The Journal of Emergency Medicine, Vol. xx, No. x, pp. xxx, 2008

0736-4679/08 $–see front matter

ELSEVIER

doi:10.1016/j.jemermed.2008.04.003

Original Contributions

MEDICAL EMERGENCY TRIAGE AND TREATMENT SYSTEM (METTS): A NEW PROTOCOL IN PRIMARY TRIAGE AND SECONDARY PRIORITY DECISION IN EMERGENCY MEDICINE

Bengt R. Widgren, MD, PHD* and Majid Jourak, MD†

*Department of Accident and Emergency Medicine and †Department of Internal Medicine, Sahlgrenska University Hospital, Göteborg, Sweden

Reprint Address: Bengt R. Widgren, MD, PHD, Department of Accident and Emergency Medicine, Sahlgrenska Academy, Sahlgrenska University Hospital, Goteborg 413 45, Sweden

□ **Abstract—Background: In many Emergency Department (ED) triage scoring systems, vital signs are not included as an assessment parameter. Objectives: To evaluate the validity of a new protocol for Emergency Medicine in a large cohort of patients referred to in-hospital care. Methods: From January 1 to June 30, 2006, 22,934 patients were admitted to the ED at Sahlgrenska University Hospital. Of those, 8695 were referred to in-hospital care and included in the study. A new five-level triage tool, combining vital signs, symptoms, and signs in the triage decision, was used. A small control of the inter-rater disagreement was also performed in 132 parallel, single-blinded observations. Results: Fifty percent of the patients were admitted by ambulance and the other 50% by walk-in. Hospital stay was significantly ($p < 0.001$) longer in those admitted by ambulance (9.3 ± 14 days) as compared with walk-in patients (6.2 ± 10 days). In-hospital mortality incidence was higher (8.1%) in patients admitted by ambulance, as compared with walk-in patients (2.4%). Hospital stay and in-hospital mortality increased with higher level of priority. In the highest priority groups, 32–53% of the patients were downgraded to a lower priority level after primary treatment. Conclusion: In the present study, the METTS protocol was shown to be a reliable triage method and a sensitive tool for secondary re-evaluation of the patient in the ED. © 2008 Elsevier Inc.**

□ **Keywords—triage; vital signs; mortality; hospital stay; emergency medicine**

INTRODUCTION

Early identification of critically ill patients and stratification into priority levels on admission to the Emergency Department (ED) is very important for the quality and safety of Emergency Medicine. In most EDs, triage assessments are made close to admittance. There are several reports on different methods of triage in the ED; in Sweden, triage has been introduced in most Emergency Departments during recent years (1–3). Previously, scoring systems—including physiological parameters—to predict mortality have been described, but in most triage methods used in EDs, vital signs or laboratory parameters are not included as standard assessments (1–5). However, vital signs have been reported to be of importance and superior for predicting mortality and stratifying critically ill patients (5). Vital signs have also been shown to be of importance in detecting high-risk hospital inpatients (6). The safety of triage systems is related to the ability to detect the critically ill and not fail to detect those who deteriorate during the ED stay (7). This safety has to be balanced with the resource implications of over-triage.

At the ED of Sahlgrenska University Hospital, we developed and introduced a new protocol including a triage algorithm combining vital signs, chief complaints, symptoms, and signs to give the priority level. The aim of the present study was to evaluate the new triage

RECEIVED: 31 December 2007; FINAL SUBMISSION RECEIVED: 25 February 2008;
ACCEPTED: 2 April 2008

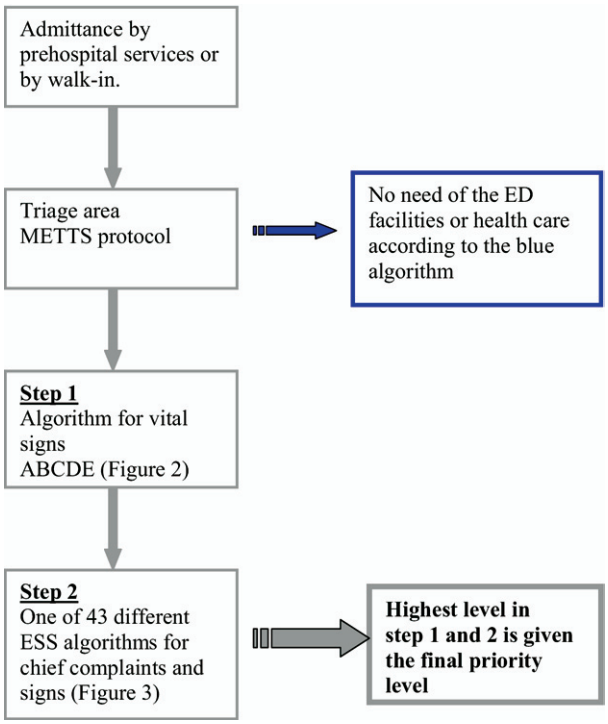

Figure 1. Flow chart of the triage procedure in METTS. METTS = Medical Emergency Triage and Treatment System; ED = Emergency Department; ESS = emergency symptoms and signs.

