

Predictive factors for hospitalization of nonurgent patients in the emergency department

Chip-Jin Ng (MD)^a, Pei-Ju Liao (PhD)^b, Yu-Che Chang (MD)^{a,c}, Jen-Tze Kuan (MD)^a, Jih-Chang Chen (MD)^a, Kuang-Hung Hsu (PhD)^{d,*}

Abstract

Nonurgent emergency department (ED) patients are a controversial issue in the era of ED overcrowding. However, a substantial number of post-ED hospitalizations were found, which prompted for investigation and strategy management. The objective of this study is to identify risk factors for predicting the subsequent hospitalization of nonurgent emergency patients. This was a retrospective study of a database of adult nontrauma ED visits in a medical center for a period of 12 months from January 2013 to December 2013. Patient triages as either Taiwan Triage and Acuity Scale (TTAS) level 4 or 5 were considered “nonurgent.” Basic demographic data, primary and secondary diagnoses, clinical parameters including blood pressure, heart rate, body temperature, and chief complaint category in TTAS were analyzed to determine if correlation exists between potential predictors and hospitalization in nonurgent patients.

A total of 16,499 nonurgent patients were included for study. The overall hospitalization rate was 12.47 % (2058/16,499). In the multiple logistic regression model, patients with characteristics of males (odds ratio, OR = 1.37), age more than 65 years old (OR = 1.56), arrival by ambulance (OR = 2.40), heart rate more than 100/min (OR = 1.47), fever (OR = 2.73), and presented with skin swelling/redness (OR = 4.64) were predictors for hospitalization. The area under receiver-operator calibration curve (AUROC) for the prediction model was 0.70. Nonurgent patients might still be admitted for further care especially in male, the elderly, with more secondary diagnoses, abnormal vital signs, and presented with dermatologic complaints. Using the TTAS acuity level to identify patients for diversion away from the ED is unsafe and will lead to inappropriate refusal of care for many patients requiring hospital treatment.

Abbreviations: CTAS = Canadian Triage and Acuity Scale, ED = emergency department, TTAS = Taiwan Triage and Acuity Scale.

Keywords: emergency department, nonurgent, Taiwan Triage and Acuity Scale, triage, vital sign

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^aEmergency Department, Chang Gung Memorial Hospital and College of Medicine, Chang Gung University, Tao-Yuan, ^bDepartment of Health Care Administration, Oriental Institute of Technology, New Taipei City, ^cDepartment of Medical Education, Chang Gung Memorial Hospital and College of Medicine, Chang Gung University, ^dLaboratory for Epidemiology, Department of Health Care Management, and Healthy Aging Research Center, and Department of Urology, Chang Gung Memorial Hospital, Chang Gung University, Kwei-Shan, Tao-Yuan, Taiwan.

* Correspondence: Kuang-Hung Hsu, PhD, Professor, Laboratory for Epidemiology, Department of Health Care Management, Chang Gung University, 259, Wen-Hwa 1st Rd, Kwei-Shan, Tao-Yuan, Taiwan (e-mail: khsu@mail.cgu.edu.tw)

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1. Introduction

Nonurgent visits are defined as patients with problems that are not likely life-threatening nor required immediate attention and the care can be safely delayed.^[1,2] In this era of emergency department (ED) overcrowding, the management of nonurgent visits to the ED are a controversial issue in the literatures.^[1–5] Taiwan has implemented a new 5 acuity triage system, Taiwan Triage and Acuity Scale (TTAS), in 2010. TTAS was modified from Canadian Triage and Acuity Scale (CTAS) and was shown to be a reliable system.^[6,7] Patients with TTAS levels 1–3 need resuscitation, emergent, or urgent care requiring timely physician evaluation, whereas patients with TTAS levels 4 and 5 are with less urgent or nonurgent conditions for whom physician assessment can more safely be delayed. In our previous study, we found patients with TTAS levels 4 and 5 comprised about 30% of all ED patients.^[6,7]

Nonurgent ED patients have negatively impacted on crowding, and unnecessary costs, whereas some authors have advocated diverting nonurgent patients away from to ED to help reduce delays and improve access for sicker patients.^[8–13] In the absence of valid measures, most administrators still believe that less or nonurgent problems should be treated in alternate health care settings, such as outpatient clinics or family physician offices rather than overburdened EDs.^[14–16] Indiscriminately redirecting patients, identified as nonurgent, to alternative care facilities is highly debated as it generates ethical and patient safety issues.^[5,9,12,17] Previous studies have examined whether nonurgent ED patients can be safely deferred to alternate health care

settings, and have identified unintended consequences of adverse outcomes in patients with unrecognized high risk conditions.^[16,18–19]

