PREHOSPITAL CARE

Triage decisions of prehospital emergency health care providers, using a multiple casualty scenario paper exercise

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Objective: To examine the accuracy of theoretical triage decision making among emergency prehospital health care professionals, using a multiple casualty paper exercise.

Methods: A standardised 20 casualty paper exercise requiring each casualty to be prioritised for treatment was given to 100 doctors, 59 nurses, and 74 ambulance paramedics who could potentially be involved at the scene of a multiple casualty incident. Each paper was scored using the triage sieve algorithm. The paper contained descriptions of two casualties regarded as dead, six priority 1 casualties, six priority 2 casualties, and six priority 3 casualties.

Results: There was no significant difference in the scores received by both doctors and nurses, but paramedics did significantly less well than both nurses and doctors ($p<0.05$) However, the actual difference in mean scores is only just over 1; both doctors and nurses had a mean score of 13.03 and paramedics a mean score of 11.83. All professional groups tended to over triage patients. While there was no significant difference between doctors and nurses there was a significant difference ($p<0.001$) between paramedics and both doctors and nurses.

Conclusions: There is little difference in the accuracy of triage decision making between the professional groups, with doctors and nurses scoring marginally better than paramedics. The rates of over triage are high posing the risk of overwhelming available resources further. Under triage rates are also high, with potentially life threatening conditions going unrecognised. However, some margin of error may be accounted for by the untested validity of the triage sieve methodology.

Over the past 15 years there have been a number of serious, high profile incidents, in the United Kingdom, which have involved extremely large numbers of injured people. A catalogue of some nine incidents, involving 773 injured, over this time frame, such as Kings Cross, Hillsborough, and Kegworth, is cited elsewhere.[1] At a local level such incidents are frequently regarded as a being extremely rare and unlikely to occur, as Auf der Heid describes "low-probability events".[2] However, incidents involving smaller but still significant numbers of victims, which place extreme demands on the emergency services, but do not generate national media interest, carry a much greater probability. This is a fact borne out in local and regional news media.

Absolute numbers of victims are initially unimportant once demand for treatment outstrips the supply of skilled emergency health care providers. An ambulance crew or immediate care doctor first on scene at an incident with three seriously injured people has to make decisions about priorities for treatment just as if there were 30 or 130 victims. The underlying principle in such circumstances is that the greatest good for the greatest number should be achieved.

This decision making process is commonly termed triage, and has been described as the sorting of medical conditions into different categories to achieve a true priority of care.[3] Yet this terminology does not have a universal interpretation. Researchers[4] in the USA in the early 1980s found that triage was associated with a wide range of patient handling activities during disasters. If, however, triage was considered to be the prioritisation of victims based upon assessment of need, the evidence suggested this rarely occurred.[4] Certainly in the UK there is an expectation that triage should be carried out at the scene of a major incident, and both the NHS Executive in England and Ambulance Service Association make reference to on scene triage,[1 5] yet neither document outlines what exactly is meant by triage. This can only lead to confusion—who should be performing triage, what form of triage should be used, triage for treatment (triage sieve) or for transportation (triage sort), should other models of triage be used, what skills should prehospital emergency care providers be taught? It is entirely possible that each provider on scene is using a different approach to triage without universal understanding.

For resources to be most usefully deployed to do the greatest good for the greatest number, not only has triage to be carried out, it must be performed well. Kennedy *et al* suggest that incorrectly performed triage may hinder attempts to moderate the outcome.[6]

The study aimed to determine the accuracy of theoretical triage decision making among emergency prehospital health care professionals, using a tabletop exercise. In identifying erroneous decision making and exposing areas where mistakes are commonly made it may be possible to provide a focus for triage training of prehospital emergency care providers.

METHODS

Sample

Subjects were recruited to the study, using a sample of convenience, representing three professional groups who potentially could be required to perform triage for treatment at the scene of a multiple casualty incident.

Doctors, nurses, and paramedics included in this study were either candidates or faculty members on three prehospital emergency care (PHEC) courses conducted by the British Association for Immediate Care education section (BASICS education).

