

Implementation of a Pediatric Emergency Triage System in Xiamen, China

Gang-Xi Lin^{1,2}, Yin-Ling Yang³, Denise Kudirka⁴, Colleen Church⁵, Collin K K Yong⁵, Fiona Reilly⁶, Qi-Yi Zeng¹

¹Department of Pediatrics, Southern Medical University, Guangzhou, Guangdong 510515, China

²Department of Pediatric Emergency Medicine, First Affiliated Hospital of Xiamen University, Xiamen, Fujian 361003, China

³Department of Emergency Medicine, First Affiliated Hospital of Xiamen University, Xiamen, Fujian 361003, China

⁴Department of Emergency Medicine, Montreal Children's Hospital, Tupper V5L 2N1, Canada

⁵Department of Emergency Medicine, British-Columbia Children's Hospital, Vancouver, BC V5L 2N1, Canada

⁶Department of Emergency Medicine, Mater Children's Hospital, Paddington, Queensland 4101, Australia

Abstract

Background: Pediatric emergency rooms (PERs) in Chinese hospitals are perpetually full of sick and injured children because of the lack of sufficiently developed community hospitals and low access to family physicians. The aim of this study was to evaluate the clinical value of a new five-level Chinese pediatric emergency triage system (CPETS), modeled after the Canadian Triage System and Acuity Scale.

Methods: In this study, we compared CPETS outcomes in our PER relative to those of the prior two-level system. Patients who visited our PER before (January 2013–June 2013) and after (January 2014–June 2014) the CPETS was implemented served as the control and experimental group, respectively. Patient flow, triage rates, triage accuracy, wait times (overall and for severe patients), and patient/family satisfaction were compared between the two groups.

Results: Relative to the performance of the former system experienced by the control group, the CPETS experienced by the experimental group was associated with a reduced patient flow through the PER (Cox-Stuart test, $t = 0$, $P < 0.05$), a higher triage rate (93.40% vs. 90.75%; $\chi^2 = 801.546$, $P < 0.001$), better triage accuracy (96.32% vs. 85.09%; $\chi^2 = 710.904$, $P < 0.001$), shorter overall wait times (37.30 ± 13.80 min vs. 41.60 ± 15.40 min; $t = 11.27$, $P < 0.001$), markedly shorter wait times for severe patients ($2.07 [0.65, 4.11]$ min vs. $3.23 [1.90, 4.36]$ min; $z = -2.057$, $P = 0.040$), and higher family satisfaction rates (94.23% vs. 92.21%; $\chi^2 = 321.528$, $P < 0.001$).

Conclusions: Implementing the CPETS improved nurses' abilities to triage severe patients and, thus, to deliver the urgent treatments more quickly. The system shunted nonurgent patients to outpatient care effectively, resulting in improved efficiency of PER health-care delivery.

Key words: Clinical Application; Emergency Care; Patient Satisfaction; Wait Time

INTRODUCTION

Studies have shown that only about 50.00%–80.00% of the patients seeking care in emergency departments are real emergency cases.^[1-3] Triage is the process of prioritizing patients seeking emergency care based on their condition severity and initial need for care.^[4] This process is intended to allow the truly urgent cases to be handled first, when there are not sufficient resources for all patients to be treated immediately.^[5]

The Canadian Triage and Acuity Scale (CTAS) was developed in the mid-1990s by a group of physicians in New Brunswick based on the Australian National Triage.^[6] It separates patients into the following five levels based on

clinical presentation and severity: Level 1, resuscitation required; Level 2, urgent; Level 3, semi-urgent; Level 4, emergency; and Level 5, nonemergency.^[7] Under this system, all patients' needs are assessed rapidly upon arrival and the Level 1 and Level 2 patients are treated immediately. Pediatric patients can have particularly rapid changes in their

Address for correspondence: Dr. Qi-Yi Zeng,
Department of Pediatrics, Southern Medical University,
Guangzhou, Guangdong 510515, China
E-Mail: zqy_88@163.com

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

© 2016 Chinese Medical Journal | Produced by Wolters Kluwer - Medknow

Received: 22-06-2016 **Edited by:** Peng Lyu

How to cite this article: Lin GX, Yang YL, Kudirka D, Church C, Yong CK, Reilly F, Zeng QY. Implementation of a Pediatric Emergency Triage System in Xiamen, China. Chin Med J 2016;129:2416-21.