algorithm used in our Accident and Emergency Department in patients referred from the ED to in-hospital care.

METHODS AND MATERIAL

Sahlgrenska University Hospital, with 48,000 annual visits to its Accident and Emergency Department, serves as an urban, academic teaching hospital. In the present retrospective study, 22,934 adult patients were admitted to the ED from January 1 through June 30, 2006. Of these, 38% (n = 8695) had an in-hospital stay and 14,239 patients were discharged from the ED. Only in-hospital patients were included in the present study. A small number of patients admitted to the ED, by helicopter (n = 45) or due to medico-legal reasons (n = 19), were excluded from this study.

A new protocol, METTS (Medical Emergency Triage and Treatment System), developed at Sahlgrenska University Hospital, has been used in the ED since January 2005. The protocol includes five priority levels. The lowest level is "blue," which is given patients without need of emergency care or any hospital facilities. Patients with blue priority are mostly referred to primary care if possible. The four higher levels in the triage method of METTS include two steps, assessed simultaneously, that include one algorithm for vital signs, and one of 43 algorithms (emergency symptoms and signs [ESS]) for different chief complaints, symptoms and signs, specific for the METTS protocol. The combined outcome of both these algorithms is given the final priority level (Figures 1–3).

"Red" priority is classified as life threatening and in need of immediate medical attention by physician and nurses. "Orange" priority level is classified as potentially life threatening and in need of medical attention within 20 min. "Yellow" priority level is classified as not life threatening but in need of medical attention within 120 min, and "Green" priority level is classified as not life threatening and not in need of immediate care. In the METTS protocol, laboratory parameters are not included in the primary triage decision.

The protocol of METTS was designed to find those critically ill and at risk of deterioration at admission, but also to detect changes in vital signs, symptoms, and signs as well as clinically significant laboratory pathology during the ED stay. According to the protocol, all patients will be re-evaluated during the ED stay. In the re-evaluation part of the protocol, step 3 or the third procedure, some laboratory parameters, such as cardiac markers, lactate, hemoglobin, and plasma glucose, can give a higher priority level than the primary priority level given in the triage area.

Vital signs were measured during the triage assessment, within minutes in those admitted by ambulance, whereas in those patients admitted by walk-in, vital signs were measured within 10 min from registration. All patients in our ED are assessed in the triage area by the ED triage team.

Physiological parameters include respiratory rate, oxygen saturation, heart rate, systolic and diastolic blood pressure, reaction level scale, and body temperature. The Reaction Level Scale (RLS85) has been evaluated and

Step 1	Method	Red	Orange	Yellow	Green
A = airway	*Inspection*	Airway compromised	Not used	Not used	Not used
B = respiration	*RR and POX%*	> 30 or < 8/min < 90 % with oxygen	> 25/min or < 90% without oxygen	< 25/min or 91–95% without oxygen	9–25/min and > 95% without oxygen
C = circulation	*HR and BP*	> 130/min or < 90 mm Hg SBP	> 120 or < 40/min	> 110 or < 50/min	51–109/min
D = disability	*RLS*	> 3 or ongoing seizure	2–3	Confusion	Alert
E = exposure	*Body temp*	Not used	> 41 or < 35	38.5–41	35.1–38.4

Figure 2. Triage algorithm for vital signs on step 1 of METTS. RR = respiratory rate; POX = pulse oximetry; HR = heart rate; BP = blood pressure; SBP = systolic blood pressure; RLS = reaction level scale.