A recent Canadian study identified a significant number of CTAS level 4 and 5 hospital admissions and concluded that using CTAS acuity as the lone criterion to redirect patients away from the ED is unsafe.^[18] In our previous study, we also found that 10.1% of the low urgency (TTAS level 4 and 5) patients were admitted.^[7] Recently Lin et al had showed that age more than 65 and arrival by ambulance may be predictors of admission in nonurgent patients in three Canadian EDs; however, factors associated with admission in nonurgent patients remained to be a multifactorial issue.^[20] This study is to identify risk factors more comprehensively for predicting the subsequent hospitalization of nonurgent emergency patients.

2. Methods

This study is a retrospective database patient cohort analysis using the adult nontrauma ED visits in a medical center located in northern Taiwan during January 1–December 31, 2013. All ED patients triaged as TTAS level 4 or 5 were considered nonurgent and included in the study. To have a more comprehensive approach, this study has collected all variables available from the information system and electronic medical chart. The study variables include: age, sex, TTAS, chief complaint, triage level, vital signs taken at triage (including BP, heart rate, respiratory rate, and body temperature), primary diagnosis, and secondary diagnosis recorded by emergency physician at ED database using International Classification of Diseases (9th revision) Clinical Modification (ICD-9-CM) coding system at ED and final disposition. Variables of vital signs were further categorized as high/medium/low systolic blood pressure (SBP >180 mmHg/111–180 mmHg/≤110 mmHg),^[21] tachycardia (HR >100 times/min), fever (BT ≥38°C), and tachypnea (RR >20 breaths/min). The respiratory rates in our nonurgent population were all less than 20 breaths/min, and the O₂ saturation were all above 94%, so the tachypnea category was excluded from the analysis. This study was approved by institutional ethics review board (#102–3459B) with a waiver of patient consent proviso.

Data are presented as mean ± standard deviation (SD) for numerical variables and as frequency (%) for categorical variables. The two sample *t* test was used to compare the difference of numerical variables between the two study groups, whereas the χ^2 test was employed to compare categorical variables between groups. Univariate analysis was performed to screen the variables before multiple regression analysis. Multivariable logistic regression analysis was applied to determine factors associated with hospitalization. The significant factors associated with hospitalization were scored and summed up by multiplying their nearest integer of odds ratio (OR) with the original values. The performance of these factors to predict hospitalization was then calculated by the area under receiver-operator calibration curve (AUROC).

3. Results

A total of 16,499 nonurgent patients (Levels 4 and 5) were extracted from 79,455 adult ED nontrauma patients in an ED during January 01–December 31, 2013. The overall hospitalization rate of the nonurgent patients was 12.47% (2058/16,499). All study variables were found to have a statistically significant association with hospitalization. Among the basic demographics

and presentation factors, the hospitalization rate of males (14.38%) and elderly (17.88%) were significantly higher than the other groups. Nonurgent patients who arrived at ED by ambulance (24.62%) also had a higher hospitalization rate. Reviewing the vital signs, those patients with higher heart rates, lower SBP, and fever were more likely to be admitted. Patients with skin swelling/redness (31.74%) or surgical complications (23.27%) had higher hospitalization rates. The top 10 reasons of adult nonurgent ED patients admitted to the hospital are listed in Table 1. These conditions accounted for over 80% of all admissions in our population. Disease of skin and subcutaneous tissue (27.39%) was the most common condition admitted followed by disease of circulatory system (24.92%); infectious and parasitic diseases (19.25%); disease of genitourinary system (13.05%); endocrine, nutritional and metabolic diseases (10.89%); disease of digestive system (9.90%); disease of musculoskeletal system and connective tissue (9.85%); poisoning and complications of surgical and medical care (8.18%); disease of respiratory systems (7.55%); and symptoms, signs, and ill-defined conditions (6.34%). Patients with more number of secondary diagnoses had a higher likelihood of hospitalization (Table 1).

The top 10 secondary diagnoses of admitted nonurgent patients are listed in appendix A, <http://links.lww.com/MD/B77>. The most frequently seen secondary diagnosis was endocrine, nutritional and metabolic diseases (12.22%) followed by disease of genitourinary system (10.19%), disease of circulatory system (10.10%), disease of digestive system (9.96%), neoplasms (6.04%), disease of musculoskeletal system and connective tissue (4.33%), disease of respiratory system (4.10%), mental disorders (1.26%), disease of nervous system (0.99%), and disease of blood and blood-forming organs (0.99%).

