Search Strategy

Medline

1 exp disaster planning/ or exp mass casualty incidents/ or Disaster Medicine/ or Rescue Work/ or ((mass or multiple) adj3 (casualt* or catastroph*)).mp. or (disaster* adj3 (medical* or natural or plan* or medicin*)).mp. or ((major or large*) adj5 (accident* or incident*)).mp. or (rescue adj2 work).mp. or exp Terrorism/ or terror*.mp.

2 Triage/ or exp Resource Allocation/ or triage*.mp. or (resource* adj3 (allocation* or management)).mp.

3 1 and 2

Embase

1 disaster planning/ or exp disaster/ or Disaster Medicine/ or ((mass or multiple) adj3 (casualt* or catastroph*)).ti,ab. or (disaster* adj3 (medical* or natural or plan* or medicin*)).ti,ab. or ((major or large*) adj3 (accident* or incident*)).ti,ab. or (rescue adj2 work).ti,ab. or exp terrorism/ or terror*.mp.

2 exp Resource Allocation/ or triage*.mp. or (resource* adj3 (allocation* or management)).mp.

3 1 and 2

Central

#1 MeSH descriptor: [Disaster Planning] explode all trees

#2 MeSH descriptor: [Mass Casualty Incidents] explode all trees

#3 MeSH descriptor: [Disaster Medicine] explode all trees

#4 MeSH descriptor: [Rescue Work] explode all trees

#5 MeSH descriptor: [Terrorism] explode all trees

#6 ((mass or multiple) near/3 (casualt* or catastroph*)) or (disaster* near/3 (medical* or natural or plan* or medicin*)) or ((major or large*) near/5 (accident* or incident*)) or (rescue near/2 work) or terror*

#7 #1 or #2 or #3 or #4 or #5 or #6

#8 MeSH descriptor: [Triage] explode all trees

#9 MeSH descriptor: [Resource Allocation] explode all trees

#10 triage* or (resource* near/3 (allocation* or management))

#11 #8 or #9 or #10

#12 #7 and #11 in Trials

Web of Science

3

#1 AND #2

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, ESCI Timespan=All years

2

TS=(Triage* or (resource* NEAR/3 (allocation* or management)))

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, ESCI Timespan=All years

1

TS=(((mass or multiple) NEAR/3 (casualt* or catastroph*)) or (disaster* NEAR/3 (medical* or natural or plan* or medicin*)) or ((major or large*) NEAR/5 (accident* or incident*)) or (rescue NEAR/2 work)) or TS=(terror*)

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, ESCI Timespan=All years

Conversion of Results

Ellebrecht 2012

		Reference standard			
		Red	**Yellow**	**Green**	**Total**
Index test	**Red**	93	40	7	140
	Yellow	4	100	20	124
	Green	1	24	231	256
	Total	98	164	258	520

Overtriage:

$$Actual\ Green = 7 + 20 = 27$$
$$Actual\ Yellow = 40$$
$$Green + yellow = 67$$
$$Overtriage\ in\ total = \frac{67}{520} * 100 = 12{,}9\% \approx 13\%$$

Undertriage:

$$Actual\ red = 4 + 1 = 5$$
$$Actual\ Yellow = 24$$
$$Red + Yellow = 29$$
$$Undertriage\ in\ total = \frac{29}{520} * 100 = 5{,}6\% \approx 6\%$$

Lee, 2015

Undertriage: (undertriage and critical triaged added)

$$PCP: 7.6\% + 2.3\% = 9.9\% \approx 10\%$$
$$FS: 8.7\% + 4.3\% = 13\%$$

Data for calculation of an overall undertriage and overtriage were not available

Navin 2010

		Reference standard				
		Immediate	**Delayed**	**Ambulatory**	**Expectant**	**Total**
Index test	**Immediate**	X	8	6	0	14
	Delayed	9	X	9	0	18
	Ambulatory	7	16	X	0	23
	Expectant	1	0	1	X	2
	Total	17	24	16	0	57

START:

Overtriage:

$$Actual\ expectant = 0 + 0 + 0 = 0$$
$$Actual\ ambulatory = 6 + 9 = 15$$

$$Actual\ delayed = 8$$
$$Expectant + ambulatory + delayed = 23$$
$$Overtriage\ in\ total = \frac{23}{193} * 100 = 11{,}9\% \approx 12\%$$

