Predicting Outcome in Medical Emergency Patients: APACHE Ⅱ Classification System, Organ Failure System, and Traditional Triage System－A Large-Scale Prospective Study

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ABSTRACT

National Health Insurance System (NHIS) has opened a new era in Taiwan. The trend of medical emergency population remains the important issue for public health. APACHE Ⅱ Classification System (ACS) and Organ Failure System (OFS) have been attempted to predict survival and mortality of ICU patients for many years. Emergency Triage System (ETS) also played an important role in ER practice. However, there is no large, prospective survey using these 3 systems simultaneously to evaluate 3 systems efficacy as well as to predict outcome for medical emergency. Thus, this study was aimed to reply these unsettled questions. From October 1995 to December 31, 1996, we evaluated 9294 patients presenting in ER. All patients received emergency triage, organ system failure, and APACHE Ⅱ score evaluation. APACHE Ⅱ score was divided into 3 parts: A denoted chronic health point; B represented age score; C_1 meant initial score of acute physiological score evaluated in ER; C_2 evaluated during observation or hospitalization period; C_3 was evaluated while on discharge. Based on score division, we separated only 4 classes: 1^o (0-10), 2^o (11-20) , 3^o (21-30), and 4^o (≧31). Organ system failure system was ranged from zero to four divisions. Triage was applied as usual. We used the odds ratio to determine each variables affecting death and survival in addition to correlation with three independent distinguished system. By the way, we applied post-hoc test to identify true efficacy of 3 systems. Finally, multivariate logistic regression model was also used to determine the real factors affecting follow-up survival. Predictions were not used to influence clinical decision-making during this study. Of 9294 patients admitted to MER, 5110 were men and 4184 were women. Based on ETS, class Ⅰ was 9 % , class Ⅱ was 12%, class Ⅲ was 54%, and class Ⅳ was 25%. According to ACS, significant risk group (Ⅲ+Ⅳ) was 8% in contrast to non-significant risk group (92%: Ⅰ+Ⅱ). Mortality among all MER patients was 9.3%. The main factors correlating the patient's survival were the following: sex, ACS(1^o - 4^o), OFS(0^o - 4^o), and ETS((1^o - 4^o)($p<0.001$). The score of survivors was significantly lower than that of nonsurvivors in any period ($p<0.001$). In terms of survival by means of multivariate logistic regression model, only age, organ system involvement, Ⅰ vs Ⅳ, and Ⅱ vs Ⅳ, showed the significant changes in ETS. No difference between Ⅲ and Ⅳ was noted. On the contrary, Ⅰ vs Ⅳ, Ⅱ vs Ⅳ, Ⅲ vs Ⅳ, sex, and organ system involvement demonstrated the significant alternations in APACHE Ⅱ score system. Thus, some differences still

existed between each other. Thus, we conclude that low triage medical emergency population still occupied the medical service largely partly due to inappropriate transferal system and inconsistent health policy. This phenomenon may result from domestic cultures, habits, and social backgrounds. Theoretically speaking, these three independent predictive models would be useful to determine aggressiveness of care through discussions with families, as well as utilization of hospital facilities. This report represents the results of our effort to validate ACS, OFS, and ETS to stratify ER patients prognostically by risk of death.

Key words : APACHE Ⅱ Classification System (ACS), Organ Failure System (OFS), Emergency Triage System (ETS).

INTRODUCTION

Following rapid growth in the economic and political arenas, Taiwan is moving into the era of universal health care, another hallmark of a developed country [(1)]. Global budgeting is a long-term goal of Taiwan's National Health Insurance scheme [(2)]. The high cost associated with emergency care in the present climate of limited health care resources has emerged as one of the major problems facing clinicians, health care-funding agencies, and society at large. The optimal use of expensive emergency care should be discussed. However, knowledge of the risk of life-threatening major complications or events in emergency practice is very important, both for the decision to perform surgery and for the selection of precautions to be applied in order to diminish potential risk. A quantitative estimation of the potential risk before admission or observation would therefore be useful.

Many applications of the APACHE Ⅱ severity of disease classification system have been suggested for the analysis of intensive care [(3-5)]. It has been proposed as being useful in providing an estimate of prognosis. Tracing back the history, in the mid-1970's, it was recognized that, for some patients support of multiple organ system failure (OSF) did not result in improved long-term survival but merely delayed death[(6-8)]. At the some time, it was reported that patients with a variety of traumatic and nontraumatic conditions were dying in multiple OSF [(6-8)].

The exact cause of this syndrome remains elusive. As the medical technologies have made the tremendous advances in this decade, it is becoming clear that the major role of mechanical and pharmacologic support of OSF is to buy time during which the primary disease process can be identified and effectively treated. Used in this way, organ system support is life saving in some emergency conditions. Additionally, as the concept of homeostasis became better defined, acute physiologic abnormalities were still recognized as an important cause of death [(8)].

