REVIEW ARTICLE

Modern Triage in the Emergency Department

Michael Christ, Florian Grossmann, Daniela Winter, Roland Bingisser, Elke Platz

SUMMARY

Background: Because the volume of patient admissions to an emergency department (ED) cannot be precisely planned, the available resources may become overwhelmed at times ("crowding"), with resulting risks for patient safety. The aim of this study is to identify modern triage instruments and assess their validity and reliability.

Methods: Review of selected literature retrieved by a search on the terms "emergency department" and "triage."

Results: Emergency departments around the world use different triage systems to assess the severity of incoming patients' conditions and assign treatment priorities. Our study identified four such instruments: the Australasian Triage Scale (ATS), the Canadian Triage and Acuity Scale (CTAS), the Manchester Triage System (MTS), and the Emergency Severity Index (ESI). Triage instruments with 5 levels are superior to those with 3 levels in both validity and reliability ($p<0.01$). Good to very good reliability has been shown for the best-studied instruments, CTAS and ESI (κ-statistics: 0.7 to 0.95), while ATS and MTS have been found to be only moderately reliable (κ-statistics: 0.3 to 0.6). MTS and ESI are both available in German; of these two, only the ESI has been validated in German-speaking countries.

Conclusion: Five-level triage systems are valid and reliable methods for assessment of the severity of incoming patients' conditions by nursing staff in the emergency department. They should be used in German emergency departments to assign treatment priorities in a structured and dependable fashion.

▶ Cite this as:
Christ M, Grossmann F, Winter D, Bingisser R, Platz E: Modern triage in the emergency department. Dtsch Arztebl Int 2010; 107(50): 892–8.
DOI: 10.3238/arztebl.2010.0892

Interdisziplinäre Notaufnahmen, Klinikum Nürnberg: Prof. Dr. med. Christ, Dipl.-Pflegefachwirtin (FH) Winter

Universitätsspital Basel, Schweiz: Grossmann MSc, Prof. Dr. med. Bingisser
Brigham and Women's Hospital, Boston, USA: Dr. med. Platz

The emergency department is the crucial interface between the emergency medical services and the hospital. As reflected in the year-on-year increases in patient numbers, however, emergency departments are increasingly being selected as the route of primary access to the healthcare system *(Figure 1)* (1). Deficits in preclinical patient guidance have been put forward as a possible explanation for this trend (2).

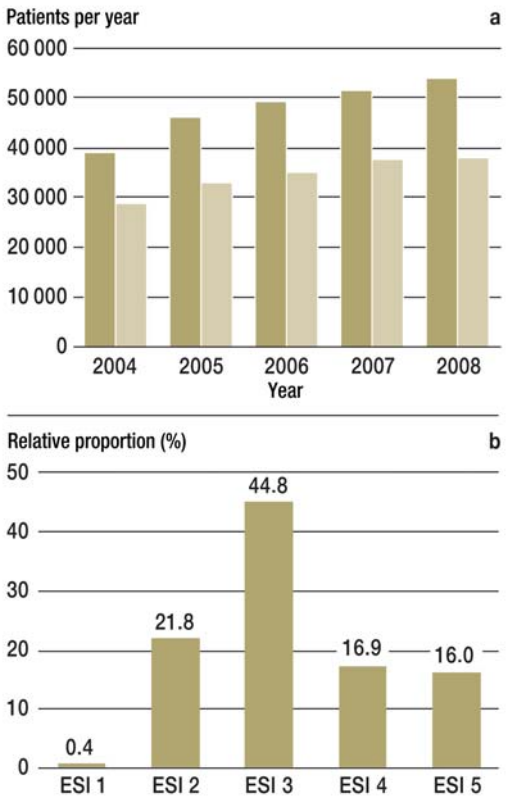
The volume of admissions to a given emergency department cannot be predicted with any great accuracy, only a certain proportion of the patients have life-endangering or medically urgent conditions *(Figure 1)* (3), and not all those admitted can be treated immediately or simultaneously. Thus, patients with life-threatening injuries or illnesses need to be reliably identified within minutes of arrival (4). Structured triage systems for emergency department admissions are already in use in the German-speaking countries (3, 4) and the relevant medical societies are calling for their introduction in nations with established hospital emergency services (4, 5).

In the emergency department "triage" refers to the methods used to assess patients' severity of injury or illness within a short time after their arrival, assign priorities, and transfer each patient to the appropriate place for treatment (5). In our view the term "triage" should be adopted in German-speaking countries in preference to the various German words that have been used, e.g., "*Sichtung*" and "*Ersteinschätzung*," as the latter are not clearly defined concepts. In some European countries, among them Germany and Switzerland, triage is performed by specially trained nursing staff (3–8). The aim of this study is to provide a systematic overview of established instruments for triage in the emergency department and evaluate their validity and reliability.

Methods

Studies were retrieved from the Medline database by a search on the following terms (search date : 5 January 2009): triage AND emergency department (n = 1587); five-level triage (n = 25); Canadian Triage and Acuity Scale (n = 40); National Triage Scale (n = 17); Australasian Triage Scale (n = 30); Manchester Triage System (n = 15); Emergency Severity Index (n = 26). Relevant information was taken from review articles and original

FIGURE 1



Emergency departments of Nuremberg Hospital (Nuremberg Hospital South: dark bars; Nuremberg Hospital North: light bars):
a) Numbers of patients, 2004 to 2008;
b) Severity of illness of the emergency patients who presented to the emergency departments in September 2009 (n = 2249), according to the five-level Emergency Severity Index (8)

studies. Only articles from peer-reviewed journals were considered *(Table, eTable)*, and only studies with published validity or reliability were then analyzed.

Validity of a triage instrument

A method is described as "valid" if its results agree with the "true" value. With regard to triage systems, the assigned priority level should correspond with the actual degree of urgency. In the absence of a gold standard for the genuine degree of urgency, surrogate markers such as rate of hospital admission, rate of admission to intensive care, mortality rate, and utilization of resources are used to assess validity (5, 9).