Undertriage:

$$Actual\ ambulatory = 1$$
$$Actual\ delayed = 16$$
$$Actual\ Immediate = 9 + 7 + 1 = 17$$
$$ambulatory + delayed + immediate = 34$$
$$Undertriage\ in\ total = \frac{34}{193} * 100 = 17{,}6\% \approx 18\%$$

STM:

- 10 patient scores were off by 1
- 5 patients' scores were off by 2
- an 11 was scored as a 9
- an 8 was scored as a 10
- a 9 was scored as a 7
- a 7 was scored as a 9
- a 9 was scored as an 11
- 1 patient's score was 11 but was scored as 8

Data to calculate over and undertriage for STM is not available since the 10 patients which had a score off by one has not been tagged as either over or undertriaged

Schencker 2006

		Reference standard				
		Red	**Yellow**	**Green**	**Black**	**Total**
Index test	**Red**	20	4	6	0	30
	Yellow	3	7	3	0	13
	Green	6	5	42	1	54
	Black	1	0	0	3	4
	Total	30	16	51	4	101

Overall overtriage:

$$Actual\ Black = 1$$
$$Actual\ Green = \ 3 + 6 = 9$$
$$Actual\ Yellow = 4$$
$$Black + Green + yellow = 14$$
$$Overtriage\ in\ total = \frac{14}{130} * 100 = 10{,}7\% \approx 11\%$$

Overall undertriage

$$Actual\ Red = 6 + 3 + 1 = 10$$
$$Actual\ Yellow = 5 + 4 = 9$$
$$Actual\ Green = 3 + 6 = 9$$

$$Red + Yellow + Green = 28$$

$$Undertriage\ in\ total = \frac{28}{130} * 100 = 21{,}5\% \approx 22\%$$

Suggestions for a Standardized Protocol for Studies Examining Accuracy in Pre-Hospital Triage Systems for Mass Casualty Incidents

Study Characteristics

Participants:
Profession and experience level of the participants may vary from one emergency medical service to another (Table 2). Therefore, it seems unfair to standardise the profession to only one type. Nevertheless, it is important that the types of professions and expertise levels vary as little as possible, as an experienced emergency physician will perform triage more skillfully than nonprofessionals will.

Distribution of cases into triage categories:
A systematic review has shown that the mean distribution of triage categories in MCIs is P1: 10%, P2: 17%, P3: 49%, P4: 5%[1]. Meanwhile, the study also shows variation in distribution depending on the type of MCI. We do not think that a universally correct distribution exists, as every MCI is unique. It is more important that each category are examined with sufficient power.

Distribution of actors and mannequins displaying the cases:
The choice of using actors or mannequins impacts reliability and validity. Mannequins provide identical situations each time they are triaged thereby improving reliability. Cases played by actors can provide a more stressful scenario resembling that of a real MCI, thereby improving validity. Standardisation is important to achieve comparable results even though there is no correct distribution. The recommended distribution is best decided in a Delphi process.

Types of mass casualty incidents:
We do not recommend standardisation of the type of mass casualty incident as it may lower the overall applicability of the collected evidence. Even though not included in this study, we encourage the inclusion of CBRN, burn, and paediatric cases when appropriate triage systems are examined – preferably systems that are able to include all types of patients.

Types of injuries:
We believe that a large variety of injury types are represented in the simulation is preferable. A broad representation of injuries is important to detect critical undertriage of P1 patients. This is necessary as a major issue with many of the triage systems is that they do not take delayed deterioration into account e.g. patients with internal haemorrhage. The exact definition and distribution should be decided in the Delphi process, preferably based on cases from real MCIs.

Reference standard:
In order to achieve a reference standard with a high level of applicability we believe that reference standards defined by records of patients from actual MCIs documenting their injuries and their need for lifesaving interventions is ideal. Both studies using patient records from actual MCIs[2] and studies defining lists of lifesaving interventions for the P1 category[3] have already been published. Alternatively, patient records from trauma registries can be used as these conceivably have great similarity to MCI patients. Lists of interventions defining P2 and P3 are yet to be developed and should be discussed in the Delphi process. P4 and P5 should be defined as death inside a predefined

timeframe. Almost every triage system will fit into this reference standard. However, systems such as the Sacco Triage Method that have distinctly different ways of categorising the patients will not be able to apply the suggested reference standard. How to develop a reference standard based on actual patient records for such systems should be discussed in the Delphi process.