In the multiple logistic regression model, patients with characteristics of males (OR=1.37; 95% confidence interval [CI]=1.24–1.51), age more than 65 years (OR=1.56; 95% CI=1.39–1.74), arriving between 08:00 and 16:00 (OR=1.53; 95% CI=1.32–1.77), arriving by ambulance (OR=2.40; 95% CI=1.78–3.23), heart rate more than 100/min (OR=1.47; 95% CI=1.31–1.65), fever (OR=2.73; 95% CI=2.06–3.60), more number of secondary diagnosis (OR=1.47; 95% CI=1.41–1.54), and presenting chief complaint as skin swelling/redness (OR=4.64; 95% CI=3.45–6.24) or surgical complications (OR=3.05; 95% CI=2.06–4.53) were associated with higher likelihood of hospitalization (Table 2). The AUROC of predictive hospitalization, which calculated by combining factors in multiple logistic regression model into a scoring index was found to be 0.70 (Fig. 1).

4. Discussion

This study has identified that a significant number of nonurgent ED patients (Levels 4 and 5) in a five-level acuity triage system, TTAS, are still being admitted to hospital. The results are consistent with several previous studies providing further evidence that diverting non-urgent patients away from the ED may lead to denial or delay of appropriate care.^[11,13,16,18]

It is important to emphasize that TTAS, similar to CTAS was developed to support triage nurses prioritize emergency patients based on presenting acuity or risk.^[22] Both triage system effectively discriminates high, intermediate, and low acuity patients, and ensure the most needed patients to receive prompt treatments.^[7,22] The high discriminant ability of these triage systems also allowed for better streaming of patients, optimizing

Table 1

The comparison of study variables between hospitalized and nonhospitalized non-urgent ED patients.

	Hospitalization			P
	No	Yes	Total	
	Mean/N SD/%	Mean/N SD/%	Mean/N SD/%	
Basic demographics and presentation				
Gender				<0.0001
Female	7,505 (89.37)	893 (10.63)	8,398 (50.90)	
Male	6,936 (85.62)	1,165 (14.38)	8,101 (49.10)	
Age, y	47.52±18.73	54.41±18.28	48.38±18.81	<0.0001
Age group, y				<0.0001
<65	11,520 (89.01)	1,422 (10.99)	12,942 (78.44)	
≥65	2,921 (82.12)	636 (17.88)	3,557 (21.56)	
Time of day				<0.0001
00:00–08:00	2766 (91.32)	263 (8.68)	3092 (18.36)	
08:00–16:00	6876 (85.63)	1154 (14.37)	8030 (48.67)	
16:00–00:00	4799 (88.22)	641 (11.78)	5440 (32.97)	
Arrival by ambulance				<0.0001
No	14,242 (87.72)	1993 (12.28)	16,235 (98.40)	
Yes	199 (75.38)	65 (24.62)	264 (1.60)	
Vital signs				
Heart rate group				<0.0001
≤100 times/min	11,823 (88.54)	1,531 (11.46)	13,354 (80.94)	
>100 times/min	2,618 (83.24)	527 (16.76)	3,145 (19.06)	
SBP group				0.0060
≤110 mmHg	1,316 (86.86)	199 (13.14)	1,515 (9.18)	
111–180 mmHg	12,157 (87.83)	1,684 (12.17)	13,841 (83.89)	
>180 mmHg	968 (84.69)	175 (15.31)	1,143 (6.93)	
Fever (≥38°C)				<0.0001
No	14,194 (87.86)	1,961 (12.14)	16,155 (97.92)	
Yes	247 (71.80)	97 (28.20)	344 (2.08)	
Chief complaint				
Skin swelling/redness	871 (68.26)	405 (31.74)	1,276 (7.73)	<0.0001
Surgical complications	211 (76.73)	64 (23.27)	275 (1.67)	
Fever/chills	324 (83.51)	64 (16.49)	388 (2.35)	
Lower extremity pain	938 (86.06)	152 (13.94)	1,090 (6.61)	
Abdominal pain	610 (86.89)	92 (13.11)	702 (4.25)	
Joint swelling	213 (88.38)	28 (11.62)	241 (1.46)	
Noncardiac chest pain	858 (88.64)	110 (11.36)	968 (5.87)	
Dizziness	150 (89.29)	18 (10.71)	168 (1.02)	
Nausea/vomiting	645 (89.34)	77 (10.66)	722 (4.38)	
Hematuria	560 (89.89)	63 (10.11)	623 (3.78)	
Others	9,061 (90.20)	985 (9.80)	10,046 (60.89)	
Primary diagnosis				
Diseases of skin and subcutaneous tissue (680–709)	1246 (72.61)	470 (27.39)	1716 (10.40)	<0.0001
Diseases of circulatory system (390–459)	494 (75.08)	164 (24.92)	658 (3.99)	
Infectious and parasitic diseases (001–139)	214 (80.75)	51 (19.25)	265 (1.61)	
Diseases of genitourinary system (580–629)	1785 (86.95)	268 (13.05)	2053 (12.44)	
Endocrine, nutritional and metabolic diseases (240–279)	311 (89.11)	38 (10.89)	349 (2.12)	
Diseases of digestive system (520–579)	2138 (90.10)	235 (9.90)	2373 (14.38)	
Diseases of musculoskeletal system and connective tissue (710–739)	1282 (90.15)	140 (9.85)	1422 (8.62)	
Poisoning and complications of surgical and medical care (960–999)	1178 (91.82)	105 (8.18)	1283 (7.78)	
Diseases of respiratory system (460–519)	1285 (92.45)	105 (7.55)	1390 (8.42)	
Symptoms, signs, and ill-defined conditions (780–799)	2217 (93.66)	150 (6.34)	2367 (14.35)	
Others*	2291 (87.34)	332 (12.66)	2623 (15.90)	
Number of secondary diagnosis	0.61±0.90	1.08±1.26	0.67±0.97	<.0001