Reliability of a triage instrument

The reliability or replicability of the results should be as high as possible; otherwise the method is not sufficiently dependable (5). Ideally, different investigators should come to the same conclusions regarding treatment priority. Reliability is described using the kappa statistic, where $\kappa = 0$ indicates a random result and $\kappa = 1$ shows total agreement between two or more measurements. Agreement is classified as follows: poor ($\kappa<0.2$), adequate ($0.2<\kappa<0.4$), satisfactory ($0.4<\kappa<0.6$), good ($0.6<\kappa<0.8$), and very good ($0.8<\kappa<1$) (5). Some studies have used weighted kappa statistics. Because usually only one of these two parameters is reported, the results cannot be directly compared.

Results

Overview of triage instruments

Registration of vital signs alone is not suitable for identification of critically ill patients in the emergency department (10). Therefore various systems are used internationally to determine initial treatment priorities. These range from unstructured classification according to one's own experience ("best guess" [11]) over instruments such as a three-level "traffic light" system (red: emergency; amber: urgent; green: non-urgent [12]) to four- and five-level scales (13–16). Some of these instruments are just used at one particular institution, so their dependability is insufficiently documented.

Five-level instruments are significantly correlated with resource utilization, rates of admission for inpatient treatment, duration of emergency treatment, and frequency of transfer to intensive care or mortality (14). Comparison of methods revealed that three-level triage systems have insufficient reliability. The interobserver reliability between triage personnel and experts is low ($\kappa = 0.19$ to 0.38 [5]), while that of the five-level system is significantly higher ($\kappa = 0.68$; $p<0.01$ [17]). We will therefore review the literature on established five-level triage systems.

The principal five-level triage instruments

Australasian Triage Scale

The Australasian Triage Scale (ATS) has been employed in all Australian emergency departments since 1994 (7). Each level of priority has a defined time limit within which evaluation by a doctor should begin *(Table)*. The process data from individual hospitals and for different regions are published on the Internet. Findings on the validity or reliability of this instrument are available, although no prospective assessment of reliability has yet been carried out *(Box)*.

Canadian Triage and Acuity Scale

The Canadian Triage and Acuity Scale (CTAS) is based on the ATS and was developed in the 1990s by emergency physicians in New Brunswick, Canada (15). Since 1997 the parameters of the CTAS have been compulsorily documented by the Canadian Institute of Health Information. As in the ATS, the times from arrival to evaluation by a doctor are recorded.

In the CTAS an extensive list of presenting clinical complaints and symptoms is used to determine the triage level. These include anamnestic parameters associated with high risk, e.g., intoxication, together with clinical signs, vital parameters, and symptoms such as shortness of breath or abdominal pain. Triage must be repeated after a defined waiting time or when there is a change in the patient's symptoms. The validity and reliability of the CTAS are outstanding *(Box)*, and a modified instrument has been developed for evaluation

TABLE

Characteristics of the most important five-level triage instruments used in emergency departments internationally

Parameter	ATS (NTS)	MTS	CTAS	ESI
Time to initial assessment	10 min	n. s.	n. s.	n. s.
Time to contact with doctor	Immediate / 10 / 30 / 60 / 120 min	Immediate / 10 / 60 / 120 / 240 min	Immediate / 15 / 30 / 60 / 120 min	Immediate / 10 min / n. s.
Performance indicators	I: 97.5%; II: 95%; III: 90%; IV: 90%; V: 85%	n. s.	I: 98%; II: 95%; III: 90%; IV: 85%; V: 80%	n. s.
Re-triage	n. s.	As required	I: continuously; II: 15 min; III: 30 min; IV: 60 min; V: 120 min	As required
Pain scale	Four-point scale	Three-point scale; considered as essential factor in triage	Ten-point scale	Visual analog scale (10 points); if score >7/10, consider allocation to ESI 2
Pediatric cases	n. s., but recognized as important factor	Considered	Special version of CTAS used for children	Take into consideration for vital signs, for differentiation between ESI 2 and ESI 3; fever criterion for children <24 months
List of diagnoses or key symptoms	Yes	52 key symptoms	Yes	Not explicitly used
Expected admission rates	From updated reports	n. s.	Yes	Data on bench-marking available
Implementation/ training material	Limited	Yes	Yes	Yes

ATS, Australasian Triage Scale (previously National Triage Scale, NTS); CTAS, Canadian Triage and Acuity Scale; MTS, Manchester Triage Scale; ESI, Emergency Severity Index; n. s., not specified; I to V: triage priority levels.

For some instruments no time limits are defined for first contact with a doctor after arrival at the emergency department. In the ATS and CTAS, adherence to these time limits is recorded as an indicator describing emergency department performance. For example, in ATS triage levels I and II at least 97.5% and at least 95% of patients, respectively, should be seen by a doctor within the defined time limits. These data are published in the performance reports of emergency departments in Australia (ATS) and Canada (CTAS), serve as reference data, and to a certain extent have an effect on reimbursement

of pediatric emergencies (18). The descriptors and modifiers of the CTAS are encapsulated in a software application (www.caep.ca). In rural areas of Canada the triage is sometimes carried out exclusively by specially trained nurses, who then decide whether patients need to be transferred elsewhere for further medical care.

Manchester Triage System

The Manchester Triage System (MTS) is used in emergency departments in Great Britain and, in a modified translation, in German emergency departments (3, 13). The MTS follows a specific approach: the patient's principal presenting complaints are allocated to one of 52 flowchart diagrams, e.g., head injury or abdominal pain. Key discriminators are defined for each of these diagrams, such as danger to life, pain, or state of consciousness. When a new patient presents to the emergency department the triage nurse assigns their reported complaints to a defined algorithm and then determines the treatment priority with the aid of fixed rules that take account of vital signs. The few studies that have been performed point to satisfactory reliability of this tool *(Box)* (19).