Access this article online

Quick Response Code:



Website:
www.cmj.org

DOI:
10.4103/0366-6999.191755

condition, and parents expect them to receive appropriate treatments immediately. Canada developed a pediatric CTAS, based on the original adult CTAS, in 2001. The 2008 revision of the pediatric CTAS is a standard procedure in children's hospitals and pediatric emergency departments across Canada.^[8]

In China, emergency triage lacks operational efficiency and there is a shortage of well-trained triage nurses. Consequently, triage becomes backed up, resulting in some unstable children not being treated on time and avoidable tragic outcomes.^[9] In September of 2011, the Chinese National Health and Family Planning Commission published the "Emergency patients triage guiding principle" guide for classifying patients into the following four levels based on severity and resource demands: Level 1, imminently endangered; Level 2, critical; Level 3, emergency; and Level 4: nonemergency. The guide provides reference ranges for heart rate, breathing, systolic blood pressure, and oxygen saturation in adult patients. However, the guide is not appropriate for pediatric care due to the developmental, physiological differences between adults and children, particularly with respect to airway function, circulatory system, and nervous system.^[10]

China lacks a standard pediatric triage system and its emergency departments often function primarily like 24-h outpatient clinics. As a result, delivery of emergency treatments to patients in the gravest conditions can be delayed. Medical professionals, researchers, and Chinese families alike are keen to see more efficient emergency care for sick and injured children. We implemented the Chinese pediatric emergency triage system (CPETS) in our hospital's pediatric emergency room (PER) in October 2013 and examined its effects on patient care parameters and patient satisfaction.

METHODS

Study aims and patient groups

The aim of the present study was to examine the utility of the CPETS in real-time clinical use in our PER. Toward this aim, we developed a new CPETS modeled on the pediatric CTAS and informed by domestic conditions, as summarized in Table 1. To reduce data artifacts related to seasonality, we compared 6-month periods encompassing the same calendar months. All patients who visited our PER in a 6-month period before (January 2013–June 2013) and a 6-month period after (January 2014–June 2014) implementation of the newly developed CPETS served as the control group and experimental CPETS group, respectively. The control group patients experienced our prior two-level triage system which segregated patients into only two groups, namely, triage into the PER for care versus shunting to the outpatient care clinic.

The control group included 114,040 PER patients (57,523 boys and 56,517 girls) and the CPETS group included 102,969 PER patients (51,936 boys and 51,033 girls). The study design was approved by the review board of First Affiliated Hospital of Xiamen University. Informed consent forms were signed by the patients' parents.

Chinese pediatric emergency triage system

The implementation scheme of the CPETS in our PER is summarized in Figure 1. Briefly, triage Level 1, 2, and 3 patients are directed to waiting area A, near the triage nurse station, and triage Level 4 and 5 patients are directed to waiting area B. Triage nurses completed a 2-month CPETS training course (120 instructional hours) before using the CPETS and associated software in the PER.

Evaluation

The dependent variables compared between the control and CPETS groups included number of PER visits, triage rate, triage accuracy, overall patient wait time, Level 1/2 patient waiting time, and care satisfaction of the patients' families. Triage rate was the percentage of check-in patients for whom a complete triage evaluation, terminating in shunting or PER admission, was made. Triage accuracy was determined by PER physicians confirming and correcting the nurse-assigned triage level. Wait times were calculated for randomly extracted samples from the populations assigned triage levels of 3, 4, or 5 ($n = 100$ per level for each group) and all patients assigned triage levels of 1 or 2. The patients' parents' satisfaction was determined by telephone survey carried out by an independent third party surveyor.