*Others include "Neoplasms (140–239)," "Disease of blood and blood-forming organs (280–289)," "Mental disorders (290–319)," "Diseases of nervous system (320–359)," and "V code."

patient, and provider resources placement, and to deliver the most appropriate care to the correspondent group of patient.^[7,22] TTAS was not designed as a tool to triage nonurgent patient away from the ED.

Our study demonstrates that, male patients, older patients, patients with more secondary diagnoses, skin swelling/redness complaints, or with surgical complications, and patients with

abnormal vital signs (tachycardia and fever) were more likely to be hospitalized. As TTAS was develop to prioritizes incoming patients at initial triage and identify the most seriously ill patients who cannot wait to be seen as TTAS 1, 2, or 3, patients with cutaneous problems might be initially assigned as nonurgent at triage. After examination by the physician, there might turn out to be severe skin infections that required intravenous antibiotics

Table 2
A multiple logistic regression model for hospitalization of nonurgent ED patients.

	95% CI for OR Odds ratio (lower, upper)	P
Basic demographics		
Gender		
Female	1.00	
Male	1.37 (1.24, 1.51)	<0.0001
Age group		
<65 years	1.00	
≥65 years	1.56 (1.39, 1.74)	<0.0001
Time of day		
00:00–08:00		
08:00–16:00	1.53 (1.32, 1.77)	<0.0001
16:00–00:00	1.32 (1.13, 1.55)	0.0005
Arrival by ambulance		
No	1.00	
Yes	2.40 (1.78, 3.23)	<0.0001
Vital signs		
Heart rate group		
≤100 times/min	1.00	
>100 times/min	1.47 (1.31, 1.65)	<0.0001
SBP group		
≤110 mmHg	1.14 (0.97, 1.35)	0.1177
111–180 mmHg	1.00	
>180 mmHg	1.13 (0.94, 1.35)	0.1837
Fever (≥38°C)		
No	1.00	
Yes	2.73 (2.06, 3.60)	<0.0001
Chief complaint		
Hematuria	1.00	
Skin swelling/redness	4.64 (3.45, 6.24)	<0.0001
Surgical complications	3.05 (2.06, 4.53)	<0.0001
Fever/chills	1.28 (0.85, 1.93)	0.2310
Lower extremity pain	1.50 (1.09, 2.07)	0.0130
Abdominal pain	1.52 (1.07, 2.16)	0.0205
Joint swelling	1.22 (0.75, 1.98)	0.4320
Dizziness	1.07 (0.61, 1.89)	0.8078
Noncardiac chest pain	1.25 (0.89, 1.74)	0.2037
Nausea/vomiting	1.16 (0.81, 1.67)	0.4274
Others	1.01 (0.77, 1.33)	0.9467
Number of secondary diagnosis	1.47 (1.41, 1.54)	<0.0001

and required admission to hospital for treatment. On the other hand, patients with surgical complications would often return to ED early for evaluation if anything wrong happened. For example, a patient with vague abdominal pain (pain scale < 4) after laparotomy may be assigned as TTAS level 4, may later be proved to be mechanical ileus after serial examinations and then be admitted.

