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Triage for Prioritisation in the Emergency Department

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VÄSTRA GÖTALANDSREGIONEN
SAHLGRENSKA UNIVERSITETSSJUKHUSET

Triage for Prioritisation in the Emergency Department [Triage för prioritering på akutmottagningen]

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1. Abstract

Background
Triage in the emergency department (ED) is a system, where waiting time is based on the patient´s individual medical urgency. Despite the use of triage systems, streaming processes and other interventions to decrease waiting times, many EDs are faced with severe overcrowding and prolonged waiting times.

Objective
To evaluate, in adult somatic emergency departments
- whether triage is more effective than no formal triage
- whether any profession or team is superior to another in conducting triage
- whether any triage system is superior to another
- what is the predictive capacity of triage systems compared with true outcomes regarding clinical outcomes (mortality, unscheduled return, admission), correct prioritisation, patient satisfaction and process outcomes (length of stay at the ED, waiting time to physician assessment, time for prioritisation process).

Methods
During January 2017 two authors performed systematic searches in PubMed, Embase, the Cochrane Library, Cinahl and HTA-databases. At least two authors selected articles independently. Inclusion was finally decided in a consensus meeting with all authors. The included studies were critically appraised using checklists. Data were extracted by at least two authors and, when possible, pooled in meta-analyses.

Main results
The literature search resulted in one systematic review (SR) and 30 observational studies, published subsequent to the last search in the SR.
Triage vs no formal triage
Correct prioritisation may increase, while *length of stay* and *waiting time to physician assessment* may be reduced, when triage is used compared with no formal triage (GRADE ⊕⊕◯◯). It is questionable whether the time reductions were of clinical relevance.
The *time for the prioritisation process* was one minute longer with triage (GRADE ⊕⊕◯◯).
It is uncertain whether *patient satisfaction* is influenced (GRADE ⊕◯◯◯).
Comparison between professions within triage model
The most common comparison was physician- versus nurse-led triage. *Mortality* and *unscheduled return* were significantly reduced with physician- compared with nurse-led triage. One large RCT (included in the SR) demonstrated a 36 minutes reduction in *length of stay* when triage was led by a physician compared with a nurse. *Waiting time to physician assessment* may be reduced, while there may be little or no difference in *patient satisfaction*.
The certainty of evidence for all outcomes in this comparison was low (GRADE ⊕⊕◯◯).
Comparison between triage models
Few triage models have been studied for comparison of clinical outcomes. There may be little or no difference in *mortality*, while *admission* may differ between triage system (GRADE ⊕⊕◯◯). The South African Triage System (SATS) and systems developed from SATS were included in comparisons with other triage systems and demonstrated that *correct prioritisation* may be improved by SATS (GRADE ⊕⊕◯◯). No general conclusions could be drawn regarding *length of stay*, *waiting time to physician assessment* and *concordance*, when comparing different triage models.
Predictive capacity of triage models compared with true outcomes
Cross-sectional studies reported *mortality* and *admission rates* to be higher in patients with high priority versus low priority levels (GRADE ⊕⊕◯◯).

Concluding remarks
The main conclusions from this report are based on low certainty of evidence (GRADE ⊕⊕◯◯);
-triage may increase *correct prioritisation*, and may reduce *length of stay* and *waiting time to physician assessment*, compared with no triage
-physician-led triage may reduce *mortality*, *unscheduled return*, *length of stay* and *waiting time to physician assessment*, compared with nurse-led triage
-the use of SATS may increase *correct prioritisation*, compared with the other studied triage systems.

If physician-led team triage is to be implemented at the Sahlgrenska University Hospital, the added cost for triage during weekdays would be approximately 14.6 million SEK per year.
In summary, this report has highlighted that triage *per se* may be beneficial and that inclusion of a physician in the triage team may improve clinical and process outcomes, although the certainty of evidence was low. The comparisons between triage models were sparse and no specific triage system can be inferred to be superior.

2. Svensk sammanfattning – Swedish summary

Bakgrund
Triage på akutmottagning innebär att varje patient tilldelas en prioriteringsgrad baserat på en första bedömning av symptom och vitalparametrar. Olika triagesystem och andra interventioner med avsikt att förbättra prioritering och minska väntetid på akutmottagning har införts, men många akutmottagningar har kvarstående problem med långa väntetider.

Syfte
Att undersöka, på en somatisk akutmottagning för vuxna
- om triage i sig är mer effektivt än ingen strukturerad triagering
- om någon profession eller team är bättre än annan profession på att triagera
- om något triage system är bättre än något annat
- hur bra ett triagesystem är på att prediktera utfall

avseende kliniska utfallsmått (mortalitet, oplanerad återsökning, inläggning), korrekt prioritering, patient nöjdhet och processmått (tid på akutmottagningen, väntetid till läkarbedömning, tidsåtgång för triagering).

Metod
Systematisk litteratursökning gjordes i PubMed, Embase, Cochrane Library och ett antal HTA-databaser (januari 2017). Minst två av författarna läste oberoende av varandra artikeltitlar, abstrakt och fulltextartiklar för inklusion av studier och för dataextraktion. Resultaten sammanvägdes i meta-analyser när så bedömdes möjligt.

Resultat
Litteratursökningen resulterade i en systematisk översikt (SBU-rapport) och 30 observationsstudier publicerade efter SBU-rapportens sista datum för sökning.
<u>Triage vs ingen strukturerad triage</u>
När triage används kan andelen korrekt prioriterade patienter öka, samt patientens totala tid på akutmottagningen och väntetid till läkarbedömning minska, jämfört med avsaknad av ett strukturerat triage system (GRADE ⊕⊕◯◯). Tidsreduktionen har en tveksam klinisk relevans. Tidsåtgången för själva prioriteringen var en minut längre med ett strukturerat triage system jämfört med inget system (GRADE ⊕⊕◯◯). Det är osäkert hur patientnöjdheten påverkas av att triage används (GRADE ⊕◯◯◯).

Jämförelse mellan professioner inom samma triage system
Den vanligaste jämförelsen var mellan läkar-och sköterskeledd triage. Mortalitet och oplanerad återsökning kan vara signifikant lägre, tid på akutmottagning och tid till läkarbedömning kortare, samt liten eller ingen skillnad i patientnöjdhet då läkarledd jämförs med sköterskeledd triage (GRADE ⊕⊕◯◯)
Jämförelser mellan triage system
Få triage system var jämförda avseende kliniska utfall. Det kan vara liten eller ingen skillnad i mortalitet, medan vissa triagesystem kan bättre prediktera inläggning (GRADE ⊕⊕◯◯) System som inkluderar South African Triage System (SATS) eller en vidareutveckling av SATS kan öka andelen korrekt prioriterade patienter (GRADE ⊕⊕◯◯) Inga slutsatser kan dras avseende processmått eller överensstämmelse mellan olika triage system.
Prediktion av kliniska utfall jämfört med sanna händelser
Enligt tvärsnitts-studier var mortalitet och inläggning vanligare bland högprioriterade jämfört med lågprioriterade patienter (GRADE ⊕⊕◯◯)

Sammanfattande kommentar
Huvudresultaten i denna rapport baseras på ett begränsat vetenskapligt underlag (GRADE ⊕⊕◯◯);
-triage kan öka korrekt prioritering, minska både väntetid till läkarbedömning och totaltid på akutmottagning, jämfört med att inte använda ett triagesystem vid prioritering av patienter
-läkarledd triage kan minska mortalitet, oplanerad återsökning, väntetid till läkarbedömning och totaltid på akutmottagning, jämfört med sköterskeledd triage
-att använda SATS eller SATS-deriverade triagesystem kan öka korrekt prioritering, jämfört med andra studerade triagesystem.

Om läkarledd triage skulle införas på Sahlgrenska Universitetssjukhusets akutmottagningar under vardagar, skulle den tillkommande kostnaden vara ca 14.6 miljoner SEK per år och 29.2 miljoner SEK om även helger inkluderas.

Sammanfattningsvis konkluderar denna rapport att triage i sig kan vara av värde och att medverkan av läkare i triageteamet kan förbättra kliniska utfall och väntetider, men att slutsatserna är baserade på ett begränsat vetenskapligt underlag. Jämförelser mellan olika triagesystem var bristfälliga och inget system kunde betraktas som överlägset ett annat.

The above summaries were written by representatives from the HTA-centrum. The HTA report was approved by the Regional board for quality assurance of activity-based HTA. The abstract is a concise summary of the results of the systematic review. The Swedish summary is a brief summary of the systematic review intended for decision makers, and is ended with a concluding summary.

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3. Summary of Findings

Outcomes	Study design Number of studies	Relative effect	Absolute effect	Certainty of evidence GRADE[1]
PICO 1 Triage vs no formal triage				
Incorrect prioritisation				
Too high urgency level (over-triage)	Cohort 1	RR (95% CI) 0.35 (0.28; 0.44)	8.6% vs 24.7 % p<0.001	⊕⊕◯◯ Low
Too low urgency level (under-triage)	Cohort 1	RR (95% CI) 0.38 (0.26; 0.55)	3.6% vs 9.5% p<0.001	⊕⊕◯◯ Low
Length of stay at the emergency department	Cohort 3 (2 in MA)	Not calculated	Mean Δ (95% CI) -0.60 (-0.66;- 0.54) hours	⊕⊕◯◯ Low
Waiting time to physician assessment	Cohort 4 (2 in MA)	Not calculated	Mean Δ (95% CI) -0.27 (-0.41; -0.12) hours	⊕⊕◯◯ Low
Time for prioritisation	Cohort 1	Not calculated	2.9 vs 1.9 min p=0.031 Mean Δ (95% CI) 1.00 (0.91; 1.09) min	⊕⊕◯◯ Low
Patient satisfaction	Cohort 1		Opposite directions in different domains	⊕◯◯◯ Very low[1]
PICO 2 Comparison between professions (presented here: physician- vs nurse-led triage)				
Clinical outcome: mortality	Cohort 1	aOR (95% CI) within 7 days: 0.72 (0.59; 0.88) 30 days: 0.84 (0.73; 0.97)	0.6% vs 1.0% p<0.001 1.5% vs 2.0% p<0.001	⊕⊕◯◯ Low
Clinical outcome: unscheduled return	Cohort 1 2	aOR or Δ (95% CI) within 24 h: aOR 0.36 (0.32; 0.40) 72h: aOR 0.36 (0.32; 0.40) Δ 0.38% (-0.74; 1.5)	2.1% vs 5.6% p<0.001 3.2% vs 8.2%, p<0.001 3.4% vs 3.0%	⊕⊕◯◯ Low
Length of stay at the emergency department	From SR: RCT 2	Not calculated	Mean Δ -36 and -45 min	⊕⊕◯◯ Low[2]
	Cohort 8		Mean Δ (95% CI) h -0.17 (-0.43; 0.09)	
Waiting time to physician assessment	From SR: Cohort 1	Not calculated	Within time limit per triage level 3 and 4: 3) 78% vs 67% 4) 73% vs 53% p<0.0001	⊕⊕◯◯ Low
	Cohort 6		Mean Δ (95% CI) h -0.56 (-0.73; -0.40)	
Patient satisfaction	Cohort 3		No difference	⊕⊕◯◯ Low

PICO 3 Comparison between triage models				
Clinical outcome: mortality	Cohort 2	RR (95% CI) ESI vs MTS: 0.98 (0.61; 1.56) PATS vs prePATS: 0.87 (0.52; 1.46)	ESI vs MTS: 0.19% vs 0.19% PATS vs prePATS: 0.07% vs 0.08%	⊕⊕◯◯ Low
Clinical outcome: admission to intensive care unit	Cohort 1	RR (95% CI) PATS vs prePATS: 0.18 (0.10; 0.32)	PATS vs prePATS: 0.06% vs 0.35% p<0.001	⊕◯◯◯ Very low[3]
Clinical outcome: admission	Cohort 2	RR (95% CI) ESI vs MTS: 1.03 (1.00; 1.06) PATS vs prePATS: 0.33 (0.18; 0.62)	ESI vs MTS: 43.7% vs 41.9% PATS vs prePATS: 21.6% vs 21.0%	⊕⊕◯◯ Low
Incorrect prioritisation				
Too high urgency level (over-triage)	Cohort 2	RR (95% CI) PATS vs prePATS: 0.73 (0.71; 0.74) SATS vs MEWS 0.51 (0.32; 0.82)	PATS vs prePATS: 41.4% vs 57.1% SATS vs MEWS 4.3% vs 8.3%	⊕⊕◯◯ Low
Too low urgency level (under-triage)	Cohort 2	RR (95% CI) PATS vs prePATS: 0.19 (0.18-0.20) SATS vs MEWS 0.29 (0.19 – 0.45)	PATS vs prePATS: 14.9% vs 45.9% SATS vs MEWS 4.4% vs 15.1%	⊕⊕◯◯ Low
PICO 4 Comparison of triage model with true outcomes, not summarised here				

aOR = adjusted odds ratio, ESI = Emergency Severity Index, MA = meta-analysis, MEWS = Modified Early Warning Score, MTS = Manchester Triage System, PATS = PMH A&E Triage Scale, prePATS = local system used before the introduction of PATS, SATS = South African Triage Score

Footnotes:
[1] Downgraded one level due to serious study limitations and imprecision.
[2] Based on RCTs, downgraded two levels due to unclear risk of bias and inconsistency.
[3] Downgraded one level due to serious indirectness.

Certainty of evidence

High certainty ⊕⊕⊕⊕	We are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty ⊕⊕⊕◯	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty ⊕⊕◯◯	Confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
Very low certainty ⊕◯◯◯	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

4. Abbreviations/Acronyms

CTAS	Canadian Triage and Acuity Scale
ED	Emergency Department
EP	Emergency Physician
ESI	Emergency Severity Index
IQR	Interquartile range
JTAS	Japanese Triage and Acuity Scale
LoS	Length of Stay
METTS	Medical Emergency Triage and Treatment System
MEWS	Modified Early Warning Score
MTE	Medical Team Evaluation
MTS	Manchester Triage System
NP	Nurse practitioner
PA	Physician assistant
PATS	PMH A&E Triage Scale
PIT	Physician in triage
PMH	Princess Marina Hospital
RETTS	Rapid Emergency Triage and Treatment System
RCT	Randomised controlled trial
RMA	Rapid Medical Assessment
RRT	Rapid triage and treatment
RTS	Rapid triage score
SATS	South African Triage Score
SD	Standard deviation
SBU	Swedish agency for health technology assessment and assessment of social services (Statens beredning för medicinsk och social utvärdering)
SR	Systematic review
TTAS	Taiwan Triage and Acuity Scale
TTS	Taiwan Triage System

5. Background

Worldwide there is a heavy patient load on emergency departments. This massive and often undulating inflow generates suboptimal working conditions, resulting in crowding and long waiting time with risks for medical errors. There have been several attempts to introduce algorithms to optimise this sorting process, many of them emanating from army medicine, so called triage systems.

The word “triage” comes from the French word “trier” which literally means “to sort, to separate”. Since most emergency departments (EDs) worldwide are facing situations when patients have to wait to be seen by the physician, a queuing system is warranted. Triage is one such system, where waiting time is based on the patient´s individual medical degree of urgency (Asplund et al, 2010). Today, the concept of triage has been integrated into modern health care systems, particularly in EDs, worldwide (Hong et al, 2015).

On a daily basis, EDs evaluate patients with a wide variation in the severity of their medical condition, from life threatening to minor complaints. To be able to handle these problems, an accurate and timely triage system is of major importance to ensure correct identification of the patient’s individual medical risk (Quitt et al, 2009). To an increasing extent, EDs have become the location of choice when seeking unscheduled, acute medical care. Emergency departments worldwide are facing a situation in which the request for health care exceeds available resources (Betz et al, 2016).

During the 1950s the concept of triage at the ED was introduced in the US. Australia and Canada followed and at the end of the 1990s and the beginning of 2000s it was spread worldwide (Asplund et al, 2010). The three-level triage system was traditionally used by the military. It has been remodelled and developed during the 1990-2000s into several five-level triage systems which are now used in most of the EDs around the world; the Australian Triage Scale (ATS), Canadian Acuity and Triage Scale (CTAS), Manchester Triage Scale (MTS) and Emergency Severity Index (ESI) (Asplund et al, 2010, Betz et al, 2016).

A survey of triage systems used in Sweden around 2009, undertaken by the Swedish Council on Health Technology Assessment (SBU), identified three major types of triage scales; Medical Emergency Triage and Treatment System (METTS), Adaptive process triage (ADAPT) and Manchester Triage Scale (MTS), as well as different adjusted versions and locally produced scales. In addition to determination of medical urgency, METTS and ADAPT also include a logistic perspective on patient ED flow. This is not included in the internationally produced five-level scales except for ESI (Asplund et al, 2010).

Despite the fact that triage systems are widely used, ED overcrowding is present worldwide and is one of the most challenging and heterogeneous problems currently facing health care systems (Holroyd et al, 2007). Overcrowding occurs “when demand for emergency service exceeds the capacity to provide care within a reasonable time frame” (Adbulwahid et al, 2016). The phenomenon is important to address and requires attention since it is associated with long waiting times and increased length of stay for patients in the ED. Furthermore, ED crowding is a major patient safety concern and associated with reduced patient satisfaction (Adbulwahid et al, 2016, Hoot et al, 2008).

A well-known factor with a pivotal impact on outflow from the ED is “access block”, i.e. “the inability to transfer, within a reasonable time frame, patients requiring hospital admission out of the ED because of lack of available inpatient beds”. This phenomenon is associated with ED crowding, extended length of stay at the ED and impaired patient and health service (Elder et al, 2015).

6. Health Technology at issue: Triage system

In the emergency department, triage can be described as the sorting of patients according to the severity of the medical condition or injury and the subsequent evaluation of the degree of urgency for health care. Different triage systems are being used worldwide but EDs are still facing extensive difficulties regarding ED overcrowding, prolonged waiting time, extended length of stay, access block and poor patient satisfaction, phenomena present also in hospital EDs in Göteborg. A systematic assessment of the clinical value of current triage systems is therefore warranted.

7. Objective

PICO P = Patients, I = Intervention, C = Comparison, O = Outcome

Questions at issue:

1) Is a structured triage process more efficient than no formal triage in the emergency department, with regard to the outcomes medical quality and efficiency?
2) Is triage efficiency profession dependent, i.e. does it matter if it is done by nurses, doctors or teams?
3) Does the choice of triage model affect medical quality and efficiency?
4) What is the predictive capacity of triage systems regarding true outcomes like mortality and admission rates?

PICO 1

P	Adults attending a somatic hospital emergency department (with access to hospital admittance). Specialised departments (e.g. ophthalmology care or gynaecology) are not included.
I	Prioritisation using a triage model (in ambulance or at the hospital)
C	Prioritisation without using a triage model
O	<u>Critical for decision making</u> Clinical outcomes: mortality, unscheduled return within specified time frame, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy <u>Important but not critical for decision making</u> Length of stay at the emergency department Waiting time to physician assessment Time for prioritisation process Patient satisfaction Staff satisfaction

PICO 2 - Comparison between professions within a triage model

P	Adults attending a somatic hospital emergency department (with access to hospital admittance) and triaged with RETTS, ADAPT, MTS, SATS, ESI or other triage models. Specialised departments (e.g. ophthalmology or gynaecology) are not included.
I	Any profession or team (physician, nurse, paramedics)
C	Other profession or team (physician, nurse, paramedics)
O	Critical for decision making Clinical outcomes: mortality, unscheduled return within specified timeframe, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy Important but not critical for decision making Length of stay at the emergency department Waiting time to physician assessment Time for triage process Patient satisfaction Staff satisfaction Concordance between professions

PICO 3 - Comparison of triage model within the same profession

P	Adults attending a somatic hospital emergency department (with access to hospital admittance) and triaged by a defined profession (doctor, nurse, team etc). Specialised departments (e.g. ophthalmology or gynaecology) are not included.
I	RETTS, ADAPT, MTS, SATS, ESI, other triage model
C	Another triage model within the same profession
O	Critical for decision making Clinical outcomes: mortality, unscheduled return within specified time frame, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy Important but not critical for decision making Length of stay at the emergency department Waiting time to physician assessment Time for triage process Patient satisfaction Staff satisfaction Concordance between triage models

PICO 4 - Comparison of triage model with true outcomes
(cross sectional studies for sensitivity/specificity)

P	Adults attending a somatic hospital emergency department (with access to hospital admittance) and triaged with RETTS, ADAPT, MTS, SATS, ESI or other triage models. Specialised departments (e.g. ophthalmology or gynaecology) are not included.
I	RETTS, ADAPT, MTS, SATS, ESI, other triage model
C	Reference standard (e.g. true events)
O	Critical for decision making Clinical outcomes: mortality, unscheduled return within specified time frame, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy

Study design:
SRs were initially included. After identification of a recent Swedish SR (Asplund et al, 2010), other SRs were disregarded and only subsequent original articles were included.
RCT
Non-randomised controlled studies with at least 100 patients included
Cross sectional studies for sensitivity and specificity, at least 10 000 patients (compared with a true reference standard and the same triage model or profession)

Publication year:
The search included articles published later than 2009-01-01, which covered the last search day of the Swedish SR (2009-03-31).

Language:
English, Swedish, Danish and Norwegian

Exclusion criteria:
Studies only including trauma patients
Studies on streaming processes subsequent to triage
Case series

8. Methods

Systematic literature search (Appendix 1)

During January 2017 two authors (TS, ME) performed systematic searches in PubMed, Embase, the Cochrane Library, Cinahl and the CRD Database. The websites of SBU (Swedish Agency for Health Technology Assessment and assessment of social services) and Folkehelseinstituttet (Norwegian Institute of Public Health) were also searched. Reference lists of relevant articles were also scrutinised for additional references. Abstracts were then screened with another co-author (CR), each abstract by at least two authors independently. Any disagreements were resolved in consensus. Full-text articles were sent to all authors for inclusion or exclusion. At least two authors scrutinised each article independently of one another and it was finally decided in a consensus meeting with all authors which articles should be included in the assessment. Search strategies, eligibility criteria and a graphic presentation of the selection process are presented in Appendix 1.

Critical appraisal and certainty of evidence

The included articles and their design and patient characteristics are presented per PICO in Appendix 2. The excluded studies and the reasons for exclusion are presented in Appendix 3.

The included studies have been critically appraised using a checklist for assessment of randomised controlled trials, from SBU and modified by HTA-centrum, and a checklist for assessment of cohort studies, also modified from SBU by HTA-centrum. The results and the assessed quality of each article have been summarised per outcome in Appendix 4. Data were extracted per outcome by one author and checked by at least one more author. When possible, data were pooled in meta-analyses using a random effects model in RevMan 5.2 and presented as forest plots. Continuous data originally presented with median and IQR were transformed to mean and SD, assuming normal distribution.
Summary results per outcome and the associated certainty of evidence are presented in a Summary-of-findings table (page 6). The certainty of evidence was defined according to the GRADE system (Atkins et al, 2004; GRADE Working group).

Ongoing research

Searches in Clinicaltrials.gov (2017-09-20) using the search terms *triage AND (emergency OR trauma)* identified 150 trials. Eight of these were relevant for our question.

9. Results

Systematic literature search (Appendix 1)

A Swedish systematic review (SBU-report Asplund et al, 2010) and original articles published subsequent to the last search date of the SR were included in the present HTA-report. The literature search identified 2,876 articles after removal of duplicates. After reading the abstracts 2,751 articles were excluded. The remaining 125 articles were sent in full-text to all authors, and 28 studies in addition to the SR were finally included in the assessment. Appendix 2 presents the included articles per PICO.

PICO 1. Triage versus no formal triage

(Appendix 4.1)

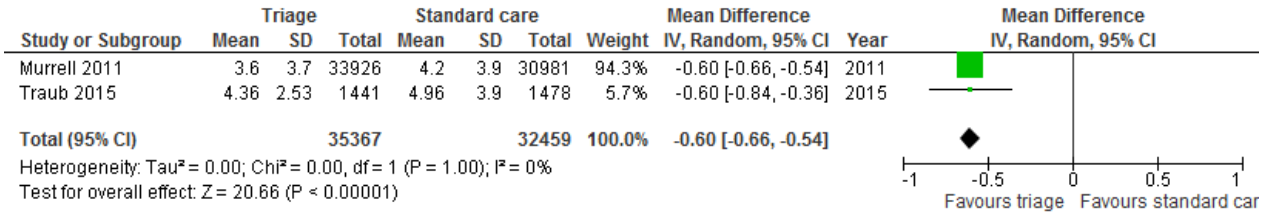
Outcomes critical for decision-making

Clinical outcomes
No clinical outcomes were reported.