When the etiology of multiple OSFs is obscure or the underlying disease persists, however, the emergency physician may ask if continued support is likely to result in cure or it is only prolonging the dying process [(6-8)]. The most effective response to the uncertainty of this question is to supplement clinical judgment with objective estimates of prognosis [(6-8)]. This prospective study aims to provide such estimates using three different distinguished modalities by examining the follow-up outcome and evaluating the individual serial APACHE Ⅱ scores as well as triage system of a large number of emergency department patients with a variety of medical diseases during their acute illness. Another purpose of this survey was to realize these three models for the prediction of the individual risk of four different class and its unique efficacy. Utilizing multiple logistic regression, we also examined the relationship between emergency patient's characteristics and the occurrence of OSF and organ system involvement in terms of death or survival.

Thus, this report presents the results of our effort not only to validate three disease classification system to stratify acutely ill emergency patients prognostically by risk of death but also describe the current trend of emergency population and the results of current practice.

Patients And Methods

From October 1, 1995 to December 31, 1996, any medical patients who visited emergency department- Chung-Gung Memorial Hospital in Kaohsiung due to various etiologies would be considered potentially eligible for this study. Death on arrival would be excluded.

A detailed history and physical examination were performed on each collected case. Emergency triage was applied to each patient. (see APPENDIX Ⅰ) APACHE Ⅱ scores were assigned as described by Knaus et al. The exact modified criteria recorded are described in detail in the APPENDIX Ⅱ.

For each patient, use recorded age, sex, prior health status, diagnosis, indications for ward and intensive care admission, and operative status. During observation period, we recorded for each patient the extent of therapy received. We also followed all patients for outcome at both intensive or emergency care and hospital discharge. On-duty research associates (usually ER and ICU nurses) were instructed in data collection using strict definitions for acute physiologic measurements and standardized forms.

Modified APACHE Ⅱ Classification System (ACS)

In 1985, Knaus et al modified the acute physiological score (APS) and named it the new version APACHE Ⅱ, containing 12 variables for APS[(5)]. Knaus et al also observed that the development of acute organ system failure was associated with high mortality in the ICU [(6)]. He used a variation of the nominal group process to choose and weigh physiologic variables. This process followed closely the suggestions of Scheffle with regard to proper construction of severity scales [(9)], and took advantage of the long-established principle of homeostasis. These new measures have been applied in some studies with good correlation and results [(3-9)]. For emergency evaluation, we modified this score system as follows : APACHE Ⅱ score was divided into 3 parts; A denoted chronic health point; B represented age score; C_1 meant initial score of APS in ER; C_2 was calculated during observation or hospitalization period; and C_3 was calculated while on discharge. Based on score division, we separated all patients into 4 classes : 1^o (0-10 points), 2^o (11-20 points) , 3^o (21-30 points), and 4^o (≧31 points). (See the APPENDIX Ⅱ)

Definitions of organ system failure (OSF)

Independent of the data collection, we also developed strict objective physiologic criteria for the diagnosis of OSF for emergency practice. The modified strict criteria were obtained from a review of the clinical literature and later modified through an informal consensus of subspecialists [6-11]. Some definitions of OSF are in APPENDIX Ⅲ. Since our goal was to provide objective estimates of the probability of survivals for patients receiving emergency therapy, we chose solid definitions that are clear, easily obtained, and relatively independent of therapeutic decisions [6-10]. These definitions were applied to all OSF patients except those receiving chronic hemodialysis prior to hospital admission. Therefore, with one important exception, we systematically avoided including any therapeutic modalities in our definitions for OSF but based them on the presence of severe physiologic derangements. The remaining definitions were applied irrespectively of new or ongoing therapeutic interventions, such as volume expansion, infusion of blood components or vasoactive agents, dialysis, and so on.

Thus, our definitions of OSF specially assume that each patient is receiving life supporting therapy directed at correcting abnormal physiology. There are designed to be independently applied to each period. By the way, to designate neurologic failure, we used a Glasgow Coma Score of 6 or less. A Glasgow Coma Score is obtained by summing the best responses during a simultaneous examination of ocular, motor, and verbal activity. The worst score (lowest) over a 24-hours period was recorded for each patient. When the patient was paralyzed or sedated, neurologic scoring was not performed and the patient was not considered in neurologic failure. When a patient was intubated but not sedated, we used clinical judgement to estimate the best verbal response.

Statistical analysis

We initially compared the characteristics and variable score of survival and mortality patients in this prospective large-scale survey. We then related the sex, class, the number of OSF, and the 4 triage system with follow-up mortality. To do this, we analyzed and evaluated the whole hospital course by APACHE Ⅱ Scoring System for all patients.

First, potential univariate correlates of adverse outcomes (mortality) were identified with use of chi-square analysis or Fisher's exact test (for dichotomas variables) and the logistic-regression technique (for categorial and continuous variables). All variables significant at a nominal two-sided P value < 0.10 were then entered into multivariate logistic regression models. Two-sided P values and 95% confidence intervals were also reported together with odds ratio (OR) competing models (by the likelihood-ratio test). Continuous variables were compared by analysis of variance for repeated measures, these values are reported as means ± SD. In addition, ACS and ETS efficacy to predict outcome for ER practice were also evaluated by means of post-hoc test. All analysis were performed with SAS computer programs (SAS Institute, Cary, N.C.).