In addition to those completing the PHEC course, immediate care doctors were recruited via those immediate care

	Patients	Priority
1	40 year old male, unresponsive, no breathing, pulse 120, compound fractured femur. His airway has been opened and has been placed in the recovery position by a member of the public	DEAD
2	32 year old male, conscious, fractured radius and ulna, multiple lacerations, respiratory rate 20, pulse 90. He has made his way from the vehicle and is sitting at the roadside	P3
3	35 year old female, conscious, bilateral fractured femurs, respiratory rate 22, pulse 115	P2
4	30 year old female, conscious, severe bruising to chest, unable to move because of the pain, respiratory rate 28, pulse 100. She remains in the vehicle	P2
5	28 year old female, unresponsive, blood from nose and right ear, noisy respiration at a rate of 30, pulse 100	P1/2
6	8 year old male, very distressed, lacerations to head, respiratory rate 26, pulse 90, rushing between patient 2 and patient 5	P3
7	55 year old male, conscious, sucking chest wound, respiratory rate 32, pulse 120	P1
8	35 year old male, conscious, multiple fractures, respiratory rate 28, pulse 130, remains trapped in the vehicle	P1
9	50 year old female, wandering around in a distressed state, uncooperative – unable to determine respiratory rate or pulse	P3
10	20 year old male, conscious, in considerable pain, fractured tibia and fibula, respiratory rate 18, pulse 90, remains trapped in vehicle	P2
11	22 year old female, conscious, paradoxical respiration, respiratory rate 32, pulse 100, remains in vehicle, but is not trapped	P1
12	30 year old female, conscious, scalp laceration, respiratory rate 20, pulse 90, unable to get out of the vehicle because of tangled wreckage and trapped casualties	P2
13	40 year old female, severe laceration to upper extremity, leg injury, unable to move, heavy blood loss, respiratory rate 20, pulse 130	P2
14	52 year old male, unresponsive, respiratory rate 8, pulse 100	P1
15	45 year old male, conscious, multiple lacerations, unable to move from his current position laying on the floor, no sensation in the lower extremities, respiratory rate 18, pulse 110	P2
16	20 year old female, no apparent injuries, unresponsive, placed in recovery position by a member of the public, no breathing, no pulse	DEAD
17	30 year old male, blood leaking from nose and ears, restless and disorientated, wandering about, respiratory rate 18, pulse 90	P3
18	15 year old male, trying to help other casualties, multiple lacerations, bruising to chest, respiratory rate 20, pulse 110	P3
19	60 year old male, bruising to abdomen, unable to move due to abdominal pain, respiratory rate 26, pulse 115	P1
20	18 year old female, large flap laceration to upper arm, respiratory rate 26, pulse 115	P3

Figure 1 You are the first on scene of a road traffic accident, a mini bus has been in collision with a tree. There are a number of casualties, who are detailed in the figure. Based upon the information provided triage the patients assigning a priority for initial treatments, using the following catergories; priority 1—immediate (P1), priority 2—urgent (P2), priority 3—delay (P3), dead (Dead).

schemes that were in regular contact with the British Association for Immediate Care (BASICS) headquarters. Nurses were predominantly recruited from accident and emergency (A&E) departments (84.2%, n=48) that had made provision to provide a mobile medical and nursing team at the request of the ambulance service. One A&E department was approached directly while other nurses were recruited when they attended an A&E nursing course or flying squad meeting. Ambulance paramedics represented three ambulance services, two rural and one metropolitan. Paramedics were recruited from individual ambulance stations, while on refresher training course or divisional managers. The number of subjects are outlined in table 1.

Materials

A paper exercise was designed giving brief casualty details of 20 individual casualties, including sufficient information to identify a priority for treatment for each casualty using the triage sieve algorithm (fig 1).

