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ORIGINAL RESEARCH

Can the emergency department triage category and clinical presentation predict hospitalization of H1N1 patients?

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Background: Human H1N1 Influenza A virus was first reported in 2009 when seasonal outbreaks consistently occurred around the world. H1N1 patients present to the emergency departments (ED) with flu-like symptoms extending up to severe respiratory symptoms that require hospital admission. Developing a prediction model for patient outcomes is important to select patients for hospital admission. To date, there is no available data to guide the hospital admission of H1N1 patients based on their initial presentation.

Objective: The aim of this study was to investigate the predictors of hospital admission of H1N1 patients presenting in the ED.

Methods: We conducted a retrospective review of all laboratory-confirmed H1N1 cases presenting to the ED of a tertiary university hospital in the Eastern region of Saudi Arabia within the period from November 2015 to January 2016. We retrieved data of the initial triage category, vital signs, and presenting symptoms. Multivariate logistic regression analysis was performed to evaluate risk factors for hospital admission among H1N1patients presented to the ED.

Results: We identified 333 patients with laboratory-confirmed H1N1. Patients were classified into two groups: admitted group (n=80; 24%) and non-admitted group (n=253; 76%). Sixty patients (75%) were triaged under category IV. Triage category of level III and less were the most predictive for hospital admission. Multivariate regression analysis showed that of all vital signs, tachypnea was a significant risk factor for hospital admission (OR=1.1; 95% CI 1.02 to 1.13, $p<0.01$). The association between lower triage category and hospital stay was statistically significant ($\chi^2=6.068$, $p=0.037$). Also, patients with dyspnea were 4.5 times more likely to have longer hospital stay (OR=4.5; 95% CI 1.2 to 17.1, $p=0.025$).

Conclusion: Lower triage category and increased respiratory rate predict the need for hospital admission of H1N1 infected patients; while patients with dyspnea or bronchial asthma are likely to stay longer in the hospital. Further prospective studies are needed to evaluate the accuracy of using the CTAS and other clinical parameters in predicting hospitalization of H1N1 patients during outbreaks.

Keywords: clinical outcome, H1N1, presentation, respiratory virus, triage category

Introduction

Pandemic swine-origin influenza A/H1N1 virus was first detected in April 2009 in Veracruz, Mexico. It took few months span to spread internationally and become the first pandemic disease of the 21st century.[1,2] In May 2009, 11,356 suspected and 822 laboratory-confirmed cases had been reported in Mexico; then in June 2009, the World Health Organization raised the pandemic level from phase 5 to phase 6

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announcing that the virus reached 43 countries with 91 reported fatalities.[3,4] In October 2009, the first laboratory evidence was detected and virologic detection methods were developed to identify influenza A/H1N1 epidemic agent. One year later, the virus extended worldwide with a tenfold mortality rate of seasonal influenza and more than 17,700 fatalities in confirmed cases.[5]

In Saudi Arabia, during the Hajj season of the year 2010, more than two million pilgrims assembled in the pilgrimage sites in Mecca and Medina that made a faster transmission of the disease. The virus was detected in 120 pilgrims out of 1600 screened at entry borders using real-time polymerase chain reaction (PCR).[6] In Saudi Arabia, the clinical features of the disease include fever (94%) and upper respiratory symptoms as cough (92%), and sore throat (66%). Headache, body aches, fatigue, diarrhea, and vomiting also have been observed. In a study of H1N1 hospital admission rates, one-third of the suspected H1N1 cases admitted to the intensive care unit (ICU) were severe cases while the other two-thirds had no complications or comorbidities.[7,8]

Hospitalization of influenza patients is associated with substantial costs in some countries.[11] Therefore, appropriate selection of patients for safe discharge or hospital admission is important from an economic point of view. The aim of this study was to identify the need for hospital admission in H1N1 patients according to the value of initial triage category, vital signs, and clinical presenting symptoms.

Methods

We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement guidelines when reporting this manuscript.[9] This study was approved by the ethics committee of the Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia (IRB-UGS-2016–01-076).