RESULTS

There were total 9294 admissions prospectively collected in Emergency Service. Using the definitions in APPENDIX Ⅰ-Ⅲ, all patients could be evaluated prospectively without delay. Of this large-scale survey, 5110 were men and 4184 were women. Based on ETS, class Ⅰ was 9%, class Ⅱ was 12%, class Ⅲ was 54%, and class Ⅳ was 25%.

According to ACS, class Ⅰ was 69%, class Ⅱ was 24%, class Ⅲ was 6%, class Ⅳ was 1%. In terms of OSF, 0^o was 84%, single-OSF was 13%, and multiple-OSF was only 3%. Mortality among all MER patients was 9.3%.

Outcomes (Table 1)

The main factors correlating the patient's survival were the following : sex (female), ACS (1^o-4^o), OSF (0^o-4^o), and ETS (1^o-4^o)($P<0.001$). To test patient characteristics associated with mortality, we compared all these 3 unique predicting modes using odds ratio method. All were illustrated in Table 1. Among patients with each predicting models, there were significant increases in total mortality rates associated with higher risk group and the numbers of OSF.

Risk factors for ER survey (Table 2)

To identify patient characteristics associated with mortality, we compared the characteristics of hospital course (using APACHE Ⅱ Score) 8840 survival patients to those (854) with fatality. Mortality was significantly more frequently occurred among patients with preexisting severe chronic health status ($P<0.001$), age greater than or equal to 65 years ($P<0.001$), and severe initial and subsequent acute physiological derangement than those without ($P<0.001$). Based on patients with septic shock or those admitted following our clinical observation a cardiac arrest were also more likely to develop multiple OSFs than patients without OSF. These patients were prone to suffering from subsequent death unless the underlying pathology could be altered by way of aggressive medical or surgical interventions just in time with proper, meticulous managements. Once multiple OSFs occurred, patients received consistently more treatment, stayed in the ICU longer (including ER ICU), and had higher death rates than patients without multiple OSFs.

Analysis of ACS and ETS scores (Table 3 & 4)

In terms of post-hoc test, the efficacy of these two system could be evaluated by way of risk of death prognostically (Table 3 and 4)($P<0.001$). Classification system ranging from 1^o to 4^o showed significant difference among each class ($P<0.001$). These two tables confirmed that traditional triage and APACHE Ⅱ score evaluation would be very useful and helpful in ER survey.

Risk factors for survival and death (Table 5 & 6)

Moreover, only age, organ system involvement, Ⅰ vs Ⅳ, and Ⅱ vs Ⅳ, showed the significant changes in ETS by means of multivariate logistic regression model. On the contrary, Ⅰ vs Ⅳ, Ⅱ vs Ⅳ, Ⅲ vs Ⅳ, sex, and organ system involvement demonstrated the significant alternations in ACS. Thus, some differences still existed between these 2 systems. Worthy of comments were that male suffered more mortality rate than female in emergency setting and patients with acute illness as well as organ system involvement (OSI) tended to have more subsequent death (3.6 folds) than those with acute illness without OSI as shown in Table 5. In other words, male patients with acute illness together with organ system involvement deserved more frequent medical attention than those without due to the higher mortality rate. But in current emergency practice, ETS is very popular. The mortality between classes IV & VI did not show any significant difference. Organ system involvement did play an important role in predicting subsequent death not only in ACS but also in ETS. Thus, these findings should be very useful and helpful for health policy decision makers.

DISCUSSION

Our results demonstrate that these three predicting models during the ER survey and subsequent hospital course confer their unique efficacy and associated predictability in ER patients for large-scale survey. The objective of this study was to provide estimates for the probability of survival from acute episodes since National Health Insurance has opened a new era in Taiwan.

Our results indicate extraordinarily high mortality rates for patients with APACHE Ⅲ& Ⅳ, EMS 1^{o}, and multiple OSFs that persist during and after aggressive intensive therapy. In this survey, we clearly demonstrate that the severity of acute disease can be measured by quantifying the degree of abnormalities of multiple physiologic variables in ER practice. By means of subsequent observation assessment, it is well established that increases in ASS are associated with increased risk of subsequent mortality.

ACS

The APCHE or APS proposed by Knaus et al. has proved to be adequate in multicenter and international studies [3-5, 11-14]. However, because it is both complex and time-consuming, it is not used routinely by many ICU teams [6]. Based on our knowledge, there was no trial utilizing this system for large- scale ER survey. Although APS is generally accepted as a reliable estimate of severity of illness in individual patients, variations in the mean number of data collected per patient may introduce a systematic bias in patient scoring because missing values are interpreted as normal. It seems appropriate, therefore, to select a standardized group of routinely available measurements which would give unbiased results. Thus, we modified A, B, and C parts of APCHEⅡScoring system. Thus, these simple standardized scoring system, valid for a majority of pathologies in different medical fields, would largely eliminate the need for specific scoring system (APS 34), thereby facilitating inter-ER comparisons of treatment and management.

