

ORIGINAL ARTICLE

Triage rapid initial assessment by doctor (TRIAD) improves waiting time and processing time of the emergency department

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Emerg Med J 2006;23:262–265. doi: 10.1136/emj.2005.025254

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Accepted for publication 4 October 2005

Aim: To evaluate the effect of triage rapid initial assessment by doctor (TRIAD) on waiting time and processing time of an emergency department (ED) without extra staff.

Method: A senior emergency doctor was put into triage instead of a consultation cubicle for seven shifts of 9 hours each. All the patients were assessed and necessary interventions started at the time of triage. Waiting time and processing time of various categories of patients were compared with a control group that was sampled during the week before the trial period.

Results: In total, there were 1310 cases in the trial period and 1355 controls. Over a quarter (27%) of the patients received triage doctor interventions. The average waiting time was reduced by 38% and the average processing time by 23%. Patients without triage intervention also had a 24% shorter waiting time because of overall improvement in efficiency. Trauma patients and patients needing radiography particularly benefited from the new system. The waiting time and processing time of category 4 and 5 patients improved significantly as a result of more efficient processing of more urgent cases.

Conclusion: The waiting time and processing time of the ED were greatly reduced by TRIAD without extra manpower.

Emergency departments (EDs) in Hong Kong have for decades been frustrated by the problems of overcrowding and long waiting times. Health providers attribute long waiting times to public misuse of the emergency service. Schemes aimed at educating the public about this have been carried out but have not improved the situation; regardless of health providers' viewpoints, patients still perceive their problems to be emergencies. The situation in Hong Kong is further complicated by the lack of comprehensive and systematic primary healthcare, and consequently the ED has become a common entry point to the public healthcare system.

We have adopted the Manchester triage system for many years. This system aims to identify potential life threatening emergencies from vital sign parameters and a brief history. Using this method, about 75% of the patients are triaged as category 4 (semi-urgent) or 5 (non-urgent). It is these groups of patients that have the longest waiting times and highest levels of patient dissatisfaction and complaints. We have taken triage as the starting point of our patient care whereas patients usually regard the time of consultation by a doctor as the endpoint of waiting. Our triage system focuses on vital signs and life threatening emergencies. This categorisation can be misleadingly reassuring as early signs may be absent in spite of acute problems. For example a patient may have stable vital signs and be triaged as category 4 (semi-urgent) in spite of a bleeding wound, severely painful renal colic, parental anxiety for a feverish child, or an expanding aortic aneurysm presenting as backache.

Because of financial constraints on the public healthcare system, the problem cannot simply be tackled by increasing staffing levels in the ED. We believe that triage is a breakthrough point for improving the service. A previous local study has shown that radiography initiated by the triage nurse reduces the processing time for low priority patients.¹ We suggest taking this a step further by putting an experienced doctor into triage, so that they can promptly identify potential emergencies and patients' ailments, and initiate timely investigation and treatment at this stage. We

designed a trial of triage rapid initial assessment by doctor (TRIAD) to test the efficacy of this concept.

METHODS

The aim of the study was to measure the effect on waiting time and processing time of putting a senior emergency doctor in triage to screen patients and to initiate prompt investigation and treatment. There was no additional staff provision.

The trial was carried out in a district hospital ED with an average daily attendance of 400 patients. The day shift (from 0800 to 1700) with average hourly attendance of 22 patients was chosen as the trial period. The trial involved no additional intervention treatment or consent of patients, merely a change in timing of such necessary interventions. All patient details remained confidential. There was therefore no requirement for ethical approval.

TRIAD is a team triage system incorporating a three person team composes of a doctor, nurse, and healthcare assistant. The nurse triages patients as usual by documenting vital signs, taking a brief history, and allocating patients to triage categories. The doctor assesses the patients at the same time and initiates necessary investigations and treatments. The healthcare assistant helps the nurse in carrying out observations and directing patients to designated cubicles or the radiography department. For consistency, one emergency doctor with 8 years' experience in emergency medicine took the role of triage doctor in the study. He was stationed at triage for 9 hours per day (from 0800 to 1700) for seven consecutive days. To achieve a fair comparison, duties were adjusted to ensure that the staffing levels during the trial and the control periods were identical. The time period of 7 days immediately prior to the trial period was used as the control period.

Additional equipment introduced at triage consisted of a computer workstation with printer, a complete set of document trays, facilities for brief physical examination including a couch and screen, and blood sampling equipment.

