

As shown by the results of the interviews (see page 15 of the chapter results) most of the indicators of the intensity of care can be expressed in time. To assess the duration of communication, administration, triage and various medical actions, a stopwatch is used. The measurements are done with a precision of 0.01 second. An important step in the stopwatch study is splitting the medical actions into elements. One should take care that the elements are distinct and well defined and therefore enable to repeated measurements[10]. The key to this step is to focus on the tasks performed most often. The list of all the tasks performed most often within the moment the action begins and ends are identified by group consensus of three ED nurses. These nurses are randomly selected from the group of ED nurses. The nurses are asked individually to list all the common tasks, including the beginning and end of each task. The tasks which caused discussion are discussed together. Especially capturing the beginning and the end of every task is critical to the validity of the entire score chart. The start- and endpoint of tasks probably vary for different ED settings, because not all hospitals have the same equipment and same working method.

The measurements have occurred on working days in May 2011 and June 2011 on the ED of the MST. The total number of days measured is 32, this applies to measurements in the evening and daytime. The patients where the measurements are carried out are randomly chosen, just like the nurses and physicians who perform the actions. Every action is measured ten times during the study. From the ten measurements the average is used as a reference for the score chart.

#### *5. Construction of the score chart*

With the findings from the literature, the observations, the interviews and the measurements, the score chart is developed. The prototype PCS have been the basis for this final score chart. A prototype PCS uses a limited number of indicators that have been shown to be predictors of the amount of care provided. These indicators are derived from the findings from the literature, the observations and interviews. Subsequently, measurement values are coupled to these indicators.

### *6. Clinimetric properties and functionality*

Because there is no "golden standard" to measure the intensity of care on the ED of the MST a pilot study is developed, to test if the score chart can measure the intensity of care correctly. The score chart is tested on the guidelines established for a PCS. A PCS can be assessed on validity, reliability, simplicity, efficiency, utility, objectivity and acceptability. Since in this research the intensity of care will be measured by a score chart, the score chart can also be tested on its responsiveness. There are two types of responsiveness, internal responsiveness and external responsiveness. Internal responsiveness is defined as the ability of a measure to change over a prespecified time frame[11]. External responsiveness is defined as the extent to which change in a measure relates to corresponding change of thing a reference measure of clinical or health status[11]. In the pilot study the validity and the reliability are tested. The responsiveness, simplicity, efficiency, utility, objectivity and acceptability of the score chart are not tested in this study.

Validity is the degree to which an instrument, or score chart, measures what it is supposed to measure[6]. Testing the validity is done by measuring the intensity of care through measure the time spend on an individual patient with a stopwatch and through the score chart. The time measured with the stopwatch will be used as the gold standard. The researcher measures the time spends on a patient with a stopwatch, while the nurse or physician fills out the score chart after the visit from the patient to the ED. These two values are compared. When these values matched, it can be concluded that the validity of the score chart was good. The measurements took place in the first week of September 2011. The patients on which the instrument is tested were randomly selected.

Reliability is the ability of an instrument to repeatedly identify the same information for use by different persons [6]. The reliability is tested by asking the physician and the nurse or two nurses to use the score chart on the same patient. These two values are compared to determine whether there would be a big difference between the outcome values. When the differences are small the score chart is reliable. The validity and reliability of the score chart are tested by measuring the intensity of care in ten patients who are visiting the ED of the MST. These patients are randomly chosen from the patients who are visiting the ED.

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## Results

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### *Identification of relevant indicators*

To identify the intensity of care, prototype PCS'-s have different key elements or indicators. During the literature research 8 articles are identified that include indicators which are applicable for measuring the intensity of care on the ED and a number of other articles with indicators which are not especially designed for use on the ED, but are used on other departments in the hospital [2-4, 6, 12-15]. Table 2 gives an overview of all the indicators found in the literature [2-4, 6, 12-15]. It is noticeable that the indicators for the PCS designed for use with hospitalized patients are quite different from the indicators of the PCS designed for the ED. This is because the PCS's designed for use with hospitalized patients include activities of daily living, preoperative and postoperative care and rehabilitation, and therefore not relevant to the ED setting[13]. Additionally, in this study the intensity of care is viewed from the perspective of planning. Some indicators are not relevant in this perspective. When the literature research is done for indicators that are relevant to the ED it is remarkable that many indicators match each other. They are only phrased slightly different. For an overview of all the indicators which are relevant for the ED and fit into the planning perspective see table 3: Indicators intensity of care on the ED obtained from the literature (Appendix 2) [2-4, 6, 12-15].

