

Implementation of the *Canadian Emergency Department Triage and Acuity Scale* (CTAS) in the Principality of Andorra: Can triage parameters serve as emergency department quality indicators?

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ABSTRACT

Objective: To assess the performance of the newly implemented *Canadian Emergency Department Triage and Acuity Scale* (CTAS) triage system in a redesigned 200-bed community hospital emergency department (ED) and to evaluate the predictive validity of CTAS in this setting.

Methods: Triage system performance was analyzed on the basis of 4 quality indicators: time to triage; triage duration; proportion of patients who left without being seen by a physician; and waiting time to nurse and physician, stratified by triage level and reported as fractile response rates. The predictive validity of CTAS was evaluated by investigating the relationship between CTAS level, hospitalization index, ED length of stay (LOS) and diagnostic test utilization.

Results: During the study period, 32 574 patients were triaged and 32 261 were eligible for study. Eighty-five percent were triaged within 10 minutes, and 98% had a triage duration of ≤ 5 minutes. Waiting times to nurse and physician were within CTAS time objectives in 96.3% and 92.3% of cases respectively. The left without being seen (LWBS) rate was 0.96%. Hospitalization rates were compatible with CTAS standards for adults in Levels I, II, III and V and for children in Level V. Median LOS and laboratory test utilization were highly correlated with CTAS Levels II to V ($p < 0.01$), and similar correlation between triage acuity and imaging utilization was noted in adult patients with non-traumatic non-musculoskeletal complaints ($p < 0.01$).

Conclusions: The CTAS is adaptable to countries beyond Canada and its operating objectives are achievable. Time to triage and fractile response rates can be considered indicators of triage quality and ED performance. CTAS is a valid instrument for predicting admission rates, hospital LOS and diagnostic utilization.

Key words: triage; *Canadian Emergency Department Triage and Acuity Scale*; CTAS; fractile response; utilization

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Received: Oct. 7, 2002; final submission: June 20, 2003; accepted: July 3, 2003

This article has been peer reviewed.

Can J Emerg Med 2003;5(5):315-22

RÉSUMÉ

Objectif : Évaluer les résultats de *L'échelle canadienne de triage et de gravité pour les départements d'urgence* (ÉTG) pour les services d'urgence, système de triage nouvellement implanté, au service d'urgence restructuré d'un hôpital communautaire de 200 lits, et évaluer la validité de l'ÉTG comme prédicteur dans ce contexte.

Méthodes : Les résultats du système de triage ont été analysés selon quatre indicateurs de qualité : la période écoulée avant le triage, la durée du triage, la proportion de patients ayant quitté la salle d'urgence sans avoir été vus par un médecin et la période d'attente avant d'être vu par une infirmière et par un médecin, stratifiée en fonction du niveau de triage et exprimée en fractiles de réponse. La valeur de l'ÉTG comme prédicteur a fait l'objet d'une évaluation s'attachant au lien entre le niveau de l'ÉTG, l'indice d'hospitalisation, la durée du séjour (DDS) au service d'urgence et l'utilisation des examens de diagnostic.

Résultats : Au cours de la période d'étude, 32 574 patients ont fait l'objet du triage, dont 32 261 étaient admissibles à l'étude. Quarante-vingt cinq pour cent ont fait l'objet d'un triage au cours des 10 premières minutes et chez 98 %, le triage a duré au plus 5 minutes. Dans 96,3 % et 92,3 % des cas, respectivement, les périodes d'attente avant d'être vu par une infirmière et par un médecin respectaient les objectifs de l'ÉTG en la matière. Le taux de patients ayant quitté sans avoir été vus par un médecin s'est établi à 0,96 %. Les taux d'hospitalisation étaient compatibles avec les normes de l'ÉTG chez les adultes des niveaux I, II, III et V et chez les enfants du niveau V. Il y avait une étroite corrélation entre les médianes de la DDS et de l'utilisation des tests de laboratoire et les niveaux II à V de l'ÉTG ($p < 0,01$), et l'on a observé une corrélation semblable entre l'exactitude du triage et l'utilisation de technologies d'imagerie chez les patients adultes présentant une affection non musculosquelettique et non traumatique ($p < 0,01$).