Abbreviations: ED, emergency department; TRIAD, triage rapid initial assessment by doctor

Data analysis

Patient identity, triage category, waiting time, and discharge time were captured by the current computer system used by all Hong Kong EDs and was generated with the help of computer technical support staff in the hospital authority headquarters office. Interventions initiated by triage in the trial period were identified by inputting a specific code on the ED record sheet. The data was then pooled using SPSS computer software (SPSS Inc., Chicago, IL, USA) for analysis. The performance on waiting times and processing times was compared and analysed.

Definitions

The efficiency of the ED was assessed against waiting time and processing time. Waiting time is usually defined by the duration from the time a patient registered in the ED to the time they were seen by a doctor. In TRIAD, the doctor triage was considered to be the end of waiting time under the following circumstances:

- Radiograph ordered.
- Injection given for pain control or other symptom relieving purpose
- Direct discharge from ED with or without referral
- Direct admission by the triage doctor
- Blood sampling after taking of brief history and physical examination at the triage
- Thorough inspection of minor wounds or injuries and definitive treatment ordered at the triage.

End waiting time was not entered for:

- Triage ordering of electrocardiogram
- Urine test
- Finger pricking for blood sugar
- Oral panadol for fever.

Our rationale for these definitions of end of waiting was based on the concept that only interventions that could be initiated by a doctor alone could be interpreted to end of waiting. An intervention that had been ordered by the triage nurse in our ED would not be counted. This would make the waiting times during the trial period and the control period comparable.

Processing time was defined as the duration from registration to leaving ED, which included discharge home, admission to hospital, admission to the observation ward, or certification of death.

RESULTS

Cases and controls

In total, there were 1310 cases and 1355 controls. The parameters of cases and controls were statistically comparable (table 1). There were slightly more critical cases requiring management in the resuscitation cubicles during the trial period, but the difference would not bias the results unfavourably.

Triage interventions

Of the 1310 patients in the trial period, 358 cases (27%) had interventions initiated by the triage doctor. Individual patients may have received more than one type of intervention. There were 167 radiographs ordered at triage, and 70 patients received injections for symptomatic relief at the time of triage. The triage doctor arranged the direct admission of 38 patients to the hospital following initial assessment, and treated and discharged 78 patients. Thus, 116 patients in total had their complete ED management directly from the triage doctor. This accounted for 9% of the total attendance. Minor triage interventions included blood sampling, removal of neck collar and spinal board, insertion of intravenous lines, prescription of albuterol sulfate inhaler, and insertion of urinary catheter.

Overall waiting time

Waiting time was significantly shorter in the trial period (table 2). The average waiting time was reduced by 38%. We compared the waiting time for those who did not receive triage intervention during the trial period and found that the waiting time for this group was 24% shorter than the control group. This showed that those patients who did not have any triage intervention still benefited from an overall reduction in waiting time.

Overall processing time

The average processing time for trial period was 23% shorter than the control period. Patients who did not receive triage intervention also had a shorter processing time because of the improved efficiency (table 2).

Trauma patients

In the control period, the waiting and processing times for trauma patients were slightly longer than those for non-trauma patients but the difference was not statistically significant. In the trial period, the waiting and processing times for trauma patients were significantly shorter than those for non-trauma patients (table 3). The waiting time was reduced by 60% and the processing time by 39%.

Radiography

For patients requiring radiographs, the average processing time was shortened by 18 minutes. This result corresponds

Table 1 Comparability of cases in trial period and control period

	Trial period	Control period	Remark
Total number of patients	1310	1355	—
% (n) of cat1 patients treated in the resuscitation cubicles	1.6% (21)	0.7%(9)	p=0.027 (Fisher's exact test)
Total time patients spent in resuscitation cubicles*	506 minutes	228 minutes	
Cumulative % (n) of cat. 1, 2, and 3 patients	25.3%(331)	25.5%(346)	—
Staff members	3 SMOs per shift (1 in observation ward, 1 in follow up clinic and 1 in triage) 4 MOs on Monday and Friday, 5 MOs on other days (all attending ED patients)	3 SMOs per shift (1 in observation ward, 1 in follow up clinic and 1 attending ED patients) 4 MOs on Monday and Friday, 5 MOs on other days (all attending ED patients)	The average number of nurses in each shift was the same for the trial and control periods
Trauma case (%)	261(19.9%)	241(17.8%)	—
XR cases (%)	481(36.7%)	470(34.7%)	—
Admission(%)	373(27.7%)	350(26.9%)	—

SMO, doctors at senior medical officer level; MO, doctors at medical officer level.; cat, category. *Total processing time of all resuscitation cubicle cases; —, no statistically significant difference.

