Efficacy of implementation of a 5 scale pediatric triage and acuity scale in pediatric emergency, Saudi Arabia

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ABSTRACT

الأهداف: تقييم فعالية تطبيق آلية الفرز الكندي الخاص بالأطفال وذلك للأطفال الذين يزورون قسم الطوارئ.

الطريقة: هذه دراسة مقطعية تقوم على تقييم جميع الأطفال الذين يزورون قسم الطوارئ خلال فترة 9 أيام في شهر مارس 2010م. وقد تم استخدام نظام الفرز الكندي الخاص بالأطفال (Ped-CTAS). تم تحليل أداء الفرز على أساس مؤشرات الجودة، ومعدل دخول الحالات للمستشفى، ومعدل الإحالة، ومدة الملاحظة والعلاقة بين الفحوصات ومستوى درجة فرز الحالة حسب نظام الفرز الكندي.

النتائج: خلال فترة الدراسة ، تم فرز (3337) مريضاً. وقد كانوا على النحو التالي: 4 مرضى (0.13%) في مستوى الفرز الأول، 1356 (12%) في مستوى الفرز الثاني، 655 (22%) في مستوى الفرز الثالث، 1810 (60%) في مستوى الفرز الرابع و 189 (6%) في مستوى الفرز الخامس. كان معدل المرضى الذين خرجوا دون ان يتم الكشف عليهم 6.25%. وقد تم عمل الفرز لكل حالة خلال مدة 5 دقائق أو أقل لنسبة 97% من الحالات. وضمن المدة المحددة في آلية الفرز الكندي والخاصة بمدة الانتظار للفحص من قبل الممرضة والطبيب، فقد تم الفحص على نسبة 100% من الحالات في الوقت المحدد لمستوى الفرز الأول. كما أن نسبة الحالات التي تحتاج للملاحظة هي 100%، 85%، 53%، 33% و 26% للمستويات1و2 و 3 و 4 و 5 على التوالي. وكانت نسبة المرضى الذين تم إدخالهم إلى المستشفى 100% لمستوى الفرز الأول. كما أنه كلما انخفض مستوى الفرز للحالة (بما يعني أن المرض أكثر حدة وخطورة) فإنها تحتاج للمزيد من استخدام الفحوصات المخبرية والإشعاعية.

الخاتمة: إن نظام الفرز الكندي الخاص بالأطفال هو أداة جيدة لفرز وتصنيف المرضى من الأطفال الذين يزورون قسم الطوارئ، طبقاً لمستويات الفرز المختلفة، ويمكن استخدام مؤشرات الفرز باعتبارها مؤشرات لقياس الأداء بقسم الطوارئ.

Objectives: To evaluate the effectiveness of implementation of the pediatric Canadian Triage and Acuity Scale (Ped-CTAS) for children visiting the pediatric emergency department (ED).

Methods: This cross-sectional study evaluated all children presented to the ED during a 9-day period in March 2010. The Ped-CTAS triage system was used. Triage performance was analyzed on the basis of quality indicators, rate of admissions, rate of referral, observation duration, and relationship between investigations requested and CTAS level.

Results: During the study period, 3,337 patients were triaged. Overall, 4 patients (0.1%) were in triage level 1, 356 (12%) were level 2, 655 (22%) were level 3, 1810 (60%) were level 4, and 189 (6%) were level 5. The left without being seen rate was 6.25%. A triage duration of 5 minutes or less was carried out for 97% of cases. Within the CTAS time objectives, the waiting time to nurse and physician was 100% for cases triaged to level 1. The proportion of cases who needed observation was 100% for level 1, 85% for level 2, 53% for level 3, 33% for level 4, and 26% for level 5. The proportion of patients admitted to the hospital was 100% for level 1. The lower the level (more acute and emergent the condition) the more use of the laboratory and radiological investigations.

Conclusion: The pediatric CTAS triage system is a good tool for categorizing pediatric patients attending the ED. Stratified by triage level, triage indicators can be used as indicators of ED performance.