Emergency Severity Index

The Emergency Severity Index (ESI) is a five-level triage algorithm that was developed in the USA in the late 1990s (20). Treatment priority is decided on the basis of disease severity and the expected resource needs *(Figure 2)*. The triage algorithm consists of four decision points where the trained triage nurse asks specific questions. First, patients with life-threatening conditions (ESI levels 1 and 2) are identified. Unstable patients are typically assigned to ESI triage level 1, e.g., in the presence of hemodynamic or respiratory instability. Patients with (potentially) life-threatening symptoms, e.g., thoracic pain in acute coronary syndrome or loss of consciousness, and also those with severe pain, psychiatric disorders, or states of intoxication, are assigned to triage level 2. The remaining levels (3 to 5) are defined by the expected resource needs and vital signs *(Figure 2)*. Resources in this sense are services such as X-ray and administration of intravenous medication that go beyond physical examination and are necessary to reach a decision on how to proceed (6). Clinical studies show that this instrument also has good validity and reliability in specific groups

BOX

Validity and reliability of five-level triage instruments

Manchester Triage Scale (MTS)

- Four analyses in adult patients (n = 50 to 167):
  - Analysis conducted by nursing staff
  - Validity of instrument only descriptively assessed in two studies: 67% of patients with high priority (MTS levels 1 and 2; endpoint: transfer to intensive care unit) were correctly identified. Of patients with cardiac chest pain, 86.8% were correctly identified by nursing staff
  - The MTS shows moderate (to good) reliability (κ = 0.31 to 0.62)
- Two analyses in children (<16 years, n = 1065 to 13 554):
  - No statistics on reliability
  - In 40% to 54% of the children there was over-triage; in 12% to 15%, under-triage
  - Authors suggest modification of the instrument for children; validity in children rated as satisfactory

Australasian Triage Scale (ATS)

- Six analyses in adult emergency patients (n = 20 to 3650):
  - One analysis to evaluate validity of instrument showed correlation with inpatient admission rate and agreement with mortality data published in Australia
  - Five studies in adult emergency patients yielded adequate to satisfactory reliability (κ = 0.25 to 0.56)
  - One study assessed dependability in evaluation of psychiatric patients (video recording); the rate of agreement in triage assessment was only about 60%. The authors conclude that the ATS is inadequate for correct evaluation of psychiatric patients

Canadian Triage and Acuity Scale (CTAS)

- Eight analyses in adult emergency patients (n = 50 to 32 261):
  - Significant correlation with hospital mortality and resource utilization (p<0.01)
  - Interobserver reliability reported as good to excellent (κ = 0.68 to 0.89)
  - The instrument has become established in European countries
- Four analyses in children:
  - Study size 54 to 1618 children
  - Good validity of the instrument, significant correlation between triage level and resource utilization
  - Good reliability of the instrument in initial evaluation of young emergency patients (κ = 0.51 to 0.72)

Emergency Severity Index (ESI)

- Twelve analyses in adult emergency patients (n = 202 to 3172):
  - The ESI triage system correlates significantly (p < 0.01) with hospital mortality and resource utilization
  - Interobserver reliability reported as good to excellent (κ = 0.46 to 0.91)
  - The instrument has become established in European countries
- One analysis in children (<16 years, n = 150):
  - Good validity and very good interobserver reliability of the instrument (κ = 0.82)

Further details of the studies can be found in the *eTable*

of patients such as children and the elderly *(Box)*. A validated translation of this tool into German has been published by a team from the emergency department of the University Hospital Basel, Switzerland (8).

Other five-level triage instruments

Regional solutions such as the Gruppo Formazione Triage system in Italy (21), the Taiwan Triage Scale (22), the Cape Triage Scale (23), and the Geneva Emergency Triage Scale (16) have been used, and yet other tools have been employed in individual hospitals. Not all of these systems have been described in journals with external peer review. Since some of these methods draw on the above-mentioned triage instruments and some have not been comprehensively evaluated, they will not be discussed further here.

Discussion

Five-level triage instruments are the gold standard in emergency medicine worldwide. The best studied and most widely distributed five-level systems are the ATS, CTAS, MTS, and ESI, all of which possess satisfactory to very good validity and reliability. The MTS and ESI have been translated into German. While the German-

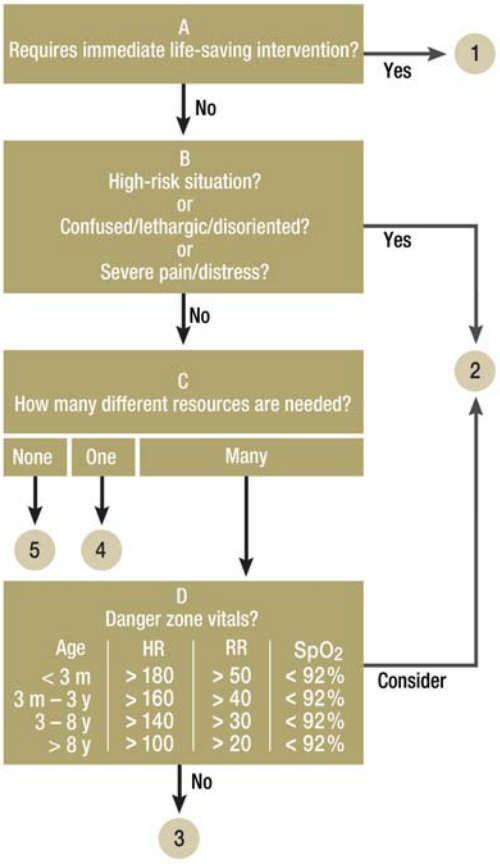
language version of the MTS has not yet been validated, data on the validity and reliability of the ESI in German have been analyzed and the results published (Grossmann FF et al.: Transporting clinical tools to new settings: cultural adaptation and validation of the Emergency Severity Index in German. Ann Emerg Med 2010; in press).

