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Are Vital Signs Strongly Associated with Criteria Predictive for Admission to the Intensive Care Unit

Keshav Murthy[1], Aruna C Ramesh[2]

Author's Affiliation:
[1]Assistant Professor, [2]Professor and Head, Department Emergency Medicine, M.S. Ramaiah Medical College and Hospital, MS Ramaiah Nagar, Mathikere, Bengaluru, Karnataka 560054, India.

Corresponding Author:
Keshav Murthy, Assistant Professor, Department Emergency Medicine, M.S. Ramaiah Medical College and Hospital, M S Ramaiah Nagar, Mathikere, Bengaluru, Karnataka 560054, India.

E-mail: statisticsclinic2018@gmail.com

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Abstract

Introduction and aim: The process of triage in the Emergency department is complex and several triage scales have been designed to guide the clinician in prioritizing the patients. This study was done to quantify patient admission to ICU through the emergency department and to identify if vital signs strongly associated with criteria predictive for admission to the intensive care unit. *Methods and results:* A cross sectional study was undertaken in the emergency department over a period of 6 months at MS Ramaiah hospital. The study included total of 824 Patient presented to emergency department. Patient's demographic data, clinical Information along with vital signs were noted. Majority of subjects were in the age group 31 to 40 years (23.7%), mean age was 41.4 ± 19.7 years. 58.3% were males and 41.7% were females, mean Heart rate was 89.80 ± 20.11, mean Respiratory Rate was 23.40 ± 6.65, mean SpO_2 was 92.73 ± 7.09, mean SBP was 119.74 ± 20.79 and mean DBP was 75.08 ± 12.43. In the study SpO2 had highest sensitivity in predicting the admission to ward, ICU, Discharge and death in emergency room compared to other vital parameters. *Conclusion:* The Abnormal vital signs are strongly associated with adverse outcome; low SpO_2 had the highest sensitivity and specificity of all the vital signs.

Keywords: Intensive care unit; Vital Signs; Emergency; ICU; Mortality.

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Introduction

Emergency department (ED) triage is used to identify patient's levels of urgency and treat them based on their triage level. The process is complex and several triage scales have been designed to guide the clinician in prioritizing the patients, first in Australia, United Kingdom and Canada.[1-3] The global advancement of triage scales in the past two decades has generated considerable research on the validity and reliability of these scales. Farrhoknia et al. have investigated the validity and reliability of the different triage scales in a systematic review.[4] The triage of patients is essential for implementing critically important care decisions and decreasing adverse outcomes. But no clear information exists in the utility of initial vital signs in identifying ill patients requiring intensive care unit. The triage of patients is essential for implementing critically important care decisions and decreasing adverse outcomes. But no clear information exists in the utility of initial vital signs in identifying

ill patients requiring intensive care unit (ICU) admission in the emergency department. The formation and content of the acute admission database are described in more detail by Barfod et al.[5] Efficient management of the Emergency Department requires a team of providers capable of correctly identifying patient's needs, setting priorities and implementing appropriate treatment, investigation and disposition. Patients referred to a medical admission unit (MAU) represent a broad spectrum of disease severity. In the interest of allocating resources to those who might potentially benefit most from clinical interventions, several scoring systems have been proposed as a triaging tool. Even though most scoring systems are not meant to be used on an individual level, they can support the more inexperienced doctors and nurses in assessing the risk of deterioration of their patients.

Objective

To quantify patient admission to ICU through the emergency department and to identify the role of vital signs in predicting admission to ICU.

Materials and Methods

A cross-sectional study was under taken for period of 6 months in the emergency department at MS Ramaiah hospital. A Patient's demographic data, clinical Information along with vital signs were noted. Vital parameters such as pulse oxymeter showing oxygen saturation of the patient (SpO_2)

Table 1:

	SpO_2 in room air	RR/min	SBP/mmHg	HR/min	GCS
Red	<80	>30/< 10	<89	>120 /<50	<8
Yellow	80–89	16–30	89–100	89–120	9–12
Green	90–100	<16	>100	50–89	13–15

measured in room air, respiratory rate measured per minute, blood pressure measured in millimeter of mercury. Triage system used in the study settings: Red– immediate resuscitation, Yellow– Emergent, Green– Non-urgent.