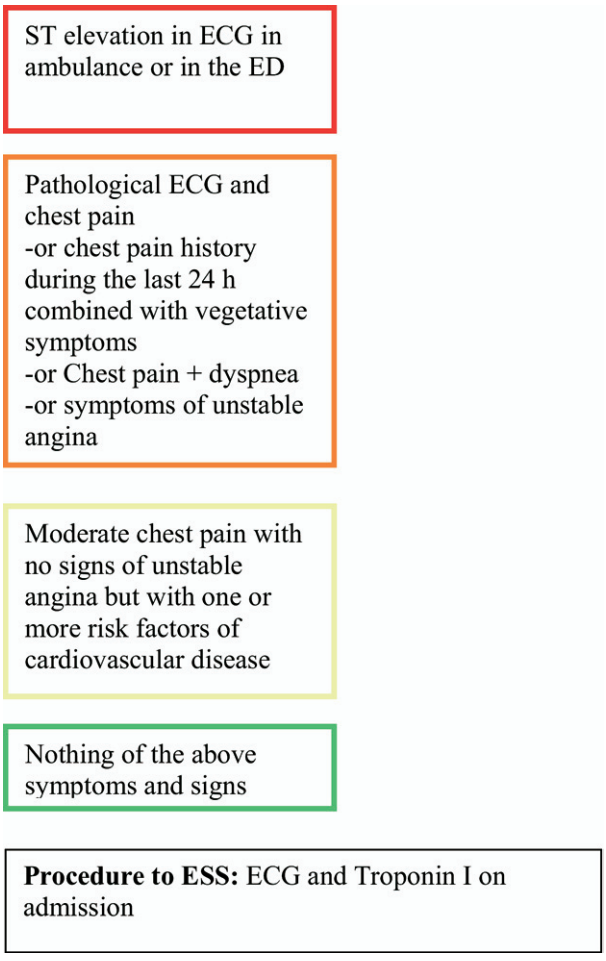

Figure 3. ESS algorithm No. 5: Chest pain in METTS; criteria in different priority levels. ECG = electrocardiogram; ED = emergency department; ESS = emergency symptoms and signs.

was shown to have a better reliability than the Glasgow Coma Scale (8).

All statistical analyses were performed with SPSS version 13.0 (SPSS Inc., Chicago, IL). Analysis of differences between the priority groups' analyses of variance was used. The inter-rater reliability analysis was performed by 132 parallel, single-blinded observations and calculated according to the definitions reported by Altman (9). This study was approved by the Ethical Committee at Sahlgrenska Academy.

Table 1. Baseline Data, Male and Female

	Male n = 4625 Mean ± SD	Female n = 4070 Mean ± SD	*p* Value
Age (years)	64 ± 20	67 ± 21	< 0.001
Hospital stay (days)	7.6 ± 12.8	7.9 ± 12.0	ns
In-hospital mortality	247 (5.3%)	208 (5.1%)	ns

Table 2. Baseline Data in Patients Divided into Walk-in or Ambulance Admittance

	Walk-in n = 4356	Ambulance n = 4339	*p* Value
Age (years) Mean ± SD	61 ± 20	69 ± 19	< 0.001
Sex (Male/female)	2321/2035	2304/2035	Ns
Hospital stay MLOS ± SD	6.2 ± 10	9.3 ± 14	< 0.001
In-hospital mortality	104 (2.4%)	351 (8.1%)	< 0.001

MLOS = mean length of stay.

RESULTS

There was a significantly ($p < 0.001$) higher percentage of male patients (54%) as compared with females (46%) in this cohort. Males were significantly older than females, whereas no significant difference was found in length of hospital stay or in-hospital mortality between males and females (Table 1).

Approximately 50% were admitted by walk-in and 50% by pre-hospital services. Age was significantly higher and hospital stay longer in patients admitted by ambulance as compared with those admitted by walk-in ($p < 0.001$). Total mortality was 5.2% (n = 455), whereas in patients admitted by ambulance, in-hospital mortality was significantly higher compared to walk-in patients ($p < 0.001$) (Table 2).

In the lower priority blue, green, and yellow levels, walk-ins were more frequent, and in the higher priority red and orange levels, ambulance was the predominant way of admittance to the ED (Table 3).

Mean age in the whole cohort was 65 ± 20 years. Patients in the blue and red priority levels were significantly younger. The number of males was higher in the blue, orange, and red priority groups. In-hospital mortality incidence was higher, and length of stay was increased in higher priority level groups (Table 4).