The literature shows that triage of emergency patients by trained nurses using a five-level system has been successfully implemented in English-speaking countries (5). Our own observations demonstrate that such systems can also be used safely by nursing staff in Germany and Switzerland and improve on the quality provided by the subjective assessment widely employed to date. This necessitates rethinking the organization of processes; more emphasis must be placed on interdisciplinary differential diagnosis, risk stratification, and the treatment of acute diseases, and this must be reflected in training. An example is provided by the key symptom of acute loss of consciousness, which can probably be managed more effectively in interdisciplinary fashion, as practiced in English-speaking countries. The introduction of a modern triage system in Australia increased patient safety, improved both the organization of the work of the emergency department staff and their job satisfaction, and reduced the patients' waiting time as well as the total time they spent in the emergency department ([24] and unpublished personal observations). Moreover, the proportion of patients who leave the emergency department without seeing a doctor because of the long waiting time is lowered significantly, by 50%, thus increasing patient safety (24). It remains to be established to what extent these results can be replicated in Germany.

The role of the five-level triage instruments in the assessment of patients with psychiatric diseases and children has not been analyzed systematically, and in our opinion these tools should not be introduced in the near future, given the specialized management of sychiatric and pediatric emergencies prevalent in the German-speaking countries. In the ESI, patients with acute psychiatric illnesses are assigned to ESI triage level 2, the same level as patients suffering severe pain, on grounds of their high level of distress. In practice, this means that psychiatric patients presenting to interdisciplinary emergency departments must always be treated immediately, whatever the overall workload in the department.

Some triage instruments (CTAS, ATS, MTS) set time limits by when a certain proportion of patients, depending on treatment priority, must have been evaluated by a doctor *(Table)*. The ESI takes a different approach for patients with low priority (ESI level 3 to 5): rather than fixed time limits, the goal is evaluation of these patients as soon as possible depending on current workload. Patients assigned to ESI level 1 must be treated immediately. Patients classified as level 2 receive nursing care straightaway, including continuous monitoring, and evaluation by a doctor must follow within 10 min at the most (6). The time to first contact with a doctor in the emergency department is one of the performance indicators in all triage systems and in some of them is used for benchmarking. In the CTAS the patient's priority level is re-evaluated after a defined time in order to register any deterioration in status as early as possible *(Table)*. The ESI and ATS suggest that re-triage—which we regard as necessary—be carried out only as and when required. To increase patient safety, in our own emergency departments we enforce re-triage at defined intervals even when using the ESI. The intervals are oriented on the stipulations of the CTAS.

FIGURE 2



Triage algorithm of the Emergency Severity Index, version 4. An accompanying brief description of this algorithm (8) supports the members of staff concerned during the triage process. The triage system is explained in detail in the original English handbook (6). At decision point D (danger zone vitals?) there are defined age-dependent thresholds (m, months; y, years) for heart rate (HR) in beats per minute, respiratory rate (RR) in breaths per minute, and oxygen saturation as measured by pulse oximetry (SpO_2). If these thresholds are exceeded, the triage nurse may decide to assign the patient to a higher priority level.

Evaluation of the triage instruments

The five-level triage scales are superior to three-level systems with regard to validity and reliability (12).

Some European societies therefore demand the use of a five-level triage system in emergency departments in which treatment capacity is sometimes exceeded (4). Taking the above-mentioned limitations of methodology into account, the highest numbers of publications refer to the five-level instruments CTAS and ESI, both of which have been the subject of multicenter studies and analyses carried out in Europe. The ATS is also well documented, but published data on the MTS are sparse.

Five-level triage instruments in German

Among the triage instruments described herein, the MTS has been documented in detail in German. In our view, however, problems arise from the fact that the German translation does not make it quite clear why the original algorithm has been modified. For example, there are only 50 instead of 52 flowchart diagrams, the defined reaction times have been changed, and various other modifications, e.g., in evaluation of pain, have been introduced. Moreover, concepts such as "hot adult" and "young pain," though defined in the book (13), are unaccustomed in German and therefore may constitute sources of error. The MTS is widely used in Germany, but there are no published data on the validity and reliability of the German version.

In the meantime a study has been conducted on the validity and reliability of the German translation of the ESI (8). Initial analyses confirm high validity and reliability of this instrument in German (Grossmann FF et al.: Transporting clinical tools to new settings: cultural adaptation and validation of the Emergency Severity Index in German. Ann Emerg Med 2010; in press). Because the training of nurses varies internationally, one might assume that triage instruments developed in English-speaking countries require modification and adaptation to circumstances in Germany. However, our experience with the implementation of the ESI in the emergency departments of Nuremberg Hospital, Germany and the University Hospital Basel, Switzerland shows that this triage instrument can be adopted without modification and safely applied by nursing staff trained in Germany. The systematic data acquired in the course of triage yield information on the severity of illness of patients presenting to German emergency departments *(Figure 1)*; this is important not only for epidemiological purposes but also for health policy and economic analyses and prognoses.

Implementation and quality management

The implementation of a structured triage system in an emergency department is associated with a transitional phase and requires careful planning involving all parties concerned, including the nursing and medical staff. Besides the development of a training program, the consequences for patient flow, the hospital information system, and the workflow of the interprofessional team must be considered. Realistically, a modern triage instrument should be able to be implemented within 9 to 12 months (6). Our own experience shows that any instrument that is implemented has to be regularly evaluated and quality improvement measures developed jointly by the members of the team. Case discussions are suggested (6). Another possibility is practice on an interactive triage simulator, as done at the University Hospital Geneva, Switzerland (16).

Synopsis

The introduction of structured triage by specially trained nursing staff in the emergency department helps to accurately identify patients whose lives are endangered, especially at times of insufficient treatment capacity. Five-level triage systems are therefore recommended by national and international societies for emergency medicine (4, 5). If it has been decided to implement a triage system, an instrument should be selected for which validity and reliability has been demonstrated—ideally in the language of the country concerned. Apart from correct identification of patients who require urgent medical care, such instruments enable estimation and planning of resources (6).

Conflict of interest statement
The authors declare that no conflict of interest exists according to the guidelines of the International Committee of Medical Journal Editors.

Manuscript received on 16 April 2009, revised version accepted on 10 February 2010.

Translated from the original German by David Roseveare.