Although newly ACS cannot replace highly specific scoring system such as those used for burn patients or patients with myocardial infarction, based on our experience, it is an efficient, highly useful indicator of mortality over a wide range of medical pathologies[6]. Although no score is without limitations, the newly ACS has the advantage of being simple, inexpensive, and reliable methodology to predict mortality for ER practice. Thus, newly ACS for ER practice can be confirmed. In other words, risk stratification and scoring index can be used in hospital emergency data resources and be compared with serial clinical evaluations to predict outcomes for promotions of ER service quality in Taiwan.

OSF

The development of objective prognostic estimates designed for use in clinical decision making for individual patient is a new undertaking for current practice [6]. A landmark in the field was the definitions for brain death developed at Harvard Medical School in 1968[15]. Recent studies have carried this effort forward by providing outcome predictions for patients with cardiac arrest and other forms of nontraumatic coma who are not brain dead but have very low probabilities of meaningful recovery [6,15-20]. Our results of this study are in general agreement with studies reported an increasing mortality rate with an increasing number of OSFs[6]. Differences in our strict definitions of OSF in comparisons with other reports are why mortality rates are higher in our study[6]. Any application of extrapolation from our data, therefore must take into strict account the nature and exact format of the underlying disease and the definitions used.

Considering the importance of the patient‘s major diagnosis in determing prognosis [21], it would have been useful to take into account the impact of the patient’s age when determining the efficacy of continued treatment[22]. In summary, the newly developed OSF system could be used reliably to predict outcomes for emergency practice.

ETS

ETS has been widely applied for ER practice all over the world. It provides a simple, useful, meaningful triage for all ER patients. In this survey, class Ⅲ and Ⅳ did not revealed significant difference in terms of mortality. Moreover, low risk population of emergency service still existed in medical center service. This phenomenon might result from domestic cultures, clinic-service habits, and social backgrounds. Overflowed population of emergency service maybe partly due to inconstant health policy, patient˙s preferrence, and lack of ineffective transferal system and emergency transporting system.

Implications of these estimates

Theoretically speaking, these 3 independent predictive models would be very useful to emergency medical physicians for triage and dispatch decisions as well as determining aggressiveness of care through discussions with families, determing utilization of hospital facilities and emergency transferal system. Our studies clearly demonstrated that patients with acute illness together with organ system involvement suffered more mortality than those without OSI. Elderly male patients and OSI should deserve more medical attention based on high mortality rate. In other words, our trial point out the defects of current emergency system policy. Large population of low risk patients occupied the most sense in emergency practice. The latter may hinder the optimal timing of the prompt managements of high-risk patients.

We acknowledge that future improvements in the design and application of life support therapy may make it possible for more high-risk patients to survive and that these prognoses may change over time. Thus, the need for prompt recognition and treatment of clinical problems that could lead to mortality was highlighted in this survey.

Regardless of future research process, there will always be patients for whom the power of our science is limited and for whom further treatment cannot alter outcome. For such patients, decisions to limit therapy are appropriate, but they will remain complex. This is because they involve questions concerning the wishes and competence of the patient, fears of legal liability, as well as the accuracy of the medical prognosis. In fact, the statistical estimates provides by this survey address only the general aspect of medical prognosis. By the way, in treating any individual patient, the clinician in combination with the patient or the patient's family must decide what look, if any, such estimates should have. If, such discussion, the decision is to reduce treatment, it will be consistent with acknowledged daily practice of aiming not prolonging death unnecessarily (death with dignity) and distributing medical resources equitably so that scarce emergency resources will more likely be available to those that can benefit. Thus, prognostic informations, when properly used, in these 3 models, could improve both the quality and the policy of emergency care and the compassion of our daily practice.

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急診內科病人使用 APACHEII分類系統、器官衰竭系統以及傳統急診檢傷分類系統 - 一大型前瞻性研究

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摘　　要

全民健保業已開啟了台灣的新紀元。緊急救護人群就醫之趨勢仍是公共衛生之重要課題。APACHEII分類系統暨器官衰竭系統評估加護中心病人之癒後已行之有年。急診處使用檢傷分類仍扮演重要角色。然而,仍無大型前瞻性研究同時評估三種系統對於內科緊急傷患癒後。因此本篇研究旨在探討它的功用並嘗試解決三種系統對於現行急診處內科病人癒後之追蹤評核。從 1995 年 10 月至 1996 年 12 月我們一共評估了 9294 位病人。所有病人皆接受三項評估。而 APACHEII(ACS)分成三大部份: A 為慢性健康指數評點; B 為年齡評分;C_1 為最初生理分數;C_2 為住院觀察分數;C_3 為出院(或)最後一次分數。我們把它分成四類:第一類為 0~10 分;第二類為 11~20 分;第三類為 21~30 分;第四類為 31 分以上。器官衰竭系統仍分四類。檢傷分類維持以往。我們使分類比來決定各變項相對於個案之死亡或存活。三項評核系統同時進行。此外我們也使用事後檢定試驗來了解此三項評核之真正功能。同時我們也應用多變數回歸分析來了解存活之真正因素。評核分數並不影響臨床決定。在我們所處理的 9294 位病人當中,男性佔 5110 位,女性佔 4184 位。根據檢傷分類,第一類(瀕死或危急)僅佔 9%,第二類(重症)為 12%,第三類緊急非生命告急者為 54%,而第四類(急性病痛)為 25%。若根據 ACS;明顯生命危險者僅佔 8%,其他則為 92%。平均死亡率為 9.3%。影響病人存活之主要因子為:性別,ACS(1 至 4 度)﹔器官衰竭系統(0 至 4 度)以及檢傷分類系統(1 至 4 度)($P<0.001$)。存活者在任何階段之分數皆比死亡者較低,便用多變數回歸分析:年齡,器官影響程度,檢傷分類中第一類比上第四類以及第二類比上第四類,皆有明顯的影響。至於第三類及第四類則無明顯差異。