Conclusions : L'ÉTG pourrait être adaptée dans d'autres pays et ses objectifs opérationnels sont réalisables. La période écoulée avant le triage et les fractiles de réponse peuvent être tenus pour des indicateurs de la qualité du triage et des résultats des services d'urgence. L'ÉTG est un instrument valable pour prévoir les taux d'admission, la DDS en milieu hospitalier et l'utilisation des examens de diagnostic.

Introduction

An ideal triage system should define how quickly patients need care based on the acuity of their condition, and should also contribute to emergency department (ED) efficiency and effectiveness.¹⁻³ These concepts led to the development of the *Canadian Emergency Department Triage and Acuity Scale* (CTAS).¹ CTAS has five acuity levels — Resuscitation, Emergent, Urgent, Less Urgent and Non Urgent — numbered I to V respectively. It enables rapid patient classification at the time of first contact based on urgency (risk and symptom severity) and likely service intensity required, and it is theoretically applicable any ED.¹

Continuous quality improvement (CQI) methodologies that appraise accessibility, quality, cost, effectiveness and efficiency are now being applied to emergency services,⁴ and the emergency medicine societies of Canada and Australasia have determined that ED triage classification systems can play a key role in quality improvement and performance measurement. Because of CTAS' potential to enhance ED management and performance measurement, triage effectiveness should be monitored using a series of indicators.

This is the first study to evaluate the feasibility and validity of the CTAS outside Canada. Our analysis focuses on triage performance, timeliness of care and predictive validity — the relationship between triage level and resource utilization, defined by hospital admission rates, length of stay (LOS), and laboratory and imaging investigations. Our hypothesis was that more severely ill or injured patients with higher CTAS levels would require more inpatient care, longer LOS and more diagnostic resources. Proving this hypothesis would support the notion that CTAS is not only an acuity indicator, but a predictor of service intensity required. Our objectives were to compare our outcomes with pre-established CTAS triage objectives, and to evaluate the relationship between CTAS triage level and hospital resource utilization (admission rate, LOS and diagnostic testing rates) in both adults and children.

Methods**Setting and patients**

This study was carried out in the ED of the Hospital Nostra Senyora de Meritxell, a 200-bed community hospital in

the Principality of Andorra in Southwestern Europe that treats 32 000 emergency patient visits yearly. All patients who presented to our ED from June 2001 to June 2002 were included for analysis. Main discharge diagnoses were assigned by physicians according to the clinical modification of the International Classification of Diseases, 9th revision (ICD-9-CM).

Intervention

The initial phase of a complex process of ED redesign was the implementation of a new triage system. After a 7-month training period, our fully computerized, CTAS-based triage system was launched on Apr. 7, 2001. In this system, nursing staff triage all ambulatory patients who arrive via the admissions door, and physicians triage those who come by ambulance.

Outcomes

Four quality indicators were used to evaluate the triage system: 1) time to triage, which should be ≤ 10 minutes; 2) triage duration, which must be ≤ 5 minutes; 3) proportion of patients leaving without being seen by a physician, which should be $< 2\%$; and 4) waiting time to nurse and physician. For study purposes, "time to triage" was defined as the interval between registration and triage, "time to nurse" as the interval between registration and first nursing care, and "time to physician" as the interval between registration and physician evaluation. Note that waiting times are also described in terms of fractile response rates, which specify the proportion of patients in each triage level seen within the CTAS time objective for that level.^{1,2}

Key utilization outcomes included hospitalization index (hospitalizations + ED deaths + patient transfers, divided by the total number of patients seen), ED LOS and the proportion of patients having laboratory and imaging tests.

Data analysis

Data were extracted from the computerized triage database and analyzed using SPSS for Windows v. 8.0. Quantitative results are expressed as medians with 95% confidence intervals (95% CI). The statistical significance of observed differences in categorical outcomes was assessed using Chi-squared or Fisher's exact test, as appropriate, while the significance of observed differences for interval data was assessed using the non-parametric Kruskal-Wallis test or Mann-Whitney U test. Odds ratios (and 95% CI) were calculated for each of the triage levels with respect to age, arrival by ambulance, hospitalization index and need for diagnostic tests. A value of $p < 0.01$ was considered significant.