Indicators			
Stevenson's tool [2]	Nursing assessment	Required nursing skill level	complexity of care
	Contact with family	Contact with patients	Physical patient characteristics
	Psychological patient characteristics	Priortiry of care	
Butler's tool [2]	Vital signs and neurologic evaluation	Interview and assessment of chief complaint	Diagnostic tests
	Movement and transportation	Medications	Treatments
	Procedures	Observation	Teaching and education
	Psychosocial intervention		
Conner's tool [2]	Vital signs and neurological status	Initial assessment	Diagnostic tests
	Movement and transportation	Monitoring/ observation	Medication
	Procedures	Teaching/ educations	Ppsycho/social
	Discharge/transfer		
Vektris [3]	Age	Sex	Futher indication
	Chronically illness	Referral for the same condition	Redirected same condition
	Diabetic	Multiple DBC's	DBC's in the same condition
	DBC's same specialty, other institution		
Belgian Nursing Minimum Data Set [4]	Care relating to hygiene	Care relating to mobility	Care relating to elimination
	Care relating to feeding	Tube feeding	Mouth care
	Prevention of pressure sores: changing position	Assistance in getting dressed	Care of patient with tracheotomy or endotracheal tube
	Nursing admission assessment	Training in activities of daily living	Emotional support
	Care of a disoriented patient	Isolation for preventing contamination	Monitoring vital signs
	Monitoring clinical signs	Cast care	Taking blood samples



Indicators			
	Medication management intramuscular, subcutaneous	Medication management intravenous	Infusion therapy
	Surgical wound care	Traumatic wound care	
Lundgren-Liane [14]	Planning and co-ordination of care	Breathing, circulation and symptoms of disease	Nutrition and medication
	Personal hygiene and excretion	Activity, movement sleep and rest	Teaching guidance in care, follow up and emotional support
Girard [6]	Patient care	Equipment setup	Anesthesia
	Number of surgical sites	Blood loss	OR time
Jones Dependency Tool [13]	Communication	ABC	Mobility
	Eating, drinking elimination and personal care	Environmental safety health and social needs	Triage
Jong [12]	Wound care	Medication administration	Patient and family support
	Infection control	Assistance activities daily living	Vital signs check
	Respiratory management	Reporting/ paper work	Miscellaneous
Levenstam [15]	Hygiene	Nutrition	Observation
	Mobilization	Uncontrolled output	Extra care needs

	Indicator intensity of care
	Act that falls under one of the indicators.
	No act usually performed on the ED.
	No indicator from the perspective planning

Table: 2 Indicators intensity of care obtained from the literature [1-3, 5, 11-14]

The observations have shown that it frequently occurs that patients stay in the ED without any direct patient care being delivered. This might be because the patient has to wait for results of medical treatment or because the patient is recorded in the hospital but no department is available. During this period there is no direct treatment but the patient is still the responsibility of the ED staff. This means that the ED physician or nurse should keep an eye on the patient but doesn't perform a direct treatment. So, because of the time investment in patient who does not have a direct demand of care, time in the ED is an indicator for the intensity of care.

### Indicators obtained from expert consultation

The presentation of the indicators found in the literature and during the observations of the nurses and physicians of the ED showed that most of the indicators found in the literature are also relevant in practice (communication, movement and transportation, administration, triage, equipment setup, psychological patient characteristics and physical patient characteristics). However, there is no diagnosis if the patient enters the ED. This means that it is difficult to divide medical actions on the ED into diagnose test, observation, treatments and procedures. In four of the six interviews it is suggested to take these actions together under the term medical actions. Medication can also fall under medical actions. Table 4, indicators intensity of care obtained from the interviews, lists all the indicators from the literature that are recognized by the personnel.

Indicators intensity of care		
Communication	Triage	Psychological patient characteristics
Movement and transportation	Time in the ED	Physical patient characteristics
Administration	Equipment setup	Medical actions

Table 4: Indicators intensity of care obtained from the interviews

An important question that remained after the determination of the critical indicators is how the various indicators could be combined. In five of the interviews it is revealed that time has to be the connecting factor between the indicators. However, not all the indicators can be expressed in time. The indicators equipment setup, psychological patient characteristics and physical patient characteristics cannot be expressed in time.

### *Time measurements to classify tasks*

In table 5: start and end of every action, there is a list with the start and end of the most common medical actions performed on the ED, as determined by group consensus of three ED nurses (appendix 3). To define the most common medical actions the ED form serves as a starting point supplemented by comments from the interviews with the ED nurses and ED physicians. During the compilation of the list, it was difficult for a number of actions to mark the beginning and the end because some actions are long but not always intense for the nurse or physician. For example the infusion, during the time that the infusion runs the nurse can perform other medical actions. Therefore it is decided to include only the preparation of the infusion and the removal of the infusion in the measurement. This list is the basis for the measurements from all the medical actions.

The measurements are performed with a precision of hundredths of a second. Because it is irrelevant and not reliable to measure in hundredths of a second, it is decided to finalize on seconds. For a complete picture of the measurements the mean, median and minimum and maximum value are showed for each action see table 6: time measurements actions (Appendix 4).

Unfortunately, it appeared to be impossible to measure all the actions ten times during the measuring period. This was because some actions are so rare, that they occurred insufficient often during the measurement period. In addition, the measurements are performed by one person so it was not possible to measure several actions at the same time. Therefore it was decided to estimate the missing actions by questioning 11 ED nurses. These nurses are randomly chosen. They are asked to estimate the minimum and maximum time for every

missing action (Appendix 5: vragenlijst tijdsduur handelingen). The average of these estimates serves as the input for the score chart. For the list with time estimates see table 7: Estimates of the nurses (Appendix 6). For some actions such as transportation, fire wounds and communication with family, a single nurse indicated that the action couldn't be estimated, but there are at least 9 estimates per action.