相對的,ACS 系統,每種程度分類皆有明顯之區分。因此,某些程度之差異性在三種系統評估仍然存在。總之,我們的結論是:低分類(非重症或非生命瀕死)病人仍是目前現行急診制度之大宗來源,這可能是肇因於轉診制度以及健保政策未能落實(大病看大醫院)有關。而這些現象背後是民眾就診習慣及社會背景有關。理論上,此三種評核模式對於與家屬討論病情相當有幫忙,亦可決定是否轉診之依據。這篇報告代表我們對於現行 ACS,器官衰竭系統,以及檢傷分類系統之評估,以及包括現行政策下急診之風貌。

關鍵字: APACHE 分類系統,器官衰竭系統,檢傷分類系統。

Table 1. Correlation of Different Variables in Relation to Survival and Death For Emergency Survey

Variable	Survival n (%)	Death n (%)	Odds Ratio (OR)	P value

(Ⅰ)Sex				
male	4570 (89.4)	540 (10.6)	1.0	<0.001
female	3870 (92.5)	314 (7.5)	0.69	
(Ⅱ)APACHE class				
1 (1-10)	6332 (99.6)	26 (0.4)	1.0	
2 (11-20)	1960 (88.5)	254 (11.5)	31.6	<0.001
3 (21-30)	152 (29.2)	368 (70.8)	589.6	
4 (≧31)	3 (1.5)	202 (98.5)	16398.3	
(Ⅲ)OSF (N^o)				
0	7663 (97.4)	202 (2.6)	1.0	
1	783 (66.4)	397 (33.6)	19.2	
2	27 (16.1)	141 (83.9)	197.3	<0.001
3	4 (4.0)	95 (96.0)	897.4	
4	0 (0.0)	20 (100.0)	1545.5	
(Ⅳ)Triage				
1	60 (10.0)	839 (90.0)	1.0	
2	1080 (80.0)	270 (20.0)	0.03	<0.001
3	4948 (99.2)	42 (0.8)	0.0009	
4	2357 (99.8)	3 (0.1)	0.00014	
(Ⅴ)OSI				
0	218 (100.0)	0 (0.0)	1.0	
1	5558 (99.1)	52 (0.9)	4.1	
2	2177 (86.1)	351 (13.9)	70.5	<0.001
3	450 (54.9)	370 (45.1)	359.4	
4	44 (36.4)	77 (63.6)	761.1	
≧5	0	5 (100.0)	4807.0	

OSF=organ system failure; OSI=organ system involvement; *OSI=0, denoting acute complaints in ER without any abnormalities of either physical or laboratory examination.

Table 2. Comparisons of Different Scores between Survival and Death for Emergency Survey

Item	Survival (N=8440)	Death (N=854)	P value

A	1.59± 1.45	3.30± 1.20	<0.001
B	2.56± 2.05	3.94± 1.76	<0.001
C_1	3.21± 3.42	16.70± 7.66	<0.001
C_2	2.07± 3.28	19.70± 7.22	<0.001
C_3	1.66± 3.20	24.34± 6.54	<0.001
Total			
APACHE 1	7.38± 5.31	24.01± 17.66	<0.001
APACHE 2	6.20± 5.11	26.98± 7.18	<0.001
APACHE 3	5.78± 5.03	31.58± 6.48	<0.001

A=chronic health points; B=age points; C_1=initial acute disease physical score; C_2=during observation or hospitalization score; C_3=discharged or final score;
$APACHE_{1\text{-}3}$=the same calculation methodology as $C_{1\text{-}3}$.