Data collection

Case records were extracted from the hospital computer system. Data for the evaluated parameters were entered into a Microsoft Excel database by two researchers independently. The data entries were cross-referenced, and any gap and inter-user differences were corrected by referring back to the original case records.

Statistical analysis

The data were analyzed in SPSS 13.0 software (SPSS, Inc., Chicago, IL, USA). Mean and standard deviation (SD) were determined for quantitative data. Patient flow trends were analyzed with the Cox-Stuart trend test. Quantitative data were compared between the two groups with Student's *t*-tests. For those nonparametric data Mann-Whitney *U*-test and Chi-square test were used to compare the data. $P < 0.05$ was considered statistically significant in all cases.

RESULTS

The patients visited to PER in control group and CPETS group were similar in terms of gender ratio ($\chi^2 = 0.004$, $P > 0.05$) and age ($t = 0.590$, $P > 0.05$). The percentages of children admitted to and treated in the PER (emergency rate %), rather than being shunted to outpatient care, decreased after implantation of the CPETS (Cox-Stuart trend test, $t = 0$, $P = 0.0156$). The monthly numbers of children subjected to triage rating (total), admitted and treated in the PER (portion of total deemed emergency cases), and referred for outpatient treatment (portion of total deemed not emergency cases) during and between the study periods are reported in Table 2. As shown in Table 3, patients' wait times for care in the PER were significantly shorter in the CPETS group than in

Table 1: Summary of Chinese pediatric emergency triage system levels^[10]

Parameters	Level 1	Level 2	Level 3	Level 4	Level 5
Status	Resuscitation	Severe	Emergency	Urgent	Not urgent
Urgency	0 min	<15 min	≤1 h	≤2 h	>2 h
Age	Neonate, ≤24 h	Neonate, ≤24 h	≤2 months	>2 months	>2 months
Body temperature (°C)	Febrile seizure	E/m: ≥41° Rc: ≥41.5°	E/m: ≥39.5° Rc: ≥40°	E/m: ≥38.5° Rc: ≥39°	E/m: ≥38° Rc: ≥38.5°
Nervous system	Deep coma; seizure	Drowsiness; superficial coma; svr headache; dysphoria; acute paralysis	Altered mental status; <24 h postconvulsion; svr headache	Fully conscious; normal PLR	Fully conscious; normal PLR
Respiration	Acute RD; breathlessness; SpO ₂ <90%; asthma attack; airway FB; acute stridor w/3° laryngeal obstruction	Midrange difficulty breathing; breath shortness; SpO ₂ <92%; hemoptysis; svr asthma attack; obvious stridor	Mild difficulty breathing; midrange asthma attack; 92% ≤ SpO ₂ ≤95%	Breathing slightly fast; no dyspnea; SpO ₂ >95%; mild asthma attack	Smooth breathing
Circulation	Cardiac arrest; serious cardiac arrhythmias; shock	Serious cardiac arrhythmias w/ unstable circulation; heart failure; svr-CP/ oppression; high BP w/ seizure, coma	Acute tachycardia w/normal tension; obvious CP Mid-high BP	Premature beating; thoracalgia	Stable circulation, warm extremities
Digestive/ urogenital systems	Massive GI hemorrhage; svr abdominal distention	Svr dehydration; alimentary tract hemorrhage; abdominal distention; GI FB; acute kidney failure	Midrange dehydration	Mild dehydration	Diarrhea, vomiting without dehydration
Anaphylactic-axis	RD; anaphylactic shock	Marked skin or membrane rash General face swelling	Widespread rashes	Local rashes, swelling	Local rashes
Blood	Coagulation disorder w/ general Bldg	Svr anemia; platelets <20×10 ⁹ /L w/Bldg	Platelets <20×10 ⁹ /L, no Bldg	Midrange anemia; purpura	Mild anemia
Other	Drowning; poisoning; electric shock	Animal bite w/toxicity; Bldg			

RD: Respiratory distress; E/m: Ear/mouth; Rc: Rectal; Svr: Severe; PLR: Pupillary light reflex; SpO₂: Peripheral capillary oxygen saturation; FB: Foreign body; w/: With; CP: Chest pain; BP: Blood pressure; Bldg: Active bleeding; GI: Gastrointestinal.