For some actions there are insufficient measurements taken, these actions are also estimated by nurses. When the results of the estimates are compared with the results of the measurements it shows that nurses overestimate the value of most actions. For example the I-stat, the measurements of the I-stat shows that the duration of this action is 0:03:23, while the estimated indicate a value of 0:07:57. Only for the chest tube the estimates are lower than the measurements, this can be explained because the chest tube during the measurements was placed by a physician in training. Because the intensity of care is viewed from a conservative perspective, it is decided to take the average of the measurements together with the average of the estimates as input for the score chart. For the list of values that serve as input for the score chart see table 8: Total overview of the duration of the actions (Appendix 7).

#### *Construction of the score chart*

In the literature, there is a number of articles about a score chart to measure the intensity of care on the ED [2, 5, 8, 13], but none of the tools is developed specifically for ED in the Netherlands. After applying existing prototype PCS's on the ED of the MST is encountered that the needs of the ED of the MST were entirely different.

A normal prototype PCS categorizes patients into groups based on whether they demonstrate one or more critical indicators [2, 5, 8, 13]. For example the Conner's classification tool [2]. This tool contains 10 critical indicators. Every indicator has four levels with points. When the level is lower, there will be fewer points. Eventually, all points of all the indicators are combined. This score determines in which category the patient is placed. When the patient has more points the category of the intensity of care of this patient is higher. Because in this research intensity of care is viewed from the planning perspective, the classification of patients into groups gives too little information. When the intensity of care is viewed from the perspective of planning the time investment of the ED personnel in the patient is interesting.

Therefore the prototype PCS is only used as basis for developing a score chart for the ED of the MST. From table 1 (page 7) it can be concluded that the indicators used in the Butler tool (prototype PCS) are the most suitable indicators for the ED of the MST. In addition, the Butler tool is broadly based tool, which does not exclude factors that influence the intensity of care in advance. Moreover, the Butler tool is comprehensive and clearly described in the literature [2]. Therefore the Butler tool is used as basis for the score chart for the ED of the MST.

As in the Butler tool, the score chart developed for the MST contains indicators. These indicators are the result of the literature research, the observations and the interviews. However, these indicators are not classified in categories but uses the time spend for every indicator.

Figure 2, the MST intensity of care score sheet, shows the score chart which can measure the intensity of care on the ED of the MST. The score chart is developed in the form of a score sheet. All indicators that can be expressed in time are included in the score sheet. In the left column it can be indicated whether the act is applicable to the patient. In the right column it can be indicated how often the action takes place. When one implements the score sheet in Excel the program can calculate the time required for every action which is applicable to the patient.

When looking at the score sheet it's remarkable that equipment setup cannot be expressed in time. However, the number of people responsible for the actions gives sufficient information about the intensity of care from the perspective of planning. In addition, the indicators psychological characteristics and physical characteristics are missing. This is chosen because it is difficult to assess the influence of psychological and physical characteristics on the intensity of care. Furthermore, there was discussion among the interviewed nurses and physicians about whether these indicators only produce an emotional burden for the staff or actually affect the intensity of care from the perspective of planning. Perhaps further research can reveal whether psychological and physical characteristics still need to be added to the instrument.

Het MST zorgzwaarte scoreformulier										
Persoonlijke gegevens			Samenstelling team			Communicatie			Overig	
			1/0			1/0			1/0	
Naam:			Standaard behandelteam			Algemeen			Triage	
Naam patiënt:			Basisteam			Familie in familiekamer			Administratie	
Ziekenhuisnummer:			Traumateam			Slecht nieuws gesprek			Kind formulier	
Aankomst tijd patiënt:			Reanimatieteam							
Vertrektijd patiënt:										
Tijd op de SEH			0:00							
<b>Onderzoeken</b>										
<b>Laboratorium</b>			<b>Onderzoeken radiologie</b>			<b>Algemene handelingen</b>			<b>Medicatie</b>	
1/0 x			1/0 x			1/0 x			1/0 x	
Urine			Foto's			Uitvragen			Tabletten/zetpillen	
Bloed			ECG			Lichamelijk onderzoek			Injectie	
I-stat			Echo			Standaard controles			Medicatie via infuus	
			CT-scan			Monitor vitale functies			Spuitspomp	
			MRI			Transport			Verneveling	
						Geïsoleerd verplegen (aan/uitkleden)				
<b>Medische (be)handelingen</b>			<b>Medische (be)handelingen</b>			<b>Medische (be)handelingen</b>			<b>Medische (be)handelingen</b>	
1/0 x			1/0 x			1/0 x			1/0 x	
Infuus			Wond reinigen/ verbinden			Passieve repositie			Masker/ballon beademing	
Zuurstof			Strips/lijm			Actieve repositie			Intubatie/beademing	
Blaas katheter			Hechtingen			Gips			Hartmassage/ defibrillatie	
Bladderen			Drukverband/nat verband/ tabigrip			Brandwonden			Thoraxdrain	
Maagsonde			Alu/mallet-/pleisterspalk			Immobiliseren			Centrale lijn/arteriële lijn	
Opwarmen/ koelen			Mitella/ collar'n cuff			Bloed bijgeven			Bewaakt transport	
			Aan- en uitkleden						Urineren met hulpmiddel	
Totaal			0:00:00							

1= ja

0 of niets = nee

x= aantal keer dat handeling uitgevoerd is

Figure 2: The MST intensity of care score sheet

### *Clinimetric properties and functionality*

The validity and reliability of the score chart are tested in the pilot study. For the score sheets and the result of the measurements of every patient see appendix 8. The most important results from the pilot study are summarized in table 9: results from the pilot study.