Results

Patients

During the study period, 32 758 patients registered in the ED but 313 (0.96%) left without being seen and 184 (0.56%) were excluded from the analysis due to missing data. The study sample included 32 261 patients — 23 099 (71.6%) adults and 9162 (28.4%) children under 14 years of age — who were triaged, assessed by a physician and had complete data. Of these, 11 156 (34.6%) were victims of accident, injury or poisoning, and 2301 (7.1%) had musculoskeletal or connective tissue diseases. These 13 457 "group 1" patients accounted for 41.7% of the study sample, while the 18 804 group 2 patients (all other ICD-9-CM diagnostic groups) accounted for 58.3%. Overall, 47 patients (0.15%) were in triage Level I, 1051 (3.26%) in Level II, 6376 (19.76%) in Level III, 16 265 (50.42%) in Level IV and 8522 (26.41%) in Level V. Figure 1 shows that 4151 (12.87%) patients arrived by ambulance and that the rate of ambulance arrival ranged from 87% in Level 1 to 3.4% in Level V ($p < 0.001$).

Timeliness of care

Time to triage was ≤ 10 minutes for 27 502 patients (85.3%) and ≤ 15 minutes for 30 961 (95.8%). Triage duration was less than 5 minutes for 31 664 patients (98.2%). The median times to nursing care and physician care were 5 minutes (95% CI, 4–6 min) and 27 minutes (95% CI, 25–29 min) respectively. Table 1 and Table 2 summarize fractile response rates (the proportion of people who were

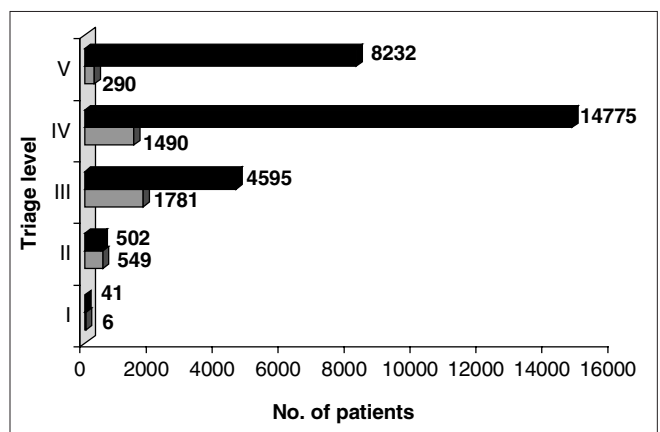


Fig. 1. Relationship of triage level to arrival mode. Level I patients were most likely to arrive by ambulance (odds ratio [OR] = 47; 95% confidence level [CI], 20–110), followed by patients in Levels II (OR = 8.4; 95% CI, 7.4–9.5); III (OR = 3.8; 95% CI, 3.6–4.1); IV (OR = 0.51; 95% CI, 0.47–0.54) and V (OR = 0.18; 95% CI, 0.16–0.20). Black bars = ambulatory (walk-in) patients; grey bars = ambulance arrivals

examined within CTAS response time objectives) by triage level. In our ED, nurses met the recommended CTAS time objective in 31 079 cases (96.3%), and physicians did so in 29 767 cases (92.3%).

Of the 313 “left without being seen” (LWBS) patients (0.96%), 16 (5%) were in Level III, 125 (40%) in Level IV and 172 (55%) in Level V. The median time these patients waited before leaving was 51 minutes (95% CI, 46–59 min). Thirty-five LWBS patients (11.2%) were readmitted to the ED within 72 hours, and 3 were hospitalized. On the second ED visit, 19 patients had the same triage level as on their index visit, 7 had improved and 9 were in a higher triage level.

Disposition and length of stay

Overall, 3114 patients (9.65%) were hospitalized, 29 068 (90.1%) were discharged and 79 (0.25%) were transferred for hospitalization elsewhere. Ten patients (0.03%) died; 8 of these were in triage Level I, including one child. Fewer children than adults were hospitalized (3.61% v. 12.04%) or transferred (0.05% v. 0.32%). Table 3 summarizes the hospitalization index (hospitalization + death + transfer) for children and adults, showing that rates progressively increased from triage Level V to Level I. Hospitalization

rates were within the expected ranges described in the CTAS operating objectives for adults in Levels I, II, III and V, but this was true only for children in Level V (Fig. 2). Table 4 shows that median ED LOS was 70 minutes for the study sample as a whole, and that LOS increased with triage acuity.