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Emergency department (ED) triage (a French term meaning "to sort") is used to identify a patient's level of urgency and treat them based on their triage level. Pediatric emergency departments (EDs) frequently become congested with non-urgent patients, resulting in delay in management of patients with more emergent conditions such as those with altered consciousness, respiratory distress, or hemodynamic compromise. The goal of pediatric ED triage is to prioritize patients rapidly and accurately based on acuity so that any critical medical needs can be met in a timely manner. Effective triage ensures that all ED patients are managed safely and assessed accurately according to their presenting condition. Triage is a complex decision-making process, and several triage scales have been designed to guide the triage nurse to a correct decision.[1] Of these, the Australian Triage Scale (ATS), Canadian Emergency Department Triage and Acuity Scale (CTAS), Manchester Triage Scale (MTS), and Emergency Severity Index (ESI) have been used in ED triage by different health institutions.[2,3] The 5-level CTAS has been adopted by the Canadian Association of Emergency Physicians (CAEPs) and National Emergency Nurses Affiliation (NENA).[4,5] The CTAS has 5 acuity levels: level 1 = resuscitation, level 2 = emergent, level 3 = urgent, level 4 = less urgent, and level 5 = non urgent. Level 1 stands for the highest acuity, and level 5 for the lowest acuity cases.

The 5-level CTAS enables rapid patient classification at the time of first contact based on urgency (risk and symptom severity). Each level has a targeted waiting period until the patient is examined by the doctor or to be reassessed again in the triage area to consider the possibility of waiting longer or to be seen immediately by the physician. According to the CTAS standards the expected waiting time is 0 minutes for level 1, 15 minutes for level 2, 30 minutes for level 3, 60 minutes for level 4, and 120 minutes for level 5.[3,6] Inadequate triage training or insufficient standardization of triage processes may lead to less validity or reliability of the triage systems.[7-9] There are review articles that suggest that the use of a valid and reliable 5-level triage system can improve ED operations.[10,11] Recent researchers reported the ability of CTAS to predict ED resource utilization as a measure of validity.[12] In 2005, a joint task force of the American College of Emergency Physicians and the Emergency Nurses Association published a review of the literature on ED triage scales.[13] Based on expert consensus and available evidence, the task force supported the adoption of a reliable 5-level triage scale. The Maternity and Children's Hospital (MCH), Buraidah, Al-Qassim region, Saudi Arabia is a tertiary 300 bed capacity hospital serving a more than 1.2 million population. The estimated number of pediatric patients seen in the ED is 420 patients per day (155,000 patients per year). With time, it is expected that as the total population is increasing there will be an increase in the pediatric patients attending the ED. This mandates the application of a good screening mechanism avoiding the delay of management of critically ill patients. This can be achieved by the implementation of the Ped-CTAS. The CTAS triage system was applied in the ED of MCH in Buraidah since April 2009. This study aims to evaluate the effectiveness of implementation of the pediatric Canadian Triage and Acuity Scale (Ped-CTAS) for children visiting the pediatric ED in Qassim.

Methods. We conducted a cross-sectional study including all pediatric patients, from 0 days to 12 years of age, presenting to the pediatric ED during the period from 12 to 20 March 2010 (9 days). The study was approved by the hospital research committee. Triage was performed by trained nurses who attended triage training courses as well as how to apply the Ped-CTAS system. Data were collected in a special form designed for that purpose. Variables collected include the triage duration, triage level, proportion of patients leaving without being seen by a physician, waiting time to physician, type of cases (namely, respiratory or neurological, gastrointestinal, and so forth). The percentage of cases for whom observation was required, laboratory and/or radiological investigations requested, and rate of admissions were recorded. The relationship between triage level and resource utilization, such as hospital admission rates, length of stay (LOS) and the use of laboratory and radiological investigations were assessed.

