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»Triage according to METTS-A involves systematic and standardized clinical examination carried out on all patients immediately upon arrival«

New accurate triage method

METTS-A provides basis for prioritizing correct level of care

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Most emergency rooms have systems for sorting and prioritizing patients in different degrees of urgency. Some priority systems are used to predict morbidity and mortality [1], while other priority and scoring systems are based on the principle of evaluating a number of important physiological variables [2-4] in patients who are in need of intensive care
Rapid and correct medical care at the emergency unit has previously been shown to be important for patient prognosis [5] where the first sorting based on vital signs and the first hour of continuing emergency process are considered to be the main factors in how the patient should be managed [6]
The UK has nationally implemented a triage method called MTS (Manchester Triage System) for prioritizing patients at emergency units [7]. MTS is based on a number of algorithms, which are each based on a contact reason to answer the question regarding just how acutely ill is the patient. One problem on the emergency unit is that the different expertise of those performing triage and a high degree of subjectivity in the method can provide high inter-individual variability between evaluators [8].
A 3-point scale for prioritizing patients appearing at the emergency unit was used at the Sahlgrenska University Hospital in Gothenburg prior to 2005. Previous studies have, however, shown that a 3-point scale is not sensitive enough to identify the sickest and the least ill patients and that inexperienced nurses risk underestimating the patient's clinical condition [9], which can lead to a priority which is too low.
In a previous retrospective study, emergency patients were evaluated with acute internal medical conditions using both anamnestic data and recorded vital signs (REMS = Rapid Emergency Medicine Score) [10]. In this study it was found that the most important predictor of mortality, in addition to age, was the respiratory rate [10]. Several of the methods of triage or ranking used lack systematic examination of vital signs in all patients with the choice of vital signs being determined by the priority level, and they are therefore measured only in selected patients [11].
A new protocol for emergency care, METTS-A (Medical Emergency Triage System and Treatment Adult), has been developed at the emergency and accident clinic at the Sahlgrenska University Hospital/Sahlgrenska providing a basis for sorting, prioritizing and risk identification of all patients at the unit and as a decision making tool for the continued emergency care process. The purpose of the protocol was to achieve a higher degree of structure, sensitivity and control during the initial care and also increased medical safety in the continued process.
The purpose of the retrospective study presented here was to validate the triage according to METTS-A and its sensitivity regarding finding the sickest patients and predict mortality; as part of the study we also wanted to identify criteria for those patients who completed treatment at the emergency and accident unit and those who were admitted for in-patient care.

MATERIAL AND METHODS

The emergency and accident unit at the Sahlgrenska University Hospital/Sahlgrenska is essentially an adult emergency department with currently 48,000 visits per year. More than 50 % of patients arriving come via the ambulance service.
Previous work methods meant that different categories of healthcare workers received, recorded, sorted and prioritized patients who arrived via the front desk or via ambulance. The documentation

was performed using the electronic patient health record, which often resulted in duplication of documentation.
Following an extensive process analysis and inventory of the different work methods, a new protocol called METTS-A was developed and tested which contains both a method for triage and a method for the follow-up process in the emergency room. METTS-A was introduced in January 2005.This method involves a structured acute patient medical record following the patient providing guidance in the prioritization process, regardless of severity, and provides a common form of documentation for all healthcare professionals and all doctors. The acute medical journal accompanies the patient throughout the acute process (for the basis of the acute medical journal (go to http://www.sahlgrenska.se) and upon discharge the acute medical record is scanned into the electronic patient medical record where it can be read by any recipient medical care units.