The triage sieve being an algorithm based assessment tool for initial prioritorisation of patients in a major incident. The assessment tool considers four clinical features; the ability to walk, airway patency with simple airway manoeuvres, presence of respiration and respiratory rate, and capillary refill time or pulse rate. Capillary refill rate is preferred to the pulse rate in most circumstances as a means of circulatory assessment as it can be carried out more rapidly than assessment of the pulse seven seconds as compared with 15 seconds

Table 1 Sample

Doctors		
Grade	General practitioner	68 (68)
	Hospital consultant	10 (10)
	Hospital doctor (Senior registrar or below)	22 (22)
Total Number		100
Nurses		
Grade	Sister/Charge nurse	14 (23.7)
	Staff nurse	32 (54.2)
	Other	13 (22.1)
Total number		59
Paramedics		
Grade	Ambulance officer	14 (18.9)
	Leading paramedic	12 (16.2)
	Qualified paramedic	48 (64.9)
Total number		74

Percentages shown in parentheses.

per patient. However, the capillary refill rate is less reliable in very cold conditions or difficult to assess in low light environments. The triage exercise opted to identify the pulse rate rather than capillary refill in each of the descriptors as this could potentially be used in all circumstances, where as environmental conditions may preclude the use of the capillary refill rate.

Procedure

Subjects were asked to complete a questionnaire, which was part of a study looking at triage decision making. In addition to providing biographical information and details of prehospital trauma experience in the preceding 12 months, subjects were requested to complete a 20 case multiple casualty paper exercise (fig 1). Subjects were required to assign a priority for treatment, from one of four possibilities; priority 1–immediate, priority 2–urgent, priority 3–delay, or dead, based upon the descriptor for each case. Subjects were not given direction as to the triage tool they should use or would be used in the marking of the completed papers. The exercise was designed to contain a range of casualties representing all four triage categories in the following proportions; Dead-2, P1–6, P2–6, and P3–6. Subjects were required to complete the exercise independently without conferring with colleagues or using reference materials. A time limit of 10 minutes was imposed, given that triage decision making in the field must be rapid if it is to be of value in sorting large numbers if injured.

The completed papers were scored against a scoring grid (fig 1), produced using the triage sieve algorithm.[1] Each case was scored as correct, incorrect–over triage, or incorrect–under triage. Where the subject failed to provide an answer the case was scored as incorrect–under triage, as in the field these casualties would have not been assigned a priority. Each subject received three scores; total number of cases correctly triaged, total number of cases over triaged and total number of cases under triaged. Not all cases presented the possibility of either over or under triage. For example, it is not possible to over triage a case which is priority 1, likewise it is not possible to under triage a case regarded as dead.

In respect of case 5 both priority 1 or priority 2 were accepted as correct as at least two versions of the triage sieve exist, one accepting a respiratory rate between 10 and 29 as adequate[8] while the other accepting a respiratory rate of between 10 and 30 as adequate.[9] Thus both priority 1 and priority 2 can be correct depending upon which version of the triage sieve is consulted. Neither tool could be regarded as completely accurate and therefore one method is unlikely to be superior to the other in terms of clinical outcome.

RESULTS

Biographical data

Unsurprisingly paramedics had attended far more prehospital trauma emergencies than either doctors or nurses. Many of the doctors and most of the nurses had not attended any prehospital trauma emergencies in the 12 months preceding data collection, while most of the paramedics had attended at least an equivalent of one every two weeks (table 2). Less still were the number of calls where there were five or more casualties involved (table 3).

Triage results

Scores ranged between 7 and 19 (table 4) Of the incorrect responses seven cases could not be over triaged. The frequency of over triage is illustrated in table 5. Two cases could not be under triaged, that is those who are dead. In addition there are six cases regarded as priority 3 who could be under triaged by being regarded as dead, however all these case descriptors suggested the casualty was alive. Therefore eight cases could

Table 2 Prehospital trauma calls attended by the participants in the preceding 12 months

	None	<25	<50	<100	<250	<500	<1000	>1000
Doctor	21% (n=21)	66% (n=66)	8% (n=8)	4% (n=4)	1% (n=1)			
Nurse	71.2% (n=42)	23.7% (n=14)	3.4% (n=2)					
Para	2.7% (n=2)	54.7% (n=41)	8% (n=6)	5.3% (n=4)	13.3% (n=10)	8% (n=6)		1.3% (n=1)