Older people are an increasing population in EDs in many countries.^[23–27] They often present with atypical symptoms and signs and multiple comorbidities that complicate diagnosis and treatment.^[25,27–29] Reports had shown that nonurgent elderly patients admitted to hospitals are characterized with very old age, male gender, low levels of education, widowhood, living alone, previous use of EDs or hospitals, and functional impairment.^[30–32] In our series, elderly patients (≥65 years) accounted for 21.56% of nonurgent group and 17.88% of them were hospitalized comparing to 10.99% of younger group. These results are comparable to a study that examined predictors for hospitalization in a CTAS nonurgent group.^[32] The authors had advocated to adopt age more than 65 years as modifies in CTAS

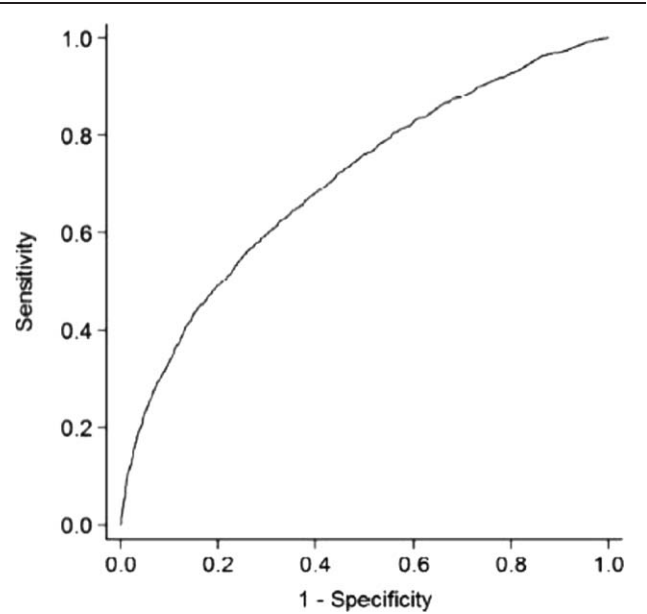


Figure 1. The predictability of score combining factors derived from multiple logistic regression to hospitalization (AUROC=0.70).

in order to improve the discriminatory and predictive power to identify patients who require hospitalization.^[32] In our studies, we also identified that elderly patients who arrived by ambulance had a higher admission rate, these findings were also comparable to previous studies.^[20,33] Frailty may be an implication of such patient’s manifestations. The characteristics of aging, comorbid status, and possible mobility problems (arriving by ambulance) among such patients are components of frailty.^[34] It is suggested that applying frailty as a modifier in TTAS in order to reflect the severity and needs of ED interventions and the subsequent hospitalization care is appropriate in the future.

Our study showed that tachycardia (HR > 100) and fever of 38°C or more were associated with higher admission in non-urgent group. Although the TTAS hemodynamic criteria stated that, the patients could be assigned into level 3 if their vital signs were at the upper and lower ends of normals and were related to presenting complaint. However, based on our observation, patients with a slightly high body temperature (e.g., 38°C–39°C) or heart rate (e.g., 110 bpm) and no apparently in distress conditions were assigned into nonurgent group. Our result stresses the importance of vital signs in predicting the subsequent hospitalization among nonurgent triaged patients. Triage nurses should be more concerned about the role of abnormal vital signs in the disease progression under different chief complaints. For instance, patients with a fever of 38°C or more under infectious etiologies could be adversely progressed over time, which can be considered upgraded.

This study has a number of limitations. First, the data were collected from a single medical center. Findings, such as admission rates and types of modifying features, may vary in regional or community ED settings. Second, cautiousness is suggested to generalize the results to trauma ED patients because we only collected nontrauma patients for the analyses in this study. Third, Taiwan has a universal national health insurance system allowing patients to access the health care facilities of their choosing. Different health care systems may pose diverse accessibility to the ED facilities. Forth, prospective validation of these findings is warranted.

5. Conclusion

Non-urgent patients might still be admitted for further care especially in male, the elderly, with more secondary diagnoses, abnormal vital signs, and presented with dermatologic complaints. Using the TTAS acuity level to identify patients for diversion away from the ED is unsafe and will lead to inappropriate refusal of care for many patients requiring hospital treatment.

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