REFERENCES

1. Pitts SR, Niska RW, Xu J, Burt CW: National Hospital Ambulatory Medical Care Survey: 2006 emergency department summary. Natl Health Stat Report 2008; 1–38.
2. Steffen W, Tempka A, Klute G: Falsche Patientenanreize in der Ersten Hilfe der Krankenhäuser. Dtsch Arztebl 2007; 104: 1088–91.
3. Schellein O, Ludwig-Pistor F, Bremerich DH: Manchester triage system: Process optimization in the interdisciplinary emergency department. Anaesthesist 2008; 58: 163–70.
4. Rutschmann OT, Siber RS, Hugli OW: Empfehlung der Schweizerischen Gesellschaft für Notfall- und Rettungsmedizin (SGNOR) zur Triage in Schweizer Notfallstationen. Schweiz Ärztezeitung 2009; 90: 1–2.
5. Fernandes CM, Tanabe P, Gilboy N, et al.: Five-level triage: a report from the ACEP/ENA Five-level Triage Task Force. J Emerg Nurs 2005; 31: 39–50.
6. Gilboy N, Tanabe P, Travers D, Rosenau AM, Eitel DR: Emergency Severity Index, Version 4. Implementation Handbook. AHRQ Publication No. 05–0046–2 ed. Rockville, MD: Agency for Healthcare Research and Quality 2005.
7. Australasian College for Emergency Medicine. Guidelines on the implementation of the Australasian Triage Scale in emergency departments. www.acem.org.au/infocentre.aspx?docId=59#POLICIES. Accessed on 5 January 2009.
8. Grossmann FF, Delport K, Keller DI: Emergency Severity Index: Deutsche Übersetzung eines validen Triageinstruments. Notfall Rettungsmed 2009; 12: 290–2.
9. Twomey M, Wallis LA, Myers JE: Limitations in validating emergency department triage scales. Emerg Med J 2007; 24: 477–9.
10. Subbe CP, Slater A, Menon D, Gemmell L: Validation of physiological scoring systems in the accident and emergency department. Emerg Med J 2006; 23: 841–5.
11. Wuerz R, Fernandes CM, Alarcon J: Inconsistency of emergency department triage. Emergency Department Operations Research Working Group. Ann Emerg Med 1998; 32: 431–5.

KEY MESSAGES

- Because the volume of patient admissions cannot be precisely planned, an emergency department may become overcrowded, so that severely ill and less ill patients are competing for the available resources.
- The goal of modern triage in the emergency department is to ascertain the severity of illness of emergency patients in a structured way, establish treatment priorities, and assign the patients to the appropriate place for treatment.
- Five-level triage instruments are the gold standard in emergency medicine. The Australasian Triage Scale, the Canadian Triage and Acuity Scale, the Manchester Triage System, and the Emergency Severity Index are all validated instruments and are the most widely used systems.
- The Manchester Triage System and the Emergency Severity Index have been translated into German and are already being used by trained nurses in some emergency departments in the German-speaking countries.
- Validated five-level triage systems should be introduced to emergency departments in the German-speaking countries in order to ensure high patient safety, especially when there is heavy pressure on resources.

12. Wuerz RC, Milne LW, Eitel DR, Travers D, Gilboy N: Reliability and validity of a new five-level triage instrument. Acad Emerg Med 2000; 7: 236–42.
13. Mackway-Jones K, Marsden J, Windle J: Ersteinschätzung in der Notaufnahme: Das Manchester Triage System. 2nd edition. Bern: Huber; 2006.
14. Tanabe P, Gimbel R, Yarnold PR, Kyriacou DN, Adams JG: Reliability and validity of scores on The Emergency Severity Index version 3. Acad Emerg Med 2004; 11: 59–65.
15. Bullard MJ, Unger B, Spence J, Grafstein E: Revisions to the Canadian Emergency Department Triage and Acuity Scale (CTAS) adult guidelines. CJEM 2008; 10: 136–51.
16. Rutschmann OT, Kossovsky M, Geissbuhler A, et al.: Interactive triage simulator revealed important variability in both process and outcome of emergency triage. J Clin Epidemiol 2006; 59: 615–21.
17. 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.
18. Warren DW, Jarvis A, LeBlanc L, Gravel J: Revisions to the Canadian Triage and Acuity Scale paediatric guidelines (PaedCTAS). CJEM 2008; 10: 224–43.
19. van Veen M, Steyerberg EW, Ruige M, et al.: Manchester triage system in paediatric emergency care: prospective observational study. BMJ 2008; 337: a1501.
20. Shelton R: The emergency severity index 5-level triage system. Dimens Crit Care Nurs 2009; 28: 9–12.
21. Gruppo Formazione Triage: Triage infermieristico. 2nd edition. McGraw-Hill Companies; 2005.
22. Chi CH, Huang CM: Comparison of the Emergency Severity Index (ESI) and the Taiwan Triage System in predicting resource utilization. J Formos Med Assoc 2006; 105: 617–25.
23. Bruijns SR, Wallis LA, Burch VC: A prospective evaluation of the Cape triage score in the emergency department of an urban public hospital in South Africa. Emerg Med J 2008; 25: 398–402.
24. Richardson JR, Braitberg G, Yeoh MJ: Multidisciplinary assessment at triage: a new way forward. Emerg Med Australas 2004; 16: 41–6.
25. Cooke MW, Jinks S: Does the Manchester triage system detect the critically ill? J Accid Emerg Med 1999; 16: 179–81.