Study design, study setting and duration

We conducted a retrospective case-control study of H1N1 cases presented to the Emergency Department (ED) of a tertiary hospital in the Eastern Region of Saudi Arabia. We retrieved data of patients' demographic characteristics, clinical presentations, radiological and laboratory investigations, and comorbidities. To minimize bias, investigators analyzing the study data were kept blinded to the clinical and microbiological information.

Eligibility criteria

Patients meeting the following inclusion criteria were included in the study:

(1) Patients with laboratory-confirmed H1N1 infection by PCR

(2) Both male and female genders at any age

(3) Patients whose data of the vital signs, clinical presentation, and Canadian Triage and Acuity Scale (CTAS) category[10] were available on the hospital records

We excluded patients with the following conditions:

(1) Patients with no documented initial vital signs during their ED visit

(2) Patients with no documented Canadian Triage and Acuity Scale (CTAS) category[10] in the ED visit.

Case definition

Patients with laboratory-confirmed H1N1 infection defined as those with positive H1N1 virus based on nasopharyngeal swab samples. The routine laboratory analysis of these samples had been done; they were collected in a universal transport medium and were analyzed immediately using a real-time PCR test, GeneXpert system (Cepheid, Sunnyvale, CA, USA) for diagnosing H1N1.

CTAS definition

The Canadian Emergency Department Triage and Acuity Scale (CTAS) is a common validated triage system that prioritizes patient care through the severity of their illness.[10]

Data analysis

Data normality was tested using the Kolmogorov–Smirnov test. Categorical variables were expressed as frequencies and percentages. For continuous variables, we used the mean and standard deviation or the median and range to summarize normally and non-normally distributed data respectively. Continuous variables were compared using the Student *t*-test or Mann–Whitney *U* test for normally and non-normally distributed data, respectively. For comparison of categorical variables, the Chi-square test and Fisher's exact test were used when appropriate. We carried out a univariate analysis to investigate the association between patient status, presenting symptoms, comorbidity, and hospital admission. Statistically significant variables (those with $p<0.05$) were selected for inclusion in the multivariate logistic regression model. Collinearity was explored with correlation matrix. Unadjusted OR (UOR)

and adjusted OR (AOR) with the corresponding 95% Confidence intervals were calculated. All analyses were carried out using the Statistical Package for Social Sciences (SPSS) 15.0 software (SPSS, Inc., Chicago, IL, USA). An alpha level below 0.05 was considered for statistical significance.

Results

Characteristics of the study population

Four hundred patients were diagnosed with laboratory confirmed H1N1 infection. Of them, 67 patients were excluded owing to missing data from the hospital records while 333 patients were included in this study. The flow diagram of study participants, their CTAS classification, and their status (discharged or admitted) is shown in Figure 1.

The demographic characteristics, vital signs at presentations and laboratory findings of the study participants are shown in Table 1.

Presenting symptoms and comorbidities among H1N1 patients

Cough was the most common presenting symptom; it was reported in 243 patients (73.2%), followed by fever reported in 161 patients (48.5%) and sore throat in 99 patients (29.8%). The percentages of the presenting symptoms in the study population (n=333) are shown in Figure 2.

In terms of comorbidities, 62 patients (18.6%) had bronchial asthma, 19 patients (5.7%) had diabetes mellitus (DM), 12 patients (3.6%) had other pulmonary diseases, 10 patients (3%) had cardiac disease, and 7 patients (2.1%) had renal disease.

CTAS triage category and hospital admission

Most patients were in the triage category IV (n=216, 64.8%). Patients with CTAS III had higher rates of hospital admission compared to CTAS IV and V (77.78% vs 27.78% and 12.15%, respectively. The frequencies of hospital admissions and triage categories are shown in Figure 3.