Correct prioritisation (Appendix 4.1.1)
One Japanese retrospective cohort study demonstrated a significant reduction of both false positives (over triage) and false negatives (under triage) when the triage system JTAS was compared with no formal triage.
Conclusion: Correct prioritisation may be increased when triage is used compared with no formal triage. Low certainty of evidence (GRADE ⊕⊕◯◯).

Outcomes important for decision-making
Length of stay at the emergency department (Appendix 4.1.2)
Three cohort studies reported data on length of stay. Two of these included data that could be extracted and pooled in a meta-analysis (Fig. 1). Both studies reported 36 minutes shorter length of stay when triage was applied, mean difference -0.60 hours (-0.66;-0.54).

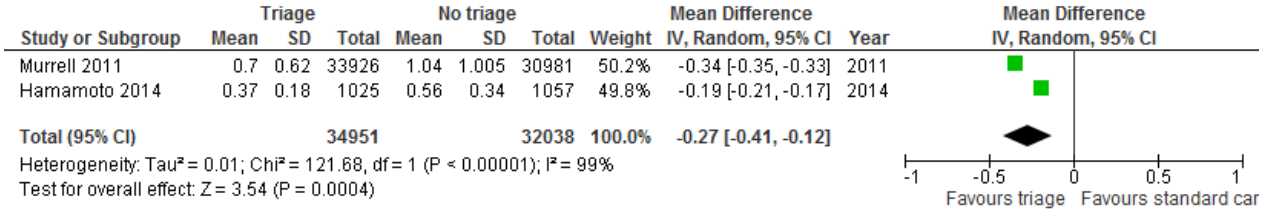
Fig. 1. Meta-analysis of studies comparing any triage with no triage.
Outcome: Length of stay (hours).



Conclusion: Triage may modestly reduce the length of stay at the ED compared with no triage.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Waiting time to physician assessment (Appendix 4.1.3)
Four cohort studies reported data on waiting time to physician assessment and two of these could be pooled in a meta-analysis (Fig. 2). There was a significant reduction in waiting time when triage was used, mean difference -16 minutes (95% CI -25; -7). The magnitude of this difference is of questionable clinical relevance.

Fig.2. Meta-analysis of cohort studies comparing any triage with no triage.
Outcome: Waiting time to physician assessment (hours).



Conclusion: There may be a small reduction in waiting time to physician assessment when triage is compared with no formal triage system.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Time for prioritisation process (Appendix 4.1.4)
In a retrospective study from Japan, the time to prioritise using a triage system was one minute longer compared with no formal triage (p=0.031), a difference which is not considered to be of any clinical relevance.
Conclusion: There may be a small increase in time for prioritisation when triage is compared with no triage.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Patient satisfaction (Appendix 4.1.5)
One prospective cohort study evaluated triage with and without MTS and reported patient satisfaction. The response rate was very low. Four different domains were evaluated and results were contradictory.
Conclusion: It is uncertain whether there any difference in patient satisfaction when triage is compared with no specific triage.
Very low certainty of evidence (GRADE ⊕◯◯◯).

PICO 2. Comparison between professions within a triage model

(Appendix 4.2)

Outcomes critical for decision-making

Clinical outcomes (Appendix 4.2.1)

Mortality (Appendix 4.2.1.1)

One large Swedish retrospective cohort study compared physician-led with nurse-led triage. A significantly lower mortality rate within seven days after physician-led triage was reported (adjusted OR 0.72 (95% CI 0.59; 0.88). Number needed to triage to prevent one death was 250.

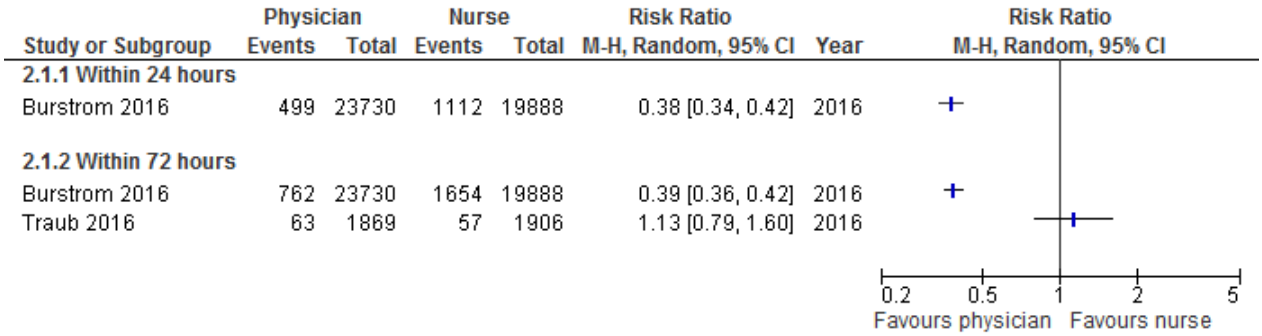
Conclusion: There may be a substantial reduction in mortality with physician-led compared with nurse-led triage.

Low certainty of evidence (GRADE ⊕⊕◯◯).

Unscheduled return (Appendix 4.2.1.2)

The Swedish cohort study reported a significantly reduced frequency of unscheduled return, both within 24 and 72 hours when comparing physician-led with nurse-led triage. An American smaller cohort study did not demonstrate any difference. The results of the two studies are depicted in Fig. 3. Data were not pooled due to large heterogeneity between studies.

Fig. 3. Forest plot of retrospective cohort studies comparing the presence of a physician with a nurse in a triage system.
Outcome: Unscheduled return within specified time frame.



Conclusion: Setting seems to be important for this comparison. In the Swedish setting, the unscheduled return was significantly reduced when a physician compared with a nurse led the triage, but not in the American setting.

Low certainty of evidence (GRADE ⊕⊕◯◯).

Correct prioritisation

No study reported this outcome.

Outcomes important for decision-making

Length of stay at the emergency department (Appendix 4.2.2)

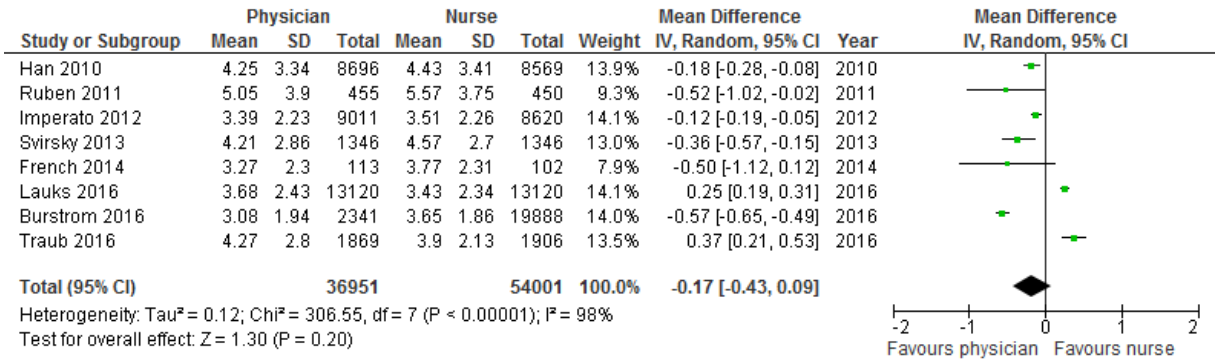
A total of 15 studies (nine cohort studies from the search, two RCTs and four cohort studies from the SR (Asplund et al, 2010) reported length of stay in different comparisons of professionals.

The two RCTs included a physician in the intervention arm and demonstrated a mean difference in length of stay of-36 ($p<0.001$) and -45 minutes ($p=0.057$), respectively. One of the RCTs presented mean length of stay of approximately 4.4 and 5 hours respectively, while the other presented much shorter time; 37 and 82 minutes respectively. Data could not be pooled since no SDs were reported.

The four cohort studies in the SR were based on mixed comparisons of staffing and could not be pooled. The results were heterogeneous (App. 4.2.2.2).

The cohort studies from the search comparing the addition of physician or a physician-led with a nurse-led triage are summarised in a meta-analysis (Fig. 4).
The majority of studies showed a reduction in length of stay (mean difference varied between 7-34 minutes). The pooled estimate showed no significant reduction when triage was led by a physician compared with a nurse.
One study was judged to have high risk of bias (Lauks et al, 2016) due to a large number of exclusions based on the matched design. If this study is omitted from the meta-analysis, the mean difference was -0.23 (95% CI -0.47; 0.01) hours. An additional study included nurse practitioners and physician assistants in the interventional arm and was therefore not included in the meta-analysis (Ducharme et al, 2009).

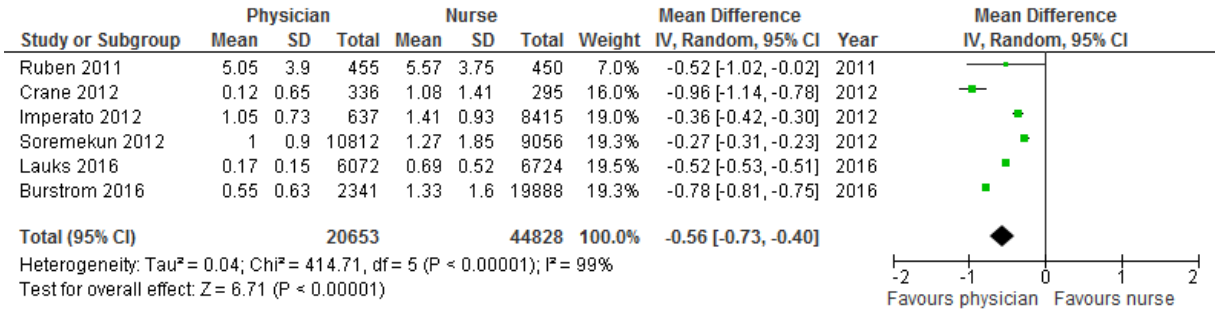
Fig. 4. Meta-analysis of cohort studies comparing physician-led triage with nurse-led triage. Outcome: Length of stay (hours).



To summarise the results of this outcome including all study designs; the largest RCT (approx. 6000 patients) showed a significant and modest reduction (36 minutes) in length of stay while the smaller RCT and the observational studies did not demonstrate any statistically significant differences when triage was led by a physician compared with a nurse.
Overall conclusion: Physician-led triage may reduce length of stay compared with nurse-led triage. Low certainty of evidence (GRADE ⊕⊕◯◯).

<u>Waiting time to physician assessment (Appendix 4.2.3)</u>
Thirteen cohort studies (eight from the search and five from the SR) reported waiting time to be assessed by a physician. Within the SR, one cohort study reported proportions of patients seen by a physician within a threshold depending on triage level (Richardson et al, 2004). In triage level 3 the proportion of patients assessed within 30 minutes increased significantly from 67% to 78%, and in triage level 4 the proportion of patients assessed within 60 minutes increased significantly from 53% to 73% ($p<0.0001$). Among the other cohort studies in the SR, a favourable effect for physician-led compared with nurse-led triage was demonstrated in two studies. The other two studies comprised other professionals in the comparison.
Data from six cohort studies from the search could be pooled in a meta-analysis (Fig. 5). The presence of a physician compared with a nurse in the triage model shortened the waiting time to physician assessment by a mean of 34 minutes (95% CI -44; -24).

Fig.5. Meta-analysis of cohort studies comparing physician-led triage with nurse-led triage. Outcome: Waiting time to physician assessment (hours).



Conclusion: The waiting time to physician assessment may be reduced when a physician is present in the triage compared with nurses.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Patient satisfaction (Appendix 4.2.4)
Three cohort studies reported patient satisfaction using different scales. The intervention was to add a physician to the triage system in all three studies. No significant differences judged to be of clinical relevance were observed.
Conclusion: There may be little or no difference in patient satisfaction when a physician is added to the triage system.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Concordance between professions (Appendix 4.2.5)
In one cross-sectional study, paramedics were evaluated against emergency physicians. The overall agreement was 72%, kappa 0.52. There were no other studies reporting on concordance between professions.

PICO 3. Comparison between triage models

(Appendix 4.3)

Outcomes critical for decision-making

Clinical outcomes (Appendix 4.3.1)
Mortality (Appendix 4.3.1.1)
Two retrospective studies reported mortality at the emergency department comparing two different triage systems. The study from The Netherlands reported similar mortality rates comparing ESI with MTS (van der Wulp et al. 2009). The urgent priority levels in both triage systems were associated with increased mortality. The study from Botswana reported similar mortality rates comparing PATS with a local triage system (Mullan et al. 2014).
Conclusion: There may be no difference in mortality when comparing different triage systems.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Admission to intensive care unit (Appendix 4.3.1.2)
One retrospective study from Botswana reported that the triage system PATS was more effective in predicting admission to intensive care unit (ICU) compared with a local triage system (Mullan et al. 2014). No other studies were identified comparing different triage systems for this outcome.
Conclusion: It is uncertain whether there is any difference in admission to ICU when comparing different triage systems.
Very low certainty of evidence (GRADE ⊕◯◯◯).

Admission (Appendix 4.3.1.3)
Two cohort studies reported admission. The study from Botswana reported that the triage system PATS was more effective in predicting admission to surgery compared with a local triage system (Mullan et al. 2014). A large study from The Netherlands reported 5-level ESI to be more effective in predicting admission to ward than 5-level MTS (van der Wulp et al. 2009).
Conclusion: Admission prediction may differ between triage systems.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Correct prioritisation (Appendix 4.3.2)
Two observational studies reported correct prioritisation using specified definitions of over- and under-triage, comparing two different triage systems. SATS was part of the comparison in both studies, although PATS was a development of SATS. A retrospective cohort study from Botswana (Mullan et al, 2014) reported that both false positives (over-triage) and false negatives (under-triage) were reduced from a remarkably high level (57% and 46% respectively), when PATS was used compared with a local triage system (RR for over-triage 0.73, 95% CI 0.71; 0.74 and for under-triage 0.32, 95% CI 0.31; 0.34), (Figures 6 and 7).
A cross-sectional study from South Africa (Rosedale et al, 2011) reported that both false positives (over-triage) and false negatives (under-triage) were reduced when SATS was used compared with MEWS (RR for over-triage 0.51, 95% CI 0.32; 0.82 and for under-triage 0.29, 95% CI 0.19; 0.45). (Figures 6 and 7). Data from the two observational studies were not pooled, since they had different designs.

Fig. 6. Forest plot of observational studies comparing SATS /PATS with other triage systems. Outcome: Proportion of false positives (over-triage)

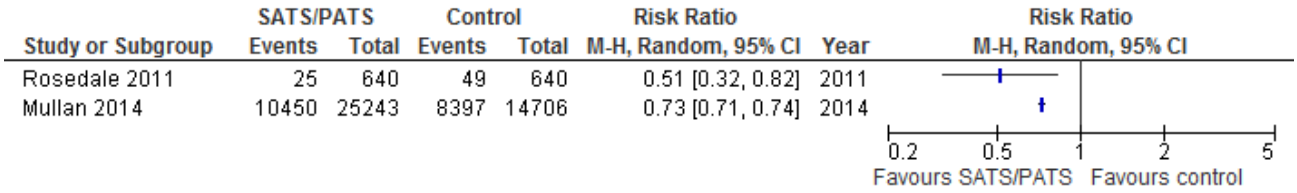
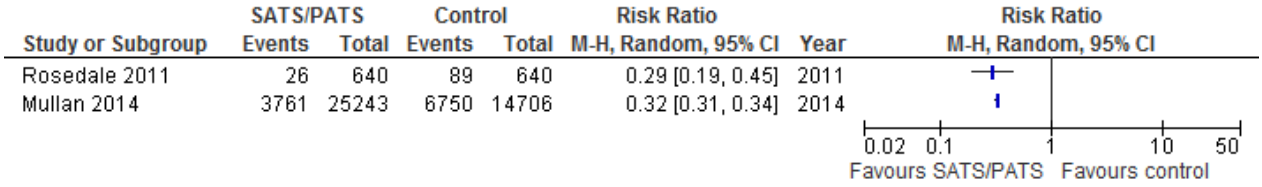


Fig. 7. Forest plot of observational studies comparing SATS /PATS with other triage systems. Outcome: Proportion of false negatives (under-triage)



Conclusion: SATS (and systems developed from SATS) may increase correct prioritisation compared with other triage systems (MEWS or local system).
Low certainty of evidence (GRADE ⊕⊕◯◯).

Outcomes important for decision-making

Length of stay at the emergency department (Appendix 4.3.3)
One cross-sectional study from Taiwan reported length of stay at different triage levels comparing 5-level CTAS with 4-level TTS (Ng et al. 2010). In low-urgency levels length of stay was shorter when TTS was used compared with CTAS. No further inference was possible.
Conclusion: No general conclusion regarding length of stay can be drawn based on comparisons between triage systems.
Very low certainty of evidence (GRADE ⊕◯◯◯).

Waiting time to physician assessment (Appendix 4.3.4)
One retrospective cohort study from Iran compared 5-level ESI with 3-level spot check triage (similar to rapid triage) (Maleki et al. 2015). The waiting time was extremely short in both groups.
Conclusion: No general conclusion regarding waiting time can be drawn based on comparisons between triage systems.
Very low certainty of evidence (GRADE ⊕◯◯◯).

Concordance between triage models (Appendix 4.3.5)
Two small retrospective cohort studies with high risk of bias reported concordance between two triage systems. A study from Canada compared CTAS with a rapid triage score (RTS) and found an overall agreement in 85% (Betz et al. 2016). A study from Brazil compared MTS (5 level) with a local standard protocol and reported the highest agreement in the orange triage level (below the most urgent) (de Souza et al. 2011).
Conclusion: No general conclusion can be drawn on concordance between different triage models.
Very low certainty of evidence (GRADE ⊕◯◯◯).

PICO 4. Comparison between triage and true outcomes (cross-sectional studies)

(Appendix 4.4)

Outcomes critical for decision-making

Clinical outcomes (Appendix 4.4.1)

Mortality (Appendix 4.4.1.1)
The SR reported mortality rates among non-urgent patients in relation to different triage systems; CTAS 0%, ATS 0.1% and 0.003%, METTS 0.5%. Two large cross-sectional studies reported mortality distribution across triage levels in MTS (5-level). Deaths were most common in the orange level (38% and 41% of all deaths, respectively). The mortality risk was more than five times higher in the high priority cluster (red+orange) compared with the low priority cluster (yellow+green+blue), RR 5.6 (95% CI 4.3; 7.2).
Conclusion: Among patients who died, few patients were triaged as low priority.
Low certainty of evidence (GRADE ⊕⊕◯◯).

Admission to intensive care unit (Appendix 4.4.1.2)
A large cross-sectional study reported ICU-admission across triage levels. ICU-admission was most common in the orange level (60% of all ICU-admissions).

Admission (Appendix 4.4.1.3)
The SR reported admission rates among non-urgent patients in relation to different triage systems; ATS 3.1-17%, ESI 0%-7%, SRTS 1.4%. Two large cross-sectional studies reported admission in relation to MTS. Admission rates in the non-urgent levels were 0.3%-10% (blue) and 13%-14% (green). The study by Gräff and co-workers reported admission to normal ward to be most common in the yellow (48%), followed by the orange level (35% of all admissions to ward). The study by Santos and co-workers reported a 4.9 relative risk of admission to normal ward (95% CI 4.3; 5.5) comparing the red+orange priority cluster with the lower priority cluster. One notices remarkably low overall admission rates (1.12%) in the Santos study and the absolute admission rate was similar in red and green triaged patients.
Conclusion: A majority of admitted patients were triaged as high priority (red+orange+yellow).
Low certainty of evidence (GRADE ⊕⊕◯◯).

10. Ethical issues

Triage represent one of the main ethical dilemmas and source of moral stress in the health care sector. It is the challenge to simultaneously provide access and effectively distribute limited resources to those in need of health services.

To select and categorise patients according to severity of a disease or an injury raises ethical issues on general versus individual interests, especially in a situation of resource shortage. There is however, to our knowledge, no agreements or standards on ethics regarding conditions of consent and humanitarian considerations applied to triage. This is also true concerning defined levels of severity, waiting time, time to physician, recommendations of re-evaluations or models to classify.

The core idea of triage, i.e. identifying the severely ill and simultaneously keep up the patient flow is, in itself contradictive. Prioritising and re-prioritising resources in order to provide a swift and effective care to the severely ill will accumulate queues. Consequently, the elements of competition in the construct of queues, has become a reason to frustration, critique and debate.

The ED crowding debate has, so far, mainly put focus on logistics and processes. One example is the four-hour target (length of stay) introduced to reduce ED waiting time in Australia and UK. However, an upcoming debate has questioned if such product-process targets really have beneficial effects on health-care outcomes. The criticism underlines that a race against the clock competes with keeping up a sufficient quality in clinical work and the burden to balance between logistic targets and quality has mainly been placed on the shoulders of clinical staff.

The use and overuse of ED services seems to be dependent of the accessibility and quality of other parts of the health care system, e.g. home help services, urgent care clinics, walk-in units and primary care centres. An expectation of the ED as a highly specialised and high-tech health care may attract the patient, even though primary health alternatives would be a more proper alternative. Accordingly, the rationale of ED triage can, from a patient perspective, be difficult to understand. A longer length of stay of the patient triaged orange or yellow than the patient triaged green (partly explained by fast-track and nurse practitioners for some low priority patients), can raise critical questions.

This report highlights the difficulty to evaluate and compare triage models. The methods differ from local to national settings regarding protocols, staffing and processes. Well-known and broadly used models are often tailored to certain contexts contributing to several “one of a kind type” of triage. Consequently, the optimal technique to perform triage in order to improve safety, prevent ED crowding and optimise the use of ED resources is still a source of debate. On the other hand, if continuously using an outdated and non-beneficial triage model if other alternatives seem to be more promising would be counterproductive. Even if a comparative evaluation of different triage-models will provide ambiguous answers, the evaluation is still necessary as a framework for ethical considerations.

11. Organisational aspects

General comments regarding setting

The phenomenon of crowding and long waiting times in emergency department is universal but its magnitude varies between settings and type of health care systems. The Swedish health care system is mainly tax financed and there are only a few privately financed emergency departments in the country.

There is a relative shortage of doctors and the health care budget is put under great pressure, resulting in relatively severe problems with emergency department overcrowding. Many of the studies on which this HTA report is based were performed in a similar setting (Australia, Netherlands, Canada), i.e. those data are highly relevant to our specific setting. Conversely, our data is applicable to many other similar settings globally.

Present use of triage within the Sahlgrenska University Hospital
In 1997 the three hospitals Sahlgrenska, Östra and Mölndal merged and Sahlgrenska University Hospital (SU) founded. Since 1999 SU is a part of Region Västra Götaland (VGR). SU provides emergency and basic care for the Göteborg region and its 700,000 inhabitants.

The Sahlgrenska hospital
The emergency department of the main hospital, the Sahlgrenska Hospital, an academic, urban level I trauma hospital, was attended by 43,072 patients in 2016. The hospital serves adults in two main specialties; internal medicine and surgery and has chief responsibility for trauma care in greater Göteborg. Predominantly, patients attending the emergency department are self-attenders (30,421 in 2016), and a smaller proportion, 12,428) are brought in by ambulance.
On arrival patients meet a receptionist at the registration desk where the main complaint will be noted. If a life-threatening condition is imminent, the patient will immediately be taken into the emergency room for acute medical attention and are not seen at the regular triage.
These patients will be registered retrospectively as triaged red. After registration, subsequent triage is performed by a registered triage nurse and a nurse assistant. Within the health care system of SU, the domestic triage system RETTS (Rapid Emergency Triage and Treatment System) is currently used and has been implemented into emergency health care since 2005.

RETTS is a decision and support system tool, used to identify and prioritise patients with potentially serious illnesses and/or injuries by triage level. The triage system consists of three different parts; obtaining the initial vital signs and related reason for ED visit/chief complaints to current symptoms (Emergency Symptoms and Signs = ESS). Taken together, the result of vital signs and ESS is converted to a triage level (colour); red, orange, yellow, green and blue, which determines medical urgency. Red colour indicates the most urgent requirement for medical care while blue colour indicates referral to other level of care, e.g. general practitioner in primary care. In the third step, given the triage level, the need for monitoring and lab works is decided.

After triage evaluation, patients are assigned to one of the designated sections of the ED. The emergency department is divided into two major treatment areas for surgery and internal medicine, where patients are further allocated into clusters according to medical urgency/triage colour; red/orange (urgent) and yellow/green (non-urgent). Further, as an improvement strategy a streamline “Stream team” has been established and incorporated into the medical section, where low priority patients are being seen and treated.
The surgical section is not further divided into clusters according to medical urgency but is accountable for incoming trauma patients.
Each team in the two sections comprises junior/senior physician or emergency physician, registered nurses and nurse assistant. A consultant is present Monday-Friday 8:00 am – 8:00 pm. In an attempt to further improve patient flow in the ED, a local version of Nurse practitioner (NP) has been introduced lately.