Corresponding author
Prof. Dr. med. Michael Christ
Klinik für Notfall- und Internistische Intensivmedizin, Klinikum Nürnberg
Prof-Ernst-Nathan-Str. 1
90419 Nürnberg, Germany
michael.christ@klinikum-nuernberg.de

For eReferences please refer to:
www.aerzteblatt-international.de/ref5010

eTables available at:
www.aerzteblatt-international.de/article10m0892

REVIEW ARTICLE

Modern Triage in the Emergency Department

Michael Christ, Florian Grossmann MSc, Daniela Winter, Roland Bingisser, Elke Platz

eREFERENCES

e1. Cooke MW, Jinks S: Does the Manchester triage system detect the critically ill? J Accid Emerg Med 1999; 16: 179–81.

e2. Goodacre SW, Gillett M, Harris RD, Houlihan KP: Consistency of retrospective triage decisions as a standardised instrument for audit. J Accid Emerg Med 1999; 16: 322–4.

e3. Speake D, Teece S, Mackway-Jones K: Detecting high-risk patients with chest pain. Emerg Nurse 2003; 11: 19–21.

e4. Roukema J, Steyerberg EW, van Meurs A, Ruige M, van der Lei J, Moll HA: Validity of the Manchester triage system in paediatric emergency care. Emerg Med J 2006; 23: 906–10.

e5. van Veen M, Steyerberg EW, Ruige M, et al.: Manchester triage system in paediatric emergency care: prospective observational study. BMJ 2008; 337: a1501.

e6. van der Wulp I, van Baar ME, Schrijvers AJ: Reliability and validity of the Manchester triage system in a general emergency department patient population in the Netherlands: results of a simulation study. Emerg Med J 2008; 25: 431–4.

e7. Jelinek G, Little M: Inter-rater reliability of the national triage scale: over 11'500 simulated occasions of triage. Emerg Med 1996; 8: 226–30.

e8. Dilley S, Standen P: Victorian nurses demonstrate concordance in the application of the national triage scale. Emerg Med 1998; 10: 12–8

e9. Van Gerven R, Delooz H, Sermeus W: Systematic triage in the emergency department using the Australian national triage scale: a pilot project. Eur J Emerg Med 2001; 8: 3–7.

e10. Doherty SR, Hore CT, Curran SW: Inpatient mortality as related to triage category in three New South Wales regional base hospitals. Emerg Med (Fremantle) 2003; 15: 334–40.

e11. Considine J, LeVasseur SA, Villanueva E: The Australasian triage scale: examining emergency department nurses' performance using computer and paper scenarios. Ann Emerg Med 2004; 44: 516–23.

e12. Creaton A, Liew D, Knott J, Wright M: Interrater reliability of the Australasian triage scale for mental health patients. Emerg Med Australas 2008; 20: 468–74.

e13. Beveridge R, Ducharme J, Janes L, Beaulieu S, Walter S: Reliability of the Canadian emergency department triage and acuity scale: interrater agreement. Ann Emerg Med 1999; 34: 155–9.

e14. Manos D, Petrie DA, Beveridge RC, Walter S, Ducharme J: Inter-observer agreement using the Canadian emergency department triage and acuity scale. CJEM 2002; 4: 16–22.

e15. Worster A, Gilboy N, Fernandes CM, et al.: Assessment of inter-observer reliability of two five-level triage and acuity scales: a randomized controlled trial. CJEM 2004; 6: 240–5.

e16. Grafstein E, Innes G, Westman J, Christenson J, Thorne A: Inter-rater reliability of a computerized presenting-complaint-linked triage system in an urban emergency department. CJEM 2003; 5: 323–9.

e17. Jimenez JG, Murray MJ, Beveridge R, et al.: Implementation of the Canadian emergency department triage and acuity scale (CTAS) in the principality of Andorra: Can triage parameters serve as emergency department quality indicators? CJEM 2003; 5: 315–22.

e18. Goransson K, Ehrenberg A, Marklund B, Ehnfors M: Accuracy and concordance of nurses in emergency department triage. Scand J Caring Sci 2005; 19: 432–8.

e19. Dong SL, Bullard MJ, Meurer DP, et al.: Predictive validity of a computerized emergency triage tool. Acad Emerg Med 2007; 14: 16–21.

e20. Dong SL, Bullard MJ, Meurer DP, Blitz S, Holroyd BR, Rowe BH: The effect of training on nurse agreement using an electronic triage system. CJEM 2007; 9: 260–6.

e21. Bergeron S, Gouin S, Bailey B, Amre DK, Patel H: Agreement among pediatric health care professionals with the pediatric Canadian triage and acuity scale guidelines. Pediatr Emerg Care 2004; 20: 514–8.

e22. Gravel J, Gouin S, Bailey B, Roy M, Bergeron S, Amre D: Reliability of a computerized version of the pediatric Canadian triage and acuity scale. Acad Emerg Med 2007; 14: 864–9.

e23. Ma W, Gafni A, Goldman RD: Correlation of the Canadian pediatric emergency triage and acuity scale to ED resource utilization. Am J Emerg Med 2008; 26: 893–7.

e24. Gravel J, Gouin S, Manzano S, Arsenault M, Amre D: Interrater agreement between nurses for the pediatric Canadian triage and acuity scale in a tertiary care center. Acad Emerg Med 2008; 15: 1262–7.

e25. Wuerz RC, Milne LW, Eitel DR, Travers D, Gilboy N: Reliability and validity of a new five-level triage instrument. Acad Emerg Med 2000; 7: 236–42.

e26. Wuerz RC, Travers D, Gilboy N, Eitel DR, Rosenau A, Yazhari R: Implementation and refinement of the emergency severity index. Acad Emerg Med 2001; 8: 170–6.

e27. Wuerz R: Emergency severity index triage category is associated with six-month survival. ESI triage study group. Acad Emerg Med 2001; 8: 61–4.

e28. 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.

e29. Eitel DR, Travers DA, Rosenau AM, Gilboy N, Wuerz RC: The emergency severity index triage algorithm version 2 is reliable and valid. Acad Emerg Med 2003; 10: 1070–80.

e30. Tanabe P, Gimbel R, Yarnold PR, Kyriacou DN, Adams JG: Reliability and validity of scores on The emergency severity index version 3. Acad Emerg Med 2004; 11: 59–65.

e31. Tanabe P, Gimbel R, Yarnold PR, Adams JG: The emergency severity index (version 3) 5-level triage system scores predict ED resource consumption. J Emerg Nurs 2004; 30: 22–9.