Table 3. Comparisons of Different Classes in APACHE Ⅱ Scoring System

ASS

Variable	**I** (0-10)	**II** (11-20)	**III** (21-30)	**IV** (≧31)	P value	Post-hoc Test
Number	6358	2214	520	205	-	-
A	1.14± 1.23	2.99± 1.18	3.39± 1.15	3.24± 1.14	<0.0001	1/2 1/3 1/4 2/3 2/4
B	2.03± 1.88	4.12± 1.72	4.17± 1.57	3.81± 1.87	<0.0001	1/2 1/3 1/4 2/4
C_1	1.87± 1.81	6.88± 3.17	17.06± 3.61	26.11± 4.45	<0.0001	1/2 1/3 1/4 2/3 2/4 3/4
C_2	0.88± 1.57	6.09± 4.84	18.72± 5.27	26.73± 4.36	<0.0001	1/2 1/3 1/4 2/3 2/4 3/4
C_3	0.66± 1.96	6.24± 6.80	20.84± 7.83	28.87± 4.41	<0.0001	1/2 1/3 1/4 2/3 2/4 3/4
Total						
$APACHE_1$	5.05± 3.32	14.04± 2.80	24.66± 3.42	33.24± 4.27	<0.0001	1/2 1/3 1/4 2/3 2/4 3/4
$APACHE_2$	4.01± 3.13	13.22± 4.64	26.11± 5.10	33.75± 4.36	<0.0001	1/2 1/3 1/4 2/3 2/4 3/4
$APACHE_3$	3.78± 3.37	13.33± 6.70	28.45± 7.70	35.01± 4.46	<0.0001	1/2 1/3 1/4 2/3 2/4 3/4

Table 4. Comparisons of Different Scores in Four Classes of Emergency Triage System

Triage

Variable	Ⅰ	Ⅱ	Ⅲ	Ⅳ	P value	Post-hoc test
A	3.24± 1.06	2.88± 1.20	1.95± 1.37	0.31± 0.72	<0.001	1/2 1/3 1/4 2/3 2/4 3/4
B	3.84± 1.74	3.66± 1.89	2.80± 2.02	1.59± 1.81	<0.001	1/3 1/4 2/3 2/4 3/4
C_1	19.27± 7.13	7.82± 5.22	3.25± 2.77	1.31± 1.75	<0.001	1/2 1/3 1/4 2/3 2/4 3/4
C_2	21.29± 6.95	7.61± 6.75	2.07± 2.82	0.43± 1.35	<0.001	1/2 1/3 1/4 2/3 2/4 3/4
C_3	24.20± 7.74	8.18± 8.89	1.76± 3.17	0.24± 1.34	<0.001	1/2 1/3 1/4 2/3 2/4 3/4
$APACHE_1$	26.40± 7.18	14.39± 7.56	8.04± 4.40	3.20± 3.08	<0.001	1/2 1/3 1/4 2/3 2/4 3/4
$APACHE_2$	28.27± 7.03	14.13± 7.56	6.83± 4.23	2.08± 2.83	<0.001	1/2 1/3 1/4 2/3 2/4 3/4
$APACHE_3$	31.31± 7.79	14.68± 9.65	6.49± 4.61	2.08± 2.80	<0.001	1/2 1/3 1/4 2/3 2/4 3/4

Table 5. Factors Affecting Survival or Death in APACHE Ⅱ Scoring Classification System by Multivariate Logistic Regression Model

Variable	β (S.E.)	OR	(95% CI)
Class			
I/IV	-8.91 (0.62)	0.00014**	($4.0x10^{-5}$~$4.55x10^{-4}$)
II/IV	-6.29 (0.59)	0.00185**	($5.83x10^{-4}$~$5.89x10^{-3}$)
III/IV	-3.46 (0.60)	0.031**	($9.7x10^{-3}$~0.102)
Age	-0.0085 (0.0045)	0.99	(0.982~1.000)
Sex (male=1)	-0.409 (0.117)	0.66**	(0.528~0.836)
OSI (0=1)	1.28 (0.08)	3.60**	(3.07~4.21)

OR=odds ratio; CI=confidence interval; OSI=organ system involvement; **P<0.001.

Tables 6. Factors Affecting Survival or Death in
Emergency Triage System by Multivariate Logistic Regression Model

Variable	β (S.E.)	OR	(95% CI)
Class			
I/IV	6.97 (0.53)	1064.2**	(376.6-3001.3)
II/IV	3.59 (0.52)	36.23**	(13.08-100.4)
III/IV	0.79 (0.53)	2.20	(0.78-6.23)
Age	0.015 (0.0085)	1.015**	(1.006-1.024)
Sex (male=1)	0.084 (0.121)	1.088	(0.858-1.379)
OSI (0=1)	1.088 (0.081)	2.97**	(2.53-3.48)

Abbreviations: see the previous table.

APPENDIX I

Emergency Triage System (Non-traumatic field) (ETS)

Class Ⅰ. Immediate life - threatening conditions c̄ unstable vital signs (Critical conditions)

1.Cardiac or respiratory arrests.
2.Any acute respiratory distress status with failure (eg: RR<10 CPM, cyanosis, status asthmatics, etc.)
3.Any comatus conditions (acute consciousness loss, severe metabolic derangement or drug intoxication).
4.Any shock status.
5.Uncontrollable bleeding with hemodynamic compromised status.
6.Severe tachy or bradyarrhythmia inducing significant hemodynamic derangement.
7.Status epileticus.
8.Severe hypothermia or hyperthermia (BT $\leqq 30^{o}$ or BT $\geqq 41^{o}$ C)

Class Ⅱ. Possible life - threatening conditions c unstable vital signs (impending but not-critical conditions)

1.Foreign body in the airway.
2.Acute onset of respiratory distress (eg: RR>30CPM)
3.Acute onset of chest pain with cold sweating, suggesting AMI or unstable angina.
4.Hypertensive crisis (eg: DBP>130 mmHg)
5.Acute onset of cerebral vascular accident (CVA).
6.Drug or chemical intoxication with significant hemodynamic derangements.
7.Cardiac arrhythmia with significant hemodynamic derangement.
8.Acute onset of abdominal pain with significant hemodynamic derangement.
9.Acute onset of severe headache with neurological deficit.
10.Acute onset of Auria.
11.Any Organ system severe pain or bleeding conditions with unstable vital sign.