The Mölndal hospital
The RETTS triage system is also used at the Mölndal hospital, in the same manner as the Sahlgrenska hospital ED, in accordance with the above description. The Mölndal hospital serves adults in two main specialties; orthopaedics and internal medicine and was attended by 33,791 patients in 2016. In an effort to increase patient throughput, a “spot check” triage done by a

registered nurse, with the possibility to order x-ray scanning, was implemented. Low priority patients with orthopaedic complaints are subsequently seen by a physician. A local version of ESS is used at the Mölndal hospital ED.

The Östra hospital
The Östra hospital ED serves adults in two main specialities; internal medicine and surgery and was attended by 32,851 patients in 2016. The RETTS triage system is also used at the Östra hospital. In conformity with the other two EDs, achievements to increase ED patient flow after the triage have been performed. An extra interdisciplinary "Stream team" staffed by emergency physician and registered nurse has been implemented, as well as additional emergency physician, Monday-Friday 6:00 pm – 23:30 pm and weekends 9:00 am – 5:00 pm. Both interventions are subsequent to triage.

Both the Mölndal and Östra hospitals have different "fast track" to streamline the admission process for patients. Separate ED units for psychiatry, gynaecology, obstetrics, ENT (ear-nose- and throat), ophthalmology and paediatrics are also a part of the emergency care of SU.

The emergency health care of SU is currently facing extensive problems concerning ED overcrowding. Increase in the number of ED presentations, extended waiting time, length of stay and subsequent decreased patient satisfaction is seen. The risk of patients leaving the ED before treatment is completed, referred to as "left without being seen" (LWBS) is also an issue. Also, a major concern is "access block", which refers to the inability to access inpatient beds within a reasonable time frame and is associated with ED crowding and prolonged length of stay at the ED. Several interventions have been implemented to improve ED patient flow but the problems still remain.

Time frame for the putative introduction or change of triage models
The results of this HTA-rapport aims to provide a basis for the choice of a triage model at the Sahlgrenska University Hospital (SU). The subsequent reorganisation of the emergency health care and development of the chosen triage system and related internal organisation of ED will take place during the following years.

Potential consequences of implementation of the new health technology for personnel
If the triage concept of physician in triage was to be implemented, it would entail the need for employing additional emergency physicians as well as further education of ED personnel, to enhance the level of competence.

Consequences for other clinics or supporting functions at the hospital or in the Region Västra Götaland
In the present situation, the choice of triage system, is not a regional (VGR) question but will most likely be of future interest, since hospitals in the region have a lot in common.

12. Economic aspects

Present costs of currently used technologies
During 2016, 152,637 patients were admitted to the ED's at the Sahlgrenska university hospital. i.e. SU/Sahlgrenska, SU/Östra and SU/Mölndal (Table 1). The characteristics of the patients admitted to the ED's are shown in Table 2. Figure 8 illustrates the patient-flow by hour of day to the EDs within Sahlgrenska University hospital during 2016.

Table 1. Visits to emergency departments at the Sahlgrenska University hospital (2016)

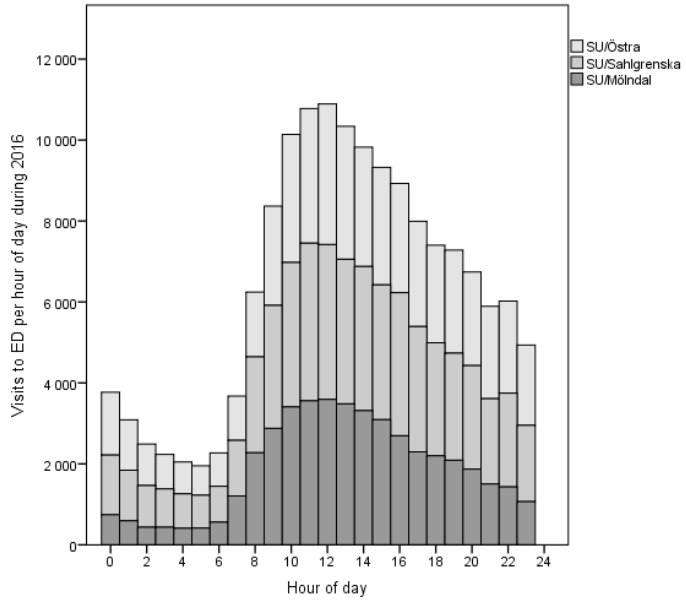
	SU/Sahlgrenska	SU/Östra	SU/Mölndal
2015	56,551	46,700	45,490
2016	56,727	50,374	45,536
2017	55,231	50,423	43,586

Table 2. Characteristics of patients admitted to the emergency departments within Sahlgrenska University hospital (2016)

	SU/Sahlgrenska	SU/Östra	SU/Mölndal
Patients sex % (male/female)	50/50	52/48	51/49
Patients mean age n (SD)	53 (22)	51 (22)	52 (23)
Arrival to ED n (%)			
Walk-in	39,642 (70)	35,051 (70)	36,057 (80)
Ambulance	16,781 (30)	15,018 (30)	9,207 (20)
Priority level n (%)			
Blue	2,350 (4)	2,944 (6)	384 (1)
Green	4,410 (8)	10,054 (20)	10,026 (22)
Yellow	24,677 (44)	21,790 (43)	22,950 (50)
Orange	14,460 (25)	2,384 (5)	6,892 (15)
Red	2,944 (5)	3,085 (6)	610 (2)
Missing data	7,886 (14)	10,117 (20)	4,674 (10)
Second assessment* n (%)	43,186 (76)	36,649 (73)	37,805 (83)

*Second assessment corresponds to contact with a physician after patients being included in triage.
ED = Emergency department; SD = standard deviation.

Fig. 8. Histogram of patient arrivals by hour of day to emergency departments within Sahlgrenska University hospital during 2016.

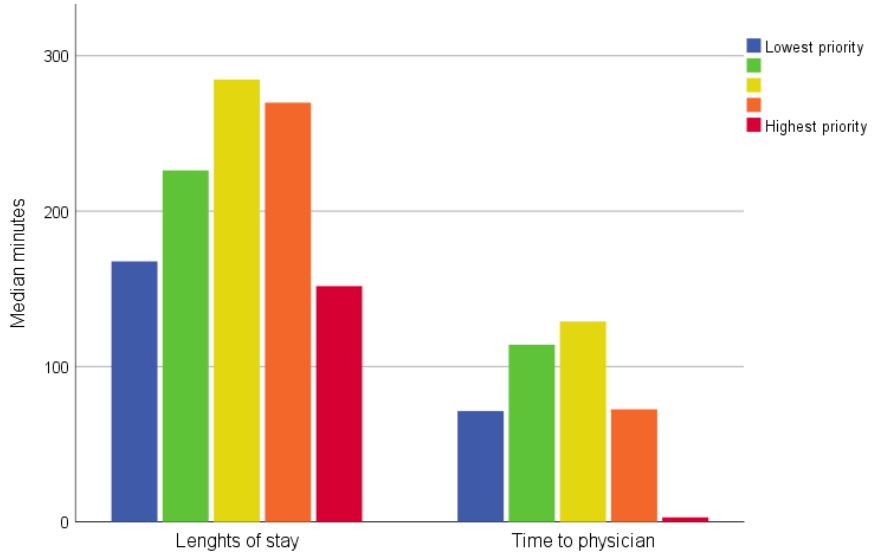


In the following presentations the term *initial assessment* is used for the triage process which may be conducted by either a nurse (present scenario) or a physician (future scenario).

The term *second assessment* is used for the assessment after the triage within the ED, and is always conducted by a physician (in both present and future scenarios).

Time estimates for patients included in the triage system
Figure 9 illustrates the median waiting time to second assessment (physician) and length of stay within each priority level at the EDs, indicating that the yellow priority level has the longest waiting times for both time to physician and length of stay.

Fig. 9. Median minutes of length of stay and waiting time to second assessment (physician) within each priority level at the emergency departments within Sahlgrenska University hospital (2016).



The median length of stay at the EDs at Sahlgrenska university hospitals were 222 minutes (3.7 hours) and the median waiting time to second assessment (physician) were 100 minutes (1.7 hours) (Table 3).

Table 3. Waiting time to second assessment and length of stay in median (Q^1-Q^3) minutes (2016)

	SU/Sahlgrenska	SU/Östra	SU/Mölndal
Waiting time to second assessment	118 (50-247)	90 (37-188)	93 (42-181)
Length of stay	377 (135-453)	190 (92-320)	208 (121-314)

Q^1-Q^3 = first quartile to third quartile

Estimated costs with the current strategy
According to the SU/Sahlgrenska cost-per-patient system (Kostnad-Per-Patient (KPP)), during 2016 the average hospital cost for a nurse-led team triage were 1,909 SEK per patient, including cost of time for the nurse with a nurse assistant and overhead costs. The cost per second assessment by a physician was 2,794 SEK, including the costs of other personnel involved (nurse and nurse assistant) and overhead costs. The overhead costs consist of cost for administration, medical equipment, pharmaceutical drugs and costs of the facilities such as rent and laundry, corresponding to 803 SEK per visit.

During 2016, 152,637 patients were admitted to the EDs and included in the triage and hence had an initial contact with a nurse, corresponding to 291.4 million SEK.

In addition, 117,640 patients had a second assessment (by physician) after the triage process, corresponding to 328.7 million SEK. The total cost during 2016 with the current triage model including second assessment (physician) were 620.1 million SEK (Table 4).

Expected costs of new strategy – additional physician in triage

In this economic analysis, PICO 2 – Comparison between professions within triage model, was included as a comparative strategy. PICO 1, 3 and 4 were not included in the economic analysis due to lack of results from clinical trials using the current triage model as a comparative strategy.

The economic analysis assumes that the current strategy will apply also in the future, but with the addition of a physician to the triage team at the EDs during daytime. Thus, the future strategy estimated in this economic analysis is calculated to have an impact only on the initial assessment (triage), while the second assessment (physician) is the same in the calculation, as in the current strategy.
The cost in this economic analysis is based on the additional marginal cost in terms of cost for salary of adding a physician to the triage team. The average annual salary during weekdays and daytime for a physician at SU/Sahlgrenska is 1.2 million SEK, including social security contribution, holiday allowance and other personnel costs, such as education. The average salary during weekends is estimated to be 2.4 million SEK.
During weekdays (Monday to Friday) and daytime (8:00 a.m. to 21:00 p.m) there were 88,042 patients admitted to the EDs and included in the triage during 2016. The corresponding figure during weekends (Saturday and Sunday) and daytime (8:00 a.m. to 21:00 p.m) were 32,113 patients. Thus, we estimated the additional need for physicians to be 12 during weekdays and six during weekends. This equals to an estimated annual cost of 14.6 million SEK during weekdays and 14.6 million SEK during weekends.

Total change of cost

The marginal total cost of adding additional physicians to the triage at Sahlgrenska University hospital is estimated to be 29.2 million SEK. In this economic analysis, we only estimated the impact on the initial assessment (triage). However the future strategy of adding physicians to the triage might also have an impact, also on the second assessment by the physicians.
Adding physicians to the triage might reduce the number of second assessments, since the initial assessment by physician may result in an increased number of discharged and referred patients compared with the present initial assessment by nurse (17%-27%, Table 2). However, the magnitude of this effect is not possible to predict.

Possibility to adopt and use the new technology within the present budget

To be able to fully implement the new strategy with physician in triage, an adequate budgetary support is required.

Available economic evaluations or cost advantages/disadvantages

The systematic review by Abdulwahid, et al (2016) reviewed the impact of senior doctor assessment at triage, also including the costs associated with senior doctor assessment at triage. The cost associated with senior doctor assessment at triage was reported in one American study indicating an overall positive financial impact with a net present value of £16.6 million. After a 13 months period the senior doctor assessment at triage were break even compared to the initial investment.

Mohan et al (2012), estimated the incremental cost-effectiveness ratio (ICER) of physicians' decision threshold (attitudes toward transferring patient to trauma centres) in comparison to perceptual sensitivity (ability to identify patients who meet transfer guidelines) using a Markov decision model. The analysis was based on US settings and had a societal perspective.

Estimates of triage patterns, mortality, utilities (QALYs) and costs were drawn from the literature. In comparison with current practice, the ICER of perceptual sensitivity was $62,799 per QALY gained. In comparison to perceptual sensitivity, the ICER of physicians' decision threshold was $104,975 per QALY gained.

13. Discussion

Summary of main results

Triage versus no formal triage

There was low certainty of evidence for a better prioritisation (reduced over- and under-triage), for a modest reduction in length of hospital stay and for a small reduction in waiting time to physician assessment at the emergency department when using triage compared to no formal triage.

Comparison between different professions

The most common comparison was between physician-led and nurse-led triage. There was low certainty of evidence that there may be a substantial reduction in mortality when a physician compared with a nurse is present in triage, that the frequency of unscheduled return to hospital may be reduced, that the length of stay at the emergency department may be reduced and that the waiting time to physician assessment may be reduced.

Comparison between triage models

There were few comparisons between triage models. There was low certainty of evidence for any difference in mortality and admission to the ICU, when comparing different triage systems. There was also low certainty of evidence that SATS/PATS may reduce both over-and under-triage compared with MEWS/local systems. Regarding length of hospital stay and waiting time to physician assessment at the emergency department, no studies relevant to the Swedish setting could be identified.

Comparison between a triage model and a true reference standard

Only rather obvious conclusions could be drawn from the available studies; that among patients who died, few patients were triaged as low-risk (non-urgent) in different triage systems, and that a majority of admitted patients were triaged as high priority.

Overall completeness and applicability of evidence

Although there is a multitude of studies on different triage models in the literature, the certainty of evidence for the efficacy of specific models remains low. This is partly because of a lack of high-quality studies, with defined control groups, but also due to the fact that different triage models are not clearly defined, often overlapping with other systems and may be valid only in a specific setting (e.g. in a particular geographical area or patient group).

The available studies have some important clinical implications. Firstly, the findings that triage may affect prioritisation and length of hospital stay. Secondly, that there is support for different favourable effects of including a physician in the triage process, including shortening of the length of stay at the ED, a reduction of the unscheduled returns to hospital, reduction in waiting time to see a physician and even decreased mortality. These results may have an impact on the staffing included in the triage system. Comparisons between different triage systems have generally shown little or no difference, with the possible exception of the outcome admission to the ward, in two studies. Finally, triage systems seem to identify low risk patients, with a low risk of mortality, but still having a not-negligible admission rate.

In summary, triage systems may affect prioritisation and identify low-risk patients. A triage that includes a physician is likely to be more effective.

Agreements and disagreements with other studies and reviews

The SBU, in 2010 published a systematic review on “Triage and flow-processes at the emergency ward” (report 197). Our results are in concordance with the SBU-demonstrating a reduction in length of stay and waiting time to physician assessment at the ED, when physician-led was compared with nurse-led triage.

Implications for research

The present report highlights the existence of many studies of poor quality in this field and a lack of randomised trials. Thus, there is a great need for larger, high quality studies that compare triage with no formal triage, as well as comparing different triage models and professions on critical outcomes, such as mortality, over- and under-triage, but also on other process outcomes, such as length of stay and waiting time to physician assessment.

14. Future perspective

Scientific knowledge gaps

The present report has identified several knowledge gaps. Particularly comparisons between triage models are lacking, but also comparisons between professions in triage. Critical outcomes such as mortality, specificity and sensitivity (over- and under-triage) should be studied.
There is also a need for further studies on process outcomes, such as length of stay and waiting time to physician assessment to improve the certainty of evidence.

Ongoing research

Results from studies of triage models at different hospitals are not fully consistent since a case-mix of patients and various study designs makes it difficult to determine the most proper triage model. Furthermore, in these studies efficacy is often focused on length of stay and waiting time and less on patient safety. This claim seems valid for both discharged patients and patients referred to in-hospital care.

Several studies of the efficacy in different triage models are ongoing or have recently been completed (ClinicalTrials.gov). A search in www.clinicaltrials.gov identified eight studies of interest, summarised in Table 5. Some of these may extend present knowledge in triage efficacy to suggest proper triage models.
In one prospective cohort study recently completed (NCT 02698319) the purpose was to compare usual care with an intervention strategy to increase the efficiency of ED operations in adding a physician to triage to perform brief medical screenings and initiate necessary patient testing and treatment. This concept is extended from previous studies in which physicians evaluated patients only following registration and then referred patients to next team of nurses and physicians.
Another observational prospective cohort study by Scheutz et al (NCT01768494) examined the association between triage priority and adverse 30 day outcome (death or intensive care unit admission). Furthermore, the need for care after hospital discharge was also analysed. Previously, there have not been many triage studies examining long-term outcome for patients and therefore the present study may be considered of potential interest. This study is completed.
These ongoing studies seem to be of potential interest and may result in a more comprehensive understanding of proper triage models. There are also more impending studies on this subject as depicted in Clinical Trials.gov and yet several more clinical issues in triage models need to be elucidated. The number of planned and completed studies is increasing and may convey valuable information to physicians and decision makers. In conclusion, triage at ED, irrespective of triage model, seems to be superior to any other method in taking care of and classifying patients with acute disease.

Table 5. Recently completed triage studies from Clinical Trials.

Author or country	Study design	n=	Inter-vention	Control	Outcome	NCT
USA	Prospective cohort	199	Behavioural physician at triage	usual care	Patient satisfaction with ED efficiency	2703701
Rutschman OT	Retro-spective cohort	69,893	No intervention		Proportion of pats evaluated with SETS. Waiting time	2980159
Norway	Inter-ventional, open label	1812	After	Before	Diagnostic accuracy	876564
Hasselbalch RB	Randomised open label	50,000	Copenhagen triage algorithm	Usual triage	All cause mortality, LoS waiting time	02698319
UK	Prospective cohort	503			Life-saving intervention	1091064
Rutschman OT	Non-randomised, open label	8000	Behaviour physician+ nurse team	Physician+ nurse team	ED LoS	1219868
Canada	Case series	928	Paramedics	Triage nurses	CTAS level assignment	468780
Switzerland	Prospective cohort	7000	ED Physician	Usual care	Triage priority, 30-day adverse events	01768494

ED= Emergency Department; LoS=Length of stay

Interest at the clinic/research group/organisation to start studies/trials within the research field at issue

Today, there exist several studies on the efficacy of triage compared with no triage and many investigations of the ideal medical staff at triage. Some studies have focused on mortality and morbidity associated with different triage models or length of stay at the ED.

However, few studies have investigated triage priority in relation to long-term outcome and whether short length of stay at the ED or a prolonged stay may influence patient's long-term prognosis.

The issue for our clinical research group may be to study whether long or short-term length of stay at ED influence outcomes after 30 days; mortality, length of hospital care, re-admittance, adverse advents and medical complications, e.g. pneumonia, urinary tract infections, and severe heart failure.

Thus, our group would be interested to perform a prospective cohort study at the Sahlgrenska University Hospital. All patients attending ED would be followed for 30 days and data would be collected accordingly. For logistic reasons we would only include patients from Internal Medicine, Surgery, Neurology, Pulmonary Medicine and Cardiology.

15. Participants in the project

The question was nominated by
Tobias Carlson, manager, Center for development of Emergency Services, Sahlgrenska University Hospital (SU), Göteborg, Sweden

Participating health care professionals
Camilla Ringström, resident physician, Dep. of Medicine, Geriatrics and Emergency care, SU, Gothenburg, Sweden
Mats Börjesson, consultant, professor, Department of Neuroscience and Physiology, Sahlgrenska Academy, University of Gothenburg, Department of Food and Nutrition and Sport Science, University of Gothenburg, SU, Göteborg, Sweden
Eric Carlström, Professor, Health Care Sciences, Emergency Department Development Center, Region Västra Götaland, Sweden
Björn Andersson, MD, Associate Professor, Internal Medicine, Chief Medical Officer Quality and Patient Safety, SU, Gothenburg, Sweden
Malin Lönnbark, logistician, Strategic Planning, SU, Gothenburg, Sweden

Participants from the HTA-centrum, Region Västra Götaland
Annika Strandell, MD, Associate professor
Henrik Sjövall, MD, Professor
Christina Bergh, MD, Professor
Therese Svanberg, HTA-librarian
Maud Eriksson, librarian
Josefine Persson, Health economist, PhD

External reviewers
Christian Rylander, MD, Associate Professor, Department of Anaesthesia and Intensive Care Sahlgrenska University Hospital, Gothenburg, Sweden
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Declaration of conflicts of interest
No conflict of interest was reported for any of the authors or reviewers in relation to this report.

Project time
HTA was accomplished during the period of 2017-01-16 – 2017-12-20
Literature searches were made 2017-01-30.

Appendix 1: Search strategy, study selection and references

Questions at issue:

1) Is a structured triage process more efficient than no formal triage in the emergency department concerning medical quality and efficiency?
2) Is triage efficiency profession independent?
3) Does the choice of triage model affect medical quality and efficiency?
4) What is the predictive capacity of triage systems compared with true outcomes?

PICO P = Patients, I = Intervention, C = Comparison, O = Outcome

PICO 1

P	Adults attending a somatic hospital emergency department (with access to hospital admittance). Specialised departments (e.g. ophthalmology care or gynaecology) are not included.
I	Prioritisation using a triage model (in ambulance or at the hospital)
C	Prioritisation without using a triage model
O	Critical for decision making Clinical outcomes: mortality, unscheduled return within specified time frame, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy Important but not critical for decision making Length of stay at the emergency department Waiting time to physician assessment Time for prioritisation process Patient satisfaction Staff satisfaction

PICO 2 - Comparison between professions within a triage model

P	Adults attending a somatic hospital emergency department (with access to hospital admittance) and triaged with RETTS, ADAPT, MTS, SATS, ESI or other triage models. Specialised departments (e.g. ophthalmology or gynaecology) are not included.
I	Any profession or team (physician, nurse, paramedics)
C	Other profession or team composition (physician, nurse, paramedics)
O	Critical for decision making Clinical outcomes: mortality, unscheduled return within specified timeframe, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy Important but not critical for decision making Length of stay at the emergency department Waiting time to physician assessment Time for triage process Patient satisfaction Staff satisfaction Concordance between professions

PICO 3 - Comparison of triage model within the same profession

P	Adults attending a somatic hospital emergency department (with access to hospital admittance) and triaged by the same profession. Specialised departments (e.g ophthalmology or gynaecology) are not included.
I	RETTS, ADAPT, MTS, SATS, ESI, other triage model
C	Another triage model within the same profession
O	Critical for decision making Clinical outcomes: mortality, unscheduled return within specified time frame, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy Important but not critical for decision making Length of stay at the emergency department Waiting time to physician assessment Time for triage process Patient satisfaction Staff satisfaction Concordance between triage models

PICO 4 - Comparison of triage model with a reference standard
(cross sectional studies for sensitivity/specificity)

P	Adults attending a somatic hospital emergency department (with access to hospital admittance) and triaged with RETTS, ADAPT, MTS, SATS, ESI or other triage models. Specialised departments (e.g. ophthalmology or gynaecology) are not included.
I	RETTS, ADAPT, MTS, SATS, ESI, other triage model
C	Reference standard (e.g. true events)
O	Critical for decision making Clinical outcomes: mortality, unscheduled return within specified time frame, admission (to intensive care or general ward) Correct prioritisation according to specified criteria Diagnostic accuracy

Eligibility criteria

Study design:

SRs were initially included. After identification of a Swedish SR (Asplund et al, 2010), other SRs were disregarded and only subsequent original articles were included.
RCT
Non-randomised controlled studies with at least 100 patients included
Cross sectional studies for sensitivity and specificity, at least 10 000 patients (compared with a true reference standard and not another triage model or profession)

Publication year:

The search included articles published later than 2009-01-01, which included the last search day 2009-03-31.