Table 3 Prehospital trauma incidents attended by the participants during the preceding 12 months involving five or more casualties

	None	1	2	3	4	5	6	7	10	15	20	25	50	125
Doctor	75% (n=75)	8% (n=8)	6% (n=6)	1% (n=1)	1% (n=1)	2% (n=2)			2% (n=2)		1% (n=1)			
Nurse	89.8% (n=53)	1.7% (n=1)	6.8% (n=4)											
Para	41.3% (n=31)	10.7% (n=8)	12% (n=9)	2.7% (n=2)	1.3% (n=1)	1.3% (n=1)	4% (n=3)	1.3% (n=1)	5.3% (n=4)	1.3% (n=1)		1.3% (n=1)	1.3% (n=1)	1.3% (n=1)

Table 4 Total number of cases correctly triaged by the participants

	7	8	9	10	11	12	13	14	15	16	17	18	19
Doctor		3% (n=3)	3% (n=3)	10% (n=10)	12% (n=12)	17% (n=17)	21% (n=21)	12% (n=12)	5% (n=5)	5% (n=5)	2% (n=2)	4% (n=4)	6% (n=6)
Nurse		1.7% (n=1)	6.8 (n=4)	5.1% (n=3)	16.9% (n=10)	16.9% (n=10)	13.6% (n=8)	10.2% (n=6)	11.9% (n=7)	5.1% (n=3)	6.8% (n=4)	1.7% (n=1)	3.4% (n=2)
Parame dic	1.3% (n=1)	5.37% (n=4)	2.7% (n=2)	10.7% (n=8)	20.7% (n=15)	21.3% (n=16)	2% (n=8)	9.3% (n=7)	4% (n=3)	1.3% (n=1)			

Table 5 Total number of cases (and degree) of over triaged and the percentage over triage by the participants

	0 (0%)	1 (5%)	2 (10%)	3 (15%)	4 (20%)	5 (25%)	6 (30%)	7 (35%)	8 (40%)	9 (45%)	10 (50%)	11 (55%)
Doctor	2% (n=2)	16% (n=16)	23% (n=23)	22% (n=22)	20% (n=20)	8% (n=8)	4% (n=4)	4% (n=4)	4% (n=4)			
Nurse	11.9% (n=7)	10.2% (n=6)	20.3% (n=12)	20.3% (n=12)	13.6% (n=8)	5.1% (n=3)	13.6% (n=8)			3.4% (n=2)	1.7% (n=1)	
Paramedi c		2.7% (n=2)	16% (n=12)	16% (n=12)	16% (n=12)	21.3% (n=16)	10.7% (n=8)	8% (n=6)	4% (n=3)	1.3% (n=1)	2.7% (n=2)	1.3% (n=1)

Table 6 Total number of cases (and degree) of under triaged and the percentage under triage by the participants

	0 (0%)	1 (5%)	2 (10%)	3 (15%)	4 (20%)	5 (25%)	6 (30%)	7 (35%)	8 (40%)	9 (45%)	10 (50%)
Doctor	9% (n=9)	7% (n=7)	13% (n=13)	13% (n=13)	22% (n=22)	19% (n=19)	5% (n=5)	7% (n=7)	1% (n=1)	3% (n=3)	1% (n=1)
Nurse	6.8% (n=4)	8.5% (n=5)	18.6% (n=11)	22% (n=13)	25.4% (n=15)	10.2% (n=6)	6.8% (n=4)	1.7% (n=1)			
Paramedi c	2.7% (n=2)	8% (n=6)	17.3% (n=13)	25.3% (n=19)	24% (n=18)	12% (n=9)	6.7% (n=5)	2.7% (n=2)	1.3% (n=1)		

be regard as not having the potential to under triage, resulting 12 cases that could be under triaged. The frequency of under triage is illustrated in table 6.