Handouts of flowcharts describing the triage system:
We recommend that handouts of flowcharts describing the triage system are used in live simulations, as we believe that such handouts should be a part of the standard equipment for any potential first responders and emergency response units. We believe that this will increase the precision of triage when physiological triage[4] is preferred.

Pre-simulation triage course:
There are both advantages and disadvantages when deciding to use a triage course or not. The advantage is that by allowing pre-simulation triage courses the risk of human errors during the exercise decreases and thereby increases the reliability. The disadvantage is that in a real scenario it seems unlikely that those who perform the primary triage will have gone through a triage course immediately before the incident and thereby decreasing validity. There is no right or wrong decision for this matter, and consequently this decision is best made through the Delphi process. We recommend that if the decision falls on using a pre-simulation triage course, decisions should also be made about the duration of the course, the curriculum and when to take course. If the decision falls on not using a pre-simulation triage course, a quarantine period from triage courses prior to the simulation should be determined.

Reporting

Another issue the standardised protocol should address is which details to report, especially regarding the methods section. Based on the findings of our study we believe that the following are some of the essential items that should be reported:

- Type of mass casualty incident simulated (plane crash, terror attack, building fire, etc)
- Details of simulation quality (how life-like were the MCI simulated)
- Number of cases
- Number of cases represented by actors
- Number of cases represented by mannequins
- Number of triage decisions
- Types of injuries presented
- Intended distribution of cases into categories
- Characteristics of those who perform triage:
    - Profession
    - Years of experience in that profession

    - Has the person performed triage before in a MCI or simulation?
- Was a flowchart of the triage system handed out to the participants?
- Did the participants use the chart? (some studies showed that the chart was not used even though it was supplied)
- Whether a pre-simulation triage course was used, and if so the duration, the curriculum and the time gap between the course and the simulation
- Triage systems examined (index test)
- In depth details of how the reference standard was developed – simply stating that it was predefined is inadequate.
- Whether all patients received a reference standard and if it was the same (if not stated explicitly it will result in unclear risk of bias for flow and timing)
- How were those who applied the index test blinded to the results of the reference standard
- How were those who applied the reference standard blinded to the results of the index test
- Link or registry number for study protocol
- To what degree was the algorithm followed (see Ellebrecht and colleagues for example of reporting)[5]

Results

Finally, the standardised protocol should handle the heterogeneity of the results.
Most importantly, it should state a preferred outcome measure. All studies adhering to the protocol should be required to report the preferred outcome measure as a minimum. A common outcome measure is crucial to obtain comparable results.

The standardised protocol should also consider what quality parameters should be examined. We believe that the body of evidence would be able to point us more strongly towards the best triage system, if time consumption and overall patient flow of the simulation is considered in future studies too.

References

1. Juncken K, Heller AR, Cwojdzinski D, et al. Verteilung der Sichtungskategorien bei Terroranschlägen mit einem Massenanfall von Verletzten. *Unfallchirurg*. 2019;122(4):299-308.
2. Kahn CA, Schultz CH, Miller KT, Anderson CL. Does START Triage Work? An Outcomes Assessment After a Disaster. *Ann Emerg Med*. 2009;54(3):424-430.
3. Vassallo J, Smith JE, Bruijns SR, Wallis LA. Major incident triage: A consensus based definition of the essential life-saving interventions during the definitive care phase of a major incident. *Injury*. 2016;47(9):1898-1902.
4. Montan KL. Triage. In: Lennquist S, ed. *Medical Response to Major Incidents and Disasters, a Practical Guide for All Medical Staff*. 1st editio. Springer-Verlag Berlin Heidelberg; 2012:63.
5. Ellebrecht N, Latasch L. Paramedic triage during a mass casualty incident exercise. *Notfall & Rettungsmedizin*. 2012;15(1):58-64.