#### Validity

Testing the validity is done by measuring the intensity of care through observation and through the score chart. When the results from the measurements and the results from the score sheet are combined the conclusion can be drawn that in four (patient A, B, E and I) out of ten times the measured value is close to the value that comes from the score sheet. In five (patient C, F, G, H, J) out of ten times the results from the score sheet give a much higher value as the time measured by the researcher. In one measurement (patient D), the value came from the score sheet was below the measured value.

Because intensity of care is approached from the perspective of planning, the values used in the instrument are well maintained. It is therefore logical that the values obtained from the score sheet are higher than the values obtained from the measurements. However, this may not be the only explanation for this difference, because the differences are too large. The fact that the score sheet gives a higher value in some cases can mostly be explained by the time spend to administration and communication. This time is much higher according to the score sheet than actually measured. This is because the time on the ED of these patients is relatively short compared to the time invested in the patient and there are relatively little activities performed on such patients. This means that the time invested in administration and communication is less than with patients on which many actions are preformed. Another reason for the difference in time is triage. Each patient is placed in a specific group depending on the severity of symptoms and the time that the patient can wait (triage), normally the triage takes place in a special room. But with patients who are placed in a group without a visit to the special room the triage is only an administrative act. The time spend to triage is then much shorter than when the patient visits the special room.

The underestimation of time by the score sheet with patient D can be explained by the time spend on plastering. This is because it was necessary to make a slit in the cast. During the time measurements used for the score sheet this never occurred. Therefore the time it took to make the slit was added to the plastering, but this is not representative for the measurements used for the score sheet.

In graph 1 (results measurements researcher versus results score sheet nurse) the times measured by the researcher are plotted versus the time resulting from the score sheet completed by the nurse. When the score sheet is valid the points are in a straight line. In addition, the results of the measurements from the researcher are plotted against the results from the score sheets of the physician and the average score of the two forms (graph 2 and 3). In all three graphs no straight line can be drawn. However, the points fall close to the imaginary straight line. The overall conclusion about the validity of the score chart is that the score chart is valid when the time spend on the ED is long and many actions are performed on the patient. The validity is less when the time spend on the ED is short and the actions performed on the patient are less numerous.

## Reliability

The reliability is tested by asking the physician and the nurse or two nurses to use the score chart on the same patient. When looking at the completed score sheets (Appendix 10) in the same patient it shows that only in two cases both forms are identical. It's also remarkable that in only three cases the score sheet is identical to what is measured by the researcher. It appears that physicians and nurses do not always know what the other person does. In addition, it frequently happens that patients are taken over by another nurse with the change of shifts or during breaks. This means that in many cases nobody knows what exactly happened to the patient. The overall conclusion about the reliability of the score chart is that the reliability of the score chart is low.

## Functionality

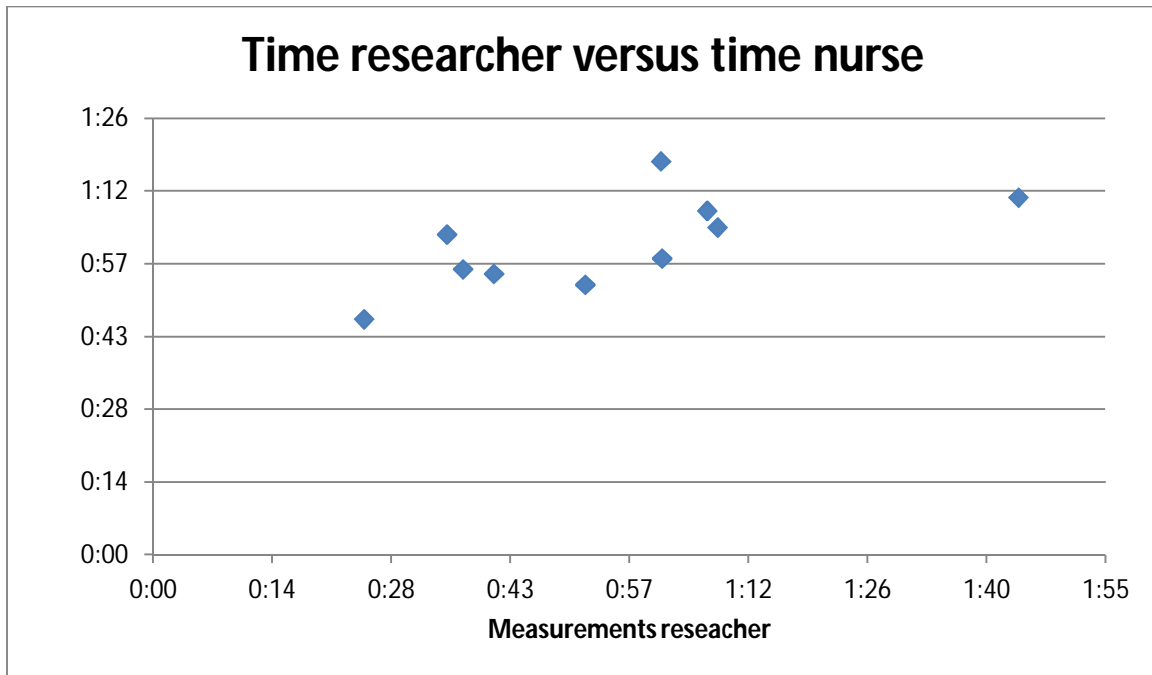
Although the reliability is low and the validity is only high under certain circumstances, the score sheet gives a clear picture of what happened to the patient. With some modifications to the score sheet, particularly with regard to the triage, communication and administration it is likely that the validity of the score sheet will be increased. Moreover, the physicians and nurses are made aware of the need to know what is happening to the patient. When this awareness increases, the reliability of the score sheet will be increased. With these changes, the score sheet provides insight into the intensity of care in the ED of the MST. Eventually, with the addition of information on patient flows the score sheet can be used to provide the planning for staff of the ED. Although during the pilot study no research has been done on the acceptability of the score chart, there are a few things noticed during the pilot study. The pilot study has shown that the staff of the ED already performs a lot of administration. The additional form to measure the intensity of care is perceived as a burden. To ensure that the score sheet will be feasible, the score sheet has to be incorporated into the daily activities of the ED personnel.