Association between the presenting symptoms and hospital admission

There was a statistically significant association between initial symptoms and patient admission status. Higher admission rates were found in patients with vomiting (p=0.001), sore throat (p=0.001), and seizures (p=0.017). A significantly higher proportion of patients with these symptoms were admitted compared to the discharged group. The results of the chi-square analysis of the association between the

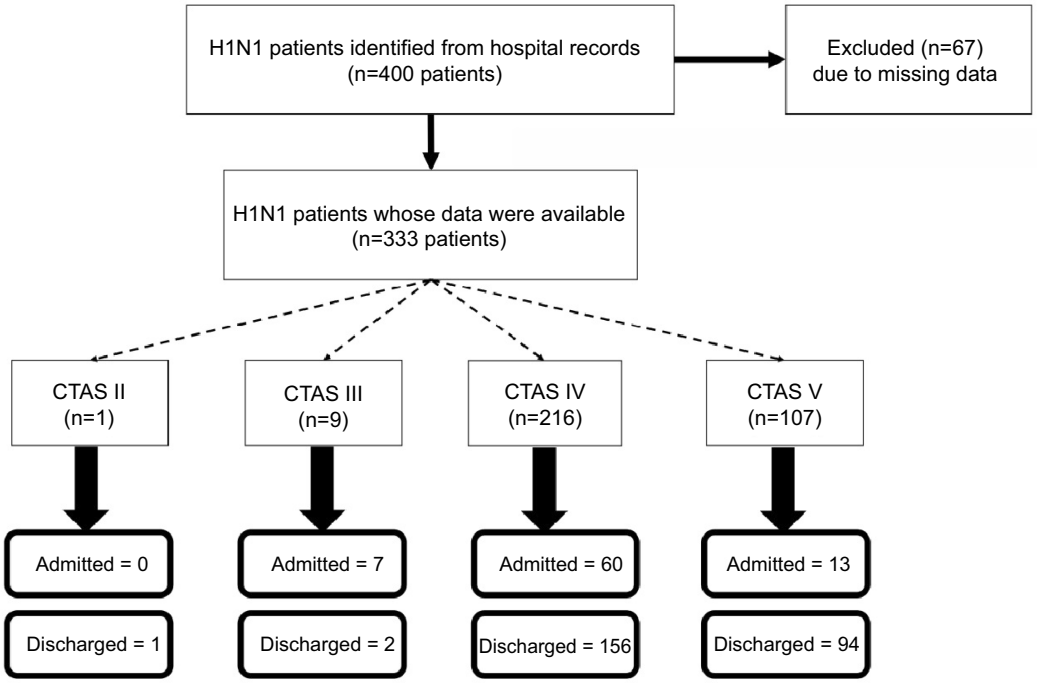

Figure 1 shows the flow diagram of the study participants, their CTAS classification, and hospitalization status.
Abbreviation: CTAS, CanadianTriage and Acuity Scale.

Table 1 Shows demographics, vital signs at presentation, and laboratory findings of the study population (n=333 patients)

Patient Demographics	
Gender (male)	174 (52.3%)
Nationality (Saudi)	277 (83.7%)
Pregnant	5 (3.2%)
Vaccinated	1 (0.3%)
Age*	16.5 (3.75–29.25) years
Vital signs at presentation	
Heart rate	110.36 (24.961) beats a minute
Systolic blood pressure	116.19 (20.400) mmHg
Diastolic blood Pressure	71.77 (13.307) mmHg
Respiratory rate	25.12 (11.091) breaths per minute
Temperature	37.970 (1.0412) °C
Laboratory values	
WBC*	5.800 (4.30–8.28) cells/mcL
BUN*	11.00 (7.00–14.00) mmol/L
Creatinine*	0.900 (0.50–1.03) mg/dL
Potassium*	4.100 (3.80–4.50) mmol/L
HCT	38.14 (5.848) per cent
PLT	224.99 (79.743) k/ul
HGB	12.337 (2.03) g/dL
Albumin	3.66 (0.548) g/dL
Sodium	134.48 (63.235) mEq/L

Notes: Categorical variables are summarized as frequencies and percentages (n%) while continuous variables are presented as mean (SD); *Continuous variables described as median (IQR) due to non-normal distribution.
Abbreviations: WBC, White Blood Cells; BUN, Blood Urea Nitrogen; HCT, Hematocrit value; PLT, Platelet; HGB, Hemoglobin.

presenting symptoms and patient status (admitted vs discharged) are shown in Table 2.

Association between comorbidities and hospital admission

The association between comorbidities and hospital admission was statistically significant in cases of pulmonary disease, cardiac disease, hypertension, kidney disease, and DM. Patients with these morbidities were likely to be admitted in the hospital compared to those who were discharged. The results of the chi-square analysis of the association between comorbidities and patient status (admitted vs discharged) are shown in Table 3.