Variables were represented in numbers and percentage as appropriate. The Statistical Package for Social Sciences version 16 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. Comparison between the different levels regarding lab investigations requested, x-ray requested, and observation required was carried out. The chi square test was used for calculation of the significance. A p-value of less than 0.05 was considered significant. Odds ratio was also calculated.

Results. During the 9-day study period, 3337 pediatric patients were registered in the ED, but 201 (1%) left without being seen, and 122 patients (0.6%)

were excluded from the analysis due to incomplete information in the data collection sheet. The study sample included 3014 patients of children under 12 years of age who were triaged, assessed by the staff nurses, seen by the physician and had complete data. Overall, 4 patients (0.1%) were in triage level 1, 356 (12%) in level 2, 655 (22%) in level 3, 1810 (60%) in level 4, and 189 (6%) in level 5 (**Table 1**). The largest group of triaged patients were in triage level 4 (less urgent cases). The mean ± standard deviation for triage duration for all levels (ideally must be 5 minutes or less) was 5.1 ± 0.6 minutes. It was less than 5 minutes for 2927 patients (97%), and 6 to 10 minutes for 87 patients (3%) (**Tables 1 & 2**). The mean length of stay (LOS) to physician ± standard deviation for all levels was 31.7 ± 20.4 minutes. The LOS to physician (the proportion of patients who were examined within the CTAS response time objectives) by triage level met the recommended CTAS time objective in 2593 cases (86%), and exceeded the CTAS time objective in 421 cases (14%) (**Tables 1 & 2**). Reassessment of patients who exceeded the objective time by CTAS level in the waiting area was carried out for only 35% of cases (147 patients were reassessed out of 421 who exceeded the objective waiting time).

The most common diagnostic category for pediatric ED visits was respiratory system affections comprising 53% of cases followed by gastrointestinal (26%), ENT (17.2%), musculoskeletal (4.2%), dermatological (2.8%), neurological (1%), genitourinary (1%), hematological (0.7%), infection (0.5%), cardiovascular (0.3%), and endocrine (0.3%) causes. A total of 1,297 patients (43%) were required to be kept in the ED for observation among the total cohort group.

We compared the different levels with each other regarding laboratory and radiological investigations requested, and observations required. Significant differences were found between levels 2 and 4. There were no significant differences between level 4 and 5 regarding laboratory and radiological investigations requested and requirement for observation (**Tables 3 & 4**). The lower the CTAS level (more urgent cases) the more the requirement for observation ($p<0.001$) (**Tables 1, 3, & 4**). Laboratory investigations were performed in 16% of patients, and radiological investigations

Table 2 - Mean and standard deviation for triage duration and time to physician (waiting time).

Triage level	n	Triage duration (mean ± SD), minutes	Time to physician (mean ± SD), minutes
I	4	5.7 ± 1.5	2 ± 4
II	356	5.15 ± 0.7	10 ± 5
III	655	5.1 ± 0.5	23.5 ± 15.5
IV	1810	5.1 ± 0.5	36.7 ± 19.45
V	189	5.14 ± 0.64	54.1 ± 16.8
Total	**3014**	**5.1 ± 0.6**	**31.7 ± 20.4**

Table 1 - Relationship of triage level and triage duration, time to physician, admission rates, observations required, and the need for laboratory and radiological investigations according to the Pediatric-Canadian Emergency Department Triage and Acuity Scale triage scale.