Table 2 Waiting time and processing time of trial period and control

	Trial period			Control period
	Total	TDI	No TDI	
Numbers	1310	358	952	1355
Mean waiting time (minutes)	29*	4*	38*	47
Mean processing time (minutes)	72*	63*	75*	93

*Statistically significant difference by two tailed *t* test, $p < 0.001$. TDI, patients received triage doctor interventions; no TDI, patients did not receive triage doctor intervention.

with findings from a similar study previously carried out in the department.¹ The average waiting time for this subgroup was reduced by 50% and the processing time by 18% (table 4).

Breakdown of results according to triage category

The waiting time for categories 1, 2, and 3 were the same for the test and control periods. These categories were treated promptly within the existing triage system. Patients in triage category 4 and 5 were shown to be those who benefited most from the TRIAD system. These groups represent approximately 75% of total attendance. The reduction in waiting and processing has shown to be statistically highly significant in these two categories (table 5).

DISCUSSION

In all the EDs in Hong Kong (and the vast majority over the world), triage has been run by experienced nurses. The idea of doctor triage is not new. Baron Dominique Jean Larrey, Napoleon Bonaparte's chief surgeon, was described as the first person to perform triage in the battlefield. Recent studies have addressed the issue of triage, and they shared the common objective to improve the service by reducing the waiting time or processing time. In the study of Partovi *et al*, a moderate improvement in processing time was offset by the relatively high cost of the additional triage officer, who was a senior ED doctor.² Several papers published later also provided positive results in service improvement but all involved extra manpower to provide a triage doctor, and did not give an account of cost effectiveness.^{3,4} All these studies were also carried out for a few days only. Despite promising results, these departments did not continue with the doctor triage system. In the study of Grant *et al*, a doctor led team triage protocol was continued for 3 months but was finally stopped due to shortage of senior staff.⁵ These experiences tell us that doctor triage is good but many departments could not support the cost for extra staff, especially senior doctors.

In this service improvement trial, no extra staff was involved. A doctor who was designated to attend patients in the ED was moved outside to manage triage. This was equivalent to sacrificing one attending doctor for that shift to the triage. The result has shown that such arrangement could improve the efficiency (in terms of waiting time and processing time) of the whole department.

Long waiting times increase the risks from occult emergencies, increases the period of patient suffering, decreases patient satisfaction, and costs valuable time for all waiting patients. The cost effectiveness of reducing the waiting time cannot be accurately computed and its importance should not be underestimated. The processing time may be a more useful measure than the waiting time to reflect the overall efficiency of an ED. A long processing time leads to congestion. In this study, using TRIAD, an average of 18 minutes (38%) reduction in waiting time and 21 minutes (23%) reduction in processing time was achieved without extra staff.

Table 3 Mean waiting and processing time of trauma and non-trauma patients

	Waiting time (minutes)		Processing time (minutes)	
	Trial period	Control period	Trial period	Control period
Non-trauma	29	47	74	92
Trauma	21	52	60	99
<i>p</i> value†	0.013*	0.121	0.008*	0.168

*Doctor triage significantly shortened the waiting and processing times for trauma cases; †two tailed *t* test.

Table 4 Mean waiting time and processing time for radiograph patients

Time (minutes)	Trial period	Control period	<i>p</i>
Waiting	20	40	<0.001*
Processing	82	100	<0.001*

*Statistically significant difference by two tailed *t* test.

Table 5 Mean waiting time and processing time (in minute) according to triage category

Category	Time	Trial period	Control period	<i>p</i>
1 (critical)	Waiting	0	0	
	Processing	25	25	
2 (emergent)	Waiting	5	5	
	Processing	27	45	<0.001*
3 (urgent)	Waiting	14	15	
	Processing	54	65	<0.001*
4 (semi-urgent)	Waiting	30	52	<0.001*
	Processing	76	98	<0.001*
5 (non-urgent)	Waiting	75	116	<0.001*
	Processing	112	146	0.001*

*Statistically significant difference by two tailed *t* test.

In the trial period, the benefit was felt by all patients, whether or not they were subject to a triage intervention. The reason for this can be summarised by the following points:

- Many simple "see and treat" conditions could be directly discharged at triage
- A considerable number of patients could be admitted following after initial triage assessment
- Radiographs were ordered at triage, and were thus already available by the time these patients saw an attending doctor, thus cutting out a rate limiting step
- Treatments for symptom control were initiated at triage. This had taken effect by the time a doctor formally examined the patients, often permitting discharge without time consuming reassessment
- Finally, prompt communication between the senior triage doctor and other attending doctors clarified apparently complicated cases.