Patient	Time nurse	Time physician	Time researcher	Remark
A	0:53:31	0:56:12	0:52:12	Time measured with the stopwatch and time that comes from the score sheet are relatively similar. The nurse forgot the time spend to clarify the problem ones.
B	1:08:09	0:58:00	1:06:57	Nurse and physician indicates that standard checks are done and monitoring of vital signs took place, this is not the case. Time difference that remains is explained by the time spent on administration.
C	0:56:35	0:56:35	0:37:25	The patient is treated only by a nurse. This is because the patient only needed a catheter. Therefore the second form is completed by the researcher. Time measured with the stopwatch is less than the time from the score sheet because triage did not take place in the triage room and administration takes less time.
D	1:10:47	1:18:40	1:44:35	There is a difference in time because the plaster was very long. This is because it was necessary to make a slit in the cast. During the time measurements this never occurred. The physician selected reposition, but this is not the case when you take repositioning as established for this study. The nurse selected tablets but the patient received the tablets during the triage.
E	1:04:53	1:13:08	1:08:12	Physician and nurse selected triage but triage did not take place in the triage room. Physician selected urinalysis but this has not occurred. The nurse forgot the time spend to clarify the problem ones.
F	1:03:28	1:00:47	0:35:29	There is a difference in time because the administration and communication takes less time. Nurse selected time spend to clarify the problem once too often.
G	1:17:57	1:32:37	1:01:22	Nurse forgot a blood test and physical examination once. Physician selected monitoring vital signs and physical examination one additional time and forgot standard controls.