Language:

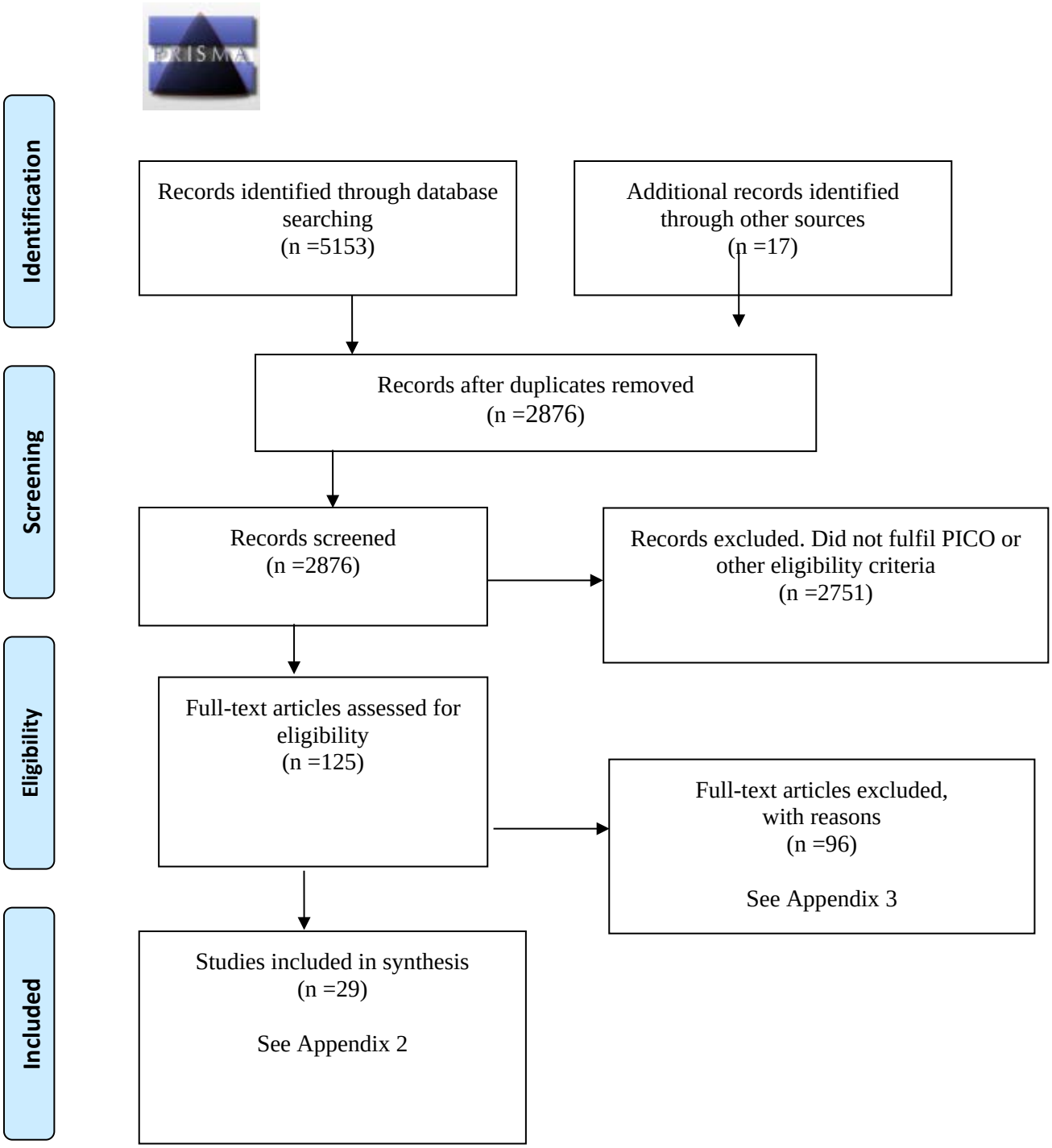
English, Swedish, Danish and Norwegian

Exclusion criteria:

Studies only including trauma patients
Studies on streaming processes subsequent to triage

Case series

Selection process – flow diagram



Search strategies

Database: PubMed
Date: 2017-01-27
No of results: 2253

Search	Query	Items found
#25	**Search #12 AND #19 Filters: Publication date from 2009/01/01; Swedish; Norwegian; English; Danish**	**2253**
#21	Search #12 AND #19 Filters: Publication date from 2009/01/01	2311
#20	Search #12 AND #19	4034
#19	Search #17 OR #18	7801447
#18	Search inter-rater[tiab] OR interrater[tiab] OR inter-observer[tiab] OR interobserver[tiab] OR validity[tiab] OR agreement[tiab] OR observational[ti] OR longitudinal[ti] OR prospective[ti] OR Control[tiab] OR controlled[tiab] OR controls[tiab] OR random*[tiab] OR compar*[tiab] OR systematic review[tiab] OR meta-analysis[tiab] OR metaanalysis[tiab] OR meta-analyses[tiab]	6766143
#17	Search "Observational Study" [Publication Type] OR "Observational Studies as Topic"[Mesh] OR "Validation Studies" [Publication Type] OR "Validation Studies as Topic"[Mesh] OR "Evaluation Studies" [Publication Type] OR "Observer Variation"[Mesh] OR "Comparative Study" [Publication Type] OR "Randomized Controlled Trials as Topic"[Mesh] OR "Meta-Analysis as Topic"[Mesh] OR "Controlled Clinical Trial" [Publication Type] OR "Meta-Analysis" [Publication Type] OR "Non-Randomized Controlled Trials as Topic"[Mesh] OR "Randomized Controlled Trial" [Publication Type] OR systematic[sb]	2732004
#12	Search #7 NOT #11	9343
#11	Search #8 OR #9 OR #10	3985688
#10	Search Editorial[ptyp] OR Letter[ptyp] OR Comment[ptyp] OR case reports[ptyp]	3149542
#9	Search child[ti] OR children[ti] OR childhood[ti] OR pediatric[ti] OR paediatric[ti] OR pediatrics[ti] OR paediatrics[ti] OR Infant[ti] OR Infants[ti] OR Toddler[ti] OR Toddlers[ti] OR Newborn[ti] OR Neonate[ti] OR Neonates[ti] OR Babies[ti]	931141
#8	Search military[ti] OR disaster[ti] OR disasters[ti] OR war[ti]	42726
#7	Search #3 AND #6	12020
#6	Search #4 OR #5	59547
#5	Search triage[tiab] OR SATS[tiab] OR ATS[tiab] OR CTAS[tiab] OR MTS[tiab] OR ESI[tiab] OR CTS[tiab] OR METTS[tiab] OR RETTS[tiab]	55388
#4	Search "Triage"[Mesh]	9210
#3	Search #1 OR #2	160670
#2	Search emergency department*[tiab] OR emergency room*[tiab] OR accident and emergency[tiab] OR trauma center*[tiab]	88938
#1	Search "Emergency Service, Hospital"[Mesh] OR "Emergency Medical Services"[Mesh]	110801

Database: Embase 1974 to 2017 January 09 (OvidSP)
Date: 2017-01-30
No of results: 1995

#	Searches	Results
1	exp *emergency health service/	45675
2	exp *emergency ward/	30427
3	(emergency department$ or emergency room$ or trauma center$ or (accident adj2 emergency)).ab,ti.	129937
4	1 or 2 or 3	165001
5	(triage or SATS or ATS or CTAS or MTS or ESI or CTS or METTS or RETTS).ab,kw,ti.	79442
6	4 and 5	10796
7	(child or children or childhood or pediatric or paediatric or pediatrics or paediatrics or Infant or Infants or Toddler or Toddlers or Newborn or Neonate or Neonates or Babies).ti.	1108547
8	(military or disaster or disasters or war).ti.	41123
9	7 or 8	1148221
10	6 not 9	9468
11	(inter-rater or interrater or inter-observer or interobserver or validity or agreement or Control or controlled or controls or random$ or compar$ or systematic review or meta-analysis or metaanalysis or meta-analyses).ab,ti.	8477478
12	(observational or longitudinal or prospective).ti.	199703
13	exp controlled clinical trial/ or exp "controlled clinical trial (topic)"/ or exp observational study/ or exp validation study/ or exp evaluation study/ or exp observer variation/ or comparative study/ or meta analysis/ or exp "systematic review"/ or exp "systematic review (topic)"/	1839371
14	11 or 12 or 13	9131690
15	10 and 14	4672
16	**limit 15 to ((danish or english or norwegian or swedish) and yr="2009 -Current" and (article or conference paper or note or "review"))**	**1995**

Database: CINAHL (EBSCOhost)
Date: 2017-01-30
No of results: 548

#	Undran	Resultat
S22	**S11 AND S19** **Avgränsare - Publiceringsdatum: 20090101-20171231**	**548**
S21	S11 AND S19	557
S20	S11 AND S19	1,020
S19	S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18	704,588
S18	(MH "Systematic Review")	27,372
S17	(MH "Meta Analysis")	18,259
S16	(MH "Comparative Studies") OR (MH "Evaluation Research+") OR (MH "Validation Studies")	120,325
S15	(MH "Observational Methods+")	15,591
S14	(MH "Clinical Trials+")	140,627
S13	TI observational OR longitudinal OR prospective	29,543
S12	TI (inter-rater OR interrater OR inter-observer OR interobserver OR validity OR agreement OR Control OR controlled OR controls OR random* OR compar* OR systematic review OR meta-analysis OR metaanalysis OR meta-analyses) OR AB (inter-rater OR interrater OR inter-observer OR interobserver OR validity OR agreement OR Control OR controlled OR controls OR random* OR compar* OR systematic review OR meta-analysis OR metaanalysis OR meta-analyses)	563,914
S11	S7 NOT S10	2,971
S10	S8 OR S9	191,921
S9	TI military OR disaster OR disasters OR war	12,723
S8	TI child OR children OR childhood OR pediatric OR paediatric OR pediatrics OR paediatrics OR Infant OR Infants OR Toddler OR Toddlers OR Newborn OR Neonate OR Neonates OR Babies	179,731
S7	S3 AND S6	3,450
S6	S4 OR S5	11,108
S5	TI (triage OR SATS OR ATS OR CTAS OR MTS OR ESI OR CTS OR METTS OR RETTS) OR AB (triage OR SATS OR ATS OR CTAS OR MTS OR ESI OR CTS OR METTS OR RETTS)	8,097
S4	(MH "Triage")	5,840
S3	S1 OR S2	49,809
S2	TI (emergency department* OR emergency room* OR trauma center* OR "accident and emergency") OR AB (emergency department* OR emergency room* OR trauma center* OR "accident and emergency")	34,194
S1	(MH "Emergency Service+")	31,052

Database: The Cochrane Library
Date: 2017-01-30
No of results: 302
Cochrane reviews 3
Other reviews 18
Technology assessments 6
Economic evaluations 7
Clinical trials 267
Method studies 1

ID	Search	Hits
#1	triage or SATS or ATS or CTAS or MTS or ESI or CTS or METTS or RETTS:ti,ab,kw (Word variations have been searched)	1954
#2	emergency or trauma:ti,ab,kw (Word variations have been searched)	19865
#3	#1 and #2	519
#4	child or children or childhood or pediatric or paediatric or pediatrics or paediatrics or Infant or Infants or Toddler or Toddlers or Newborn or Neonate or Neonates or Babies:ti (Word variations have been searched)	67577
#5	military or disaster or disasters or war:ti (Word variations have been searched)	559
#6	#4 or #5	68093
#7	**#3 not #6 Publication Year from 2009 to 2017**	**302**

Database: CRD
Date: 2017-01-30
No of results: 55

ID	Search	Hits
#1	(emergency OR trauma) AND (triage OR SATS OR ATS OR CTAS OR MTS OR ESI OR CTS OR METTS OR RETTS)	125
#2	**(emergency OR trauma) AND (triage OR SATS OR ATS OR CTAS OR MTS OR ESI OR CTS OR METTS OR RETTS) FROM 2009 TO 2017**	**55**

The web-sites of **SBU** and **Kunnskapssenteret** were visited
2017-01-30
Nothing relevant to the question at issue was found

Reference lists
A comprehensive review of reference lists brought 17 new records

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Reference lists

Included studies:

Asplund K, Castren M, Ehrenberg A, Farrokhnia N, Goransson K, Jonsson H, et al. Triage methods and patient flow processes at emergency departments. Stockholm: Swedish Council on Technology Assessment in Health Care (SBU), 2010.

Betz M, Stempien J, Wilde A, Bryce R. A comparison of a formal triage scoring system and a quick-look triage approach. Eur J Emerg Med. 2016;23(3):185-9.

Burström L, Engstrom ML, Castren M, Wiklund T, Enlund M. Improved quality and efficiency after the introduction of physician-led team triage in an emergency department. Ups J Med Sci. 2016;121(1):38-44.

Crane W, Yerman B, Schneider M. A lack of effect on patient satisfaction scores in one large urban emergency department. Int J Clin Med 2012;3:740–3.

de Souza CC, Toledo AD, Tadeu LF, Chianca TC. Risk classification in an emergency room: agreement level between a Brazilian institutional and the Manchester Protocol. Rev Lat Am Enfermagem. 2011 Jan-Feb;19(1):26-33.

Ducharme J, Alder RJ, Pelletier C, Murray D, Tepper J. The impact on patient flow after the integration of nurse practitioners and physician assistants in 6 Ontario emergency departments. Cjem. 2009;11(5):455-61.

French S, Lindo JL, Williams Jean EW, Williams-Johnson J. Doctor at triage - effect on waiting time and patient satisfaction in a Jamaican hospital. Int Emerg Nurs. 2014;22(3):123-6.

Gräff I, Goldschmidt B, Glien P, Bogdanow M, Fimmers R, Hoeft A, et al. The German Version of the Manchester Triage System and its quality criteria--first assessment of validity and reliability. PLoS One. 2014;9(2):e88995.

Hamamoto J, Yamase H, Yamase Y. Impacts of the introduction of a triage system in Japan: a time series study. Int Emerg Nurs. 2014;22(3):153-8.

Han JH, France DJ, Levin SR, Jones ID, Storrow AB, Aronsky D. The effect of physician triage on emergency department length of stay. J Emerg Med. 2010;39(2):227-33.

Imperato J, Morris DS, Binder D, Fischer C, Patrick J, Sanchez LD, et al. Physician in triage improves emergency department patient throughput. Intern Emerg Med. 2012;7(5):457-62.

Imperato J, Morris S, Sanchez D, Setnik G. Improving patient satisfaction by adding a physician in triage. J Hosp Adm 2014;3(1):7–13.

Khankeh HR, Khorasani-Zavareh D, Azizi-Naghdloo F, Hoseini MA, Rahgozar M. Triage effect on wait time of receiving treatment services and patients satisfaction in the emergency department: Example from Iran. Iran J Nurs Midwifery Res. 2013;18(1):79-83.

Lauks J, Mramor B, Baumgartl K, Maier H, Nickel CH, Bingisser R. Medical Team Evaluation: Effect on Emergency Department Waiting Time and Length of Stay. PLoS One. 2016;11(4):e0154372.

Maleki M, Fallah R, Riahi L, Delavari S, Rezaei S. Effectiveness of Five-Level Emergency Severity Index Triage System Compared With Three-Level Spot Check: An Iranian Experience. Arch Trauma Res. 2015;4(4):e29214.

Mullan PC, Torrey SB, Chandra A, Caruso N, Kestler A. Reduced overtriage and undertriage with a new triage system in an urban accident and emergency department in Botswana: a cohort study. Emerg Med J. 2014;31(5):356-60.

Murrell KL, Offerman SR, Kauffman MB. Applying lean: implementation of a rapid triage and treatment system. West J Emerg Med. 2011;12(2):184-91.

Neeki MM, Dong F, Avera L, Than T, Borger R, Powell J, et al. Alternative Destination Transport? The Role of Paramedics in Optimal Use of the Emergency Department. West J Emerg Med. 2016;17(6):690-7.

Ng CJ, Hsu KH, Kuan JT, Chiu TF, Chen WK, Lin HJ, et al. Comparison between Canadian Triage and Acuity Scale and Taiwan Triage System in emergency departments. J Formos Med Assoc. 2010;109(11):828-37.

Ng CJ, Yen ZS, Tsai JC, Chen LC, Lin SJ, Sang YY, et al. Validation of the Taiwan triage and acuity scale: a new computerised five-level triage system. Emerg Med J. 2011;28(12):1026-31.

Rosedale K, Smith ZA, Davies H, Wood D. The effectiveness of the South African Triage Score (SATS) in a rural emergency department. S Afr Med J. 2011;101(8):537-40.

Ruben F, Widgren BR. Shorter waiting time in emergency departments with physicians in the triage team. Comparison of standard and emergency physician triage. Lakartidningen. 2011;108(7):340-2.

Santos AP, Freitas P, Martins HM. Manchester Triage System version II and resource utilisation in the emergency department. Emerg Med J. 2014;31(2):148-52.

Soremekun OA, Capp R, Biddinger PD, White BA, Chang Y, Carignan SB, et al. Impact of physician screening in the emergency department on patient flow. J Emerg Med. 2012;43(3):509-15.

Storm-Versloot MN, Vermeulen H, van Lammeren N, Luitse JS, Goslings JC. Influence of the Manchester triage system on waiting time, treatment time, length of stay and patient satisfaction; a before and after study. Emerg Med J. 2014;31(1):13-8.

Svirsky I, Stoneking LR, Grall K, Berkman M, Stolz U, Shirazi F. Resident-initiated advanced triage effect on emergency department patient flow. J Emerg Med. 2013;45(5):746-51.

Traub SJ, Bartley AC, Smith VD, Didehban R, Lipinski CA, Saghafian S. Physician in Triage Versus Rotational Patient Assignment. J Emerg Med. 2016;50(5):784-90.

Traub SJ, Wood JP, Kelley J, Nestler DM, Chang YH, Saghafian S, et al. Emergency department rapid medical assessment: overall effect and mechanistic considerations. J Emerg Med. 2015;48(5):620-7.

van der Wulp I, Schrijvers AJ, van Stel HF. Predicting admission and mortality with the Emergency Severity Index and the Manchester Triage System: a retrospective observational study. Emerg Med J. 2009;26(7):506-9.

Studies from SR Asplund et al, 2010, presented in Appendix 4:

Considine J, Martin R, Smit D, Winter C, Jenkins J. Emergency nurse practitioner care and emergency department patient flow: case-control study. Emerg Med Australas. 2006 Aug;18(4):385-90

Grant S, Spain D, Green D. Rapid assessment team reduces waiting time. Emerg Med. 1999 Jun; 11(2):72-7.

Holroyd BR, Bullard MJ, Latoszek K, Gordon D, Allen S, Tam S, et al. Impact of a triage liaison physician on emergency department overcrowding and throughput: a randomized controlled trial. Acad Emerg Med. 2007 Aug;14(8):702-8.

Partovi SN, Nelson BK, Bryan ED, Walsh MJ. Faculty triage shortens emergency department length of stay. Acad Emerg Med. 2001 Oct;8(10):990-5.

Richardson JR, Braitberg G, Yeoh MJ. Multidisciplinary assessment at triage: a new way forward. Emerg Med Australas. 2004 Feb;16(1):41-6.

Sakr M, Kendall R, Angus J, Sanders A, Nicholl J, Wardrope J. Emergency nurse practitioners: a three part study in clinical and cost effectiveness. Emerg Med
J. 2003 Mar;20(2):158-63.

Subash F, Dunn F, McNicholl B, Marlow J. Team triage improves emergency department efficiency. Emerg Med J. 2004 Sep;21(5):542-4.

Travers JP, Lee FC. Avoiding prolonged waiting time during busy periods in the emergency department: Is there a role for the senior emergency physician in triage? Eur J Emerg Med. 2006 Dec;13(6):342-8.

Excluded studies:

Abdulwahid MA, Booth A, Kuczawski M, Mason SM. The impact of senior doctor assessment at triage on emergency department performance measures: systematic review and meta-analysis of comparative studies. Emerg Med J. 2016;33(7):504-13.

Alpert EA, Lipsky AM, Hertz D, Rieck J, Or J. Simulated evaluation of two triage scales in an emergency department in Israel. Eur J Emerg Med. 2013;20(6):431-4.

Alquraini M, Awad E, Hijazi R. Reliability of Canadian Emergency Department Triage and Acuity Scale (CTAS) in Saudi Arabia. Int J Emerg Med. 2015;8(1):80.

Anderson CK, Zaric GS, Dreyer JF, Carter MW, McLeod SL. Physician workload and the Canadian Emergency Department Triage and Acuity Scale: the Predictors of Workload in the Emergency Room (POWER) Study. Cjem. 2009;11(4):321-9.

Arya R, Wei G, McCoy JV, Crane J, Ohman-Strickland P, Eisenstein RM. Decreasing length of stay in the emergency department with a split emergency severity index 3 patient flow model. Acad Emerg Med. 2013;20(11):1171-9.

Ashour OM, Okudan Kremer GE. Dynamic patient grouping and prioritization: a new approach to emergency department flow improvement. Health Care Manag Sci. 2016;19(2):192-205.

Asha SE, Ajami A. Improvement in emergency department length of stay using an early senior medical assessment and streaming model of care: A cohort study. Emerg Med Australas. 2013;25(5):445-51.

Azeredo TR, Guedes HM, Rebelo de Almeida RA, Chianca TC, Martins JC. Efficacy of the Manchester Triage System: a systematic review. Int Emerg Nurs. 2015;23(2):47-52.

Bambi S, Ruggeri M, Sansolino S, Gabellieri M, Tellini S, Giusti M, et al. Emergency department triage performance timing. A regional multicenter descriptive study in Italy. Int Emerg Nurs. 2016;29:32-7.

Barfod C, Lauritzen MM, Danker JK, Soletormos G, Berlac PA, Lippert F, et al. The formation and design of the 'Acute Admission Database'- a database including a prospective, observational cohort of 6279 patients triaged in the emergency department in a larger Danish hospital. Scand J Trauma Resusc Emerg Med. 2012;20:29.

Barfod C, Lauritzen MM, Danker JK, Soletormos G, Forberg JL, Berlac PA, et al. Abnormal vital signs are strong predictors for intensive care unit admission and in-hospital mortality in adults triaged in the emergency department - a prospective cohort study. Scand J Trauma Resusc Emerg Med. 2012;20:28.

Boeke AJ, van Randwijck-Jacobze ME, de Lange-Klerk EM, Grol SM, Kramer MH, van der Horst HE. Effectiveness of GPs in accident and emergency departments. Br J Gen Pract. 2010;60(579):e378-84.

Bullard MJ, Chan T, Brayman C, Warren D, Musgrave E, Unger B. Revisions to the Canadian Emergency Department Triage and Acuity Scale (CTAS) Guidelines. Cjem. 2014;16(6):485-9.

Burström L, Nordberg M, Ornung G, Castren M, Wiklund T, Engstrom ML, et al. Physician-led team triage based on lean principles may be superior for efficiency and quality? A comparison of three emergency departments with different triage models. Scand J Trauma Resusc Emerg Med. 2012;20:57.

Cameron A, Ireland AJ, McKay GA, Stark A, Lowe DJ. Predicting admission at triage: are nurses better than a simple objective score? Emerg Med J. 2017;34(1):2-7.

Camilloni L, Giorgi Rossi P, Farchi S, Chini F, Borgia P, Guasticchi G. Triage and Injury Severity Scores as predictors of mortality and hospital admission for injuries: a validation study. Accid Anal Prev. 2010;42(6):1958-65.

Cheng I, Castren M, Kiss A, Zwarenstein M, Brommels M, Mittmann N. Cost-effectiveness of a physician-nurse supplementary triage assessment team at an academic tertiary care emergency department. Cjem. 2016;18(3):191-204.

Cheng I, Lee J, Mittmann N, Tyberg J, Ramagnano S, Kiss A, et al. Implementing wait-time reductions under Ontario government benchmarks (Pay-for-Results): a Cluster Randomized Trial of the Effect of a Physician-Nurse Supplementary Triage Assistance team (MDRNSTAT) on emergency department patient wait times. BMC Emerg Med. 2013 Nov 11;13:17.

Christensen M, Rosenberg M, Mahon E, Pineda S, Rojas E, Soque V, et al. Pivot Nursing: An Alternative to Traditional ED Triage. J Emerg Nurs. 2016;42(5):395-9.

Clifford-Brown J, Challen K, Ryan B. What happens at triage: a naturalistic observational study. Emerg Med J. 2010;27(12):931-3.

Davis RA, Dinh MM, Bein KJ, Veillard AS, Green TC. Senior work-up assessment and treatment team in an emergency department: a randomised control trial. Emerg Med Australas. 2014;26(4):343-9.

Day TE, Al-Roubaie AR, Goldlust EJ. Decreased length of stay after addition of healthcare provider in emergency department triage: a comparison between computer-simulated and real-world interventions. Emerg Med J. 2013;30(2):134-8.

Dinh MM, Oliver M, Bein KJ, Roncal S, Byrne CM. Performance of the New South Wales Ambulance Service major trauma transport protocol (T1) at an inner city trauma centre. Emerg Med Australas. 2012;24(4):401-7.