Variables	Level I	II	III	IV	V	Total
			n (%)			
Triage duration						
5 minutes or less	3 (75.0)	338 (95.0)	638 (97.0)	1766 (98.0)	180 (95.0)	**2925**
6 to 10 minutes	1 (25.0)	18 (5.0)	17 (3.0)	44 (2.0)	9 (5.0)	**89**
Time to physician						
0 min	3 (75.0)	0	0	0	0	**3**
15 min or less	1 (25.0)	302 (85.0)	262 (40.0)	0	0	**565**
16 to 30 minutes	0	54 (15.0)	192 (29.0)	972 (54.0)	0	**1218**
31 to 60 minutes	0	0	201 (31.0)	654 (36.0)	146 (77.0)	**1001**
61 to 120 minutes	0	0	0	184 (10.0)	43 (23.0)	**227**
Laboratory investigations requested, yes	4 (100)	206 (58.0)	145 (22.0)	120 (7.0)	6 (3.0)	**481**
X-ray requested, yes	2 (50.0)	147 (41.0)	110 (17.0)	163 (9.0)	4 (2.0)	**426**
Observation required, yes	4 (100)	299 (84.0)	110 (17.0)	599 (33.0)	50 (26.0)	**1062**
Admission, yes	3 (75.0)	62 (17.0)	30 (5.0)	14 (1.0)	1 (0.5)	**110**
Total	**4 (0.13)**	**356 (12.0)**	**655 (22.0)**	**1810 (60.0)**	**189 (6.0)**	**3014**

Table 3 - Comparison between cases in triage level II and IV regarding the requirement for laboratory or radiological investigations.

Level	Lab investigations requested		X-ray requested		Observation required		Total
	Yes	No	Yes	No	Yes	No	
II	206	150	147	209	299	57	**356**
IV	120	1690	163	1647	599	1211	**1810**
Total	**326**	**1840**	**310**	**1856**	**898**	**1268**	**2166**
OR	19.3		7.1		10.6		
95% CI	14.6-25.6		5.5-9.3		7.9-14.3		
P-value	<0.0001		<0.0001		<0.0001		

OR - odds ratio, CI - confidence interval

Table 4 - Comparison between cases in triage level IV and V regarding the rate of admissions and requirement for laboratory or radiological investigations.

Level	Laboratory investigations requested		X-ray requested		Observation required		Admission	
	Yes	No	Yes	No	Yes	No	Yes	No
IV	120	1690	163	1647	599	1211	**14**	1796
V	6	183	4	185	509	139	**1**	188
P-value	0.06		<0.001		<0.06		-	

in 14% of patients. The lower the CTAS level (more urgent cases) the more the utilization of the laboratory and radiological investigations (p<0.001, odds ratio of 16.0 [7-25] at 95 confidence interval [CI]) (**Tables 1, 3, & 4**). Regarding admissions and referral to other hospitals, 110 patients (3.6%) were hospitalized, and 140 patients (4.6%) were transferred to other hospitals. Most referrals (70%) were in triage level 2. The lower the CTAS level (more urgent the case) the higher the rate of admission and referral (p<0.001) (**Table 4**). No patients deteriorated while waiting to be seen by the physician.

Discussion. Emergency department overcrowding impairs health care efficiency regardless of the quality of ED staffing and care processes. It is difficult to identify and isolate the high-risk cases from low risk cases if there is no valid triaging system. It is recommended that the ED should have a valid triaging system, assuring that patients are prioritized by severity and care is delivered within a reasonable time frame.

It is important to carryout reassessment if the patient is not seen in the correct time according to the triage level, or if the patient exceeded the length of stay (LOS) in the ED. The waiting area should be in front of the staff for them to observe patients while waiting to be seen by the physician. The main goal of triage in the ED is to prevent a situation where a patient could deteriorate while waiting to be seen by the physician.

There are a number of triage systems that have been developed for adults ED. The MTS, the ESI, the Ped-CTAS, and the ATS are commonly used triage systems and contain specific parts for children. The optimal triage system is difficult to be determined. There are some reviewers reporting that the MTS or the Ped-CTAS both seem to be valid and reliable to triage children in pediatric emergency care.[12]

The CTAS was developed in the late 1990s by the Canadian Association of Emergency Physicians and National Emergency Nurses' Affiliation.[7] In 2001 the Ped-CTAS was first published,[14] and it was then revised in 2008.[15] Studies have shown that the Ped-CTAS has moderate to good reliability and validity.[12,16,17] The CTAS, a 5-level triage scale for classifying the acuity of a patient's condition, is based primarily on the patient's presenting complaint.[3] In the 2008 update of the Ped-CTAS, there is more focus on the timely reassessment of patients waiting to be seen to make sure that delayed patients are safe.[15]