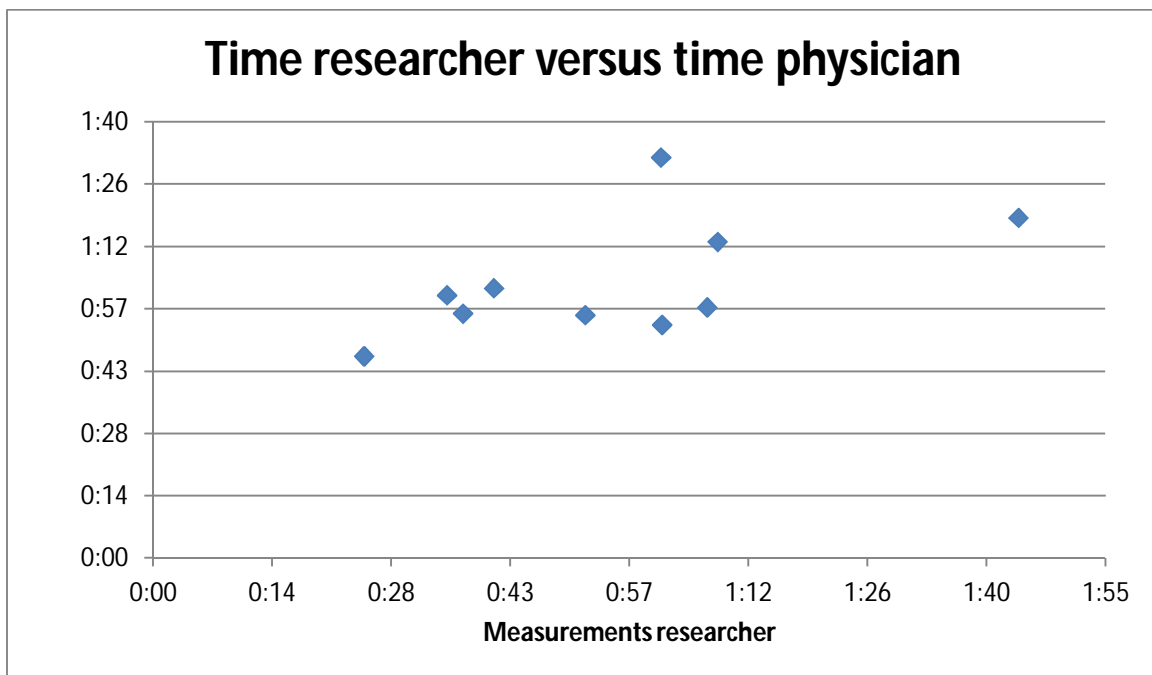


Patient	Time nurse	Time physician	Time researcher	Remark
H	0:46:43	0:46:43	0:25:28	There is a difference in time because the administration and communication takes less time. Nurse and physician selected time spend to clarify the problem but this is not observed by the researcher because the patient came from the X-ray.
I	0:58:43	0:53:56	1:01:29	Physician forgot triage and physical examination once. Nurse forgot physical examination twice. Standard checks are performed during triage but selected by the nurse and physician.
J	0:55:40	1:02:25	0:41:10	Physician selected monitoring vital signs but this has not occurred. Nurse forgot physical examination once. There is a difference in time because the administration and communication takes less time.

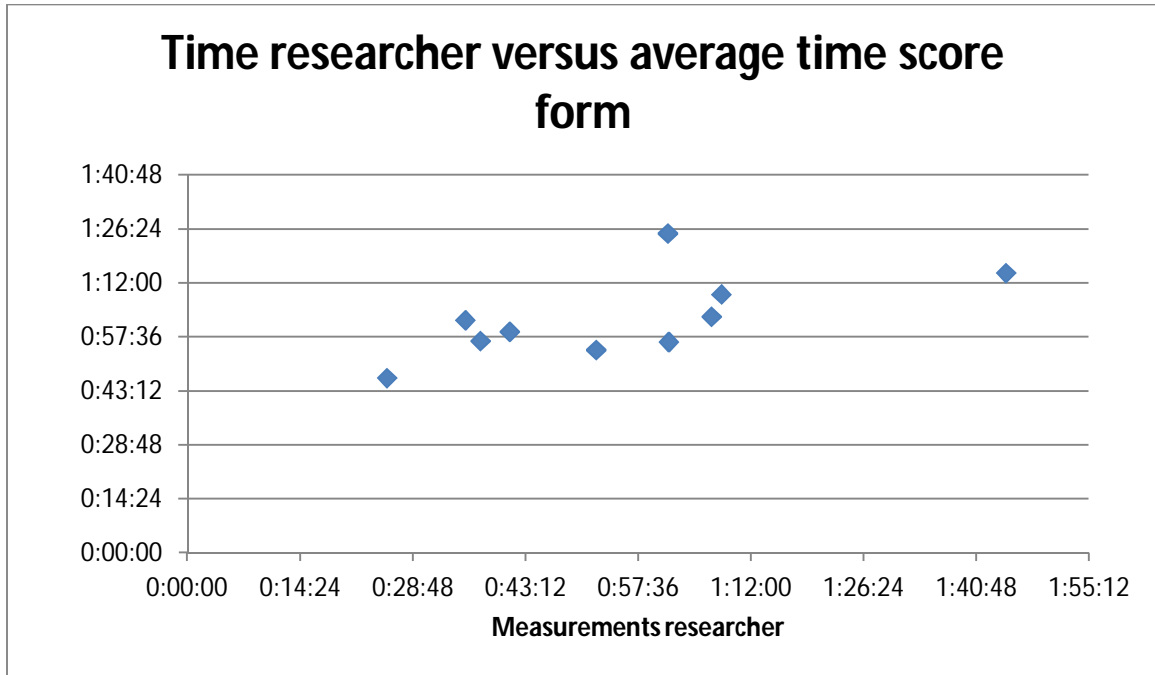
Table 9: Results from the pilot study



Graph 1: Results measurements researcher versus results score sheet nurse



Graph 2: Results measurements researcher versus results score sheet physician



Graph 3: Results measurements researcher versus average score sheet physician and nurse

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## Discussion

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The critical indicators for measuring the intensity of care the ED of the MST are communication, administration, triage, time in the ED, equipment setup, movement/transportation, psychological patient characteristics, physical patient characteristics and medical actions. An important question that remained after the determination of the critical indicators was how the various indicators could be combined. Five of the seven interviews showed that time has to be the connecting factor between the indicators. Therefore measurements of all indicators that can be expressed in time are undertaken. With the results of the measurements the MST intensity of care score sheet has been developed to measure the intensity of care on the ED. The validity and reliability of the score sheet were relatively small, but it is likely that with minor modifications the validity and reliability could be increased making the score sheet valuable information on the intensity of care.