Predictors of hospital admission

The multivariate logistic regression analysis showed that four variables could significantly predict hospital admission of H1N1 patients presenting to ED (Table 4). Predictors of hospital admission were tachypnea (OR 1.08, 95% CI 1.02 to 1.14, p=0.005), CTAS triage of III or less (OR 2.981, 95% CI 1.52 to 5.83, p=0.001), presence of cardiac disease (OR 7.96, 95% CI 2.01 to 31.55, p=0.003), and presence of DM (OR 3.86, 95% CI 2.01 to 31.55, p=0.005).

Discussion

Summary of main results

Our study showed that predictors of hospital admission of H1N1 patients presenting to the ED are: (1) tachypnea, (2) CTAS triage of III or less, and (3) comorbidities as pulmonary disease, cardiac disease, and DM.

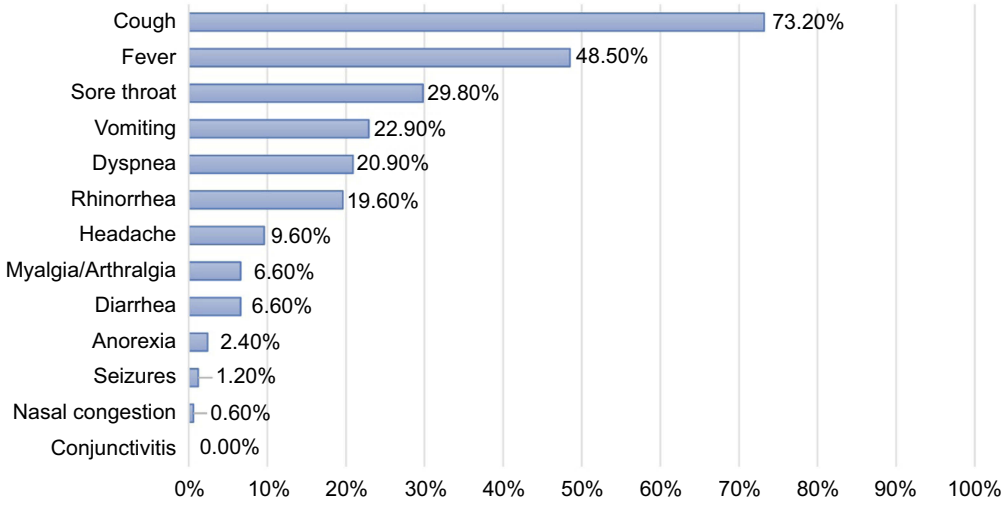

Figure 2 Clustered bar chart of the percentages of the presenting symptoms in the study population.