Table 2: Numbers of pediatric emergency room visitors by month

Months	Number of patients			Emergency rate (%)
	Shunted to outpatient clinic	Admitted to PER	Total	
Pre-CPETS control period				
January 2013	18,161	16,755	34,916	47.99
February 2013	10,331	16,752	27,083	61.85
March 2013	19,097	14,635	33,732	43.39
April 2013	22,788	18,385	41,173	44.65
May 2013	27,343	22,262	49,605	44.88
June 2013	31,776	25,251	57,027	44.28
Post-CPETS experimental period				
January 2014	26,628	17,064	43,692	39.06
February 2014	14,706	9725	24,431	39.81
March 2014	27,778	16,481	44,259	37.24
April 2014	31,710	20,118	51,828	38.82
May 2014	31,651	20,622	52,273	39.45
June 2014	39,934	18,959	58,893	32.19

Note that emergency rate encompasses all patients not shunted to the outpatient clinic (i.e., CPETS Levels 1–4 in the post-CPETS period). CPETS: Chinese pediatric emergency triage system; PER: Pediatric emergency room.

the control group, both overall and for severe (Level 1 or 2) patients.

The numbers of patients triaged, triage accuracy, and patient satisfaction for each group are reported in Table 4. Briefly, the triage rate for the CPETS group (93.40%) was significantly increased compared to that of the control group (90.75%). In addition, triage accuracy calculations indicated that triage accuracy rate was also significantly improved in the CPETS group (96.32% of a sample of 9679 cases) relative to that in the control group (85.09% of a sample of 8978 cases). Finally, patient satisfaction in the CPETS group (94.23%) was significantly greater than that observed in the control group (92.21%).

DISCUSSION

In the present study, we examined the effects of implementing a five-level CPETS on patient care variables and patient satisfaction. We observed positive effects of the CPETS on every variable assessed, including triage rate, triage accuracy, overall waiting time, Level 1/2 waiting times, and parent satisfaction.

Interestingly, although the number of patients who were treated in the PER in the CPETS group was less than that in the control group, there were actually more pediatric