Dugas AF, Kirsch TD, Toerper M, Korley F, Yenokyan G, France D, et al. An Electronic Emergency Triage System to Improve Patient Distribution by Critical Outcomes. J Emerg Med. 2016;50(6):910-8.

Durand AC, Gentile S, Gerbeaux P, Alazia M, Kiegel P, Luigi S, et al. Be careful with triage in emergency departments: interobserver agreement on 1,578 patients in France. BMC Emerg Med. 2011 Oct 31;11:19.

Ebrahimi M, Heydari A, Mazlom R, Mirhaghi A. The reliability of the Australasian Triage Scale: a meta-analysis. World J Emerg Med. 2015;6(2):94-9.

Elder E, Johnston AN, Crilly J. Review article: systematic review of three key strategies designed to improve patient flow through the emergency department. Emerg Med Australas. 2015;27(5):394-404.

Elder E, Johnston AN, Crilly J. Improving emergency department throughput: An outcomes evaluation of two additional models of care. Int Emerg Nurs. 2016 Mar;25:19-26.

Elias P, Damle A, Casale M, Branson K, Churi C, Komatireddy R, et al. A Web-Based Tool for Patient Triage in Emergency Department Settings: Validation Using the Emergency Severity Index. JMIR Med Inform. 2015;3(2):e23.

Elkum NB, Barrett C, Al-Omran H. Canadian Emergency Department Triage and Acuity Scale: implementation in a tertiary care center in Saudi Arabia. BMC Emerg Med. 2011 Feb 10;11:3.

Esmailian M, Zamani M, Azadi F, Ghasemi F. Inter-Rater Agreement of Emergency Nurses and Physicians in Emergency Severity Index (ESI) Triage. Emerg (Tehran). 2014;2(4):158-61.

Fan MM, Leung LP. Validation of the Hong Kong accident and emergency triage guidelines. Hong Kong Med J. 2013;19(3):198-202.

Farrohknia N, Castrén M, Ehrenberg A, Lind L, Oredsson S, Jonsson H, Asplund K, Göransson KE. Emergency department triage scales and their components: a systematic review of the scientific evidence. Scand J Trauma Resusc Emerg Med. 2011 Jun 30;19:42.

Funakoshi H, Shiga T, Homma Y, Nakashima Y, Takahashi J, Kamura H, et al. Validation of the modified Japanese Triage and Acuity Scale-based triage system emphasizing the physiologic variables or mechanism of injuries. Int J Emerg Med. 2016 Dec;9(1):1.

Ganley L, Gloster AS. An overview of triage in the emergency department. Nursing standard (Royal College of Nursing (Great Britain) : 1987). 2011;26(12):49-56.

Gardner A, Forson PK, Oduro G, Stewart B, Dike N, Glover P, et al. Diagnostic accuracy of the Kampala Trauma Score using estimated Abbreviated Injury Scale scores and physician opinion. Injury. 2017;48(1):177-83.

Goransson KE, von Rosen A. Interrater agreement: a comparison between two emergency department triage scales. Eur J Emerg Med. 2011;18(2):68-72.

Granström A, Strömmer L, Schandl A, Östlund A. A criteria-directed protocol for in-hospital triage of trauma patients. Eur J Emerg Med. 2016 May 10. doi: 10.1097/MEJ.0000000000000397

Grouse AI, Bishop RO, Bannon AM. The Manchester Triage System provides good reliability in an Australian emergency department. Emerg Med J. 2009;26(7):484-6.

Gunaydin YK, Caglar A, Kokulu K, Yildiz CG, Dundar ZD, Akilli NB, et al. Triage using the Emergency Severity Index (ESI) and seven versus three vital signs. Notf Rett Med. 2016;19(3):209-16.

Haac B, Varela C, Geyer A, Cairns B, Charles A. The utility of the Kampala trauma score as a triage tool in a sub-Saharan African trauma cohort. World J Surg. 2015;39(2):356-62.

Hamada SR, Gauss T, Duchateau FX, Truchot J, Harrois A, Raux M, et al. Evaluation of the performance of French physician-staffed emergency medical service in the triage of major trauma patients. J Trauma Acute Care Surg. 2014;76(6):1476-83.

Harding KE, Taylor NF, Leggat SG. Do triage systems in healthcare improve patient flow? A systematic review of the literature. Aust Health Rev. 2011;35(3):371-83.

Haruno L, Geling O, Kakuda J. Re-engineering an American emergency department with Team Triage-adapting to increasing patient volume in emergency services. BMC Proc. 2012; 6(Suppl 4): P52.

Hong R, Sexton R, Sweet B, Carroll G, Tambussi C, Baumann BM. Comparison of START triage categories to emergency department triage levels to determine need for urgent care and to predict hospitalization. Am J Disaster Med. 2015;10(1):13-21.

Hunt DL, Berg GM, Zackula RE, Ekengren FH, Lippoldt D, Ablah E, et al. Treatment provider is most predictive of ED dismissal in minimally-injured trauma patients: a retrospective review. J Trauma Manag Outcomes. 2013;7(1):5.

Khan A, Mahadevan SV, Dreyfuss A, Quinn J, Woods J, Somontha K, et al. One-two-triage: Validation and reliability of a novel triage system for low-resource settings. Emergency Medicine Journal. 2016;33(10):709-15.

Kim SW, Li JY, Hakendorf P, Teubner DJ, Ben-Tovim DI, Thompson CH. Predicting admission of patients by their presentation to the emergency department. Emerg Med Australas. 2014;26(4):361-7.

Kondo Y, Abe T, Kohshi K, Tokuda Y, Cook EF, Kukita I. Revised trauma scoring system to predict in-hospital mortality in the emergency department: Glasgow Coma Scale, Age, and Systolic Blood Pressure score. Crit Care. 2011;15(4):R191.

Kong G, Yin X, Wang T, Body R, Chen YW, Wang J, et al. Current state of trauma care in China, tools to predict death and ICU admission after arrival to hospital. Injury. 2015;46(9):1784-9.

Lee JY, Oh SH, Peck EH, Lee JM, Park KN, Kim SH, et al. The validity of the Canadian Triage and Acuity Scale in predicting resource utilization and the need for immediate life-saving interventions in elderly emergency department patients. Scand J Trauma Resusc Emerg Med. 2011 Nov 3;19:68.

Leeies M, Ffrench C, Strome T, Weldon E, Bullard M, Grierson R. Prehospital Application of the Canadian Triage and Acuity Scale by Emergency Medical Services. CJEM. Epub 2016 Aug 10.

Lidal IB, Holte HH, Gundersen MW. [Triage systems for emergency medical services – pre-hospital and at hospital admission]. Oslo: Norwegian Knowledge Centre for the Health Services (NOKC), 2011.

Lidal IB, Holte HH, Vist GE. Triage systems for pre-hospital emergency medical services - a systematic review. Scand J Trauma Resusc Emerg Med. 2013 Apr 15;21:28.

Lin D, Worster A. Predictors of admission to hospital of patients triaged as nonurgent using the Canadian Triage and Acuity Scale. Cjem. 2013;15(6):353-8.

Lindberg SO, Lerche la Cour J, Folkestad L, Hallas P, Brabrand M. The use of triage in Danish emergency departments. Dan Med Bull. 2011;58(10):A4301.

Martins HM, Cuna LM, Freitas P. Is Manchester (MTS) more than a triage system? A study of its association with mortality and admission to a large Portuguese hospital. Emerg Med J. 2009;26(3):183-6.

Ming T, Lai A, Lau PM. Can Team Triage Improve Patient Flow in the Emergency Department? A Systematic Review and Meta-Analysis. Adv Emerg Nurs J. 2016;38(3):233-50.

Mirhaghi A, Kooshiar H, Esmaeili H, Ebrahimi M. Outcomes for emergency severity index triage implementation in the emergency department. J Clin Diagn Res. 2015;9(4):Oc04-7.

Mirhaghi A, Heydari A, Mazlom R, Ebrahimi M. The Reliability of the Canadian Triage and Acuity Scale: Meta-analysis. N Am J Med Sci. 2015;7(7):299-305.

Mirhaghi A, Mazlom R, Heydari A, Ebrahimi M. The Reliability of the Manchester Triage System (MTS): A Meta-analysis. J Evid Based Med. 2016. [Epub ahead of print]

Nissen L, Kirkegaard H, Perez N, Horlyk U, Larsen LP. Inter-rater agreement of the triage system RETTS-HEV. Eur J Emerg Med. 2014;21(1):37-41.

Nordberg M, Lethvall S, Castrén M. The validity of the triage system ADAPT. Scand J Trauma Resusc Emerg Med. 2010;18(S1):P36.

Olofsson P, Gellerstedt M, Carlstrom ED. Manchester Triage in Sweden - interrater reliability and accuracy. Int Emerg Nurs. 2009;17(3):143-8.

Oredsson S, Jonsson H, Rognes J, Lind L, Göransson KE, Ehrenberg A, et al. A systematic review of triage-related interventions to improve patient flow in emergency departments. Scand J Trauma Resusc Emerg Med. 2011 Jul 19;19:43.

Ozucelik DN, Kunt MM, Karaca MA, Erbil B, Sivri B, Sahin A, et al. A model of complaint based for overcrowding emergency department: Five-Level Hacettepe Emergency Triage System. Ulus Travma Acil Cerrahi Derg. 2013;19(3):205-14.

Parenti N, Ferrara L, Bacchi Reggiani ML, Sangiorgi D, Lenzi T. Reliability and validity of two four-level emergency triage systems. Eur J Emerg Med. 2009;16(3):115-20.

Parenti N, Reggiani ML, Iannone P, Percudani D, Dowding D. A systematic review on the validity and reliability of an emergency department triage scale, the Manchester Triage System. Int J Nurs Stud. 2014;51(7):1062-9.

Perez N, Nissen L, Nielsen RF, Petersen P, Biering K. The predictive validity of RETTS-HEV as an acuity triage tool in the emergency department of a Danish Regional Hospital. Eur J Emerg Med. 2016;23(1):33-7.

Pourasghar F, Daemi A, Tabrizi JS, Ala A. Inter-rater Reliability of Triages Performed by the Electronic Triage System. Bull Emerg Trauma. 2015;3(4):134-7.

Preyde M, Crawford K, Mullins L. Patients' satisfaction and wait times at Guelph General Hospital Emergency Department before and after implementation of a process improvement project. Cjem. 2012;14(3):157-68.

Quitt J, Ryser D, Dieterle T, Luscher U, Martina B, Tschudi P. Does nonmedical hospital admission staff accurately triage emergency department patients? Eur J Emerg Med. 2009;16(4):172-6.

Ro YS, Shin SD, Song KJ, Cha WC, Cho JS. Triage-based resource allocation and clinical treatment protocol on outcome and length of stay in the emergency department. Emerg Med Australas. 2015;27(4):328-35.

Rogg JG, White BA, Biddinger PD, Chang Y, Brown DF. A long-term analysis of physician triage screening in the emergency department. Acad Emerg Med. 2013;20(4):374-80.

Rominski S, Bell SA, Oduro G, Ampong P, Oteng R, Donkor P. The implementation of the South African Triage Score (SATS) in an urban teaching hospital, Ghana. Afr J Emerg Med. 2014 Jun;4(2):71-75.

Rutschmann OT, Hugli OW, Marti C, Grosgurin O, Geissbuhler A, Kossovsky M et al. Reliability of the revised Swiss Emergency Triage Scale: a computer simulation study. Eur J Emerg Med. 2017 Feb 14.[Epub ahead of print].

Scott I, Vaughan L, Bell D. Effectiveness of acute medical units in hospitals: a systematic review. Int J Qual Health Care. 2009 Dec;21(6):397-407.

Seiger N, van Veen M, Steyerberg EW, Ruige M, van Meurs AH, Moll HA. Undertriage in the Manchester triage system: an assessment of severity and options for improvement. Arch Dis Child. 2011;96(7):653-7.

Shawhan RR, McVay DP, Casey L, Spears T, Steele SR, Martin MJ. A simplified trauma triage system safely reduces overtriage and improves provider satisfaction: a prospective study. Am J Surg. 2015;209(5):856-62; discussion 62-3.

Silcock DJ, Corfield AR, Gowens PA, Rooney KD. Validation of the National Early Warning Score in the prehospital setting. Resuscitation. 2015 Apr;89:31-5.

Smith DT, Snyder A, Hollen PJ, Anderson JG, Caterino JM. Analyzing the Usability of the 5-Level Canadian Triage and Acuity Scale By Paramedics in the Prehospital Environment. J Emerg Nurs. 2015;41(6):489-95.

Steiner D, Renetseder F, Kutz A, Haubitz S, Faessler L, Anderson JB, et al. Performance of the Manchester Triage System in Adult Medical Emergency Patients: A Prospective Cohort Study. J Emerg Med. 2016;50(4):678-89.

Storm-Versloot MN, Ubbink DT, Chin a Choi V, Luitse JS. Observer agreement of the Manchester Triage System and the Emergency Severity Index: a simulation study. Emerg Med J. 2009;26(8):556-60.

Storm-Versloot MN, Ubbink DT, Kappelhof J, Luitse JS. Comparison of an informally structured triage system, the emergency severity index, and the manchester triage system to distinguish patient priority in the emergency department. Acad Emerg Med. 2011;18(8):822-9.

Subbe CP, Kellett J, Whitaker CJ, Jishi F, White A, Price S, et al. A pragmatic triage system to reduce length of stay in medical emergency admission: feasibility study and health economic analysis. Eur J Intern Med. 2014;25(9):815-20.

Taboulet P, Moreira V, Haas L, Porcher R, Braganca A, Fontaine JP, et al. Triage with the French Emergency Nurses Classification in Hospital scale: reliability and validity. Eur J Emerg Med. 2009;16(2):61-7.

Torabi M, Mirafzal A, Rastegari A, Sadeghkhani N. Association of triage time Shock Index, Modified Shock Index, and Age Shock Index with mortality in Emergency Severity Index level 2 patients. Am J Emerg Med. 2016;34(1):63-8.

Tshitenge ST, Ogunbanjo GA, Mbuka DO. The effectiveness of the South African Triage Toll use in Mahalapye District Hospital - Emergency Department, Botswana. Afr J Prim Health Care Fam Med. 2016;8(1):e1-5.

Twomey M, Mullan PC, Torrey SB, wallis L, Kestler A. The Princess Marina Hospital accident and emergency triage scale provides highly reliable triage acuity ratings. Emerg Med J. 2012;29(8):650-3.

Twomey M, Wallis LA, Thompson ML, Myers JE. The South African Triage Scale (adult version) provides reliable acuity ratings. Int Emerg Nurs. 2012;20(3):142-50.

Vegting IL, Alam N, Ghanes K, Jouini O, Mulder F, Vreeburg M, et al. What are we waiting for? Factors influencing completion times in an academic and peripheral emergency department. Neth J Med. 2015;73(7):331-40.

White BA, Brown DF, Sinclair J, Chang Y, Carignan S, McIntyre J, et al. Supplemented Triage and Rapid Treatment (START) improves performance measures in the emergency department. J Emerg Med. 2012;42(3):322-8.

Widgren BR, Jourak M. Medical Emergency Triage and Treatment System (METTS): a new protocol in primary triage and secondary priority decision in emergency medicine. J Emerg Med. 2011;40(6):623-8.

Yuen MS, Mann SK, Chow DH. A simplified emergency trauma score for predicting mortality in emergency setting. Nurs Crit Care. 2016 Jul;21(4):9-15.

Yuksen C, Sawatmongkornkul S, Suttabuth S, Sawanyawisuth K, Sittichanbuncha Y. Emergency severity index compared with 4-level triage at the emergency department of Ramathibodi University Hospital. Asian Biomed. 2016;10(2):155-61.

Ziegler B, Almroth H, Bergman J, Jansson E, Rylander L, Wickbom A. Early team assessment relieves the emergency department. Lakartidningen. 2014;111(9-10):392-4.

Other references:

Abdulwahid MA, Booth A, Kuczawski M, Mason SM. The impact of senior doctor assessment at triage on emergency department performance measures: systematic review and meta-analysis of comparative studies. Emerg Med J. 2016;33(7):504-13.

Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, et al. GRADE Working Group. Grading quality of evidence and strength of recommendations. BMJ. 2004 Jun 19;328(7454):1490-4.

[Checklist from SBU regarding cohort studies. (Modified) Version 2010:1]. [Internet]. [cited 2017 Mar 28] Available from: https://www2.sahlgrenska.se/upload/SU/HTA-centrum/Hj%c3%a4lpmedel%20under%20projektet/B03_Granskningsmall%20f%c3%b6r%20kohortstudier%20med%20kontrollgrupp%202014-10-29.doc

[Checklists from SBU regarding randomized controlled trials. (Modified) [Internet]. [cited 2017 Mar 28] Available from: https://www2.sahlgrenska.se/upload/SU/HTA-centrum/Hj%c3%a4lpmedel%20under%20projektet/B02_Granskningsmall%20f%c3%b6r%20%20randomiserad%20kontrollerad%20pr%c3%b6vning%20RCT%202014-10-29.doc

Elder E, Johnston AN, Crilly J. Review article: systematic review of three key strategies designed to improve patient flow through the emergency department. Emerg Med Australas. 2015;27(5):394-404.

GRADE Working Group. [Internet]. [Place unknown]: GRADE Working Group, c200-2017 [cited 2017 Feb 13]. Available from: http://www.gradeworkinggroup.org

Holroyd BR, Bullard MJ, Latoszek K, Gordon D, Allen S, Tam S, et al. Impact of a triage liaison physician on emergency department overcrowding and throughput: a randomized controlled trial. Acad Emerg Med. 2007 Aug;14(8):702-8.

Hoot NR, Aronsky D. Systematic review of emergency department crowding: causes, effects, and solutions. Ann Emerg Med. 2008 Aug;52(2):126-36.

Mohan D, Barnato AE, Rosengart MR, Angus DC, Smith KJ. Optimal approach to improving trauma triage decisions: a cost-effectiveness analysis. Am J Manag Care. 2012;18(3):e91-e100.

Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009 Jul 21;6(7):e1000097.

Quitt J, Ryser D, Dieterle T, Luscher U, Martina B, Tschudi P. Does nonmedical hospital admission staff accurately triage emergency department patients? Eur J Emerg Med. 2009;16(4):172-6.

Subbe CP, Kellett J, Whitaker CJ, Jishi F, White A, Price S, et al. A pragmatic triage system to reduce length of stay in medical emergency admission: feasibility study and health economic analysis. Eur J Intern Med. 2014;25(9):815-20.

Project: Triage for Prioritisation in the Emergency Department
Appendix 2 – Characteristics of included studies

Author Year Country	Study Design	Setting	Study Duration	Study Groups; Intervention vs control (Triage model and professions)	Patients (n)	Age (years) Mean (SD) / Median (IQR)	Outcome variables
PICO 1 - Triage vs no triage							
Hamamoto 2014 Japan	Retro-spective cohort	Seven EDs; six hospitals for tertiary cases and one for secondary care cases.	I: March 2011 to February 2011. C: November 2010 to February 2011.	I: Nurse triage with JTAS. Triage nurses. C: Nurse triage without JTAS. Triage nurse	I: n=1025 C: n=1057	I: 39.5 (27.1) C: 39.5 (26.9)	Over triage Under triage Waiting time Time for triage process
Khankeh 2013 Iran	Retro-spective cohort	Shahid Rajaee Hospital, Karaj, Iran	2009	I: Nurse triage C: No triage	I: n=300 C: n=300	Not specified	Waiting time
Murell 2011 USA	Retro-spective cohort	Community hospital ED, Sacramento	I: March 2007 – August 2007 C: August 2006 – January 2007	I: Triage with RRT. C: Standard triage without RTT. ED technician, triage nurse and physician.	I: n=33926 C: n=30981	Not specified	Length of stay Waiting time
Storm-Versloot 2014 Holland	Pro-spective cohort	University teaching hospital level 1 trauma centre, Netherlands	2005 (10 days), 2008 (April)	I: Triage with MTS. ED nurse. C: Triage without MTS (an informally structured triage system was used), by experienced receptionist or ED nurse.	I: n=897 (310+587) C: n=906	I: 36 (19-54) C: 36 (21-54)	Length of stay Waiting time Patient satisfaction
Traub 2015 USA	Retro-spective cohort	Suburban tertiary teaching hospital, Phoenix	November 2010 – April 2011	I: RMA-team. Nurse and a physician. C: Without RMA-team.	I: n=1441 C: n=1478	I: 62.8 (20.9) C: 62.9 (21.0)	Length of stay

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Appendix 2 – Characteristics of included studies

Author Year Country	Study Design	Setting	Study Duration	Study Groups; Intervention vs control (Triage model and professions)	Patients (n)	Age (years) Mean (SD) / Median (IQR)	Outcome variables
PICO 2 - Comparison between professions within triage model							
Burström 2016 Sweden	Retro-spective cohort	County hospital, Sweden	During 2 years; 2008 (baseline) and 2012 (follow up)	I: Physician-led team triage. (Senior physician and a registered nurse first met the patient.) Followed by team; junior physician, registered nurse and assistant nurse. C: Nurse triage (junior physician in step two).	I: n=23765 C: n=20076	I: 23.3% 45-64 years C: 24.2% 45-64 years	Mortality Unscheduled return visit Length of stay Waiting time
Crane 2012 USA	Retro-spective cohort	Urban tertiary, academic, hospital	2006-03-27 to 2006-10-01	I: Physician in ambulatory triage area. C: Triage without physician. Nurse triage.	I: n=336 C: n=295 (calculated)	Not specified	Waiting time Patient satisfaction
Ducharme 2009 Canada	Retro-spective cohort	Six medium-sized community hospitals	I: June 11 2007 to June 29 2007 C: November 13 2006 to December 3 2006	I1:NP, directly involved in the care of patient or indirectly by being on duty. CTAS. I2: PA, directly involved in the care of patient or indirectly by being on duty. CTAS. C: Standard care, CTAS.	I1+I2: n=10007 C: n=9585	Not specified	Length of stay Waiting time
French 2014 Jamaica	Cross-sectional	University hospital, Kingston	Two weeks during 2006	I: Physician led team triage. Doctor and two nurses. Four-level triage system. C: Nurse led team triage. Nurses only. Four-level triage system.	I: n=146 C: n=111	Not specified	Length of stay Patient satisfaction
Han 2010 USA	Retro-spective cohort	Urban, academic tertiary trauma centre	May 11, 2005 to July 10, 2005 July 11, 2005 to September 9, 2005	I: An additional physician in triage. C: Standard care, no additional physician in triage.	I: n=8696 C: n=8569	I: 38 (26-51) C: 38 (27-52)	Length of stay

Project: Triage for Prioritisation in the Emergency Department
Appendix 2 – Characteristics of included studies

Author Year Country	Study Design	Setting	Study Duration	Study Groups; Intervention vs control (Triage model and professions)	Patients (n)	Age (years) Mean (SD) / Median (IQR)	Outcome variables
Imperato 2014 USA	Retro-spective cohort	Emergency department, community teaching hospital	I: April to September 2008 C: April to September 2008	I: PIT C: Triage without PIT.	I: n=508 C: n=458		Patient satisfaction
Imperato 2012 USA	Retro-spective cohort	ED, community teaching hospital	I: April to September 2008 C: April to September 2008	I: PIT C: Triage without PIT.	I: n=9011 C: n=8620	Not specified	Length of stay Waiting time
Lauks 2016 Switzerland	Retro-spective cohort	Urban academic tertiary care centre, Basel	10 months during 2014	I: MTE. Triage nurse and a senior emergency physician. C: Without MTE. Triage nurse, ESI level, followed by physician.	I: n=13120 C: n=13120	I: 51 (33–71) C: 52 (34–71)	Length of stay Waiting time
Neeki 2016 USA	Cross-sectional	Large Level II trauma centre, Colton	April 2015 to November 2015	I: Paramedics assessing patient´s acuity level to determine the need to transport to an ED. C: Standard care (ED physician).	n=505	Not specified	Concordance between professions
Ruben 2011 Sweden	Retro-spective cohort	Sahlgrenska university Hospital, Gothenburg	September 2009 October 2009	I: METTS, with senior doctor in triage. C: METTS, team without doctor.	I: n=455 C: n=450	I: 59 (21) C: 59 (21)	Length of stay Waiting time
Soremekun 2012 USA	Retro-spective cohort	Urban tertiary academic centre	I: December 2007-2008 C: December 2006-2007	I: Physician in triage system. C: Without physician in triage system.	I: n=10812 C: n=9056		Waiting time
Svirsky 2013 USA	Pro-spective cohort	Community-based academic level III trauma hospital	16 days during November 2011 to February 2012.	I: Emergency medicine resident physician initiated triage. C: Without emergency medicine resident.	I: n=1346 C: n=1346	I: 44.9 (19.7) C: Not specified	Length of stay
Traub 2016 USA	Retro-spective cohort	Suburban tertiary care teaching hospital, Phoenix	2012 and 2013	I: Physician in triage. C: Rotational patient assignment.	I: n=1869 C: n=1906	I: 60.7 (20.8) C: 60.9 (20.6)	Unscheduled return visit Length of stay