### *Comparison with the existing literature*

Because the instrument developed in this study is a score sheet and not PCS, it is difficult to compare the MST intensity of care score sheet with a PCS. But something can be said about the validity and reliability. The PCS'-s that have been specifically developed for use in ED's have often failed to demonstrate validity and reliability[13]. Only three studies reported evidence of good validity and reliability: the ED Patient Classification Matrix developed in the US; the Conner's Tool developed in Australia and the Jones Dependency Tool (JDT) developed in the UK[8]. The validity and reliability of the score sheet are not optimal yet. This is due to the small pilot study and the necessary adjustments that still need to be done. What can be concluded is that evidence of reliability and validity are essential for accurate predictions of staffing needs, both for the PCS as the score sheet[8].

### *Limitations*

A limitation of the research is that the personnel on the ED knew what the intentions of the research were. This makes it possible for the staff to behave differently during the measurements, so that the measurements may deviate slightly from reality. In practice, this means that the researcher was often asked about whether the act should be done quickly or slowly. Moreover, during the measurement period the hospital went from an administration system on paper to a computer system. This may also have influenced the results, because staff had to adjust to the new system so that some actions, like administration, took longer.

This study involved a relatively small number of measurements (10 of every action). Because not all were measurable, the duration of a number of actions are estimated (see Appendix 6). Some of these values are broad estimated. This can result in inaccurate measurements and it may also happen that coincidences have too much influence. In addition, in the drafting of the beginning and end of each action it is assumed that the action was performed as a whole. In practice, actions are regularly interrupted. The duration of these actions are increased because first has to be determined what was needed to be done.

The pilot study involved a relatively small number of patients. The score sheet is tested on 10 random selected patients. There is a good chance that the illnesses of the patients in the pilot study are not a good reflection of the illnesses in the patient population. This means that the pilot study did not include all illnesses that are regularly encountered in the ED. This also means that not all parts of the score sheet were tested in the pilot study. For example,

there were no trauma patients and patients with wounds in the pilot study, so actions such as suturing a wound, immobilization and placing a chest tube did not occur in the pilot study.

The instrument uses average times for each action. But if it turns out that under certain circumstances, actions always take longer, this should be reflected in the intensity of care and planning of personnel. For example, blood sampling lasted an average of 3:53 minutes. If, however, it is shown that in the night, relatively more patients visit the ED where taking blood samples is difficult, this affects the intensity of care in the night.

The indicators psychological characteristics and physical characteristics are excluded from the score sheet. To determine whether this is the right decision it should be determined what the actual impact of these indicators is on the intensity of care. Psychological characteristics and physical characteristics such as aggression and obesity cannot directly be expressed in time. However, the impact of these characteristics on the time spent on an act can be considered.

The MST intensity of care score sheet is not directly applicable to other ED's because the circumstances on the ED of the MST probably vary from other ED's. This is reflected, for example, in the fact that the CT-scan from the MST is located outside the department resulting in more intensity of care than in a hospital that has its CT-scan in the department. The results are also not directly applicable to other wards of the MST, because intensity of care depends on several indicators which are different for patients on the ED than for patients on normal wards. For example, ordinary wards often have activities such as training in activities of daily living and nutrition. Nonetheless, these results might be helpful for conducting further research.

### *Recommendations*

In the long term the information about the intensity of care per patient can be used for staff planning. A comparison between the number of nursing hours needed to care for a given population of patients and the number of nursing hours available to care for them may be taken into account[5]. Because acute medical events and even ED health-seeking behavior are not random events, but rather have definite time-geographic distribution patterns, it will be possible to predict the patient population on the day[16]. It is also possible to develop clinical care pathways. With this information and the information obtained from the score sheet, it is possible to constitute a workforce.

The score sheet developed in this research gives only information about the direct nursing time and the indirect nursing time. However, the unavailable nursing time is not included in the current score sheet. When the workforce is to be derived from the score sheet it is necessary to take into account the time that staff carries out to activities not directly related to the patients.

For a better overview of the intensity of care per patient, the score sheet must be adjusted. The tasks that didn't occur during the time measurements such as creating a slit in the plaster and the removal of wound cultures, should be added to the score sheet. It is also possible that actions at the ED did not occur during the time measurements and during the pilot study. Should it be the case that such an action occurs with some regularity, it should be added. In the case that this act is very rare, the recital should be made whether it makes sense to add this action to the score sheet. A major change in the score sheet is the

replacement of triage by triage in the triage room. This change is necessary because triage in the triage room take much more time than triage outside the triage room. Triage outside the triage room can then be included in the administration. In addition, administration and communication should be further specified. There are several options. A possibility is to check whether there is a connection between the length of stay on the ED and the time spent on administration and communication. If it appears that the time spent on administration and communications is always, for example, 1/3 of the length of stay on the ED, then the time spent on administration and communication will be a fixed percentage of the time in the ED. When it appears that this is not the case it is also a possibility to ask the person who fills out the score sheet to estimate the time spent on administration and communication instead of taking a fixed value for administration and communication.