SUMMARY
A new method for triage according to METTS-A (Medical Emergency Triage and Treatment System Adult) has been validated using 12,317 patients who sought care at the emergency and accident unit at Sahlgrenska University Hospital/Sahlgrenska in Gothenburg and using 17,921 patients who were admitted for inpatient care from the emergency unit.
Triage according to METTS-A occurs at five sorting levels, where the vital signs and reasons for contact were combined to provide four levels of priority.
The study showed that the triage method has a high level of sensitivity for finding the patients most sick and predicting mortality both at the emergency unit and during the subsequent period of medical care.
According to the study two vital signs (respiratory rate and level of consciousness) are what mainly determine whether the patient is awarded a high priority level.
Triage according to METTS-A is simple and logical with low inter-individual variability

FACT. Five sorting levels in METTS-A
METTS-A (Medical Emergency Triage and Treatment System Adult) includes five sorting levels designated using colours.
Red, orange, yellow and green comprise priority levels 1–4: red is the highest priority, defined as life-threatening, followed by orange, yellow and green.
Blue is a primary sorting level used for patients <80 years old, presenting via reception with an isolated problem and that via a special algorithm is not considered as needing to undergo monitoring of vital signs.

Triage according to METTS-A contains an algorithm that includes vital signs designated as ABCDE combined with a module that contains algorithms for different reasons for contact. Triage includes checks of the following:

A open airways
B respiratory rate (using capnograph) and oxygen saturation (using pulse oximeter)
C heart rate (using cardioscope) and blood pressure (automatic noninvasive blood pressure)
D level of consciousness according to RLS (Reaction Level Scale) (subjective assessment)
E body temperature

The documentation of vital signs takes place using the acute medical journal and gives the patient a provisional priority while the nurse in the triage area using an algorithm for the specified reason for contact assigns the patient his/her final priority. This priority is a combination of results from vital signs and reasons for contact, so-called ESS (Emergency Symptoms and Signs).

METTS-A currently has 39 ESS algorithms corresponding to 97 different contact reasons, according to the International Classification of Diseases (ICD-10). These contact reasons account for 99 percent of those appearing at the emergency unit. Each algorithm also contains guidance regarding how re-prioritization should take place and how and when possible measures shall be taken during the acute process.

METTS-A contains five sorting levels where four of them constitute the priority levels 1-4 while the fifth is a primary sorting level (see Fact). Priority level constitutes a decision making support for lead times regarding physicians, the need for monitoring and standardized sampling according to the protocol.

The study included 12,317 consecutive patients who sought care in emergency and accident unit at the Sahlgrenska University Hospital/Sahlgrenska during the second quarter of 2005. A total of 51,566 patients sought help at the unit during 2005.
To calculate mortality in emergency and accident unit the basic material was used n = 12,317 in other words all patients who appeared at the unit during the second quarter of 2005. In order to calculate the mortality outside the unit itself, meaning during the subsequent hospitalization period, all patients who were admitted for in-patient care from the emergency and accident unit throughout 2005 were used excluding patients who were admitted for in-patient care between January 1st and 7am on January 17th before METTS-A was introduced (n = 17,921).
Inter-individual variability in METTS-A was studied using 132 parallel, independent observations by the ordinary nurse in the triage area, an emergency nurse, an experienced physician and a midwife all performing triage simultaneously on the same patients.

Statistics
Variance analysis was used (ANOVA, analysis of variance) for hypotheses testing regarding differences in mean values between the groups. Kappa analysis was used [12 in the analysis of inter-individual variability. The SPSS 13.0 data program was used for statistical processing.

RESULTS

Basal data and priority outcomes
The proportion of patients admitted for in-patient care increased with higher priority levels. In the blue sorting group 9 % of patients were admitted for in-patient care. These consisted of patients with mild orthopedic disorders, who for various reasons required follow-up measures or diagnostics. In the red priority group (life-threatening),12 % were discharged home directly from the accident and emergency unit. These patients had in a few cases hyperventilation syndrome, while the majority had alcohol poisoning or GHB (gamma-hydroxybutyrate) overdosing and after a period of observation and analysis at the unit they were re-prioritized to a lower priority level and then discharged.
The reason for the high primary priority of the patients who were discharged directly from the unit was in all cases of poisoning RLS>3, in other words a substantially lower level of consciousness.
The mean age was significantly higher in women (60.7 ± 23 years) than in men (56.9 ± 21 years (P <0.01).
The mean age was significantly higher in the orange and red priority group (P <0.001) (Table I).
There were no significant gender differences in the priority groups or in the proportion admitted for in-patient care.
The influence of vital signs and ESS on the distribution of the priority groups is shown in Table II. In the red priority group, only 9 % of patients have this priority based on the ESS, while 91 % have impact on one or more vital signs that result in red priority. In the green priority group, no patients have influenced the vital signs, which is built into the algorithm