Table 3. Priority Level Groups in Walk-in or Ambulance Admittance

	Walk-In n = 4356	Ambulance n = 4339	*p* Value
Blue	190	30	< 0.001
Green	1108	510	< 0.001
Yellow	1755	1388	< 0.001
Orange	1014	1510	< 0.001
Red	289	901	< 0.001

Table 4. Baseline Data in Patients Divided into Priority Level Groups

	Blue n = 220	Green n = 1618	Yellow n = 3143	Orange n = 2524	Red n = 1190	*p* Value
Age (years) Mean ± SD	51 ± 23***	65 ± 21	66 ± 19	66 ± 19	62 ± 21	< 0.001
Sex Male/female	148/72***	809/809 (ns)	1609/1534 (ns)	1365/1159***	694/496***	
Hospital stay MLOS ± SD	4.1 ± 11	7.5 ± 11	7.7 ± 12	8.0 ± 13	8.7 ± 15	< 0.01
In-hospital mortality	1 (0.5%)	48 (3.0%)	94 (3.0%)	147 (5.8%)	165 (14%)	< 0.001

Significantly differences within the priority level groups: *** $p < 0.001$.
MLOS = mean length of stay.

Primary Triage and Triage Decision at Follow-up

When the primary priority level at admission to the ED and secondary emergency level during the ED stay were analyzed, it was shown that only a small number of patients in the lowest priority group were upgraded to higher priority levels during the ED stay. In the green and yellow groups, there were a number of patients who were upgraded one or more priority levels due to deterioration in their medical condition, whereas in the orange priority group, there were a substantial number of patients who were downgraded during their ED stay. In the red priority level group, there was also a substantial change in the secondary priority level; over 50% of the red priority patients were downgraded to a lower priority level after primary treatment. In 283 patients (3.3%), no secondary priority level was given during the ED stay (Table 5).

Inter-rater Variability

As a pilot control of the inter-rater variability, a reliability study showed a good concordance and low inter-rater disagreement between triage nurses and senior Emergency Physicians in 132 parallel patient observations in the triage area (Table 6).

Table 5. Primary and Secondary Priority Levels in the Whole Material (n = 8695)

Primary/ Secondary Triage Level	NoSec	sBlue	sGreen	sYellow	sOrange	sRed
Blue n = 220	22	187	4	5	2	0
Green n = 1618	29	1	1494	61	31	2
Yellow n = 3143	72	0	154	2790	125	2
Orange n = 2524	81	0	117	690	1620	16
Red n = 1190	79	0	29	152	451	479

s = secondary priority level; NoSec = no secondary triage category decision made.

DISCUSSION

In the present study, it was shown that the METTS protocol includes a sensitive triage algorithm to find those with high or low medical risk in the ED. The aim with this new protocol was to establish a higher sensitivity to identify the level of acuity and stratify patients into one of five priority levels close to admittance. It is clear that the priority level in METTS, based on the combination of vital parameters, symptoms, and signs, is closely related to in-hospital mortality and hospital length of stay. Ambulance admittance was more frequent in those patients with higher priority levels, whereas those with lower priority levels were admitted by walk-in in most cases. However, there were a number of patients admitted by walk-in who were triaged to a high primary priority level. This confirms that a standardized clinical triage including vital signs as a standard assessment and not only chief complaints in the triage decision, is of importance to increase the sensitivity to find those at medical risk on admission to the ED. Our protocol includes physiological parameters, and this part of the triage algorithm has previously been shown to be a sensitive tool to find those critically ill (10). Many studies are often based on protocols that do not include vital signs or combinations of chief complaints and vital signs, or protocols for follow-up during the ED stay, and often include selected groups of patients (1–3,5,11,12). In this study, we investigated a large number of patients with both lower and higher degrees of emergency

Table 6. Inter-rater Observations

Observer	Triage Nurse Kappa Value
Emergency doctor	0.903
Nurse 1	0.761
Nurse 2	0.86

Uncorrected kappa values according to Altman (9).

illness, with a systematic protocol used in a similar way in all patients.

In Emergency Medicine there is a strong need for sensitive tools to identify and characterize patients at admission to the ED. Therefore, it is important that ED triage and management be more standardized to minimize the inter-rater disagreement, and that vital signs are assessed in all adult patients admitted to the ED and that assessment of important physiological parameters is not a decision of the triage nurse only (1,13). This protocol was shown to have low inter-rater disagreement and high kappa value, which confirms that the protocol is useful and reliable in different kinds of patients and in the hands of medical staff with different triage experience.

Our data demonstrate that a cohort of patients given a rather high priority level mainly based on vital signs had a higher in-house mortality compared with those with a low priority level. These data confirm that the triage algorithm is sensitive to identify those patients at high risk but also to identify those at low risk during the ED and in-hospital stay.