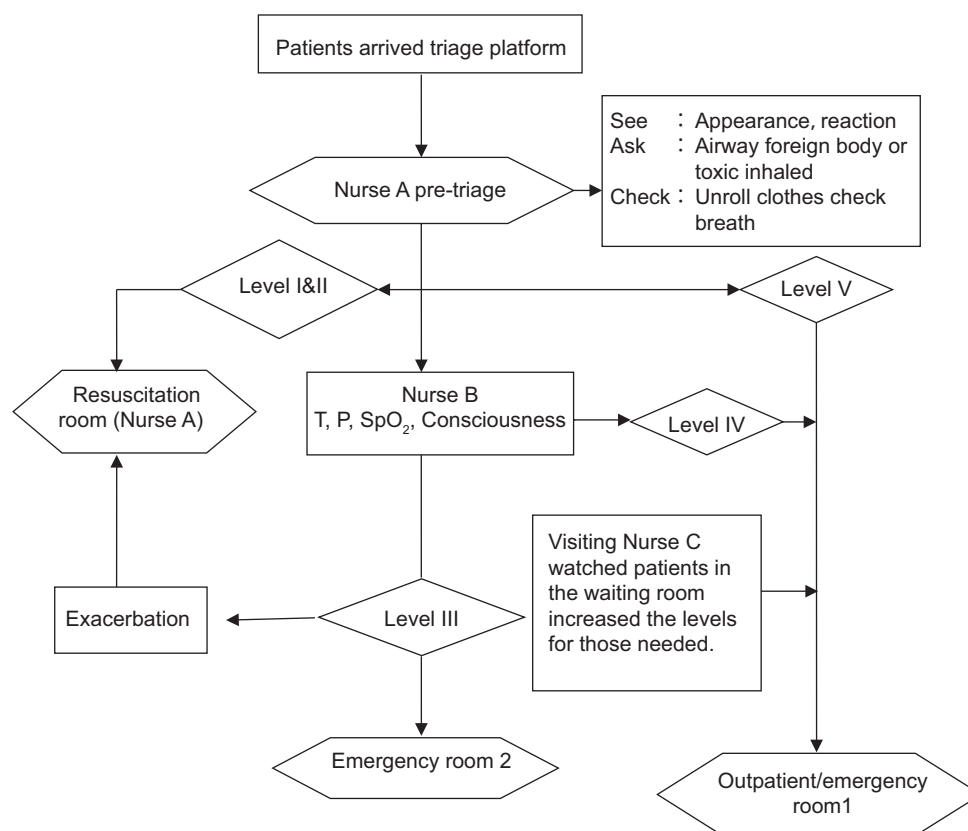


Figure 1: Flowchart of Chinese pediatric emergency triage system. A triage nurse first determines whether the patient is Level 1 or 2. If so, the patient is brought in for immediate treatment. Second, if a patient does not meet the criteria for Level 1 or 2, then the nurse evaluates whether the patient is Level 5. If so, then the patient's case is deemed a nonemergency and shunted to outpatient care. Subsequently, if the patient did not meet Level 1 or 2 criteria and also did not meet Level 5 criteria, then the patient is subjected to further evaluation to distinguish whether a Level 3 or Level 4 classification is more appropriate. Level 3 cases are monitored regularly for potential recategorization. T: Body temperature; BP: Blood pressure; SpO₂: Peripheral capillary oxygen saturation; P: Pulse.

Table 3: Effects of Chinese pediatric emergency triage system on pediatric emergency room waiting times (min)

Groups	Overall waiting time	Level 1/2 waiting time
Control	41.60 ± 15.40	3.23 (1.90, 4.36)
CPETS	37.30 ± 13.80*	2.07 (0.65, 4.11) [†]

Data are presented as mean ± standard deviation or median (interquartile Range). *Highly significant ($t = 11.27, P < 0.001$); [†]Significant comparison outcomes demonstrated reduced waiting times for care in the PER in the CPETS group relative to the control group, both overall and for severe (Level 1 or 2) patients ($Z = -2.057, P = 0.040$). CPETS: Chinese pediatric emergency triage system.

patients treated in our hospital during the CPETS study period (275,378 patients, January 2014–July 2014), when the CPETS was in place, than during the control period (243,536 patients, January 2013–July 2013). The reduction in PER visits can be attributed to an addition of 142.40% number of people rather than treating in the outpatient clinic in the post-CPETS study period (172,409 out patients) versus during the control period (71,127 out patients). The downward trend in PER-admitted patients seen per month became apparent in October 2013 [Table 2], the 1st month that the CPETS was active. These shifts in patient numbers

indicated that the CPETS shunted nonemergency (Level 4/5) patients to the outpatient clinic effectively. The resultant reduction in PER cases should alleviate overcrowding and help ensure that appropriate resources are available for truly urgent cases.^[11]

Given that parents often lack the medical knowledge to determine when their children should be brought to the PER, triage rate is a key nursing quality evaluation index of emergency department care.^[12] A higher triage rate, such as we found with the CPETS versus in the control period, represents more patients being treated in accordance with their needs. To help improve our triage rate, the CPETS includes a reminder function to recall (through a loud speaker) checked-in patients in the PER for reevaluation.