Mortality data
Mortality on the emergency and accident unit among patients with red priority was 7 % (n = 50) and in those with orange priority it was 0.2 % (n = 3), whereas it was 0 % among those with lower priority levels in the actual material (n = 12,317).
For patients who over 12 months were enrolled for in-patient care from the emergency and accident unit (n = 17,921) mortality increased during the subsequent hospitalization period with a higher priority (Table III).

Vital signs
The respiration rate increases with increasing degree of priority, while the oxygen saturation level and consciousness level declines (RLS increases). The outcome for the vital signs shows that the respiratory rate and level of consciousness are the parameters that primarily determine which patients are prioritized to the red priority group (Table IV).

Variability in triage according to METTS-A
The kappa values were high, indicating that the inter-individual variability between different evaluators was low when the METTSA- triage method was used simultaneously and on the same patients (Table V).

DISCUSSION

The fact that the emergency process is systematized from the point of arrival until discharge is a prerequisite for high sensitivity in risk identification, sorting and prioritizing, and for high safety during subsequent care at the emergency and accident unit. Ideally, even data from the pre-hospital care chain should be included to gain both time and medical safety.

Our study includes a very large patient material and shows that the METTS-A triage method has high sensitivity when assigning priority at the correct level according to the patient's current healthcare needs and medical risk. The study also shows that there is a strong correlation between the level of priority and the risk of death at the emergency unit and also a correlation between the priority level and mortality during subsequent hospitalization period.

In this material there was a clear difference in mean age between the red and orange higher priority levels, which according to METTS-A are classified as being “life-threatening” or “potential life-threatening” and the other levels. This agrees well with the clinical picture that the elderly often have more and more complex medical conditions than younger patients which in this study were to a greater extent sorted to lower priority groups. In METTS-A age does not appear to be a factor that affects prioritizing, either primarily or secondarily, other than for patients aged >80 years that are not able to be referred to other forms of care without having undergone triage according to METTS-A. The fact that the protocol still has this sorting effect reinforces the impression that METTS-A is a method that confirms previously published data regarding risk factors where age was found to have the strongest predictive value for mortality during hospitalization periods [10].

Our study also shows that sensitivity when sorting and prioritizing patients correctly increases if you measure and document vital signs and combine this with a structured work method, where the reason for contact, signs and alarm symptoms are compiled on the basis of one predetermined algorithm per reason for contact. Previous studies have shown that the addition of vital signs to a great extent means that the patient is given a higher priority level indicating that primary sorting based only on the reason for contact and symptoms risks assigning the patient a priority level which is too low.

As part of our study we also saw the same trend (Table II) that the majority of critically ill patients who were given high priority also had vital signs which were affected, while those patients with lower priority and who were less ill were often prioritized on the basis of an ESS algorithm. Our data and previously published data reinforces the impression that if we only use symptoms as the basis for decision making variable during triage, we risk assigning patients with priority levels that are too low [7].

In the case of several patient groups methods for risk stratification have been developed - patients with trauma [13], patients who are critically ill [14] and patients with suspected acute coronary syndrome [15]. An ideal triage method for the identification of medical risk should incorporate high sensitivity, be simple and systematic and risk identification should be done in the immediate vicinity of arrival, ideally already at a pre-hospital stage.

Method simplicity can also result in less inter-individual variability, and previous studies have shown varying degrees of variability depending on the system that is used [11, 16]. In our study we could show a low inter-individual variability, and although the number of observations was relatively small the high kappa values do however indicate good usability and high consensus even among staff not specially trained in the triage method.