In the pilot study the score chart is only tested on the validity and reliability. For a complete picture of the functionality of the score sheet, the sheet should also be tested on its responsiveness, simplicity, efficiency, utility, objectivity and acceptability. Although in the pilot study no research has been done on the responsiveness of the score sheet there is something to say about the responsiveness. The responsiveness issue is about whether the score sheet is sensitive enough to detect relevant changes. For example, a change in the needles for blood sampling which results in faster blood samples, should lead to a change in the score sheet. However, the score sheet uses fixed times so changes in circumstances do not reflect in the score sheet on the moment. An important part of simplicity, efficiency, utility, objectivity and acceptability is the view of those who have to work with the score sheet. The simplicity, efficiency, utility, objectivity and acceptability can be tested to by developing a questionnaire for nurses and physicians who are working with the score sheet. However, the pilot study has shown that the staff of the ED has already a lot of administration. The additional form to measure the intensity of care is perceived as a burden. Therefore it would be better to integrate the score sheet within the current computer system. The system used on the ED of the MST is Ecare. At present, this system is still in development. It is already possible to indicate all the different actions carried out by a nurse or a physician in the system. To integrate the score sheet in the current system there should only be a link between the actions and the duration of the action. Examination of this system proved that it is actually possible.

As discussed under limitations, the number of time measurements and the size of the pilot study were small. To exclude coincidences and to do precise measurements the scale of the study should be increased. The scale of the time measurements can be increased by performing multiple measurements with multiple researchers. The scale of the pilot study can be increased by increasing the duration of the pilot study and selecting a minimum of 100 patients who participate in the pilot.

### *Conclusion*

Overall, a score sheet has been developed which is well applicable to the ED of the MST. Using the score sheet, there is a better understanding of the investment of time per patient. In addition, the results from the score sheet give a better understanding of the activities in the ED than a situation in which only the number of patients is counted. Further assessment of validity and reliability of the score sheet within the ED setting would be recommended.

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## References

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1. Bigbee, J.L., J. Collins, and K. Deeds, *Patient classification systems: A new approach to computing reliability*. Applied Nursing Research, 1992. **5**(1): p. 32-38.
2. Conners, A.M., *Patient classification system in a rural emergency department*. Accident and Emergency Nursing, 1994. **2**(1): p. 7-20.
3. Boo, A.de, W.I.J. de Boer, and J.A. van Erkelens. *Zorgzwaarte-indicatoren op aandoeningsniveau*. 2008 [cited 2011 8 February]; Available from: [http://www.vektis.nl/downloads/Rapport\\_Zorgzwaarte.pdf](http://www.vektis.nl/downloads/Rapport_Zorgzwaarte.pdf).
4. Sermeus, W., et al., *Measuring the intensity of nursing care: Making use of the Belgian Nursing Minimum Data Set*. International Journal of Nursing Studies, 2008. **45**(7): p. 1011-1021.
5. Nelson, M.S., *A triage-based emergency department patient classification system*. Journal of emergency nursing, 1994. **20**(06): p. 511-516.
6. Girard, N.J. and B.A. Keeler, *A Patient Classification System for the OR*. Association of periOperative Registered Nurses, 1986. **44**(2): p. 162-164, 166-170.
7. Hasman, A., et al., *Evaluation of a patient classification system for community health care*. International Journal of Bio-Medical Computing, 1993. **33**(2): p. 109-118.
8. Williams, S. and R. Crouch, *Emergency department patient classification systems: A systematic review*. Accident and Emergency Nursing, 2006. **14**(3): p. 160-170.
9. *Medisch Spectrum Twente, jaarverantwoording 2009*. 2009 [cited 2011 7 March]; Available from: [http://www.mst.nl/onzeorganisatie/jaarverantwoording\\_mst\\_2009\\_de.pdf](http://www.mst.nl/onzeorganisatie/jaarverantwoording_mst_2009_de.pdf).
10. Rama-Rao, V.S. *Steps involved in Stop Watch Time study*. 2008 [cited 2011 14 June]; Available from: <http://www.citeman.com/3357-steps-involved-in-stop-watch-time-study/>.
11. Husted, J.A., et al., *Methods for assessing responsiveness: a critical review and recommendations*. Journal of Clinical Epidemiology, 2000. **53**(5): p. 459-468.
12. de Jong, A.E.E., J. Leeman, and E. Middelkoop, *Development of a nursing workload measurement instrument in burn care*. Burns, 2009. **35**(7): p. 942-948.
13. Crouch, R. and S. Williams, *Patient dependency in the emergency department (ED): Reliability and validity of the Jones Dependency Tool (JDT)*. Accident and Emergency Nursing, 2006. **14**(4): p. 219-229.
14. Lundgrén-Laine, H. and T. Suominen, *Nursing intensity and patient classification at an adult intensive care unit (ICU)*. Intensive and Critical Care Nursing, 2007. **23**(2): p. 97-103.
15. Levenstam, A.-K. and I. Bergbom, *The Zebra index: one method for comparing units in terms of nursing care*. Journal of Nursing Management, 2011. **19**(2): p. 260-268.
16. Ong, M.E.H., et al., *Using demand analysis and system status management for predicting ED attendances and rostering*. The American Journal of Emergency Medicine, 2009. **27**(1): p. 16-22.



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## **Appendices**

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The appendices are not included in the research report, but available as a separate document. For information and to request the document with the appendixes please contact the contact person below.

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