Test utilization

Laboratory tests were performed on 22.6% of patients and imaging tests on 44.7%. Fig. 3 shows a strong direct relationship between triage acuity and laboratory testing. This relationship is less clear for imaging rates, which tend to be highest in triage Level I, lowest in Level IV, then rise in Level V (Fig. 3 and Table 5). Table 5 summarizes imaging utilization according to age, diagnostic group and triage level.

Discussion

The primary objectives of triage are to assure that patients are prioritized by severity and that care is delivered within a reasonable time frame. Key measures of triage effectiveness include time to triage, triage duration, time to nurse or physician, and fractile response rates. In this study, we

Table 1. Fractile response* rates: Time to first nursing care

CTAS time objective	% of patients meeting time objectives, by triage level				
	I	II	III	IV	V
Level I: 0 min	97.90	75.80			
Level II: ≤ 15 min	2.10	23.60			
Level III: ≤ 30 min		0.60	97.20		
Level IV: ≤ 60 min			2.80	95.70	
Level V: ≤ 120 min				4.30	99.90
> 120 min					0.10

*Fractile response defines the percentage of patients seen within specified CTAS time objectives for each triage level.

Table 2. Fractile response* rates: Time to physician

CTAS time objective	% of patients meeting time objectives, by triage level				
	I	II	III	IV	V
Level I: 0 min	61.70				
Level II: ≤ 15 min	29.80	91.50			
Level III: ≤ 30 min	8.50	8.50	93.10		
Level IV: ≤ 60 min			6.90	89.40	
Level V: ≤ 120 min				10.60	97.60
> 120 min					2.40

*Fractile response defines the percentage of patients seen within specified CTAS time objectives for each triage level.

showed that CTAS operating objectives are achievable, that measurable triage parameters are useful quality indicators, and that CTAS is a valid predictor for key utilization parameters.

In our institution, time to triage may be longer than necessary because of delays in the registration process, which is not completely computerized. For this reason, many hospitals perform triage before registration. Despite these system concerns, we observed a relatively brief delay of about 5 minutes — mainly in the Less Urgent (Level IV) and Non Urgent (Level V) categories — and the fractile re-

sponse for the time to physician was met for 92.3% of the patients.

Patients who leave without being seen

Depending on the series cited, from 1% to 15% of patients who register in an ED leave without seeing a physician.⁵⁻⁸ LWBS rates increase with waiting times, and waiting time to physician is related to ED efficiency, patient volume and acuity, structural limitations, understaffing and overcrowding.⁹⁻¹¹ It is important to note that ED overcrowding (due to limited access to inpatient services) impairs ED efficiency

Table 3. Hospitalizations, deaths and transfers, by triage level*

Adults (N = 23 099)	No. (and %)	Hospitalized, no. (and %)	Deaths, no. (and %)	Transfers no. (and %)	OR† (95% CI)
Level I	41 (0.2)	24 (58.5)	7 (17.1)	5 (12.2)	51.00 (20–131)
Level II	920 (4.0)	475 (51.6)	0 (0.0)	21 (2.3)	9.80 (8.5–11.2)
Level III	5 101 (22.1)	1 431 (28.1)	1 (0.02)	34 (0.7)	4.80 (4.4–5.2)
Level IV	10 896 (47.2)	699 (6.4)	0 (0.00)	12 (0.1)	0.33 (0.3–0.36)
Level V	6 141 (26.6)	153 (2.5)	1 (0.02)	2 (0.03)	0.14 (0.12–0.16)
Children (N = 9 162)					
Level I	6 (0.07)	4 (66.7)	1 (16.7)	1 (16.7)	
Level II	131 (1.4)	27 (20.6)	0 (0.00)	3 (2.3)	8.41 (5.51–12.84)
Level III	1 275 (13.9)	152 (11.9)	0 (0.00)	1 (0.08)	5.68 (4.54–7.10)
Level IV	5 369 (58.6)	133 (2.5)	0 (0.00)	0 (0.00)	0.44 (0.36–0.56)
Level V	2 381 (26.0)	16 (0.7)	0 (0.00)	0 (0.00)	0.14 (0.08–0.22)

*Hospitalization index = (hospitalizations + deaths + transfers / total no.) × 100.