Triage accuracy is critical to improve the quality of care delivered in the PER, particularly with respect to ensuring that truly urgent cases are prioritized immediately. Indeed, one of the leading causes of death among pediatric patients is poor outcome when patient is in critical condition.^[13] If critical cases are recognized promptly, urgently needed treatments can be delivered without delay, preventing serious complications and deaths.^[14] Currently, in China, triage quality is variable ranging from more attentive administrators

Table 4: Group comparisons of number of patients triaged, triage accuracy, and satisfaction of pediatric emergency room patients' parents

Parameters	Control, <i>n</i>	CPETS, <i>n</i>	Sum, <i>n</i>	χ^2	<i>P</i>
Number patients triaged, <i>n</i>					
Total	114,040	102,969	217,009	801.546	<0.001*
Triaged	103,495	96,790	200,285		
Not triaged	10,545	6179	16,724		
Triage accuracy, <i>n</i>					
Total	8978	9679	18,657	710.904	<0.001†
Correct	7640	9323	16,963		
Incorrect	1338	356	1694		
Parent satisfaction, <i>n</i>				321.528	<0.001‡
Total	106,061	95,770	201,831		
Satisfied	97,804	90,245	188,049		
Not satisfied	8257	5525	13,782		

*The CPETS experienced by the experimental group was associated with a higher triage rate; †Better triage accuracy; ‡Higher family satisfaction rates. CPETS: Chinese pediatric emergency triage system.

to less attentive administrators. Commonly, administrators staff triage desks with their most inexperienced nurses, preferring to assign the most experienced nurses to the resuscitation room.^[15] Indeed, a prior survey conducted among triage nurses in a Swedish emergency department indicated that 20% of triage-station nurses were lacking triage knowledge, leaving their patients vulnerable to triage misjudgments.^[6] In the present study, the improved triage accuracy combined with the lower emergency rate indicate that our PER had likely been over-triaging patients and that the CPETS reduced over-triage incidents.

As implemented in our PER, the CPETS provides clear computer-administered guidance to triage nurses, leading them to check patient variables item by item, resulting in a more comprehensive assessment, regardless of the triage nurse's experience. Notably, the present results indicate that utilization of the CPETS resulted in a triage accuracy rate that was 11.23% higher than that obtained in the control period, demonstrating the system's value in a live clinical setting.

In the Chinese healthcare system, there are not a sufficient number of family doctor offices for family doctors to serve as the primary administrators of healthcare for children nationwide. Moreover, although the Chinese government has highlighted the importance of general practices to encourage people to visit physicians in community hospitals, many parents prefer to bring their children to a PER in a tertiary hospital because they are skeptical of the competence of community hospital physicians. Consequently, a larger proportion of children in China receive medical care primarily in the PER than that in the western world. A great deal of progress is still needed in this regard. An important component to improving this situation is the implementation of a high-quality triage system that shunts nonemergency cases from the PER to outpatient clinics while facilitating the delivery of emergency care in true emergency cases.

The most common complaint of PER parents is long wait times. Parents in China have even resorted to violent behavior when they felt that their child was not attended to properly.

The intense reactions of parents might be exacerbated by the fact that most Chinese families have only a single child. Previously, Partovi *et al.*^[16] found that implementation of a professional triage system in their hospital emergency department reduce length of stay from an average of 445 s (*n* = 814 cases) to an average of 363 s (*n* = 920 cases), an 18.40% reduction in average wait time. A computerized triage system enables general information collected by the triage nurse (e.g., demographics, vital signs, and history) to be viewable by the physician on his or her computer, reducing redundancy of communication and data, thereby saving time.^[17] The significant reductions in waiting times observed in this study support the idea that computerized triage systems can help reduce wait times. Moreover, we believe that the reduced waiting times observed in the present study were likely due to a combination of the outpatient shunting effect (discussed above) and reduced redundancy.^[18]