Project: Triage for Prioritisation in the Emergency Department
Appendix 2 – Characteristics of included studies

Author Year Country	Study Design	Setting	Study Duration	Study Groups; Intervention vs control (Triage model and professions)	Patients (n)	Age (years) Mean (SD) / Median (IQR)	Outcome variables
PICO 3 - Comparison of triage model within same profession							
Betz 2016 Canada	Cross-sectional	Urban tertiary-care hospital	Not specified	I: Triage score utilizing a simple quick-lock method (observation + chief complaint), called RTS. Triage nurse. C: CTAS	n=496	Not specified	Concordance between triage models
de Souza 2011 Brazil	Cross-sectional	Public hospital	September 22 2005 to September 22 2007	I: Manchester protocol. C: Standard protocol.	n=382 (randomization of files)	39.3 (17.4)	Concordance between triage models
Maleki 2015 Iran	Retro-spective cohort	Imam Khomeini hospital	20 March to 19 July 2010 21March to 20 July 2011	I: ESI 5-level triage. C: 3-level spot check triage.	n=770 (Records of patients)	I: 35.74 (19.58) C: 35.70 (20.67) p=0.988	Waiting time
Mullan 2014 Botswana	Retro-spective cohort	Princess Marina, tertiary referral Hospital (PMH)	I: 5 April 2010 to 1 May 2001 C: 1 October 2009 to 24 March 2010	I: PATS C: Pre-PATS/standard care.	I: n=25243 C: n=14706	I: 73% 13-64 years C: 75% 13-64 years p<0.05	Mortality Admission to ICU Admission Over triage Under triage
Ng 2010 Taiwan	Cross-sectional	Three different hospitals in Taiwan	Not specified	I: 5-level CTAS. C: 4-level TTS.	n=2091	47.0 (20.1)	Length of stay
Rosedale 2011 South Africa	Cross-sectional	Government hospital, referral centre, KwaZulu	One month period in June 2009	I: MEWS C: SATS	n=640	38.2 (17.3)	Over triage Under triage
van der Wulp 2009 Holland	Retro-spective cohort	Four hospitals in Holland	1 January to 18 July 2006	I: ESI C: MTS	I: n=38330 C: n=46537	I: 38.7 23.6) C: 42.4 (23.5)	Mortality Admission

Project: Triage for Prioritisation in the Emergency Department
Appendix 2 – Characteristics of included studies

Author Year Country	Study Design	Setting	Study Duration	Study Groups; Intervention vs control (Triage model and professions)	Patients (n)	Age (years) Mean (SD) / Median (IQR)	Outcome variables
PICO 4 – Comparison of triage model with a true reference standard (cross sectional studies)							
Gräff 2014 Germany	Cross-sectional	University Hospital, Interdisciplinary Emergency department, Bonn	January 1 2010 to December 31 2011 (triage protocols)	I: German version of MTS. C: True events.	I: n=45469 Inter-rater reliability C: n=167	Median 44	Mortality Admission to ICU Admission
Ng 2011 Taiwan	Cross sectional	11 different academic medical centres, 18 regional and 4 district hospitals.	10 October 2006 to 30 July 2007	I: Computerised 5-level TTAS. C: 4-level TTS.	n=10533	50.2 (20.6)	Admission
Santos 2014 Portugal	Cross sectional	Hospital ED	11 July and 13 October 2011.	I: MTS C: True events.	n=25128	52.3(19.9)	Mortality Admission
PICO – Mixed							
Asplund 2010 Sweden PICO 2 and 4	SR	-	Literature search from 1966 to 31of March 2009	-	-	-	Mortality Admission Length of stay Waiting time

CTAS = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **EP** = Emergency Physician, **ESI** = Emergency Severity Index, **JTAS** = Japanese Triage and Acuity Scale, **METTS** = Medical Emergency Triage and Treatment System, **MEWS** = Modified Early Warning Score, **MTE** = Medical Team Evaluation, **MTS** = Manchester Triage System, **NP** = Nurse practitioner, **PA** = Physician assistant, **PATS** = PMH A&E Triage Scale, **PIT** = Physician in triage, **PMH** = Princess Marina Hospital, **RMA** = Rapid Medical Assessment, **RRT** = Rapid triage and treatment, **RTS =** Rapid triage score, **SATS** = South African Triage Score, **SD** = Standard Deviation, **SR** = Systematic Review, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage System

Project: Triage for Prioritisation in the Emergency Department
Appendix 3. Excluded articles

Study author, publication year	Reason for exclusion
Abdulwahid, 2016	Systematic review.
Alpert, 2013	Simulated triage scenarios.
Alquraini, 2015	Wrong comparison, junior vs senior nurses.
Andersson, 2009	Case study, no control group.
Arya, 2013	Not concurrent with PICO.
Ashour, 2016	No triage-model. Theoretical model, construction of an algorithm.
Asha, 2013	Comparison was between staffing subsequent to triaging.
Azerado, 2015	Systematic review, no data from including articles.
Bambi, 2016	Case study, no comparison.
Barfod, 2012	Wrong study type, creating a database.
Barfod, 2012	Case study, no comparison.
Boeke, 2010	Comparison was between staffing subsequent to triaging.
Bullard, 2014	Wrong study type.
Burström 2012	Two interventions at the same time; different triage model and different staffing.
Camilloni, 2010	Only trauma patients.
Cameron, 2017	Wrong outcome, admission only.
Cheng, 2016	Not concurrent with PICO.
Cheng, 2013	Comparison was between staffing subsequent to triaging.
Christensen, 2016	Outcome Length of stay and Waiting time were excluded from PICO 4.
Clifford-Brown, 2010	Case study, wrong outcome.
Davis, 2014	Triage only for exclusion of patients. Comparison was between staffing subsequent to triaging.
Day, 2013	No triage model, method development.
Dinh, 2012	Case study, too few patients.
Dugas, 2016	Mortality not reported separately, data not extractable.
Durand, 2011	Outcome Agreement was excluded from PICO 4.
Ebrahimi, 2015	Meta-analysis, is not within the included study timeframe.

Appendix 3. Excluded articles

Study author, publication year	Reason for exclusion
Elder, 2015	Systematic review.
Elder, 2016	MAU (Medical Assessment Unit) only difference between arms.
Elias, 2015	Too few patients.
Elkum, 2011	Case study, too few patients. No control.
Esmailian, 2014	Wrong design.
Fan, 2013	Not concurrent with PICO.
Farrohknia, 2011	SBU-rapport, duplicate.
Funakoshi, 2016	Case study, not a cross-sectional study, descriptive.
Ganley, 2011	No PICO, no outcome.
Gardner, 2017	Only trauma patients.
Goransson, 2011	Too few patients.
Granström, 2016	Only trauma patients.
Grouse, 2009	Too few patients.
Gunaydin, 2016	Methods not assessable.
Haac, 2015	Only trauma patients.
Hamada, 2014	Wrong comparison, too small case-study.
Harding, 2011	Included articles too old.
Haruno, 2012	Wrong study type.
Hong, 2015	Two interventions at the same time; different triage model and different staffing. Too few patients for PICO 4
Hunt, 2013	Only trauma patients.
Khan, 2016	Too few patients for cross sectional study. Written cases in phase II.
Kim, 2014	Not concurrent with PICO.
Kondo, 2011	Only trauma patients.
Kong, 2015	Only trauma patients.
Lee, 2011	No comparison, too few patients.
Leeies, 2016	Not concurrent with PICO.

Project: Triage for Prioritisation in the Emergency Department
Appendix 3. Excluded articles

Study author, publication year	Reason for exclusion
Lidal, 2011	HTA-report, older than the included report by Asplund.
Lidal, 2013	HTA-report, older than the included report by Asplund.
Lin, 2013	Only inter-rater agreement.
Lindberg, 2011	No PICO, no comparison.
Martins, 2009	Case study/database, wrong outcome.
Ming, 2016	Systematic review.
Mirhaghi, 2015	No comparison according to PICO
Mirhaghi, 2015	Systematic review.
Mirhaghi, 2016	Systematic review.
Nissen, 2014	Not concurrent with PICO.
Nordberg, 2010	Wrong study types.
Olofsson, 2009	No comparison.
Oredsson, 2011	SBU-rapport, duplicate.
Ozucelik, 2013	Only inter-rater agreement/reliability, only one group.
Parenti, 2009	Paper-based scenarios.
Parenti, 2014	Systematic review.
Perez, 2016	No comparison, too few patients.
Pourasghar, 2015	Electronic triage system, not concurrent with PICO.
Preyde, 2012	Implementation of management model in ER. Effect of triaging not specified.
Quitt, 2009	Implementation of different triage model and different staffing at the same time.
Ro, 2015	Comparison was between staffing subsequent to triaging.
Rogg, 2013	Two interventions at the same time; introduction of triage and increased staffing.
Rominski, 2014	Too few patients.
Routschman, 2017	Simulation study.
Scott, 2009	No triage, wrong purpose.

Appendix 3. Excluded articles

Study author, publication year	Reason for exclusion
Seiger, 2011	Wrong population (children).
Shawhan, 2015	Only trauma patients.
Silock, 2015	Not concurrent with PICO, no comparison.
Smith, 2015	Implementation of different triage model and different staffing at the same time.
Steiner, 2016	No comparison, too few patients.
Storm-Versloot, 2009	Wrong design.
Storm-Versloot, 2011	Paper-based scenarios.
Subbe, 2014	Outcome Length of stay only for admitted patients.
Taboulet, 2009	Too few patients.
Torabi, 2016	Too few patients for cross sectional study.
Tshitenge, 2016	Too few patients.
Twomey, 2012	No outcome according to PICO.
Twomet, 2012	No outcome according to PICO.
Vegting, 2015	No triage model.
White, 2012	Comparison was between staffing subsequent to triaging.
Widgren, 2011	No comparison, too few patients.
Yuen, 2016	No comparison, too few patients.
Yuksen, 2016	Two interventions simultaneously.
Ziegler, 2014	Two interventions at the same time; different triage model and different staffing.

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.1.1 PICO 1: Triage vs no formal triage
Outcome variable: Correct prioritisation

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	**Control No triage model/ standard care**				
Hamamoto 2014 Japan	Retro-spective cohort	I: n=1025 C: n=1057	Not specified	I: Nurse triage with JTAS. **Over triage** (Definition see below) **Overall** 8.6%, p<0.001 **Decrease in triage level:** **Level 5 assigned as level 4:** 5.5% p<0.001 **Level 4 assigned as level 3**: 1.7% p<0.001 **Level 5 assigned as level 3:** 0.6% p<0.01 **Under triage** (Definition see below) **Overall** 3.6%**,** p<0.001 **Decrease in triage level:** **Level 4 assigned as level 5:** 2.0% p<0.001 **Level 2 assigned as level 3**: 0.5% p<0.01	C: Nurse triage without JTAS. 24.7% 15.7% 6% 2.1% 9.5% 5.7% 1.6%	Six hospitals for tertiary cases and one for secondary care cases. JTAS is the Japanese version of CTAS. Children 0-17 years are included. The difference in assigned level of urgency between triage nurses and ED physicians decreased from 34.2% to 12.2%, p<0.001. Physicians are reference standard for assessment of sensitivity and specificity.	+	?	+

CTAS = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **JTAS** = Japanese Triage and Acuity Scale

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.1.2 PICO 1: Triage vs no formal triage
Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	Withdrawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control No triage model/ standard care				
Murell 2011 USA	Retro-spective cohort	I: n=33926 C: n=30981	Not specified	I: RTT; rapid triage with low-acuity patient seen and treated by an additional physician in the triage area. Mean (SD), (95% CI) h 3.6 (3.7), (3.6 ; 3.7), p<0.001	C: Standard triage without RTT. Triage nurse. Not further described. Mean (SD) (95% CI) h 4.2 (3.9) (4.2 ; 4.3)	Community hospital in Sacramento.	+	?	+
Storm-Versloot 2014 Holland	Pro-spective cohort	I: n=897 C: n=906	I: n=4 C: n=1	I: Triage with MTS. ED nurse. Median (min-max) h:min n=771 1:45 (0:04 – 12:55), p<0.05	C: Triage without MTS. An informally structured triage system was used by experienced receptionist or ED nurse. Median (min-max) h:min n=856 1:30 (0:05 – 9:13)	University teaching hospital level I trauma centre in the Netherlands.	+	?	-
Traub 2015 USA	Retro-spective cohort	I: n=1441 C: n=1478	Not specified	I: RMA-team; consists of nurse and an additional physician. Mean (SD) min 261.7 (151.9), p<0.0001	C: Without RMA-team. Not further specified. Mean (SD) min 297.8 (233.9)	Suburban tertiary teaching hospital in Phoenix. Mondays and Fridays 10:00 am to 10:00 pm.	+	-	+

CI = Confidence Interval, **ED** = Emergency Department, **MTS** = Manchester Triage System, **RRT** = Rapid Triage and Treatment, **RMA** = Rapid Medical Assessment, **SD** = Standard Deviation

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.1.3 PICO 1: Triage vs no formal triage
Outcome variable: Waiting time to physician assessment

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control No triage model/ standard care				
Hamamoto 2014 Japan	Retro-spective cohort	I: n=1025 C: n=1057	Not specified	I: Nurse triage with JTAS. Mean (SD) min 22.4 (11.0), p<0.001	C: Nurse triage without JTAS. Mean (SD) min 33.6 (20.4)	Six hospitals for tertiary cases and one for secondary care cases. JTAS is the Japanese version of CTAS. Children 0-17 yrs are included.	+	?	+
Khankeh 2013 Iran	Retro-spective cohort	I: n=300 C: n=300	Not specified	I: Nurse triage, not further described. Mean (SD) min 10.69 (3.79), p<0.01	C: No triage. Mean (SD) min 8.91 (3.77)	Hospital in Karaj. The observations of the first 3 days were left out in the data in order to diminish bias.	-	-	-
Murell 2011 USA	Retro-spective cohort	I: n= 33926 C: n= 30981	Not specified	I: RTT; rapid triage with low-acuity patient seen and treated by an additional physician in the triage area. Mean (SD), (95% CI) min 41.9 (37.7), (41.5; 42.4), p<0.001	C: Standard triage without RTT. Triage nurse. Not further described. Mean (SD), (95% CI) min 62.2 (60.3), (61.5; 63.0)	Community hospital in Sacramento.	+	?	+
Storm-Versloot 2014 The Netherlands	Pro-spective cohort	I: n=897 C: n=906	I: n=4 C: n=1	I: Triage with MTS. ED nurse. Median (min-max) h:min n=776 0:12 (0 – 3:30)	C: Triage without MTS. An informally structured triage system was used by experienced receptionist or ED nurse. Median (min-max) h:min n=887 0:10 (0 – 2:31)	University teaching hospital level I trauma centre in the Netherlands.	+	?	?

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **JTAS** = Japanese Triage and Acuity Scale, **MTS** = Manchester Triage System, **RRT** = Rapid Triage and Treatment, **SD** = Standard Deviation

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.1.4 PICO 1: Triage vs no formal triage
Outcome variable: Time for prioritisation process

Author year country	Study design	Number of patients n=	Withdrawals - dropouts	Results		Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control No triage model/ standard care				
Hamamoto 2014 Japan	Retro-spective cohort	I: n=1025 C: n=1057	Not specified	I: Nurse triage with JTAS. Mean (SD) min 2.9 (1.3) p=0.031	C: Nurse triage without JTAS. Mean (SD) min 1.9 (0.8)	Six hospitals for tertiary cases and one for secondary care cases. JTAS is the Japanese version of CTAS. Children 0-17 years are included.	+	?	+

CTAS = Canadian Triage and Acuity Scale, **JTAS** = Japanese Triage and Acuity Scale, **SD** = Standard Deviation

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.1.5 PICO 1: Triage vs no formal triage
Outcome variable: Patient satisfaction

Author year country	Study design	Number of patients n=	Results		Setting and comments	Directness *	Study limitations *	Precision *
			Intervention Triage model	Control No triage model/ standard care				
Storm-Versloot 2014 The Netherlands	Prospective cohort	I: n=897 C: n=906	I: Triage with MTS. ED nurse. n=286/897, 31.9% **Spoken information:** S: n=176, 61.7%, p<0.05 FS: n=107, 37.6% NS: n=2, 0.7% **Opportunity to tell complaints:** S: n=213, 74.6%, p<0.05 FS: n=67, 23.6% NS: n=5, 1.8% **Time spent in ED:** S: n=104, 36.6 %, p<0.05 FS: n=134, 46.9% NS: n=47, 16.5% **Problem sorted out:** S: n=203, 71.2 %, p<0.05 FS: n=69, 24.4% NS: n=12, 4.4%	C: Triage without MTS. An informally structured triage system was used by experienced receptionist or ED nurse. n=356/906, 39.3% **Spoken information:** S: n=272, 76.5%, p<0.05 FS: n=78, 22.1% NS: n=4, 1.4% **Opportunity to tell complaints:** S: n=292, 82.1%, p<0.05 FS: n=93, 26.2% NS: n=6, 1.7% **Time spent in ED:** S: n=95, 26.7%, p<0.05 FS: n=202, 57.0% NS: n=58, 16.3% **Problem sorted out:** S: n=188, 53.0 %, p<0.05 FS: n=155, 43.6% NS: n=12, 3.4%	University teaching hospital level I trauma centre in the Netherlands. The study suffered from a mediocre response rate on patient satisfaction. Patient satisfaction was defined as; - Satisfied (S) - Fairly satisfied (FS) - Not satisfied (NS)	+	-	?

ED = Emergency Department, **MTS** = Manchester Triage System

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.2.1.1 PICO 2: Comparison between professions
Outcome variable: Clinical outcome - Mortality

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	**Control Other profession/ Standard care**				
Burström 2016 Sweden	Retro-spective cohort	I: n=23,765 C: n=20,076	I: n=35 C: n=188	I: Physician-led team triage. Senior physician and a registered nurse first met the patient. Followed by team with; junior physician, registered nurse and assistant nurse. **Mortality** **Within 7 days after first visit:** n=133/23,765; 0.6% p<0.001 **OR:** (95% CI) 0.70 (0.52; 0.85), p<0.001 **Adjusted OR:** 0.72 (0.59; 0.88) **Within 30 days after first visit:** n=367; 1.5% p<0.001 **OR:** (95% CI) 0.80 (0.70; 0.92), p<0.001 **Adjusted OR:** 0.84 (0.73; 0.97)	C: Nurse triage followed by junior physician. (Junior physician could be assisted by senior physician if necessary). **Mortality** **Within 7 days after first visit:** n=195/20,076; 1.0% **Within 30 days after first visit:** n=415; 2.0%	County hospital in Sweden. Two different computer systems were used in the two periods. The triage times were 09:00-20:00 h in the internal medicine section, 10:30-16:30 h in the orthopaedic section, and 10:00-16:00 h in the surgical section on all weekdays. Odds ratio; physician-led team triage compared with nurse triage as a reference. Adjusted for non-independent confounder; study year, mode of arrival, admission, age and sex.	+	+	+

CI = Confidence Interval, **OR** = Odds Ratio

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.2.1.2 PICO 2: Comparison between professions
Outcome variable: Clinical outcome - Unscheduled return within specified timeframe

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	**Control Other profession/ Standard care**				
Burström 2016 Sweden	Retro-spective cohort	I: n=23,765 C: n=20,076	I: n=35 C: n=188	I: Physician-led team triage. Senior physician and a registered nurse first met the patient. Followed by team with junior physician, registered nurse and assistant nurse. **Unscheduled return: Within 24h** n=499/23,730, 2.1%, p<0.001 **OR:** (95% CI) 0.37 (0.33; 0.41), p<0.001 **Adjusted OR:** 0.36 (0.32; 0.40) **Within 72h** n=762/23,730; 3.2%, p<0.001 **OR:** (95% CI) 0.37 (0.33; 0.41), p<0.001 **Adjusted OR:** 0.36 (0.32; 0.40)	C: Nurse triage followed by junior physician in step two. (Junior physician could be assisted by senior physician if necessary). **Within 24h** n=1112/19,888; 5.5% **Within 72h** n=1654/19,888; 8.2%	County hospital in Sweden. Two different computer systems were used in the two periods. The triage times were 09:00-20:00 h in the internal medicine section, 10:30-16:30 h in the orthopaedic section, and 10:00-16:00 h in the surgical section on all weekdays. Odds ratio; physician-led team triage compared with nurse triage as a reference. Adjusted for non-independent confounder; study year, mode of arrival, admission, age and sex.	+	+	+

CI = Confidence Interval, **OR** = Odds Ratio

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
\- Major problems

Appendix 4.2.1.2 PICO 2: Comparison between professions
Outcome variable: Clinical outcome - Unscheduled return within specified timeframe

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	**Control Other profession/ Standard care**				
Traub 2016 USA	Retro-spective cohort	I: n=1869 C: n=1906	Not specified	I: Physician in triage, not further described. **Unscheduled return** All patients **Return within 72h** n=63/1869, 3.37% Difference: 0.38% 95% CI (-0.74; 1.5%) **Return within 72h with hospital admission** n=18/1869; 0.96% Difference: -0.3% 95% CI (-0.96%; 0.37%)	C: Nurse in triage followed by, physician via rotational patient assignment. Not further described. **Unscheduled return** All patients **Return within 72h** n=57/1906, 2.99% **Return within 72h with hospital admission** n=24/1906; 1.26%	Suburban tertiary care teaching hospital, Phoenix. Mondays and Fridays from 10:00 am to 10:00 pm.	+	+	+

CI = Confidence Interval, **OR** = Odds Ratio

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.2.2 PICO 2: Comparison between professions
Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession or team/ standard care				
Asplund 2010 Sweden	SR								
-Holroyd 2007 Canada	RCT	I: n=2831 C: n=2887		I: Triage physician. 4 h 21 min Difference: -36 min, p<0.001	C: No triage physician. 4 h 57 min				
-Subash 2004 Northern Ireland	RCT	I: n=530 C: n=498		I: Team triage, physician and nurse in triage. 37 min MD -45min, p=0.057	C: No team triage. 82 min	Team triage 9 am to 12 am.			
-Partovi 2001 USA	Prospective cohort	I: n=920 C: n=841		I: With additional senior physician in triage. 363 min MD -82 95% CI (-111; -54 min)	C: Without senior physician in triage.445 min				
-Grant 1999 Australia	Prospective cohort with retrospective control	I: n=10,691 C: n=10,476		I: Rapid assessment team, physician and nurse. 3.2 h Difference: 0	C: Regular triage. 3.2 h				
-Sakr 2003 England	Prospective cohort with retrospective control	I: n=1447 C: n=1315 I: n=102		I: Nurse practitioner instead of physicians. Only patients with minor in injury. 51.5 min, MD 43.9 min,	C: Regular emergency department with all patients seen by physician. 95.4 min				

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **EP** = Emergency Physician, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team Evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **RCT** = Randomised controlled trial, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.2.2 PICO 2: Comparison between professions
Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession or team/ standard care				
-Considine 2006 Australia	Prospective cohort with matched controls	C: n=623		p<0.0001 I: Nurse practitioners for patients with minor injuries. Median 125.5 min Difference: 11.5 min, p=0.28	C: Matched controls seen by physician. Median 137 min				
Burström 2016 Sweden	Retrospective cohort	I: n=23,765 C: n= 20,076	I: n=35 C: n=188	I: Physician-led team triage. Senior physician and a registered nurse first met the patient. Followed by team with; junior physician, registered nurse and assistant nurse. 25th percentile: 110 min Median: 185 min 75th percentile: 266 min, p<0.001	C: Nurse triage followed by junior physician in step two. (Junior physician could be assisted by senior physician if necessary). 25th percentile: 137 min Median: 219 min 75th percentile: 320 min	County hospital in Sweden. Two different computer systems were used in the two periods. The triage times were 09:00-20:00 h in the internal medicine section, 10:30-16:30 h in the orthopaedic section, and 10:00-16:00 h in the surgical section on all weekdays.	+	+	+

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **EP** = Emergency Physician, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team Evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **RCT** = Randomised controlled trial, **SD** = Standard Deviation, **SR** = Systematic Review