e32. Baumann MR, Strout TD: Evaluation of the emergency severity index (version 3) triage algorithm in pediatric patients. Acad Emerg Med 2005; 12: 219–24.

e33. Chi CH, Huang CM: Comparison of the emergency severity index (ESI) and the Taiwan triage system in predicting resource utilization. J Formos Med Assoc 2006; 105: 617–25.

e34. Worster A, Fernandes CM, Eva K, Upadhye S: Predictive validity comparison of two five-level triage acuity scales. Eur J Emerg Med 2007; 14: 188–92.

e35. Baumann MR, Strout TD: Triage of geriatric patients in the emergency department: validity and survival with the emergency severity index. Ann Emerg Med 2007; 49: 234–40.

e36. Elshove-Bolk J, Mencl F, van Rijswijck BT, Simons MP, van Vugt AB: Validation of the emergency severity index (ESI) in self-referred patients in a European emergency department. Emerg Med J 2007; 24: 170–4.

eTABLE

Published validity and reliability of the five-level triage scales listed in *Table 1*

Scale	Goal	κ-statistic	Remarks	
MTS	Assessment of validity with regard to identification of patients requiring intensive care	n. s.	Retrospective analysis of instrument validity in 91 patients transferred to an intensive care unit: 67% of patients were correctly assigned to MTS 1/2, 18 patients were incorrectly assigned to a lower priority level, 5 of 6 patients deteriorated during their stay in the emergency department, 1 patient was not correctly identified.	(1)
MTS	Assessment of interrater reliability of MTS and NTS/ATS	0.31–0.63	Adequate to good reliability; four emergency physicians retrospectively matched their triage decisions to 50 selected case files, using first ATS, then MTS	(2)
MTS	Assessment of validity in acute coronary syndrome	n. s.	Investigation of 167 patients showed that MTS achieved sensitivity of 86.8% in detection of high-risk cardiac chest pain by nursing staff.	(3)
MTS	Assessment of validity in pediatric emergency department (<16 years)	n. s.	Validity of MTS was evaluated in a representative sample (1065 of 18 469 pediatric emergency patients). MTS level was compared with resource utilization, inpatient admission rate, and a predefined reference classification: only 63% (sensitivity) of the patients identified by an expert panel as emergencies or very urgent (reference classification) were assessed correctly by triage nurses using MTS (specificity 73%). Under-triage occurred in 15%, over-triage in 40% of patients. The authors suggest modification of MTS for use in children, in order to attain higher instrument validity.	(4)
MTS	Validity of MTS in children (<16 years)	n. s.	A total of 13 554 children underwent computer-assisted classification by MTS in a Dutch emergency department: 34% of the triages corresponded with the reference (vital parameters, diagnoses, etc.), 54% of the children were over-triaged, 12% under-triaged. The authors conclude that the MTS has moderate validity in children presenting to an emergency department; assessment of children represents a challenge.	(5)
MTS	Assessment of validity and reliability	0.62 (w)	Prospective evaluation of 50 patient scenarios by triage nurses in two Dutch emergency departments, re-evaluation by the same nurses 19 days later. Gold standard provided by MTS experts. Test-retest reliability = 0.75; sensitivity for high priority 53.2%; high rate of under-triage in older patients (25.3%).	(6)
NTS/ATS	Assessment of interrater reliability of NTS/ATS	n. s.	No κ-statistic was calculated: 115 nurses evaluated 110 case scenarios. Agreement within one level of the scale was achieved in 86% of cases.	(7)
NTS/ATS	Assessment of interrater reliability of NTS/ATS	0.25	Adequate reliability; 108 nurses evaluated 20 case scenarios.	(8)
NTS/ATS	Assessment of interrater reliability of MTS and NTS/ATS	0.27–0.53	Adequate to satisfactory interrater reliability (see above)	(2)
ATS	Assessment of validity	n. s.	Characterization of ATS validity in a pilot study of 3650 emergency patients at a Belgian university hospital: 4.2%, 24.4%, 39.2%, 28.0% and 4.1% of patients were assigned to triage categories I, II, III, IV and V respectively. Higher triage categories correlated significantly with admission rate ($p<0.001$). Regarding relative frequency of key symptoms and admission rate, the Belgian cohort agreed well with the data from an Australian reference cohort.	(9)
ATS	Assessment of validity	n. s.	Comparison of mortality data from three rural Australian hospitals with published data from large hospitals in Victoria: overall mortality in the three rural hospitals was lower than the published data; there were distinct differences from the published data, with significantly higher rates of mortality and admission for patients classified as ATS 3 ($p<0.05$).	(10)
ATS	Assessment of interrater reliability	0.42/0.56	Fourteen written descriptions of case scenarios and 14 computer-displayed scenarios with photographs were evaluated by 167 nurses. Evaluation of the scenarios led to better agreement.	(11)
ATS	Assessment of reliability in psychiatric patients	n. s.	Assessment of instrument reliability from video scenarios of psychiatric patients depending on workload in the emergency department. There was only 53% to 66% agreement in triage evaluation. Conclusion: ATS is inadequate for identification of such patients, especially at busy times.	(12)
CTAS	Assessment of interrater reliability	0.80	Very good reliability: nine nurses and eight doctors triaged 50 case scenarios selected from genuine triage decisions (ten cases per triage level).	(13)
CTAS	Assessment of interrater reliability in first-time users of CTAS	0.77 (w)	Good reliability: 20 people (5 doctors, 5 nurses, 10 from the emergency rescue services) evaluated 41 case scenarios selected randomly from among 50 published scenarios (13).	(14)
CTAS	Assessment of reliability of CTAS instrument	0.91 (w)	After a refresher course for experienced nurses, the CTAS showed outstanding reliability (200 case scenarios).	(15)
CTAS	Assessment of interrater reliability	0.75 (w)	Fifteen nurses evaluated 266 patients with the aid of computer-assisted CTAS triage. Reliability was good: the instrument is suitable for benchmarking and other comparisons.	(16)