Class Ⅲ. Acute conditions with stable vital signs (emergency treatment maybe comfortable-saving)

1.Acute onset of any pain, which disease entity should be identified.
2.Unstable thermia (eg : hyperthermia $>39^{o}$ C ($<41^{o}$ C) and hypothermia $<35^{o}$ C ($>30^{o}$ C)).
3.Any organ-system bleeding conditions.
4.Acute gastroenteritis with suspicious food poisoning.
5.Hypertension with any chest distress (SBP>180mmHg, or DBP>110mmHg).
6.Allergic reactions.
7.Any renal or biliary colic or organ system obstruction.

8.Any infectious disease which needs urgent therapy.
9.Foreign body in any hollow organ system (except respiratory tract)
10.Acute onset of psychotic reactions (eg: violence or sucidal attempt).
11.Difficult breathing without any cardiopulmonary embarrassment.

Class Ⅳ. Non-emergency conditions (Stable vital signs without acute episodes)

1.URI (fever <39 ^{o} C).
2.Chronic illness without acute episodes.
3.Old CVA sequela without deterioration.
4.Any cancer patient with cancer-related complications. (no new acute episodes)
5.OPD transferal for admission without acute episodes.
6.Unspecific complaints without acute episodes.

Abbreviations: RR=respiratory rate; CPM=cycles per minute; BT=body temperature; MI=myocardial infarction; DBP=diastolic blood pressure; SBP=systolic blood; URI=upper respiratory tract infection; OPD=outpatient clinic department.

APENDIX Ⅱ: APACHE Ⅱ SCORE in ER SURVEY (ACS) (Form A)

Clinical Data: ____

Positive PE: ____

Tentative Diagnosis: ____________________ Final Diagnosis: ______________

APACHE Ⅱ Score ( )* Add if any of following : Class : __________

Emergency surgery or intenvention (5)

Elective surgery or intervention (2)

Total Scores : A+B+C; 1° (0-10); 2° (11-20); 3° (21-30); 4° (≧31)

A: Chronic health points: ( )

(1)Any severe organ system insufficiency (Add: 3)

Definitions:

1.Decompensated liver cirrhosis (c̄ portal HT c̄ EV bleeding or c̄ hepatic encephalopathy, Child B/C)

2.CV: CCHF (NYHA: 3/4)-Any kind.

Unstable Angina (NYHA: 3/4)

Recent MI (within 3 months)

Aortic Dissection (proximal type or progressive within 3 months)

Previous life-threatening tachy or brady- arrhythmic episodes.

3.Chest: Cor-pulmonale of any etiology; or moderate-severe COPD with hypoxemia or hypercapnia (O_2<60mmHg, CO_2>50mmHg)

Chronic pulmonary thromboembolism with pulmonary hypertension.

4.GU: Any kind of ESRD.

5.Neuro: Chronic bed-ridden patients with or without neurological sequelae.

6.DM c̄ triopathy (c̄ one organ system severe derangement)

(2)Imunmocompromized host: Any cancer patients; or patients with receiving immunosuppressive or chemotherapy or radiation therapy, (Add 3) including SLE with steroid therapy.

(3) Any organ system insufficiency (Add 1)

GI:1.Liver cirrhosis (Child A) or chronic liver disease with derangements.

2.Chronic pancreatitis with underlying etiology.

3.Chronic alcoholism.

4.Chronic peptic ulcer with bleeding.

5.Abdominal surgery with frequent abdominal episodes.

6.Chronic biliary tract problems.

CV: 1.Angina (CAD-NYHA 1/2)

2.CCHF (NYHA I/2)

3.Old MI/Aortic Aneurysm

4.Any kind of cardiomyopathy

5.HCVD (ECG or Echo-documented)

6.Any peripheral vascular disease.

7.Any kind of valvular heart disease.

8.Frequent attack of PSVT including Af.

Chest: COPD. Asthma.
Neuro: minor stroke/seizure episodes
GU: chronic renal parenchymal disease or obstructive uropathy.