†Odds ratios (ORs) refer to the odds of (hospitalization or transfer or death) by triage level.

CI = confidence intervals

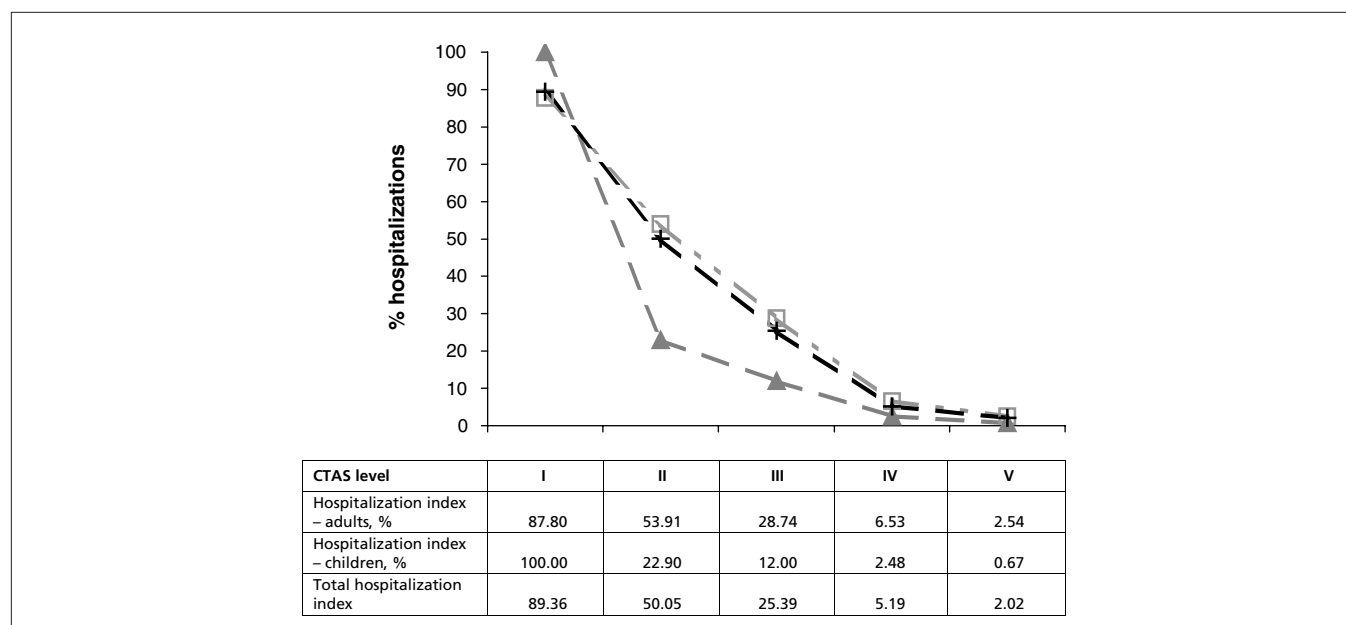


Fig. 2. Hospitalization rate by triage level. Hospitalization rate (index) = (hospitalizations + transfers + deaths / total n) × 100. Grey squares = Hospitalization index (adults); grey triangles = hospitalization index (children); black crosses = Total hospitalization index.

regardless of the quality of ED staffing and care processes. Recognizing the importance of waiting times, many departments have developed “fast-track” systems, which reduce time to physician, LOS and LWBS rates.¹¹⁻¹⁴ In keeping with previous literature, the relatively short wait times to physician seen in this study (median, 27 min) were associated with a 0.96% LWBS rate, well below rates observed in most other studies.⁴

By themselves, LWBS rates are of limited importance. It is more important to know whether high acuity patients leave without necessary care or deteriorate after doing so. A 1990 study reported that 46% of LWBS patients “probably” required physician attention, and that 11% were hospitalized during the following week.⁵ Demetrios and col-

leagues⁹ came to similar conclusions, but other research suggests that relatively few LWBS patients have severe problems.¹⁵⁻¹⁸ Our CTAS triage data enabled us to determine that, of 313 patients who left without being seen during the study period, none were in Levels I or II (Resuscitation or Emergent), and only 16 (5%) were in Level III (Urgent). Moreover, while 35 LWBS patients (11.2%) revisited the ED within 72 hours, only 9 (3%) were triaged into a higher acuity level on their repeat visit and only 3 (1%) were hospitalized.