Given the critical status of patients seeking treatment in PERs, treatment delays can have life or death consequences: the shorter the wait time, the higher the success rate of lifesaving treatments.^[19] In the interest of minimizing delay, CPETS assessments are conducted from Level 1 downward. If a patient meets the criteria for Level 1 or 2, he/she is sent to the resuscitation room immediately, without further triage assessment. Level 1 and 2 cases are relatively rare, and such patients can receive treatment immediately upon being identified.^[20] That being said, because patients triaged as Level 3 can progress rapidly into a Level 2 or 1 condition, they must be monitored closely. Indeed, Partovi SN *et al.*^[16] found that conditions changed for 25% of Level 3 patients while they were waiting to be seen. Therefore, it is important that Level 3 patients be seated in the immediate vicinity of the triage station, as is done in our CPETS procedure, so that if their conditions worsen, the triage nurse is immediately accessible to update their level designation and expedite delivery of lifesaving treatments.^[21]

There are several aspects of our CPETS procedures that we believe have contributed to an overall improvement in PER

care and patient satisfaction. First, the CPETS-associated reduction in PER patient flow helps reduce wait times as discussed above. Second, under the new system, the triage station is now located at the PER entrance, such that families arriving from multiple directions encounter the triage nurse immediately and receive triage and guidance promptly upon their arrival, which should help alleviate families' anxieties. Third, the nurse now patrols patients regularly in accordance with reminders from the CPETS software. Accordingly, patients' vital signs are rechecked, enabling nurses to recognize condition changes that would otherwise be missed; this increased patient–nurse interaction can sometimes enable nurses to alleviate problems immediately.^[22] In addition, a rubric of the triage levels is posted in the waiting room for parents to see, which should help alleviate their worries about the care their child is receiving. Finally, having a standardized software-led triage form makes the triage process less arbitrary and less at risk of errors related to triage nurse inexperience.

Regarding study limitations, it is important to note that this study was conducted at a single center in a tertiary hospital in Xiamen. Consequently, it might not be representative of the whole city's PER characteristics, not to mention the whole province's or nation's PER characteristics. However, the study site is the first place where the CTAS has been introduced in the mainland of China, after being modified to fit the Chinese PER setting with an integration plan. Thus, given its significant benefits, this first implementation provides an important example case for other cities in China to study in implementing their own PER triage systems.

In conclusion, the present study demonstrated that implementation of the CPETS, which was developed in accordance with international standard five-level PER triage practices, results in a shunting of nonemergency patients to outpatient care (thereby reducing PER patient flow), improves triage accuracy, reduces wait times, especially for critical patients for whom reduced delays amount to a better rescue success rate, and improves the satisfaction of the patients' parents. The present comparison of 6-month periods indicates that this system is clinically useful and suggests that its broader implementation should be promoted.

Financial support and sponsorship

This work was supported by the grant from the State of Foreign Experts Bureau (No. 20133502015).