CTAS	Assessment of validity	n. s.	Evaluation of 32 261 emergency patients in an emergency department in Andorra shows that CTAS can also be established outside Canada. Inpatient admission rates, resource utilization, and length of stay were comparable with Canadian data.	(17)
CTAS	Assessment of interrater reliability	0.46	Swedish emergency department nurses without special training evaluated 18 case scenarios of emergency patients using the CTAS. Agreement on classification was only moderate, leading the authors to suggest analysis of the reasons.	(18)
CTAS	Assessment of validity	n. s.	A total of 29 524 patients were evaluated by computer-assisted CTAS. This instrument correlates excellently with hospital mortality, hospital and emergency department costs, and resource utilization.	(19)
CTAS	Assessment of interrater reliability	0.65 (w)	After two-stage training, reliability was determined using 555 case records. Because interrater reliability was only moderate (0.55) after brief training, the authors suggest regular schooling for triage personnel.	(20)
PaedCTAS	Assessment of interrater reliability	0.51/0.39	Comparison of interrater reliability between specially trained nurses and pediatric emergency physicians. Interrater reliability was no more than satisfactory (nurses 0.51, doctors 0.39). Further evaluation and continued development of the CTAS are recommended.	(21)
PaedCTAS	Assessment of interrater reliability	0.72	In 54 case scenarios, 18 nurses evaluated the reliability of a computer-assisted triage process versus classical CTAS triage. Particularly in urgent cases computer-assisted triage is connected with distinctly higher reliability (0.72 versus 0.55).	(22)
PaedCTAS	Assessment of validity	n. s.	There is a significant correlation between PaedCTAS level and resource utilization (defined by costs) in 1618 young emergency patients (0–19 years). No differences for the low PaedCTAS levels (IV and V)	(23)
PaedCTAS	Assessment of interrater reliability	0.61 (w)	Prospective cohort study: 499 pediatric emergency patients underwent computer-assisted evaluation by triage nurses; only in 10 patients was a discrepancy of more than one triage level demonstrated.	(24)
ESI (vers. 1)	Assessment of interrater reliability and validity	0.80	In an emergency department that originally used a three-level triage system, an emergency physician and a nurse (authors of the study) prospectively evaluated the ESI classification in 351 real case records. The agreement between these two raters was calculated; the hospitalization rate was significantly correlated with the ESI level.	(25)
ESI (vers. 1)	Implementation of ESI in two emergency departments; assessment of validity and interrater reliability	0.73	Good reliability. The ESI instrument was implemented in two university hospital emergency departments: two authors (219 real triage decisions) re-evaluated the triage classification; reliability was calculated from the evaluation by the original triage personnel and the authors' re-evaluation; validity could be demonstrated by the correlation between the patients' hospitalization rate and the resource utilization. The specially instructed nurses evaluated the ESI tool as simpler and better than the three-level scale they had used previously.	(26)
ESI (vers. 1)	Association of ESI level and 6-month mortality	n. s.	The 6-month mortality of 202 emergency patients was significantly associated with the ESI triage level assigned: I, 32%; II, 14%; III, 17%; IV/V, 0%	(27)
ESI (vers.1)	Comparison of reliability and validity between ESI und a three-level instrument	0.53 (three levels); 0.68 (ESI)	Good reliability of the five-level triage instrument	(28)
ESI (vers. 2)	Reliability and validity of instrument	0.69–0.87	Evaluation of the instrument in seven emergency departments in the USA. The instrument showed outstanding reliability and excellent validity (correlation with inpatient admission rate and 6-day mortality).	(29)
ESI (vers. 3)	Assessment of reliability	0.89 (w)	After nurses experienced in CTAS triage had undergone brief training, the ESI instrument showed outstanding reliability (200 case scenarios).	(15)
ESI (vers. 3)	Assessment of reliability	0.89 (w)	The reliability of the instrument was determined in hospitals other than those where it was originally developed. Excellent reliability was demonstrated. The assigned ESI level correlated with the overall admission rate and the rate of admission to the intensive care unit. Only 2% of the ESI level 3 patients—and none of the ESI level 4/5 patients—had to be transferred to intensive care.	(30)
ESI (vers. 3)	Assessment of validity	n. s.	Correlation with resource utilization and length of stay in the emergency department was found in 403 emergency patients. There was no correlation with the inpatient admission rate.	(31)
ESI (vers. 3)	Assessment of validity and reliability in children	0.82 (w)	Prospective initial assessment of pediatric emergency patients: agreement was excellent, and the triage level was significantly correlated with inpatient admission rate, length of stay in the emergency department, and resource utilization.	(32)
ESI (vers. 3)	Assessment of validity between ESI und Taiwan Triage System	n. s.	Compared with the Taiwan Triage System, the ESI instrument permitted more accurate initial assessment of the 3172 patients analyzed with regard to medical urgency, length of stay in the emergency department, and inpatient admission rate.	(33)

ESI (vers. 3)	Assessment of validity between ESI and CTAS	n. s.	The association of prospectively assigned ESI and CTAS levels with 1) resource utilization, 2) hospital admission, and 3) hospital mortality was evaluated in 486 patients. The strongest correlation was between ESI classification and resource utilization (–0.54), the weakest correlation between CTAS classification and mortality (–0.16). No difference was found between the two instruments with regard to any of the prospectively defined parameters.	(34)
ESI (vers. 3)	Validity of triage algorithm in geriatric patients	n. s.	In 929 patients over the age of 65 years, triage level was significantly associated with hospitalization rate ($p<0.001$), length of stay in the emergency department ($p<0.001$), resource utilization (Spearman´s correlation $R= –0.683$), and 1-year mortality (Kaplan-Meier analysis, $p<0.001$).	(35)
ESI (vers. 3)	Assessment of validity	n. s.	Prospective evaluation of the ESI instrument in 1832 self-presenting emergency patients (>14 years) in a Norwegian teaching hospital. Resource utilization, inpatient admission rate, and need for consultation with a specialist correlated significantly with ESI classification.	(36)

w, weighted statistic; n.s., not stated or not applicable