CTAS as a utilization predictor

Previous authors have suggested that CTAS can predict a patient’s need for hospital-based resources, regardless of their age or the type of hospital.^{1,2} The hospitalization index has traditionally been considered an important indicator of severity, which some scales have related to the patient’s triage level.³ Our study confirms a strong relationship between CTAS acuity level, hospitalization rate, ED LOS and diagnostic test utilization in adult and pediatric patients, although admission rates and diagnostic test utilization are lower for children than for adults in the same triage level. A preliminary study¹⁹ of the Paediatric CTAS² suggests that it may in fact tend to place children in higher acuity categories than previous scales, with a lower capacity to predict the need for hospitalization.

It is important to appreciate that hospitalization rates by

Table 4. Median emergency department length of stay, in minutes

CTAS level	No. of patients	ED LOS* (95% CI)
I	47	176 (101-311)
II	1 051	161 (151-172)
III	6 376	117 (115-120)
IV	16 265	66 (65-67)
V	8 522	55 (54-56)
All	32 261	70 (69-71)

ED = emergency department
 *Length of stay (LOS) differences were statistically significant ($p < 0.01$) except between Levels I and II.

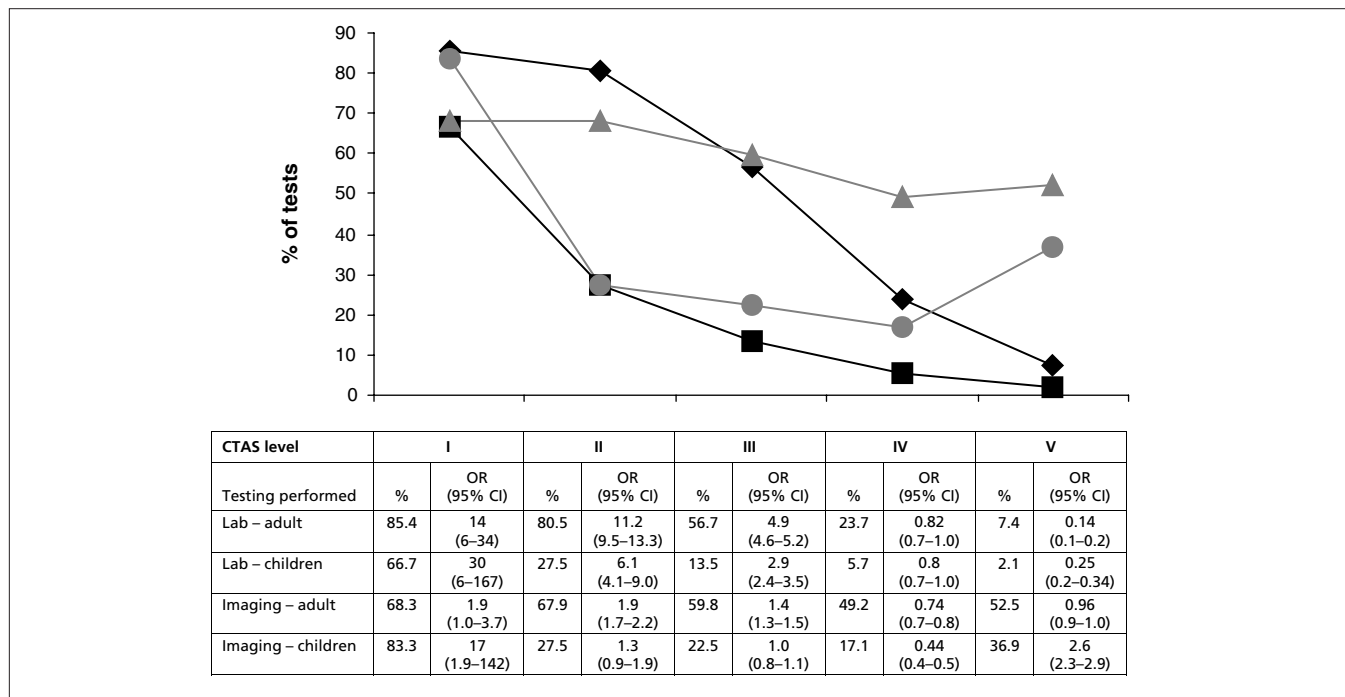


Fig. 3. Likelihood of testing, stratified by triage level. Black diamonds = Lab (adults); black squares = Lab (children); grey triangles = Imaging (adults); grey circles = Imaging (children).