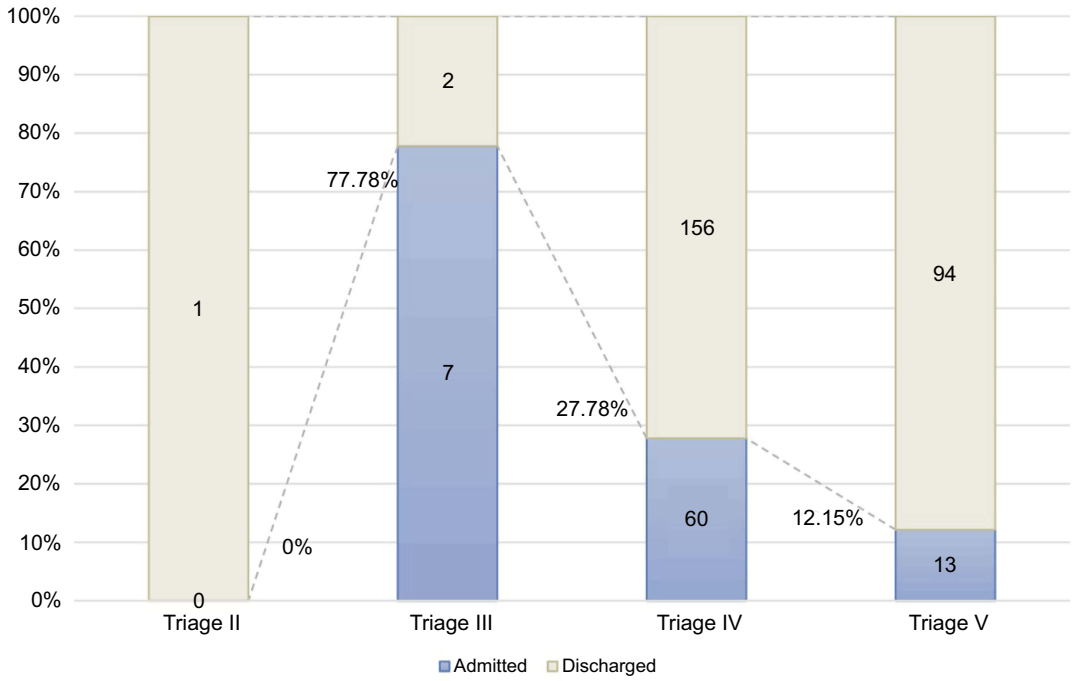

Figure 3 Hospital admission rates of H1N1 patients in different CTAS categories. Abbreviation: CTAS, Canadian Emergency Department Triage and Acuity Scale.

Table 2 Association between initial symptom variables and patient status

Variable	Patient status		Chi-square	*p*-value
	Discharged n (%)	Admitted n (%)		
Fever	128 (50.8)	33 (41.2)	2.214	0.137
Sore throat	87 (34.5)	12 (15.0)	11.060	0.001
Rhinorrhoea	50 (19.8)	15 (18.8)	0.046	0.830
Nasal congestion	2 (0.8)	–	0.639	0.424
Conjunctivitis	–	–	–	–
Dyspnea	49 (19.5)	20 (25.3)	1.220	0.269
Cough	184 (73.0)	59 (73.8)	0.017	0.897
Headache	24 (9.5)	8 (10.0)	0.016	0.900
Anorexia	4 (1.6)	4 (5.0)	3.007	0.083
Vomiting	47 (18.7)	29 (36.2)	10.655	0.001
Diarrhea	13 (5.2)	9 (11.2)	3.641	0.056
Myalgia/arthralgia	18 (7.1)	4 (5.0)	0.451	0.502
Seizures	1 (0.4)	3 (3.8)	5.736	0.017

Significance of the study findings

The pandemic H1N1 influenza has been reported in many countries. However, there has been less attention to the criteria of hospital admission of H1N1 patients. Hospitalization of influenza patients is associated with substantial costs in some countries.[11] Therefore, appropriate selection of patients for safe discharge or hospital admission is important from an economic point of view.

Previous studies

Morton et al[12] found that oxygen exchange and CRP are the most important predictors of safe discharge of H1N1

Table 3 Association between comorbidities and patient status

Variable	Patient status		Chi-square	*p*-value
	Discharged n (%)	Admitted n (%)		
Bronchial asthma	45 (17.8)	17 (21.2)	0.481	0.511
Pulmonary disease	2 (0.8)	10 (12.5)	23.991	0.000
Cardiac disease	3 (1.2)	7 (8.8)	11.879	0.001
Hypertension	7 (2.8)	8 (10.0)	7.342	0.007
Kidney disease	1 (0.4)	6 (7.5)	14.844	−0.000
Hepatic disease	–	–	–	–
Diabetes mellitus	9 (3.6)	10 (12.5)	8.972	0.003
Immune disease	–	1 (1.2)	3.160	0.075
Cancer	–	–	–	–

Table 4 Logistic regression results; Risk factors for admission into hospital among H1N1 patients who report to the ED