Triage according to METTS-A involves a systematic and standardized clinical examination, conducted on all patients immediately upon arrival. This means that we can detect the sickest patients at an early stage and also identify the less sick patients who appear at the emergency unit. There is an obvious advantage in early data capture and in detecting failing vital organ functions and monitor how the functions of various organ systems change. At the same time, results from the measurements of vital signs are the basis for how the continued emergency process should be planned.

In addition to the triage method, METTS-A also has a protocol for follow-ups at the emergency unit which differentiates METTS-A from most other triage methods [17].

The early clinical examination combined with structured follow-ups including sampling determined by the priority level, provides a broad decision making tool. It also reduces the need for the duplication of documentation and repeated patient medical histories and, in addition, resources are freed allowing for the creation of added value for patients in the form of nursing care. Another advantage of early clinical examination and structured collective documentation is that patients feel well cared for and do not have to repeat providing their entire medical history on several occasions.

Our study shows that by using the METTS-A method of triage you can achieve great sensitivity in finding patients with high medical risks both on the emergency unit and during any subsequent

hospitalization period. Our experiences and conclusions from the emergency and accident unit at Sahlgrenska University Hospital/Sahlgrenska are also that METTS-A is a simple, efficient and secure protocol which is easy to implement within your organization regardless of what triage method has previously been used.

Any potential conflict of interests or competing interests: The name METTS-A is registered and protected as a trademark with the Swedish Patent and Registration Office in the name of Bengt R Widgren. Other authors: None specified

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"Our study shows that by using METTS-A as the triage method we can achieve high sensitivity when detecting patients with high medical risk both at the emergency unit and during subsequent hospital stays"

TABLE I. Basal data in the different priority groups (n=12,317) (*: P<0.001). For explanation of colour scale, see Facts 1.**

	Blue	Green	Yellow	Orange	Red
	n=3 430	n=3 391	n=3 461	n=1 339	n=696
Age, year	49 ± 22	58 ± 20	58 ± 21	71 ± 21***	72 ± 18***
Men, %	29.1	25.1	26.7	13.3	5.8
Women, %	24.7	28.1	27.9	14.1	5.1
Discharged,	3121	2360	1626	411	86
number (%)	(91)	(70)	(47)	(24)	(12)
Admitted,	309	1031	1865	1295	560
number (%)	(9)	(30)	(53)	(76)	(81)

TABLE II. Effect of vital signs and ESS on which priority group the patient is assigned to; numbers indicate %. (ESS = Emergency Symptoms and Signs, i.e. algorithms for contact reason) For explanation of colour scale, see Facts 1.

Priority group	Vital parameters	ESS
Red priority	91	9
Orange priority	55	45
Yellow priority	13	87
Green priority	0	100

TABLE III. Mortality during subsequent hospital stay for all patients admitted to hospital (n=17 921). For explanation of colour scale, see Facts 1.

	Blue	Green	Yellow	Orange	Red
	n=251	n=6714	n=6500	n=3302	n=1154
Number	0	47	91	142	150
% of admitted	0	0.7	1.4	4.3	13

TABLE IV. Vital signs within respective priority group.
(AF = respiratory rate, POX% = oxygen saturation with pulse oximetry,
HF = heart rate, SBT = systolic blood pressure, DBT = diastolic blood pressure, RLS = Reaction Level Scale.) For explanation of colour scale, see Facts 1.

	Green	Yellow	Orange	Red	P
AF/min	16 ±1	16±4	18±6	22± 7	<0.005
POX%	98 ±1	97±1	94±5	91± 9	0.04
HF/min	61 ±9	91± 16	95 ± 25	93 ± 33	ns
SBT, mm Hg	126 ± 12	149 ± 18	139 ± 30	134 ± 46	ns
DBT, mm Hg	84 ± 14	92 ± 18	82 ± 18	81 ± 25	ns
RLS	1 ±0	1± 0	1.1 ± 0.4	3.43 ± 2.6	<0.001

TABLE V. Triage according to METTS-A, concordance between different evaluators.

Evaluator	Ordinary triage, kappa value
Physician	0.90
Midwife	0.76
Nurse	0.86

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