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Twomey M, Cheema B, Buys H, Cohen K, de Sa A, Louw P, *et al*. Vital signs for children at triage: A multicentre validation of the revised South African triage scale (SATS) for children. *S Afr Med J* 2013;103:304-8. doi: 10.7196/samj.6877.
- Eroglu SE, Toprak SN, Urgan O, Onur OE, Denizbasi A, Akoglu H, *et al*. Evaluation of non-urgent visits to a busy urban emergency department. *Saudi Med J* 2012;33:967-72.
- Carret ML, Fassa AG, Kawachi I. Demand for emergency health service: Factors associated with inappropriate use. *BMC Health Serv Res* 2007;7:131. doi: 10.1186/1472-6963-7-131.
- Wang L, Zhou H, Zhu JF. Application of emergency severity index in pediatric emergency department. *World J Emerg Med* 2011;2:279-82. doi: 10.5847/wjem.j1920-8642.2011.04.006.
- Crellin DJ, Johnston L. Poor agreement in application of the Australasian triage scale to paediatric emergency department presentations. *Contemp Nurse* 2003;15:48-60. doi: 10.5172/conu.15.1-2.48.
- Goldmann DA, Saul CA, Parsons S, Mansoor C, Abbott A, Damian F, *et al*. Hospital-based continuous quality improvement: A realistic appraisal. *Clin Perform Qual Health Care* 1993;1:69-80.
- Chaiyakulsil C, Pandee U. Validation of pediatric early warning score in pediatric emergency department. *Pediatr Int* 2015;57:694-8. doi: 10.1111/ped.12595.
- Gouin S, Gravel J, Amre DK, Bergeron S. Evaluation of the Paediatric Canadian Triage and Acuity Scale in a pediatric ED. *Am J Emerg Med*. 2005 ;23:243-7. doi: 10.1016/j.ajem.2004.02.046.
- Seiger N, van Veen M, Almeida H, Steyerberg EW, van Meurs AH, Carneiro R, *et al*. Improving the manchester triage system for pediatric emergency care: An international multicenter study. *PLoS One* 2014;9:e83267. doi: 10.1371/journal.pone.0083267.
- Lin GX, Luo YM, Cheng A, Yang SY, Wang JS, Goldman RD. Personal experience in pediatric emergency medicine training in Canada and China. *Chin Med J* 2012;125:3747-9. doi: 10.3760/cma.j.issn.0366-6999.2012.20.028.
- Murray M, Bullard M, Grafstein E; CTAS National Working Group; CEDIS National Working Group. Revisions to the Canadian emergency department triage and acuity scale implementation guidelines. *CJEM* 2004;6:421-7.
- Pascual-Fernández MC, Ignacio-Cerro MC, Jiménez-Carrascosa MA. Triage evaluation making in a pediatric emergency department of a tertiary hospital. *Rev Enferm* 2014;37:30-5.
- Al-Hindi AA, Al-Akhfash AA, Fareed AM, Alhusainan KS, Algasomy SF, Althowainy IR. Efficacy of implementation of a 5 scale pediatric triage and acuity scale in pediatric emergency, Saudi Arabia. *Saudi Med J* 2014;35:999-1004.
- Göransson KE, Ehrenberg A, Ehnfors M. Triage in emergency departments: National survey. *J Clin Nurs* 2005;14:1067-74. doi: 10.1111/j.1365-2702.2005.01191.x.
- Aronsky D, Jones I, Raines B, Hemphill R, Mayberry SR, Luther MA, *et al*. An integrated computerized triage system in the emergency department. *AMIA Annu Symp Proc* 2008:16-20.
- Partovi SN, Nelson BK, Bryan ED, Walsh MJ. Faculty triage shortens emergency department length of stay. *Acad Emerg Med* 2001;8:990-5.
- Doyle SL, Kingsnorth J, Guzzetta CE, Jahnke SA, McKenna JC, Brown K. Outcomes of implementing rapid triage in the pediatric emergency department. *J Emerg Nurs* 2012;38:30-5. doi: 10.1016/j.jen.2010.08.013.
- Li J, Caviness AC, Patel B. Effect of a triage team on length of stay in a pediatric emergency department. *Pediatr Emerg Care* 2011;27:687-92. doi: 10.1097/PEC.0b013e318226c7b2.
- van Veen M, Steyerberg EW, Lettinga L, Ruijter M, van Meurs AH, van der Lei J, *et al*. Safety of the manchester triage system to identify less urgent patients in paediatric emergency care: A prospective observational study. *Arch Dis Child* 2011;96:513-8. doi: 10.1136/adc.2010.199018.
- Debono P, Debattista J, Attard-Montalto S, Pace D. Adequacy of pediatric triage. *Disaster Med Public Health Prep* 2012;6:151-4. doi: 10.1001/dmp.2012.32a.
- Kezirian J, Muhammad WT, Wan JY, Godambe SA, Pershad J. Cost analysis and provider satisfaction with pediatrician in triage. *Pediatr Emerg Care* 2012;28:971-6. doi: 10.1097/PEC.0b013e31826c6dc4.
- Tsai VW, Shariieff GQ, Kanegaye JT, Carlson LA, Harley J. Rapid medical assessment: Improving pediatric emergency department time to provider, length of stay, and left without being seen rates. *Pediatr Emerg Care* 2012;28:354-6. doi: 10.1097/PEC.0b013e31824d9d27.