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Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession or team/ standard care				
Ducharme 2009 Canada	Retrospective cohort	I1+I2: n=10,007 C: n=9585	Not specified	I1: NP (Nurse practitioners) directly involved in the care of patient or indirectly by being on duty. (NPs were added staff.) I2: PA (Physician assistants), directly involved in the care of patient or indirectly by being on duty. (PAs were added staff.) CTAS was used. Mean (%) min, (95% CI) **I1: NP directly involved:** 131.1 min -48%, (35%-62.7%) **I1: NP on duty:** 233.8 min -9.3%, (4.6%-13.9%), p<0.01 **I2: PA directly involved:** 182.9 min -30.3%, (21.6%-39%), p<0.01 **I2: PA on duty:** 277.2 min -8.9%, (3.6%-14.1%), p<0.01	C: Standard care, not further described. CTAS was used. 256.3 min 257.7 min 262.4 min 304.2 min	Six medium-sized community hospitals.	-	?/-	+

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **EP** = Emergency Physician, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team Evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **RCT** = Randomised controlled trial, **SD** = Standard Deviation, **SR** = Systematic Review

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Appendix 4.2.2 PICO 2: Comparison between professions
Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession or team/ standard care				
French 2014 Jamaica	Cross-sectional	I: n = 146 C: n = 111	Not specified	I: Physician-led team triage. Not further described. Mean (SD) h n =113 (all patients) 3.27 (2.30) h, p=0.116 **Triage level P3** 4.50 ± 3.7 h p=0.2019 **Triage level P4** 3.16 ± 1.98, p=0.3590	C: Nurse-led team triage. Specialist emergency medicine trained nurses. Four-level triage system was used. Mean (SD) h n=102 (all patients) 3.77 (2.31) h **Triage level P3** 4.70 ± 3.7 h **Triage level P4** 3.52 ± 2.0	University hospital in Kingston. Monday and Tuesday 9:00 am to 3:00 pm. A four-level triage system was used, level four (P4) = fast track patients. Patient enrolled were those assigned a triage category P3 and P4. Those with more severe illnesses (P1 and P2) requiring urgent attention were not enrolled in this study.	?/+	?	-
Han 2010 USA	Retrospective cohort	I: n=8696 C: n=8569	Not specified	I: Physician triage. Emergency physician (added) and triage nurse. Median (IQR) min 255(138-407) p<0.001	C: Nurse triage. Not further described. Median (IQR) min 266(150-424)	Urban, academic tertiary trauma centre. Physician in triage 7 days of week from 1:00 pm to 9:00 pm. Overall ED length of stay decreased but it was entirely attributed to non-admitted patients. No difference was observed in admitted patients.	+/?	?	+

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **EP** = Emergency Physician, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team Evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **RCT** = Randomised controlled trial, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.2 PICO 2: Comparison between professions
Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession or team/ standard care				
Imperato 2012 USA	Retrospective cohort	I: n=9011 C: n=8620	I: n=274 C: n=205	I: PIT (Physician in triage), an additional physician in triage. Not further described. Median (IQR) h **All patients:** n=9011 3.39 (2.24 – 5.23) Difference: 0.12h, p<0.001 **Admitted:** n=2453 4.57 (3.43 – 6.35) Difference 0.24h, p<0.001 **Discharged**: n=6558 3.10 (2.07 – 4.44) Difference 0.07h, p<0.001	C: Nurse triage without PIT (Physician in triage). Not further described. Median (IQR) h **All patients**: n=8620 3.51 (2.37 – 5.40) **Admitted:** n=2584 5.21 (3.58 – 7.04) **Discharged**: n=6036 3.17 (2.17 – 4.48)	Emergency department, community teaching hospital. Retrospective blinded cohort. One additional physician in triage (PIT), daily 1:00 pm to 9:00 pm.	+	?	+

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **EP** = Emergency Physician, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team Evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **RCT** = Randomised controlled trial, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.2 PICO 2: Comparison between professions
Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession or team/ standard care				
Lauks 2016 Switzerland	Retrospective cohort	I: n= 13120 C: n=13120	I: n=7048 C: n=6396	I: MTE. Triage nurse was teamed with and an additional senior ED physician. ESI was used. Median (IQR) h **All patients**: n=13,120 3.68 (2.30 - 5.55), p<0.01 **Admitted:** 5.23 (3.60 - 7.15), p<0.01 **Discharged:** 3.00 (1.89 – 4.47), p<0.01	C: Nurse triage used ESI. Median (IQR) h **All patients:** n=13,120 3.43 (2.12 - 5.26) **Admitted:** 5.01 (3.59 – 7.10) **Discharged:** 2.66 (1.74 – 4.08)	Urban academic tertiary care centre in Basel. Participants were excluded in four steps; transition, filtering, missing data and finally cases that were not used in the matching process. 9:00 am to 10:00 pm, 7 days a week.	+/?	-	-
Ruben 2011 Sweden	Retrospective cohort	I: n=455 C: n=450	C: n=9	I: Physician in triage: Senior doctor (specialist) in triage using METTS. Mean (SD) min n=455 303 (234), p<0,05	C: Nurse triage: Using METTS. Mean (SD) min n=441 334 (225)	Sahlgrenska university Hospital in Gothenburg. Physician in triage area from 8:00 to 16:00.	+/?	?	?

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **EP** = Emergency Physician, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team Evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **RCT** = Randomised controlled trial, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.2 PICO 2: Comparison between professions
Outcome variable: Length of stay

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession or team/ standard care				
Svirsky 2013 USA	Prospective cohort	I: n=1346 C: n=1346	None	I: Physician in triage: Triage nurse and a junior or senior resident physician. All patients 4.21 h Difference: -36 min 95% Cl (-59 to -4) min p<0.001	C: Nurse triage. All patients 4.57 h	Community-based academic level III trauma hospital. Initially 12:00 pm to 6:00 pm weekdays but was changed halfway through the intervention to 2:00 pm to 8:00 pm to capture a higher number of patients. Data stated are adjusted for age, sex and triage level.	+	+	?
Traub 2016 USA	Retrospective cohort	I: n=1869 C: n=1906	Not specified	I: Physician in triage. Not further described. Mean (SD) min 255.9 (168) Difference: 21.8 min 95% CI (12.2 - 31.3)	C: Nurse in triage followed by physician via rotational patient assignment. Not further described. Mean (SD) min 234.2 (127.6)	Suburban tertiary teaching hospital in Phoenix. Mondays and Fridays from 10:00 am to 10:00 pm.	?	+	?

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **EP** = Emergency Physician, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team Evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **RCT** = Randomised controlled trial, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.3 PICO 2: Comparison between professions
Outcome variable: Waiting time to physician assessment

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession/ Standard care				
Asplund 2010 Sweden -Travers 2006 Singapore	SR Prospective cohort with retrospective control	I: n=290 C: n=286		I: Senior physician in triage with nurse. 19min Difference: 16.5 min, p<0.05	C: No emergency physician in triage. 35.5min	Physician in triage 10 am to 4 pm. Waiting time to see doctor in treatment area (triage category 3).			
-Grant 1999 Australia	Prospective cohort with retrospective control	I: n=10,691 C: n=10,476		I: Rapid assessment team, physician and nurse. 32min Difference: 18 min, p<0.001	C: Regular triage. 35min				
-Richardson 2004 Australia	Prospective cohort with retrospective control	I: n=2193 C: n=1991		I: Senior emergency physician in triage. Waiting time to see doctor within thresholds: **Triage category 3:** 78%, p<0.0001 **Triage category 4:** 73%, p<0.0001	C: No emergency physician in triage. Waiting time to see doctor within thresholds: **Triage category 3:** 67% **Triage category 4:** 53%				

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **EP** = Emergency Physician, **ESI** =Emergency Severity Scale, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.3 PICO 2: Comparison between professions
Outcome variable: Waiting time to physician assessment

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession/ Standard care				
-Sakr 2003 England	Prospective cohort with retrospective control	I: n=1447 C: n=1315		I: NP (Nurse practitioner) instead of physicians. Only patients with minor in injury. 19min MD -37.4min, p<0.0001	C: Regular emergency department with all patients seen by physician. 56.4min				
-Considine 2006 Australia	Prospective cohort with matched controls	I: n=102 C: n=623		I: NP (Nurse practitioners) for patients with minor injuries. Median 4min Difference: 0 min, p=0.96	C: Match controls seen by physician. Median 4min				
Burström 2016 Sweden	Retro-spective cohort	I: n=23,765 C: n=20,076	I: n=35 C: n=188	I: Physician-led team triage. Senior physician and a registered nurse first met the patient. Followed by team with junior physician, registered nurse and assistant nurse. 25^{th} percentile: 15 min Median: 33 min 75^{th} percentile: 66 min, p<0.001	C: Nurse triage followed by junior physician in step two. (Junior physician could be assisted by senior physician if necessary). 25^{th} percentile: 36 min Median: 80 min 75^{th} percentile: 165 min	County hospital in Sweden. 2 different computer systems were used in the 2 periods. The triage times were 09:00-20:00 h in the internal medicine section, 10:30-16:30 h in the orthopaedic section, and 10:00-16:00 h in the surgical section on all weekdays.	+	+	+
Crane 2012 USA	Retrospective cohort	I: n=336 C: n=295	Not speci-fied	I: Physician in ambulatory triage area. Not further described. Median 7±39.1 min	C: Nurse triage. Not further described. Median 65±84.4 min	Urban tertiary, academic hospital. Monday- Friday 12:00-10:00 pm Type of distribution measurements not defined.	+	?	+

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **EP** = Emergency Physician, **ESI** =Emergency Severity Scale, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.3 PICO 2: Comparison between professions
Outcome variable: Waiting time to physician assessment

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession/ Standard care				
Ducharme 2009 Canada	Retrospective cohort	I1+I2: n=10,007 C: n=9585	Not speci-fied	I1: NP (Nurse practitioners) directly involved in the care of patient or indirectly by being on duty. (NPs were added staff) I2: PA (Physician assistant), directly involved in the care of patient or indirectly by being on duty. (PAs were added staff) CTAS was used. OR for (PA vs no PA)* 1.6, 95% CI (1.3-2.1), p<0.05 OR for (NP vs no NP)* 2.1, 95% CI (1.6-2.8), p<0.05 OR for (PA vs no PA)** 1.9, 95% CI (1.6-2.4), p<0.01 OR for (NP vs no NP)** 1.5, 95% CI (1.3-1.8), p<0.01	C: Regular care, not further described. CTAS was used.	Six medium-sized community hospitals. Data states the absolute changes in the proportion of patients who were seen within the benchmarks with PA and NP involvement, respectively. Data stated are adjusted for hospitals, time of day and acuity level. *Odds of patient being seen within the benchmark waiting time when X was involved compared to when X was not involved. **Odds of patient being seen within the benchmark waiting time when X was on duty but not directly involved compared to when X was not.	-	?/-	+

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **EP** = Emergency Physician, **ESI** =Emergency Severity Scale, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.3 PICO 2: Comparison between professions
Outcome variable: Waiting time to physician assessment

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	**Control Other profession/ Standard care**				
Imperato 2012 USA	Retrospective cohort	I: n= 9011 C: n=8620	I: n=274 C: n=205	I: PIT, an additional physician in triage. Median (IQR) h 1.05 (0.41 – 1.39), p<0.001	C: Nurse triage without PIT. Not further described. Median (IQR) h 1.41 (1.05 – 2.30)	ED, community teaching hospital. During the interventional time an additional physician was assigned to triage (PIT), daily 1:00 pm to 9:00 pm.	+	?	+
Lauks 2016 Switzerland	Retrospective cohort	I: n=13,120 C: n=13,120	I: n=7048 C: n=6396	I: MTE triage. Triage nurse was teamed with and an additional senior ED physician. ESI was used. Median (IQR) min **All patients**: n=13120 10.06 (5.65 - 18.07), p<0.01 **Admitted:** 9.48 (5.18 - 7.15), p<0.01 **Discharged:** 10.37 (5.92 – 18.07), p<0.01	C: Triage nurse used ESI. Median (IQR) min **All patients**: n=13120 41.23 (24.78 - 66.62) **Admitted:** 33.84 (19.95 – 55.44) **Discharged:** 45.85 (28.08 – 72.93)	Urban academic tertiary care centre in Basel. Participants were excluded in four steps; transition, filtering, missing data and cases that were not use in the matching process. 9:00 am to 10:00 pm, 7 days a week.	+/?	-	-
Ruben 2011 Sweden	Retrospective cohort	I: n=455 C: n=450	C: n=9	I: Physician in triage. Senior doctor (specialist) in triage using METTS. Mean (SD) min n=455 303 (234), p<0.05	C: Nurse triage: Using METTS. Mean (SD) min n=441 334 (225)	Sahlgrenska University Hospital in Gothenburg. Physician in triage area from 8:00 to 16:00.	+/?	?	?

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **EP** = Emergency Physician, **ESI** =Emergency Severity Scale, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.3 PICO 2: Comparison between professions
Outcome variable: Waiting time to physician assessment

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession/ Standard care				
Soremekun 2012 USA	Retrospective cohort	I: n=10,812 C: n=9056	Not specified	I: Physician in triage. Registered nurse and physician. Median (IQR) min 60 (32-105) Difference: (95% CI) -16 (-19 to -14), p<0.001	C: Nurse triage: Registered nurse. Median (IQR) min 76 (34-183)	Urban tertiary academic centre. 11:00 am to 10:00 pm	?	?	+

CI = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **EP** = Emergency Physician, **ESI** =Emergency Severity Scale, **IQR** = Interquartile range, **MD** = Mean difference, **METTS** = Medical Emergency Triage and Treatment System, **MTE** = Medical Team evaluation, **NP** = Nurse practitioner, **PA** = Physician assistant, **PIT** = Physician in Triage, **SD** = Standard Deviation, **SR** = Systematic Review

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.4 PICO 2: Comparison between professions
Outcome variable: Patient satisfaction

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	**Control Other profession/ Standard care**				
Crane, 2012 USA	Retro-spective cohort	I: n=336 C: n=295 (calculated)	Not specified	I: Physician in ambulatory triage area. Not further described. **Overall satisfaction** 79.7±10.5 (95% CI 77.7, 82.1) p=0.9	C: Nurse triage. Not further described. **Overall satisfaction** 78.8±9.2 (95% CI 76.5, 81.1)	Urban tertiary, academic hospital. Monday to Friday 12:00 to 10:00 pm. The Press Ganey patient satisfaction survey (rating score) 1-5, was used to determine patient satisfaction. Overall satisfaction was not defined.	+	?	+
French, 2014 Jamaica	Cross-sectional	I: n=146 C: n=111	Not specified	I: Physician-led team triage. 88.3% satisfaction rate p=0.827	C: Nurse-led team triage. Specialist emergency medicine trained nurses. Four-level triage system was used. 89.6% satisfaction rate	University hospital in Kingston. Monday and Tuesday 9:00 am to 3:00 pm. A four-level triage system was used, level four (P4) = fast track patients. Patient enrolled were those assigned a triage category P3 and P4. Those with more severe illnesses (P1 and P2) requiring urgent attention were not enrolled in this study. Patients were asked to rate their level of satisfaction with the service based on a Likert like scale with the following responses; slightly satisfied, satisfied, very satisfied, dissatisfied, very dissatisfied. The three patients´ satisfaction and dissatisfaction categories were merged during data analysis as the number of responses were too small for meaningful analysis.	?/+	?	-

CI = Confidence Interval, **ED** = Emergency Department, **PIT** = Physician in Triage, **SD** = Standard Deviation

Project: Triage for Prioritisation in the Emergency Department

* + No or minor problems
? Some problems
- Major problems

Appendix 4.2.4 PICO 2: Comparison between professions
Outcome variable: Patient satisfaction

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	Control Other profession/ Standard care				
Imperato 2014 USA	Retro-spective cohort	I: n=458 C: n=508	Not specified	I: PIT (Physician in triage). Registered nurse and physician. **Overall rating ED care** n=446 Mean (SD) 4.38 (0.93), p=0.013	C: Nurse triage: Registered nurse. Not further described. **Overall rating ED care** n=488 Mean (SD) 4.22 (1.02)	Emergency department, community teaching hospital One additional physician in triage PIT, daily 1:00 pm to 9:00 pm. Children 0-17 years are included. The Press Ganey patient satisfaction survey (rating score) with 10 questions was used. For each question patients responded with “Very poor, Poor, Fair, Good or Very good”, which were converted to scores 1-5 for each alterative.	+	?	+

CI = Confidence Interval, **ED** = Emergency Department, **PIT** = Physician in Triage, **SD** = Standard Deviation

Project: Triage for Prioritisation in the Emergency Department

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Appendix 4.2.5 PICO 2: Comparison between professions
Outcome variable: Concordance between professions

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Profession in triage	**Control Other profession/ Standard care**				
Neeki 2016 USA	Cross sectional	n=505	n=2	I: Emergency medical service/Paramedics (not further described) assessing patient´s acuity level to determine the need to transport to an ED. Not further described. n= 503 Over-all agreement between paramedics´ and emergency physicians´ on patient´s acuity level was (224+98+39=361) 361/503, 71.8% Inter-rater agreement paramedic´s and EP´s assessment on the same cohort of patients. κ 0.5174, p<0.0001	C: Emergency physician assessing patient´s acuity level at the ED.	Large Level II trauma centre in Colton. **Emergent conditions** were definition as requiring immediate attention with treat of life. **Urgent conditions** were defined as requiring immediate attention without treat of life that could go to a non-ED facility. **Non-emergent/non-urgent** was defined as patients not requiring transportation.	+	?	+

ED = Emergency Department, **EP** = Emergency Physician

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.1.1 PICO 3: Comparison between triage models
Outcome variable: Clinical outcome: Mortality

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Comments and Setting	Directness *	Study limitations *	Precision *
				Intervention Triage method 1	Control Triage method 2				
Mullan 2014 Botswana	Retro-spective cohort	I: n=25,243 C: n=14,706		I: Nurse triage. Triage model PATS, (development of SATS), was used. **ED Mortality** All triage levels n=47/25,243, 0.19% % (95% CI) 0.19% (0.13-0.24%) p=0.93	C: Triage nurses categorised patients (pre-PATS) patients; life-threatening (I), potentially life-threatening (II) or non-life-threatening (III). **ED Mortality** All triage levels, 0.19% % (95% CI) 0.19% (0.12-0.26%)	Tertiary referral hospital in Botswana. SATS was used as a model for developing PATS. Princess Marina Hospital Paediatric age was defined as ≤12 years and adult age as ≥13 years C: Paediatric patients: (197+2145)/14706, 15.9% I: Paediatric patients: (491+4180)/25243, 18.5%	?	+	?
van der Wulp 2009 The Netherlands	Retro-spective cohort	I: n=38,330 C: n=46,537	I: n=356 C: n=12,279	I: Nurse triage with 5-level ESI. **ED Mortality** All triage levels n=28/37974, 0.07% **Triage level** ESI 1: 82.1%, n=23 ESI 2: 10.7%, n=3 ESI 3: 7.1%, n=2 ESI 4: 0.0 ESI 5: 0.0 p<0.01	C: Nurse triage with 5-level MTS **ED Mortality** All triage levels n=29/34258, 0.08% **Triage level** Red: 75.9%, n=22 Orange: 20.7%, n=6 Yellow: 3.4%, n=1 Green: 0.0 Blue: 0.0	4 major city hospitals. Significant association between the urgent categories of both triage systems and mortality.	+	+	?

CI = Confidence Interval, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **MTS** = Manchester Triage System, **PATS** = PMH A&E Triage Scale, **SATS** = South African Triage Score

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.1.2 PICO 3: Comparison between triage models
Outcome variable: Clinical outcomes: Admission to intensive care unit

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	Results		Setting and Comments	Directness *	Study limitations *	Precision *
			Intervention Triage method 1	Control Triage method 2				
Mullan 2014 Botswana	Retrospective cohort	I: n=25,243 C: n=14,706	I: Nurse triage. Triage model PATS, (development of SATS), was used. **Admission To ICU** **All patients:** % (95% CI) 0.06 (0.03-0.09) n=16 p<0.001 **Triage level** Red: 66%, n=31 Orange: 26%, n=12 Yellow: 4%, n=2 Green: 0% Unk: 3%, n=2	C: Triage nurses categorised patients (pre-PATS); life-threatening (I), potentially life-threatening (II) or non-life-threatening (III).x **Admission To ICU** **All patients:** % (95% CI) 0.35 (0.25-0.40) n=51 **Triage level** I: 3%, n=1 II: 62%, n=17 III: 35%, n=10	Tertiary referral hospital in Botswana. SATS was used as a model for developing PATS. Princess Marina Hospital Paediatric age was defined as ≤12 years and adult age as ≥13 years. Unk=Unrecorded triage level.	?	+	+

CI = Confidence Interval, **ICU** = Intensive care unit, **PATS** = PMH A&E Triage Scale, **SATS** = South African Triage Score

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.1.3 PICO 3: Comparison between triage models
Outcome variable: Clinical outcomes: Admission

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage method 1	Control Triage method 2				
Mullan 2014 Botswana	Retro-spective cohort	I: n=25,243 C: n=14,706		I: Nurse triage. Triage model PATS, (development of SATS), was used. **Admission to ward (or surgery)** 11,038/25,243, 43.7% 95% CI (43.1-44.3%) p<0.05 **Triage level** Red: 83% Orange: 58% Yellow: 39% Green: 16%, p<0.001	C: Triage nurses categorised patients (pre-PATS); life-threatening (I), potentially life-threatening (II) or non-life-threatening (III). **Admission to ward (or surgery)** 6161/14,706, 41.9% 95% CI (41.1-42.7%) **Triage level** I: 48% II: 51% III: 47%	Tertiary referral hospital in Botswana. SATS was used as a model for developing PATS Princess Marina Hospital Paediatric age was defined as ≤12 years and adult age as ≥13 years.	?	+	+
van der Wulp 2009 The Netherlands	Retro-spective cohort	I: n=38,330 C: n=46,537	I: n=356 C: n=12,279	I: Nurse triage with 5-level ESI. Admission total: 21.6% **Admission to ward** **Triage level** 1: 1.8% 2: 25.8% 3: 58.0% 4: 12.35 5: 1.9% **Prediction of admission:**	C: Nurse triage with 5-level MTS. Admission total: 21.0% **Admission to ward** **Triage level** Red: 1.9% Orange: 35.5.8% Yellow: 48.9% Green: 13.5% Blue: 0.1% **Prediction of admission:**	4 city hospitals included. Distribution of admitted cases. Triage levels, age and	+	+	+

CI = Confidence Interval, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **MTS** = Manchester Triage System, **NS** = Not Significant, **OR** = Odds Ratio, **PATS** = PMH A&E Triage Scale, **SATS** = South African Triage Score

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.1.3 PICO 3: Comparison between triage models
Outcome variable: Clinical outcomes: Admission

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage method 1	**Control Triage method 2**				
				OR (95% CI) **Triage level ESI** 1: 34.0 (23.8-48.6) 2: 13.8 (12.5-15.8) 3: 5.91 (5.47-6.39) 4: 1 5: 0.32 (0.27-0.38)	OR (95% C) **Triage level MTS** Red: 21.4 (15.5-29.5) Orange: 8.6 (7.8-9.4) Yellow: 4.8 (4.4-5.2) Green: 1 Blue: 0.5 (0.28-1.1) NS	hospital were predictive factors for admission. ESI had higher predictive ability than MTS.			