B Age Point: (   )
≦44 (0), 45-54 (2), 55-64 (3), 65-74 (5), ≧75 (6)

(Form B)

C.APS Score I ( ) O ( ) D ( ) I: initial evaluation in ER O: observational period

D: discharge period

Variables Initial During Discharge	High +4	+3	+2	Range +1	 0	Low +1	abno rmal +2	+3	range +4
( )( )( )	≧41	39.0 40.9		38.5 38.9	36.0 38.4	34.0 35.9	32.0 33.9	30.0 31.9	≦29.9
( )( )( ) BP without drug	≧160	130 159	110 129		70 109		50 69		≦49
( )( )( ) HR (BPM)	≧180	140 179	110 139		70 109		55 69	40 54	≦39
( )( )( ) RR	≧ 50	35 49		25 34	12 24	10 11	6 9		≦ 5
( )( )( ) FiO_2 ≧0.5($AaDO_2$) FiO_2 ≦0.5	≧ 500	350 499	200 349		<200 >70	61-70		55-60	<55
( )( )( ) pH	≧7.7	7.60 7.69		7.50 7.59	7.33 7.49		7.25 7.32	7.15 7.24	<7.15
( )( )( ) NA	≧180	160 179	155 159	150 154	137 149	130 136	120 129	111 119	≦110
( )( )( ) K	≧7.0	6.0 6.9		5.5 5.9	3.5 5.4	3.0 3.4	2.5 2.9		<2.5
( )( )( ) Cr^+($^+$ARF)	≧ 3.5	2.0 3.4	1.5 1.9		0.6 1.4		<0.6		
( )( )( ) Hct	≧ 6.0		50.0 59.9	45.0 49.9	30.0 44.9		20.0 29.9		<20
( )( )( ) WBC (in 1000)	≧40		20 39.9	15 19.9	3.0 14.9		1.0 2.9		<1.0
( )( )( ) GCS	GCS=15- actual GCS				inotropic BP(mmHg)	≧100	80 100	60 79	<60

Abbreviations :HT=hypertension; EV=esophageal variceal; CV=cardiovascular; GU=genitourinary tract; CCHF=chronic congestive heart failure; NYHA=New York Heart Association;

COPD=chronic obstructive pulmonary disease; ESRD= end-stage renal disease;
DM=diabetes mellitus; MI=myocardial infarction; CAD=coronary artery disease;
SLE=systemic lupus erythematous; HCVD=hypertensive cardiovascular disease;
PSVT=paroxysmal supraventricular tachycardia; Af=atrial fibrillation;
BP=blood pressure; HR=heart rate; BPM=beats per minute; RR=respiratory rate;
FiO_2=fraction of inspired oxygen content; $AaDO_2$=alveolar-artery oxygen difference;
Na=sodium; K=potassium; Cr^{++}=creatinine; Hct=hematocrite; WBC=white blood count;
GCS=Glasgow Coma Scale.

APPENDIX Ⅲ Definitions of Organ-System Failure (OSF)

If the patient had at least two or more of the following during a 24hour period (regardless of other values), OSF existed on that day. All patients should have their own system embaressments and suffered from acute emergency status.

1.Cardiovascular failure (presence of two or more of the following)

A. Heart rate ≦50/min.

B. Mean arterial blood pressure ≦49mmHg.

C.Ocurrence of ventricular tachycardia and/or ventricular fibrillation.

D.Serum pH ≦7.2 with a PaO_2 of ≦50mmHg.

2.Respiratory failure (presence of two or more of the following)

A. Respiratory rate ≦5/min or ≧35/min.

B. $PaCO_2$ ≧50mmHg or PaO_2≦50mmHg (room air).

C. $AaDO_2$≧350mmHg ($AaDO_2$=713 FiO_2-PaCO2-PaO_2).

D. Dependent on ventilator on the fourth day of other OSF, e.g., not applicable for the initial 72h of OSF.

3.Renal failure (presence of two or more of the following or dialysis)

A. Urine output≦479 ml/24h or 159 ml/8h.

B. Serum BUN≧100 mg/100ml.

C. Serum creatinine≧3.5 mg/100ml.

D. Presence of DIC.

4.Hematologic failure (presence of two or more of the following)

A. WBC≦1000 mm^3.

B. Platelets≦20,000 mm^3.

C. Hematocrit≦20 %.

5.Neurologic failure

Glasgow Coma Score≦6 (in absence of sedation at any one point in day)

Glasgow Coma Score: Sum of best eye opening, best verbal, and best motor response.

Scoring of responses as follows: (points)

Eye-Open; spontaneously (4), to verbal command (3), to pain (2); no response (1). Motor-Obeys verbal Command (6); response to painful stimuli; localized pain (5), flexion withdrawal (4), decorticate rigidly (3), decerebrate rigidity (2), no response (1); moment without any control (4); verbal-oriented and converses (5), disorient and converses (4), inappropriate words (3), in comprehensible sounds (2), no response (1).

If intubated, use clinical judgment for verbal responses as follows: patient generally unresponsive (1),

patient's ability to converse in question(3), patient appears able to converse(5).

6.Defensive (Human Immuno-Defensive) failure: Septic syndrome (presence of all following items)

A. Clinical evidence of infection

B. Fever or hypothermia.

C. Significant hemodynamic derangements (tachypnea/ tachycardia).

D. Impaired organ system function or perfusion (altered mention, hypoxemia, oliguria, and elevated plasma lactate).

7.Other failures definitions: See The ICU Book (Ref. 10).