As a result of TRIAD, many cases where an intervention was carried out were treated and followed a rapid pathway through the department. This allowed more space and time for all patients, even those who did not have triage interventions.

Trauma patients

Trauma patients accounted for 15–20% of our ED visits. Minor trauma patients are usually triaged to category 4 and have to cope with long waiting times, up to several hours. Our study has demonstrated a system that can dramatically

improve waiting and processing times for these patients. Such an improvement is desirable when the ED serves as the only possible destination for care for this patient group.

Ordering of radiographs and triage interventions

At the time of this study, the triage officer had no prior experience and no standard guideline on which to base his decisions as to who should have a radiograph or an injection at triage. During the trial period, the triage officer ordered 167 of the 481 radiographs taken from the 1310 presenting patients during this period. The difference could be partly accounted by category 1 and 2 cases that were too ill to be sent to the radiography department from triage. The indications for radiography for some others were ascertained after in depth consultation with another doctor. Although only the minority of the radiographs was ordered by the triage doctor, the overall processing time for radiography patients was significantly shortened.

Impact of TRIAD on various triage categories

The results of waiting and processing time gave us a general impression that this triage system mainly benefits lower triage categories. It may therefore be questioned whether an ED triage system should target low priority patients. However, by detailed analysis of our triage interventions, we found that patients in higher triage categories actually received more interventions than those in lower categories (table 6). This finding was supported by shorter processing times in triage for categories 2 and 3, although the waiting times were unaffected (table 5). It is postulated that prompt treatment of category 2 and 3 patients resulted in the overall improvement of waiting time and processing time for the whole department, which is reflected in the findings for category 4 patients.

Criticisms

The 7 day experience of triage officer deeply impressed on us that this is a demanding role. The triage officer was under severe time pressure when hourly attendance exceeded 25 patients, and it was impossible to satisfactorily carry out the task when the hourly attendance rose above 30 for two or more consecutive hours. During these peak hours, the triage officer could not assess all the patients properly and as a result, opportunities for intervention were missed. Working under such time pressure risks making mistakes, however experienced the staff. In this study, we followed the progress of all intervened cases for 1 week and identified one such error. This was the case of a 57 year old woman who was given an intramuscular injection for pain control. She was subsequently found to be on warfarin for chronic rheumatic heart disease, but this had not been disclosed or discovered at triage, as she was unaware that she should not receive intramuscular injections. She required a pressure dressing for the injection site without further complication.

CONCLUSION

TRIAD is a triage system that can improve the waiting time and processing time of category 4 and 5 patients in busy EDs without additional staff. This improvement might reflect improved efficiency of patient processing from category 2 and 3. Trauma patients and patients undertaking radiographs benefited most from this new triage system.

ACKNOWLEDGEMENTS

We would especially like to thank Mr E Kwong from the hospital authority for his technical support in generating the data. We would also like to express their gratitude towards the nursing staff, especially Mr R Chan and Mr. P-F Lau who worked supportively with the triage doctor.

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Table 6 Intervened cases by triage category

Category	Total cases	Intervened cases	%
1	21	0	
2	18	6	33
3	292	94	32
4	890	248	28
5	89	10	11
Total	1310	358	27

N/A, not applicable.

Competing interests: none declared

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COMMENTARY

This paper is another in an increasing trend that examines how we can improve processing in emergency departments. The authors are to be congratulated, especially the saintly doctor who did seven straight shifts in triage.

It is now well established that senior doctor assessment soon after the arrival of the patient improves waiting time and total department time. However, this paper brings out some important points.

- Sustainability: the methods of this paper are clearly not sustainable. Seven straight shifts in triage seeing 22 patients an hour is a herculean feat. Even if this system were to be shared on a rota, it is hard to see how many of us could match this throughput. One variable will be the case mix. It is likely that there was a high proportion of primary care patients in this group.
- Risks: this is an honest paper that has made an attempt to ensure the quality of care. One adverse event in over a thousand is very good. However, most of us who have experience of this model do feel that it is intrinsically more risky than "taking the next card". With increased risk comes increased stress.
- Future research: quantitative research should look to some form of randomised trial. This should address outcomes of patents (including unplanned returns, adverse incidents), and complaints (broken down into waiting time, clinical, and other). There is a major opportunity to undertake some high quality qualitative research among staff undertaking this role. If it is becoming clear that the role is effective, why are we not all enthusiastic about it? The answers will probably be that it is pressurised, stressful, and risky, but that is only an educated guess.

This issue will not go away because we do not like undertaking this role. We need to understand the conditions that will make it work and reduce the stress and risk. Most patients will love it... until something goes wrong!

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Competing interests: none declared