Analysis using the one way analysis of variance with Tukey post hoc test shows that both doctors and nurses achieved significantly more correct cases than paramedics, doctors $p<0.05$, nurses $p<0.05$ (F=6.416, df between groups =2, within groups =231). There was no significant difference between the doctors' and nurses' scores. However, the degree of difference is small with the mean score for both doctors and nurses being 13.03 and for paramedics 11.83. A number of subjects had attended one or more courses such as; Advanced Trauma Life Support (ATLS), ATLS observer, Pre Hospital Emergency Care (PHEC), Pre Hospital Trauma Life Support (PHTLS), Major Incident Medical Management and Support (MIMMS), others had received no additional training. There was no correlation between score and any one course or combination of courses. All possible permutations of courses were not demonstrated in the sample.

- Paramedics were significantly more likely to over triage cases when compared with both doctors and nurses;, doctors $p<0.001$, nurses $p<0.001$ (F=13.446, df between groups =2, within groups =231)
- There was no significant difference between the professional groups in relation to frequency of under triage. The extent to which cases were either over or under triaged is illustrated in tables 4 and 5. Six cases emerged as being incorrectly answered by more than 50% of the subjects across the professional groups.
- Patient 1 (over triage 77.5%)
- Patient 8 (under triage 59.4%)
- Patient 10 (under triage 52.5%)
- Patient 12 (under triage 79.1%)
- Patient 13 (under triage 72.6%)
- Patient 17 (over triage 73.8%).

DISCUSSION

Rapidly sorting a number of injured persons, at the scene of an incident, and identifying a priority for care based on clinical need is fraught with difficulty. When faced with a large number of injured, prioritisation for treatment may be based on factors other than clinical need. For example, people may be treated with regard to their location at the incident, those at the periphery treated first, others being treated as the team move further into the incident, and ultimately those at the centre of the incident being treated last. Treatment may be based upon accessibility and mobility of the injured. Thus the walking wounded and non-trapped people may be treated and transported to hospital before the trapped or more seriously injured. This phenomenon seems to have occurred at the Kegworth incident where Allen [10] reports how the first 20 injured patients were removed to hospital by what he regards as "load and go" Neither of these approaches have much regard for clinical need. Other approaches loosely based on clinical need may lack objectivity in decision making—prioritising patients based on apparent severity of injury, or assigning high priority to the sickest and most time consuming patients who are unlikely to survive despite prolonged and high resource interventions. In reality prioritisation of the injured is likely to entail a combination of some or all of these approaches.

While the triage sieve approach may not be perfect, it reduces subjectivity, can be applied consistently, and is likely to be reliable. The validity of the tool is as yet unproven and as such it is difficult to judge the effects of this method or other methods described in terms of patient outcome. However, a systematic approach to patient assessment based upon vital functions and physiological parameters is likely to be as effective as other approaches, if not better and lends itself to subsequent evaluation of outcome.

The use of the paper triage exercise effectively forces the subject into attempting to formulate a triage decision for each individual patient. The prioritisation based upon the location of the patient at the incident site cannot occur. It would be possible for the subject to sort the patients based on their ability to walk, as detailed in the patient descriptors. Again this is unlikely to occur in the paper exercise as they are requested to assign a priority to each patient and not just to identify those patients to remove to hospital first. Prioritisation of patients based upon the perceived severity of injuries is possible during the triage exercise, but descriptions are less powerful than being faced with an actual injured patient. The exercise only gives some insight into the decision making process and which does not necessarily translate into the action that would be taken at the site of an incident. Nor does the exercise expose the subject to the difficulty in determining a respiratory rate or pulse rate in a dark, wet, noisy environment.