CI = Confidence Interval, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **MTS** = Manchester Triage System, **NS** = Not Significant, **OR** = Odds Ratio, **PATS** = PMH A&E Triage Scale, **SATS** = South African Triage Score

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.2 PICO 3: Comparison between triage models
Outcome variable: Correct prioritisation

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Triage method 1	Triage method 2				
Mullan 2014 Botswana	Retro-spective cohort	I: n=25,243 C: n=14,706	Not specified	I: Nurse triage. Triage model PATS, (development of SATS), was used. **Over-triage** (adults) 41.4% (95% CI 40.3-42.5) p<0.001 **Under-triage** (adults) 14.9% (95% CI 13.4-16.5) p<0.001 .	C: Triage nurses categorised patients (pre-PATS); life-threatening (I), potentially life-threatening (II) or non- life-threatening (III). **Over-triage** (adults) 57.1% (95% CI 48.9-65.3) **Under-triage** (adults) 45.9% (95% CI 44.3-47.4)	Tertiary referral hospital in Botswana. SATS was used as a model for developing PATS. Princess Marina Hospital **Over-triage** occurs when patients receives a high acuity triage assignment (red or yellow) and is subsequently discharged. **Under-triage** occurs when a patient receives a low acuity assignment (green) and subsequently dies or is admitted. Paediatric age was defined as ≤12 years and adult age as ≥13 years.	?	+	+

CI = Confidence Interval, **ED** = Emergency Department, **ICU** = Intensive care unit, **MEWS** = Modified Early Warning Score, **PATS** = PMH A&E Triage Scale, **PMH =** Princess Marina Hospital, **RR** = Risk ratio, **SATS** = South African Triage Score

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.2 PICO 3: Comparison between triage models
Outcome variable: Correct prioritisation

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Triage method 1	Triage method 2				
Rosedale 2011 South Africa	Cross-sectional	n=640	n=101	SATS used by nursing staff. **Over-triage** (Definition; if MEWS≥ 4 or SATS = level red or orange, but patient was discharge.) n=25, 4.3% (19 medicine, 1 surgery and 5 trauma) RR 0.51 (95% CI 0.32; 0.82) **Under-triage** (Definition; MEWS 0-2 or SATS = green, but patient was admitted.) n=26, 4.4% (19 medicine, 3 surgery and 4 trauma) RR 0.29 (95% CI 0.19; 0.45)	MEWS used by nursing staff. **Over-triage** n= 49, 8.3% (39 medicine, 4 surgery and 6 trauma) **Under-triage** n=89, 15.1% (45 medicine, 11 surgery, 28 trauma and 5 psychiatry)	Government hospital, referral centre in KwaZulu. Rural setting. Weekdays between the hours of 08h00 and 16h00. Exclusion criteria included children under 12 years. Allocation of patients included in the study; 47.5% medical, 33% trauma, 17% surgical, 1.5% psychiatry. n=253/589 required admission. n=4/589 died. RR is calculated from reported data.	-	-	?

CI = Confidence Interval, **ED** = Emergency Department, **ICU** = Intensive care unit, **MEWS** = Modified Early Warning Score, **PATS** = PMH A&E Triage Scale, **PMH =** Princess Marina Hospital, **RR** = Risk ratio, **SATS** = South African Triage Score

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.3 PICO 3: Comparison between triage models
Outcome variable: Length of stay

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage method 1	Control Triage method 2				
Ng 2010 Taiwan	Cross-sectional	n=2091	n=240	I: Triage nurse used 5-level CTAS. Median (IQR) min **Triage level** 1: 248.5 (126.0-890.5) 2: 234 (114-840) 3: 168 (79.5-509.5) 4: 78 (44-200) 5: 66 (30-118)	C: Trained research nurse used 4-level TTS. Median (IQR) min **Triage level** 1: 258.5 (133.0-548.5) n.s. 2: 162 (78-414) n.s. 3: 118 (58-421) p<0.05 4: 47.5 (23.5-101) p<0.05 5: -	Three different hospitals in Taiwan. Prospective observational study conducted over five consecutive afternoons and evenings (12:00-22:00) at three different medical centres in Taiwan.	?	+	?/+

CTAS = Canadian Triage and Acuity Scale, **IQR** = Interquartile Range, **TTS** = Taiwan Triage System

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.4 PICO 3: Comparison between triage models
Outcome variable: Waiting time to physician assessment

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Triage method 1	Triage method 2				
Maleki 2015 Iran	Retrospective cohort	n=770	Not specified	5-level triage with ESI. Not further described. Mean (SD) min 8.92 (9.66), p<0.001	3-level spot check triage. Not further described. Mean (SD) min 6.46 (9.96)	Imam Khomeini hospital.	?	-	-

ESI = Emergency Severity Index, **SD** = Standard Deviation

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.3.5 PICO 3: Comparison between triage models
Outcome variable: Concordance between triage models

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results Intervention Triage methods	Setting and Comments		Directness *	Study limitations *	Precision *
Betz 2016 Canada	Cross sectional	n=496	Not specified	I: Triage score utilizing a simple quick-lock method (observation + chief complaint), called RTS. Triage nurse. n=419/496, (84.5%) were in agreement (CTAS-score compared with RTS-score). Scoring discrepancies ranged from (-2 to +2). **CTAS-score compared with RTS-score:** Triage level: proportion concordant: 1: 5/5, 100% 2: 60/62, 96.8% 3: 168/191, 88.0% 4: 94/125, 75.2% 5: 92/113, 81.4% Total: 419/496, 84.5% Mean K 0.83 (19 nurse) Quadratic weighting produced a mean K 0.88.	C: Triage nurse, used CTAS.	Urban tertiary-care hospital.	?	-	-
de Souza 2011 Brazil	Cross sectional	n=382	n=38	I: MTS protocol used by triage nurse. Kappa (global linear) 0.48 Kappa (squared) 0.61 **Kappa ratio classification per colour:** Red 0.25 Orange 0.53 Yellow 0.26 Green 0.37 Blue 0.06	C: Local standard protocol used by triage nurse.	Public hospital.	-	-	?

CTAS = Canadian Triage and Acuity scale, **RTS** = Rapid Triage Score, **MTS** = Manchester Triage System

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.1 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Mortality

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
Asplund 2010 Sweden	SR of observ-ational studies 1 study 2 studies 1 study 3 studies 4 studies	 n=11,751 n=17,334 (total) n=11,751 n=18,320 (total) n=28,446 (total)		**Vital signs:** OR* **Respiratory rate:** Study 1: 1.9 **Saturation:** Study 1: 1.4 Study 2: 1.7 **Pulse rate:** Study 1: 1.7 **Level of consciousness** Study 1: 2.1 Study 2: 1.7 Study 3: 11.7 **Age** Study 1:1.7 Study 2: 1.3 Study 3: 2.6 Study 4: 1.1	True events (death)	Predictive value regarding mortality related to every step of deterioration in RAPS and/or REMS. *Interpretation of OR; for every step in the scale of RAPS/REMS mortality will increase by the factor OR indicates.			

ATS = Australian Triage Scale, **CTAS** = Canadian Triage and Acuity Scale, **CI** = Confidence Interval, **ED** = Emergency Department, **IQR** = Interquartile Range, **METTS** = Medical Emergency Triage and Treatment System, **MTS** = Manchester Triage System, **OR** = Odds Ratio, **RAPS** = Rapid Acute Physiology Score, **REMS** = Rapid Emergency Medicine Score, **ROC** (curve) = Receiver Operating Characteristic, **RR** = Risk ratio, **SR** = Systematic Review, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.1 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Mortality

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
Asplund 2010 Sweden	SR of observ-ational studies 1 study 2 studies 1 study	 n=29,346 n=12,707 n=8695		Mortality in triage level 5 (non-urgent/green) **CTAS** Study 1: 0% **ATS** Study 1: 0.1% Study 2: 0.003% **METTS** Study 1: 0.5%	True events (death)	5-level triage scales were examined for predictive value regarding mortality among patient in triage level 5 (non-urgent/green).			
Gräff 2014 Germany	Cross sectional	n=45,469	None	German version of MTS. Specialist nurses. **Mortality among all patients** 618/45,456; 1.36% **Mortality among admitted patients** 618/14,960; 4.1% **Mortality rate per triaged patient at each level** Red: 193/630; 30.6% Orange: 236/7999; 3.0% Yellow: 154/21,221; 0.7% Green: 30/13,811; 0.2% Blue: 5/1795; 0.3%	True events (death)	University hospital Bonn. The German version of MTS differs from the English version with respect to presentation diagrams and change indicators, which have a significant impact on the category assigned. Adult age was defined as ≥14 years.	?	?	+

ATS = Australian Triage Scale, **CTAS** = Canadian Triage and Acuity Scale, **CI** = Confidence Interval, **ED** = Emergency Department, **IQR** = Interquartile Range, **METTS** = Medical Emergency Triage and Treatment System, **MTS** = Manchester Triage System, **OR** = Odds Ratio, **RAPS** = Rapid Acute Physiology Score, **REMS** = Rapid Emergency Medicine Score, **ROC** (curve) = Receiver Operating Characteristic, **RR** = Risk ratio, **SR** = Systematic Review, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.1 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Mortality

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
				Distribution of mortality across triage levels Red: 193/618; 31.2% Orange: 236/618; 38.2% Yellow: 154/618; 25.0% Green: 30/618; 4.9% Blue: 5/618; 0.8% **Time dependent ROC-curve for MTS and 30-day likelihood for survival:** Area under ROC-curve: 0.613					
Santos 2014 Portugal	Cross sectional	n=25128	n=497	MTS. Not further described. **Mortality among all patients,** all MTS-levels n=276/24,721; 1.12% **Mortality rate among admitted patients,** all MTS-levels n=276/1128; 24.5% **Mortality rate per triaged patient at each level** Red: 30/98; 30.6%% Orange: 113/3467; 3.3% Yellow: 2/8150; 0.9% Green: 32/10,982; 0.3% Blue: 3/918; 0.3% White:26/1106; 2.4%	True events (death)	Large hospital in Portugal. All patients included; general adults, gynaecology and obstetrics, paediatric cases and basic emergency services. Medical specialities included psychiatry. Surgical specialities included ophthalmology and ENT (ear, nose and throat).	?	-	+

ATS = Australian Triage Scale, **CTAS** = Canadian Triage and Acuity Scale, **CI** = Confidence Interval, **ED** = Emergency Department, **IQR** = Interquartile Range, **METTS** = Medical Emergency Triage and Treatment System, **MTS** = Manchester Triage System, **OR** = Odds Ratio, **RAPS** = Rapid Acute Physiology Score, **REMS** = Rapid Emergency Medicine Score, **ROC** (curve) = Receiver Operating Characteristic, **RR** = Risk ratio, **SR** = Systematic Review, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.1 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Mortality

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
				Distribution of mortality across triage levels Red: 30/276, 11.0% Orange: 113/276, 41.0% Yellow: 72/276, 26.1% Green: 32/276, 11.6% Blue: 3/276, 1.1% White: 26/276, 9.4% **Relative risk of death** RR (95% CI) 5.58 (4.31-7.22) The risk in the high acuity/priority cluster (red+orange) was 5.58 times of the risk of the low acuity/priority cluster (yellow+green+blue).					

ATS = Australian Triage Scale, **CTAS** = Canadian Triage and Acuity Scale, **CI** = Confidence Interval, **ED** = Emergency Department, **IQR** = Interquartile Range, **METTS** = Medical Emergency Triage and Treatment System, **MTS** = Manchester Triage System, **OR** = Odds Ratio, **RAPS** = Rapid Acute Physiology Score, **REMS** = Rapid Emergency Medicine Score, **ROC** (curve) = Receiver Operating Characteristic, **RR** = Risk ratio, **SR** = Systematic Review, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.2 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Admission to intensive care unit

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - dropouts	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
Gräff 2014 Germany	Cross sectional	n=45,469	None	German version of MTS. Specialist nurses. **All triage levels** 2310/45469, 5.0% **Distribution of ICU-admission across triage levels** Red: 495/2310, 21.4% Orange: 1393/2310, 60.3% Yellow: 380/2310, 16.6% Green: 39/2310, 1.7% Blue: 3/2310, 0.13% **Sensitivity for admission to ICU-care:** Area under ROC-curve: 0.87 95% CI (0.86 to 0.88)	True events (admission to ICU)	University hospital in Bonn. The German version of MTS differs from the English version with respect to presentation diagrams and change indicators, which have a significant impact on the category assigned. Adult age was defined as ≥14 years.	?	?	+

CI = Confidence Interval, **ICU** = Intensive care unit, **MTS** = Manchester Triage System, **ROC** (curve) = Receiver Operating Characteristic

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.3 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Admission

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
Asplund 2010 Sweden	SR of observ-ational studies 3 studies 5 studies 1 study	 n=131,230 n=13,361 n=33,850		Percent admitted in triage level 5**:** **Triage model ATS** Study 1: 3.1% Study 2: 9% Study3: 17% **Triage model ESI** Study 1: 0% Study 2: 2% Study 3: 4% Study 4: 5% Study 5: 7% **Triage model SRTS** Study 1: 1.4%	True events (admission decision)	Predictive value regarding need for admission in triage level 5 (non-urgent) in 5-level triage scales.			

ATS = Australian Triage Scale, **CI** = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **MTS** = Manchester Triage System, **RR** = Risk Ratio, **SRTS** = Soterion Rapid Triage Scale, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.3 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Admission

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
Gräff 2014 Germany	Cross sectional	n=45,469	None	German version of MTS. Specialist nurses. **Admission**, all triage levels of MTS 14,960/45,456; 32.9% **Discharge** 30,496/45,456; 67.1% **Admission (ICU and normal ward) per triaged patient in each level** Red: 630/630; 100% Orange: 5867/7999; 73.3% Yellow: 6475/21,221; 30.5% Green: 1819/13,811; 13.2% Blue: 169/1795; 9.4% **Distribution of admission (ICU and normal ward) across triage levels** Red: 630/14,960; 4.2% Orange: 5867/14,960; 39.2% Yellow: 6475/14,960; 43.3% Green: 1819/14,960; 12.2% Blue: 169/14,960; 1.1% **Sensitivity for general hospital admission:** Area under ROC-curve: 0.749, 95%CI (0.744; 0.754)	True events (admission decision)	University hospital in Bonn. The German version of MTS differs from the English version with respect to presentation diagrams and change indicators, which have a significant impact on the category assigned. Adult age was defined as ≥14 years.	?	?	+

ATS = Australian Triage Scale, **CI** = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **MTS** = Manchester Triage System, **RR** = Risk Ratio, **SRTS** = Soterion Rapid Triage Scale, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.3 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Admission

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
Ng 2011 Taiwan	Cross sectional	n=10,533	-	Trained research nurse used computerised 5-level TTAS. **Hospitalisation rate** n, % **Triage level** Level 1: 375, 92.4% Level 2: 1009, 55.7% Level 3: 1418, 32.6% Level 4: 308, 11.7% Level 5: 94, 7.1% p<0.001	True events (admission to hospital)	The study included 11 different academic medical centres, 18 regional and 4 district hospitals. Level 5 = non-urgent.	?	+	+
Santos 2014 Portugal	Cross sectional	n=25,128	n=497	MTS **Admission** All triage levels of MTS n=1128/24,721 (4.6%) **Discharge:** n=(24721-1128)/2472, 95.4% **Admission per triaged patient in each level** Red: 58/98; 59.2% Orange: 427/3467; 12.3% Yellow: 386/8150; 4.7% Green: 146/10,982; 1.3% Blue: 3/918, 0.3% White: 108/1106, 9.8%	True events (admission decision)	Large hospital in Portugal. Profession in triage not described. All patients included; general adults, gynaecology and obstetrics, paediatric cases and basic emergency services. Medical specialities included psychiatry. Surgical specialities included ophthalmology and ENT (ear, nose and throat).	?	-	+

ATS = Australian Triage Scale, **CI** = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **MTS** = Manchester Triage System, **RR** = Risk Ratio, **SRTS** = Soterion Rapid Triage Scale, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 4.4.1.3 PICO 4: Comparison of triage model with true outcomes
Outcome variable: Clinical outcome: Admission

* + No or minor problems
? Some problems
- Major problems

Author year country	Study design	Number of patients n=	With-drawals - drop-outs	Results		Setting and Comments	Directness *	Study limitations *	Precision *
				Intervention Triage model	Control Reference standard				
				Distribution of admittance across triage levels Red: 58/1128; 5.1% Orange: 427/1128; 37.6% Yellow: 386/1128; 34.2% Green: 146/1128; 12.9% Blue: 3/1128; 0.3% White: 108/1128; 9.6% **RR for admission in:** High (red+organge) vs low priority (yellow+green+blue) cluster. RR (95% CI) 4.86 (4.28-5.52)					

ATS = Australian Triage Scale, **CI** = Confidence Interval, **CTAS** = Canadian Triage and Acuity Scale, **ED** = Emergency Department, **ESI** = Emergency Severity Index, **MTS** = Manchester Triage System, **RR** = Risk Ratio, **SRTS** = Soterion Rapid Triage Scale, **TTAS** = Taiwan Triage and Acuity Scale, **TTS** = Taiwan Triage Scale

Project: Triage for Prioritisation in the Emergency Department
Appendix 5: Ethical aspects

The effect of the intervention on health	
Q1: Health: How does the intervention effect patients' health in terms of quality of life and life-length (including adverse effects)?	Triage is performed in order to sustain quality of life and life-length; however, a non-effective triage-model can jeopardise the outcome quality.
Q2: Knowledge gaps: If there is lack of scientific evidence for the effect of the intervention, are there ethical and/or methodological problems with future research in order to strengthen this evidence.	Adaption of triage to local circumstances results in a broad variety of techniques. The comparability is limited as an effect of the differentiation.
Q3: Degree of severity: What degree of severity has the condition the intervention is supposed to treat?	Not applicable
Q4: Third parties: How does the intervention affect the health of third parties?	Not applicable
Summary: How is the benefit/risk – ration for the intervention (given the answers of Q1-Q4)?	The need to identify the severely ill and simultaneously keeping up the patient flow is a considerable challenge when performing triage. The triage-model itself is tailored to handle the risk of an adverse balance. Absence of a triage-model, e.g. ad hoc assessment, will will imply higher risks than practicing a common triage technique.
Q5: Equality and justice: Is there a risk that access to the intervention violates the Human Dignity principle or the Swedish Discrimination Act?	Not applicable
The compatibility of the intervention with ethical values	
Q6: Autonomy: Can the intervention affect patients' and others' participation in decisions and their ability to make informed and relevant decisions about the intervention?	A selection, categorisation and prioritisation of patients according to the kind and severity of a disease or an injury raise ethical issues of the common interest versus the individual interest. There is, to our knowledge, no agreements or standards on ethics regarding conditions of consent and humanitarian considerations applied to triage.
Q7: Privacy: How does the intervention affect patient's and significant others' physical and personal privacy?	Triage can affect the patient's and others' physical and personal privacy and has to be performed and documented according to secrecy routines.
Q8: Cost effectiveness: Is the balance between the cost and effects of the intervention reasonable?	Not investigated
Summary: Is the use of the intervention compatible with ethical values (given the answers of Q5-Q8)?	Not applicable

Project: Triage for Prioritisation in the Emergency Department

Appendix 5: Ethical aspects

Structural factors that can affect the use and consequences of the intervention	
Q9: Resources and organisation: Are there resource- or organizational limitations that can affect who will get access to the intervention or that can lead to less access to other care if the intervention is used?	See summary Q1-Q4
Q10: Professional values: Can values within the affected care professions influence the use of the intervention and thereby lead to unequal access?	Not applicable
Q11: Stake holder interests: Are there stake holder interests that can influence the use of the intervention and thereby lead to unequal access?	Not applicable
Summary: Are there reason to believe that an equal access to the intervention (or other care interventions) can be affected (given the answers to Q9-Q11)?	See summary Q1-Q4
Long-term ethical consequences	
Q12: Long-term consequences: Can the use of the intervention result in more long-term consequences?	Not applicable
Overall summary	
How can the ethical aspects regarding the intervention be summarised? Does this summary indicate that the intervention should be modified or that there should be special requirements associated with offering the intervention?	The studied phenomenon, triage, is not one certain intervention. The question is not applicable.

Region Västra Götaland, HTA-centrum

Health Technology Assessment
Regional activity-based HTA

HTA

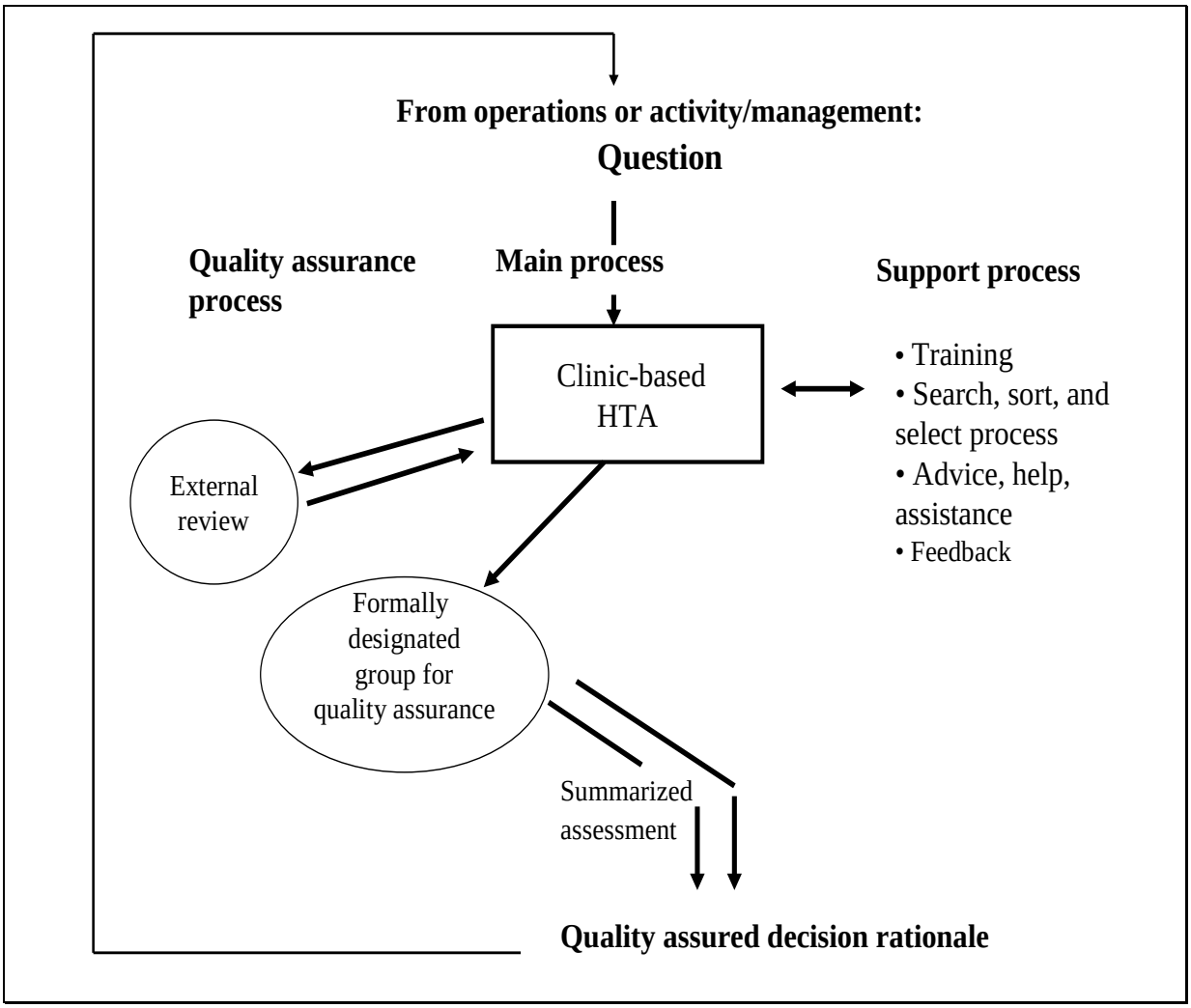
Health technology assessment (HTA) is the systematic evaluation of properties, effects, and/or impacts of health care technologies, i.e. interventions that may be used to promote health, to prevent, diagnose or treat disease or for rehabilitation or long-term care. It may address the direct, intended consequences of technologies as well as their indirect, unintended consequences. Its main purpose is to inform technology-related policymaking in health care.

To evaluate the quality of evidence the Centre of Health Technology Assessment in Region Västra Götaland is currently using the GRADE system, which has been developed by a widely representative group of international guideline developers. According to GRADE the level of evidence is graded in four categories:

High quality of evidence	= (GRADE⊕⊕⊕⊕)
Moderate quality of evidence	= (GRADE ⊕⊕⊕O)
Low quality of evidence	= (GRADE ⊕⊕OO)
Very low quality of evidence	= (GRADE ⊕OOO)

In GRADE there is also a system to rate the strength of recommendation of a technology as either “strong” or “weak”. This is presently not used by the Centre of Health Technology Assessment in Region Västra Götaland. However, the assessments still offer some guidance to decision makers in the health care system. If the level of evidence of a positive effect of a technology is of high or moderate quality it most probably qualifies to be used in routine medical care. If the level of evidence is of low quality the use of the technology may be motivated provided there is an acceptable balance between benefits and risks, cost-effectiveness and ethical considerations. Promising technologies, but a very low quality of evidence, motivate further research but should not be used in everyday routine clinical work.

Christina Bergh, Professor, MD.
Head of HTA-centrum


From operations or activity/management:
Question
Quality assurance process
Main process
Support process
Clinic-based HTA
• Training
• Search, sort, and select process
• Advice, help, assistance
• Feedback
External review
Formally designated group for quality assurance
Summarized assessment
Quality assured decision rationale

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