Our study demonstrated that triaging patients with the 5-level triage system led to greater discrimination of patients who will require laboratory and radiological investigations, and those who need admissions or referrals. Examining the correlation between CTAS acuity and admission rates, previous studies report that the hospitalization rates were 45-100% for cases in triage level 1, 15-37% for those in level 2, 2.5-14% for those in level 3, 2-4% for those in level 4, and 0-2% for those in level 5.[12,17,18] A valid triage system is necessary to identify patients who are in greatest need for medical attention, to minimize delays in patient care, and to define the department's acuity.

The study demonstrated that patients triaged at lower levels (level 1 and 2) appeared to require observation more than those at level 4 and 5. They also required more use of laboratory and radiological investigations (**Tables 1, 3, 4**). In our study, we found that 60% of patients attending the ED are in triage level 4 (non emergent cases), which means that this percentage of patients can be dealt with in the Primary Health Care setting (PHC). There were significant differences between level 2, as a representative of urgent cases, and level 4, as a representative of non-urgent cases, regarding laboratory and radiological investigations requested, and observations required (**Tables 3 & 4**). The relationship between patient acuity level and

outcome depends on surrogate outcome markers, and the impact of confounding factors such as patient types and complexity, patient volumes, rates and surges of patient presentation, and efficiency of care provided. During the triage process, it was observed that there was confusion regarding the triage of patients to either level 4 or 5. Other observers documented this also. This could be related to inadequate training of the triage nurses or ambiguity in the criteria for triaging patients to either triage 4 or 5.[19]

With a valid system, administrators can better define resource needs, compare sites and regions, and perform benchmarking comparisons. The process of triage and acuity assignment is dynamic and should involve multiple reassessments, and possible reassignments of a CTAS acuity level.[3] The CTAS triage system can be used in predicting the ED physician staffing needs.[20]

Reassessment should be carried out for all patients who exceeded the objective time by CTAS level in the waiting area. In our study, it was carried out for only 35% of cases (147 patients were reassessed out of 421 patients who exceeded the objective waiting time). This can be improved by proper training of the triage team. There is a need to develop a strategy to educate the ED team on the triage system used in their hospitals. It is better to use the Ped-CTAS to improve standardization until we can have a modified triage system that suits national needs. In some countries; for example, in Taiwan they implemented a modification of the Ped-CTAS to meet their national needs, allowing them to create a 5-level Pediatric Taiwan Triage and Acuity System (Paed-TTAS).[21] A computerized triage system (eTRIAGE) is available and showed a better agreement in correct triage outcome, compared with the usual noncomputerized method of ED triage.[22-24] Previous research has shown that an electronic triage tool is easy to learn, and is readily accepted by triage nurses.[25] The length of stay suggested by the Ped-CTAS to be seen by physician matches with the severity of the disease (Ped-CTAS level). During our experience in applying the Ped-CTAS for pediatric emergency triage, we found that no patients deteriorated while waiting to be seen by a physician.

Study limitations. The study is a single center, and of a limited time. It is not a blind study with no intra-observer and inter-observer variability assessment.

In conclusion, the application of a more accurate acuity and triage system for use in pediatric emergency care should provide greater patient safety and more timely utilization of appropriate ED resources. According to the severity of the disease, the Ped-CTAS triage system is a good tool for categorizing pediatric patients attending the ED. The 5-level triage system is a good tool predicting the utilization of medical resources. This study demonstrated good correlation among CTAS scores and patient severity (admission rate) and resource utilization. Reassessment should be carried out for all patients who exceeded the objective time by CTAS level in the waiting area to avoid the presence of patients who might deteriorate while waiting in the triage area. Proper training of the triage team is important for appropriate application of the system. In our study we found that 60% of patients attending the ED are in triage level 4 (non-emergent cases), which means that this percentage of patients can be dealt with in Primary Health Care (PHC) setting.

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