During the ED stay, the primary priority level was re-evaluated in a majority of patients, and in the highest priority level, more than 50% were downgraded to lower priority levels after primary treatment and observation. Most patients with red priority level are given the priority level due to vital signs of single- or multiple-organ failure. There also were a substantial number of intoxicated patients with decreased reaction level in the red priority group; after primary treatment they were downgraded due to normalized reaction levels. The strategy with a primary triage decision and a follow-up protocol is to give attention to deteriorating patients during the ED stay and to establish a more early and aggressive intervention in those cases with sudden deterioration.

Limitations

In this study we didn't limit the population to specific diagnoses, as has been done in many other studies. Rather, we studied our METTS protocol in a broader ED population and found that our protocol can be used as a simple and safe method. A limitation in the present study was the large number of patients and, therefore, statistical significance can been reached by chance, and without clinical relationships. However, in the present study such clinical relationships were present.

CONCLUSIONS

We believe that our protocol for early detection of organ failure and follow-up during ED stay can increase the medical safety and lower the mortality of the ED population.

We did also find that the METTS triage method is a sensitive tool to find those in need of immediate medical attention, and for early detection of those with deterioration during the ED stay. This gives us a reliable and validated protocol for both triage and follow-up management in the ED.

REFERENCES

1. Baumann MR, Strout TD. Evaluation of the emergency severity index (version 3) triage algorithm in paediatric patients. Acad Emerg Med 2005;12:219–24.
2. Mackway-Jones K. Emergency triage: Manchester Triage Group. London: BMJ Publishing Group; 1997.
3. Travers DA, Waller AE, Bowling JM, Flowers D, Tintinalli J. Five-level triage system more effective than three-level in tertiary emergency department. J Emerg Nurs 2002;28:395–400.
4. Knaus WA, Draper EA, Wagner DP, Zimmerman JE, Lawrence DE. Apache II: a severity of disease classification system. Crit Care Med 1985;13:818–29.
5. Olsson T, Terent A, Lind L. Rapid emergency medicine score can predict long-term mortality in nonsurgical emergency department patients. Acad Emerg Med 2004;11:1008–13.
6. Goldhill DR, McNarry AF. Physiological abnormalities in early warning scores are related to mortality in adult inpatients. Br J Anesth 2004;92:882–4.
7. Cooke MW, Jinks S. Does the Manchester triage system detect the critically ill? J Accid Emerg Med 1999;16:179–81.
8. Stålhammar D, Starmark JE, Holmgren E, et al. Assessment of responsiveness in acute cerebral disorder. A multicentre study on the reaction level scale (RLS85). Acta Neurochir 1988;90:73–80.
9. Altman D. Practical statistics for medical research. London, UK: Chapman & Hall; 1991.
10. Widgren BR, Jourak M. Serum lactate, an indicator of critical illness in emergency medicine. (Submitted).
11. Shapiro NI, Wolfe RE, Moore RB, Smith E, Burdick E, Bates DW. Mortality in Emergency Department Sepsis (MEDS) score: a prospective derived and validated clinical prediction rule. Crit Care Med 2003;31:670–5.
12. Reilly BM, Evans AT, Schaider JJ, et al. Impact of a clinical decision rule on hospital triage of patients with suspected acute cardiac ischemia in the emergency department. JAMA 2002;288:342–50.
13. Göransson K, Ehrenberg A, Marklund B, Ehnfors M. Accuracy and concordance of nurses in emergency department triage. Scand J Caring Sci 2005;19:432–8.

ARTICLE SUMMARY

1. Why is this topic important?

Early identification, especially of critical ill patients, in the Emergency Department (ED) is of great importance to increase medical safety and quality.

2. What does this study attempt to show?

This study shows that if vital signs are combined with symptoms and signs in the triage decision, the sensitivity is high to identify those at medical risk as well as those without medical risk in the ED.

3. What are the key findings?

One of the key findings is that our triage method in METTS (Medical Emergency Triage and Treatment System) is reliable and with low inter-rater disagreement, and with the strategy of a primary triage decision, follow-up by a protocol is given attention to deteriorated patients during the ED stay and a possibility to establish more early and aggressive intervention in those cases with sudden deterioration. We also find that the METTS triage method is a valid method to predict ED outcome.

4. How is patient care impacted?

The use of the METTS protocol gives an earlier identification, prioritization, and a systematic management of the patients regarding monitoring the vital signs and standard blood sampling according to their priority level.