Doctors and nurses scored slightly higher than paramedics although several subjects from each professional group were assigning priorities incorrectly for 50% or more of the patients. Errors occurred by both over and under triaging patients; however most errors occurred by over triage, that is assigning the patient a priority higher than that indicated by the triage sieve. It could be argued that it is safer to increase the priority of the patient rather than decrease it. However, if all patients increased priority soon no priority would exist, furthermore there is a risk that unnecessary high priority places greater demands on limited resources possible at the expense of patients who are correctly prioritised in a high banding. The Canadian Association of Emergency Physicians[11] in considering field triage as a tool for identifying life threat to determine if patients should be sent to a trauma or non-trauma centre, suggest that under triage should be below 5% and over triage below 50%. While the purpose of triage in these circumstances is slightly different, parallels may be drawn as the principle of overburdening limited resources or failing to adequately treat those with life threatening injuries is the same. Few subjects had an over triage rate greater than 50% (table 4), however an over triage rate of 50% in a major incident would clearly pose a significant problem for receiving hospitals. In practice it is likely high rates of over triage would be revised by the use of the triage sort, based upon the Revised Trauma Score [12] and the Triage Revised Trauma Score. The Revised Trauma Score generates a coded value for three parameters; respiratory rate, systolic blood pressure, and Glasgow Coma Score. Each value is multiplied by its weighting coefficient, recognising the relative importance of each physiological parameter, the three scores are then totalled to produce the Revised Trauma Score. The Triage Revised Trauma Score recognises the impracticality of undertaking complex calculations at the scene of an incident. The weighting coefficients are not considered, but the sum of the coded values are related to probability of survival. A maximum score of 12 carries a probability of survival of 99.5%, a score of 11 has a probability of survival of 96.9%, and so on to a score of 0, which carries a probability of survival of 3.7%. The triage sort uses this information as an indicator of severity of injury and suggests that patients at the scene of a major incident should be prioritised for transportation to hospital on the following basis; a coded score of 1–10 is prioritised as immediate, a score of 11 is prioritised as urgent, and a score of 12 is prioritised as delayed.

The under triage rates for all three professional groups were generally well in excess of 5% peaking at between 10% to 20% (table 5). While two patients with normal physiological signs were trapped resulting in a priority increased by the entrapment rather than the physiological signs, the extent of under triage is of concern—some patients with potentially life threatening problems are going unrecognised.

Some patients were over or under triaged by more than half the subjects;

- Patient 1—using the triage sieve once the airway has been opened and the patient makes no respiratory effort they would be classified as being dead. Using this methodology assessment of the patients circulation would not be carried out. Given this patient requires more than simple treatment they would monopolise one of possibly only two rescuers and effectively prevent the treatment of those with a simple airway obstruction who have spontaneous breathing when placed in the recovery position for example. Triage of other patients would not be possible if the first person on scene were a sole responder.
- Patient 8—has a circulatory problem resulting in him being a priority 1 patient despite the respiratory rate being within the priority 2 parameter. It may be that subjects failed to recognise the circulatory problem or that the approach of treating those who can be moved first.
- Patient 10—has physiological signs that place him as a priority 3 patient, however as he is unable to walk his priority must be 2 or above. Again subjects may have under triaged the patient because of the normal physiology or because they aimed to treat those who can be moved first. It may be argued that the subjects are correct in assigning a priority 3 based on the physiological signs and that the triage sieve over triages this particular patient.
- Patient 12—is essentially the same as patient 10.
- Patient 13—has a circulatory problem resulting in her being a priority 1 patient despite the respiratory rate being within the priority 2 parameter. It may be that subjects failed to recognise the circulatory problem and established priority on the airway and respiratory parameters alone.
- Patient 17—is a priority 3 patient based upon the triage sieve, however it is probable that subjects have used a degree of clinical judgement and upgraded the patient based on suspicion of other potentially life threatening problems. Again this brings into question the reliability of the triage sieve for this patient.

In conclusion, there seems to be little difference in the accuracy of triage decisions between doctors, nurses, and paramedics measured against the triage sieve, however doctors and nurses did achieve higher scores than paramedics. While there is a tendency for all groups to over triage patients at the risk of overwhelming limited resources further there are substantial numbers from each professional group who under triage significant numbers of patients with potentially life threatening conditions. However, the validity of the triage sieve assessment tool may have an important impact on the interpretation of over and under triage. Alternative methods of triage using validated trauma scoring tools require time consuming patient assessment and mathematical calculations thus making them impractical for the triage at multiple casualty incidents. While the validity of the triage sieve methodology may not be tested the tool does provide a framework, based on physiologically important parameters, which is preferable to triaging patients by their location at the incident or the apparent severity of their observable injuries.

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