triage level are not objectives or standards. Hospitalization is, however, a marker of illness severity and a “sentinel event” that will reveal differences in triage standards between hospitals and highlight “triage drift” over time. Hospitalization rates and other sentinel events will help to assess inter-hospital triage reliability and assure the comparability of ED case-mix groups across institutions. For example, changing proportions of Level II patients at two hospitals might reflect actual changes in patient acuity or merely different application of triage guidelines. If the former was true, then hospitalization rates within triage levels would tend to remain constant, but if the latter was true, these rates would tend to change.

With respect to diagnostic utilization, we observed a close relationship between CTAS acuity level and laboratory testing in both children and adults. The relationship for imaging modalities was less clear, perhaps because, in the lower triage levels, there was more imaging of minor traumatic injuries while in the higher acuity levels there was more abdominal, thoracic and central nervous system imaging for patients with non-traumatic pathology. The higher imaging rates seen in non-urgent patients with traumatic complaints may also be related to “defensive” behaviour by physicians.

Limitations

This study has limitations. We did not formally evaluate interobserver triage reliability; nor can we comment on inter-hospital reliability and external validity. While we believe the implementation of this triage system enhanced ED efficiency, we did not assess the key outcome parameters prior

to CTAS implementation; nor did we assess the impact of other potentially confounding variables like ED volume, acuity, case mix, LOS and overcrowding, which may have influenced the operation of the triage system and the efficiency of the ED. Future studies will help clarify the value of triage data, along with other administrative data, as indicators of work load, efficiency and to define ED case-mix groupings for benchmarking and comparative purposes.

Conclusion

The CTAS is adaptable to countries beyond Canada, and its operating objectives are achievable. Time to triage and fractile response rates can be considered indicators of triage quality and ED performance. CTAS is a valid instrument for predicting admission rates, hospital LOS and diagnostic utilization.

Competing interests: None declared.

Acknowledgements: We extend our gratitude to our ED members for their dedication and professionalism, to the helpful members of our Informatics Service, to the Servei d'Estudis del Ministeri de Finances, and especially to Mr. Josep Ma Francino as statistical consultant.

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Table 5. Imaging utilization by age, acuity and diagnostic grouping

Group 1*				Group 2†			
	Triage level	Imaged, no. (and %)	Odds ratio (95% CI)		Triage level	Imaged, no. (and %)	Odds ratio (95% CI)
Adults				Adults			
	I	8 (100)	n/a		I	20 (61.0)	2.28 (1.13–4.58)
	II	148 (72.5)	1.29 (0.45–1.76)		II	478 (66.8)	3.19 (2.72–3.74)
	III	1109 (74.0)	1.25 (1.11–1.42)		III	1939 (53.8)	2.21 (2.04–2.39)
	IV	3442 (62.9)	0.67 (0.62–0.73)		IV	1916 (35.3)	0.68 (0.64–0.74)
	V	2704 (70.6)	0.82 (0.76–0.89)		V	518 (22.4)	0.36 (0.32–0.40)
Children				Children			
	I	2 (100)	n/a		I	3 (75.0)	27.84 (2.89–268.00)
	II	13 (52.0)	0.72 (0.33–1.59)		II	23 (21.7)	2.62 (1.64–4.18)
	III	128 (69.9)	1.61 (1.16–2.23)		III	160 (14.7)	1.77 (1.47–2.15)
	IV	560 (49.3)	0.43 (0.37–0.51)		IV	356 (8.4)	0.67 (0.57–0.79)
	V	763 (69.4)	2.08 (1.76–2.46)		V	114 (88.9)	0.88 (0.71–1.09)

*Group 1 includes patients with lesions, traumatic injury, poisoning, or diseases of the musculoskeletal system and connective tissue.

†Group 2 includes all other ICD-9-CM diagnostic groups.

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