Variable	Unadjusted			Adjusted		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Triage						
2	0.00	-	1.000	0.00	-	1.000
3	27.12	5.04 −145.91	0.000	-	-	1.000
4	2.981	1.52 −5.83	0.001	4.59	1.26 −16.66	0.021
5	1.00	-		1.00		
Vomiting						
Yes	2.48	1.42–4.32	0.001	2.15	0.82–5.6	0.118
No	1.00			1.00		
Asthma						
Yes	1.25	0.67–2.33	0.488			
No	1.00					
Cardiac diseases						
Yes	7.96	2.01–31.55	0.003	0.915	0.05–15.6	0.951
No	1.00			1.00		
Diabetes						
Yes	3.86	2.01–31.55	0.005	2.641	0.517–13.50	0.243
No	1.00			1.00		
Age	1.002	0.98–1.02	0.773			
RR	1.08	1.02–1.14	0.005	1.07	1.02–1.13	0.004
Creatinine	1.131	0.81–1.57	0.463			

Abbreviation: RR, respiratory rate.

patients.[12] In 2014, a registry-based study of 104 H1N1 patients showed that serum albumin levels and glucose levels at the time of presentation can be used as predictors for intensive respiratory or vasopressor support.[13]

In 2015, Hlavinkova et al[14] reported that cardiovascular diseases, DM, and bronchial asthma are significant predictors of hospital admission. Additionally, patients with high CURB-65 scores were likely to be admitted according to Challen et al.[15]

High CRP level, the partial pressure of oxygen to fraction of inspired oxygen ratio (PaO_2/FiO_2<300), and the simple triage scoring system might predict hospital stay and the need for ICU admission and the use of mechanical ventilation.[16–18] In 2015, Morton et al[16] suggested that the use of PaO_2/FiO_2 ratio is more reliable than simple triage scoring system to predict hospital stay.

In another study, H1N1 patients were evaluated in terms of their hospital stay and the presence of two or more risk

factors as old age (≥65 years), altered mental status, hypoxia (PaO2/FiO2≤250), and bilateral lung infiltration.[19] The severity of H1N1 infection was attributed to obesity, pregnancy, and comorbidities such as chronic obstructive pulmonary disease, CVD, and malignancies.[14,20] In a retrospective study of 77 H1N1 patients, the increased duration of dyspnea prior to admission, pneumonia, low PaO2/FiO2 ratio, higher PaCO2 on admission, and higher O2 requirement were associated with a poorer outcome.[21] Multiple retrospective case-control studies of H1N1 patients showed that morbid obesity might be associated with hospitalization due to pandemic H1N1 infection.[22,23]

Strength points and limitations of the study

Our study has several strength points. First, the relatively larger sample size of our study compared to previous reports. Secondly, we performed multivariate logistic regression analysis to identify the predictors of hospital admission among H1N1 patients presenting to the ED. Thirdly, to the best of our knowledge, no previous studies have investigated the predictors of hospital admission among H1N1 patients in Saudi Arabia.

Our study has few limitations: (1) the retrospective study design did not allow to include more clinical variables; we were confined to the available data in the hospital records; data of 67 patients were missing and therefore, they were not included in the study; (2) some community clusters have no access to health care and therefore, might have a high tolerance to the disease; those patients might have lower estimates compared to reported in our study; and (3) inter-rater and intra-rater variations should have been taken into consideration.

Conclusion

Lower triage category and increased respiratory rate predict the need for hospital admission of H1N1 infected patients whereas patients with dyspnea or BA are likely to stay longer in the hospital. Further prospective studies are needed to evaluate the accuracy of using the CTAS and other clinical parameters in predicting hospitalization of H1N1 patients during outbreaks.

Ethics approval and consent to participate

Patient consent was not required, and all patient data were kept confidential. No patients were involved neither in the design, recruitment and conduction of this study nor in the development of outcome measures. We will publish the results of the study in lay language for patient interest groups. We obtained ethics approval from Standing Committee for Research Ethics on Living Creatures (SCRELC) from the Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia with IRB number: IRB-UGS-2016-01-076.

Abbreviations

BA, Bronchial asthma; CI, Confidence interval; CRP, C-reactive protein; CTAS, Canadian triage and acuity scale; CVD, Cardiovascular disease; DM, Diabetes mellitus; ED, Emergency departments; H1N1, Hemagglutinin type 1 and neuraminidase type 1; ICU, Intensive care unit; OR, Odds ratio; PCR, Polymerase chain reaction; STSS, Simple triage scoring system.

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Author contributions

All authors contributed toward data analysis, drafting and revising the paper, gave final approval of the version to be published and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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