Statistical analysis: Data was entered into Microsoft Excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. A chi-square test was used as a test of significance for qualitative data. Continuous data were represented as mean and standard deviation. The predictive ability of vital signs was estimated by Sensitivity, Specificity, Positive predictive value (PPV) and negative predictive value (NPV). Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram and ROC Curve. A *p*-value <0.05 was considered as statistically significant after assuming all the rules of statistical tests. Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

Results

The study was done on 824 patients who were admitted to ICU or referred to ICU from the emergency department. Of the majority of subjects were in the age group 31 to 40 years (23.7%), mean age was 41.4 ± 19.7 years. 58.3% were males, however, and 41.7% were females, mean heart rate was 89.80 ± 20.11, mean respiratory rate was 23.40 ± 6.65, mean SpO_2 was 92.73 ± 7.09, mean SBP was 119.74 ± 20.79 and mean DBP was 75.08 ± 12.43 (Table 2).

Table 2: Baseline characteristics of subjects

		Count	Percentage (%)
Age	<10 years	57	6.9
	11 to 20 years	57	6.9
	21 to 30 years	110	13.3
	31 to 40 years	195	23.7
	41 to 50 years	145	17.6
	51 to 60 years	121	14.7

		Count	Percentage (%)
	61 to 70 years	77	9.3
	71 to 80 years	48	5.8
	81 to 90 years	14	1.7
Age (Mean ± SD)		41.4 ± 19.7	
Sex	Male	480	58.3
	Female	344	41.7
Heart rate		89.80 ± 20.11	
Respiratory rate		23.40 ± 6.65	
SpO_2		92.73 ± 7.09	
SBP		119.74 ± 20.79	
DBP		75.08 ± 12.43	

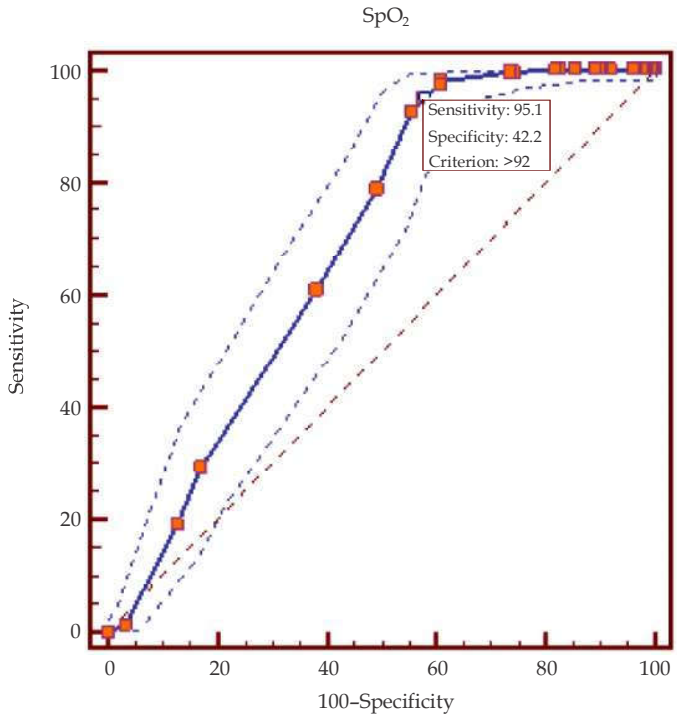

Fig. 1: ROC curve showing validity of SpO_2 in predicting admission to ward.

In the study, SpO_2 had the highest sensitivity in predicting the admission to ward compared to other vital parameters. SpO_2>Respiraotry rate>Heart rate>SBP>DBP. (Table 3).

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Table 3: Validity of vital signs in predicting admission to ward

	Area under the curve					
Test result variable (s)	**Area**	**SE**	***p*-value**	**Cut-off**	**Sensitivity**	**Specificity**
Heart rate	0.613	0.020	<0.001*	≤98	88.6%	33.7%
Respiratory Rate	0.634	0.019	<0.001*	≤25	92.3%	33.2%
SpO_2	0.688	0.018	<0.001*	>92	95.1%	42.2%
SBP	0.554	0.021	0.014*	>119	62.6%	49.8%
DBP	0.541	0.021	0.062	>66	89%	21.6%

Table 4: Validity of vital signs in predicting admission to ICU

Area under the curve						
Test result variable (s)	**Area**	**SE**	***p*-value**	**Cut-off**	**Sensitivity**	**Specificity**
Heart rate	0.805	0.017	<0.001*	>89.7	70.5%	79.4%
Respiratory rate	0.822	0.016	<0.001*	>23	73.5%	81.2%
SpO_2	0.873	0.015	<0.001*	≤93	79.4%	89.7%
SBP	0.517	0.022	0.430	>135	26.48%	86.03%
DBP	0.516	0.022	0.436	>82	26.13%	85.29%

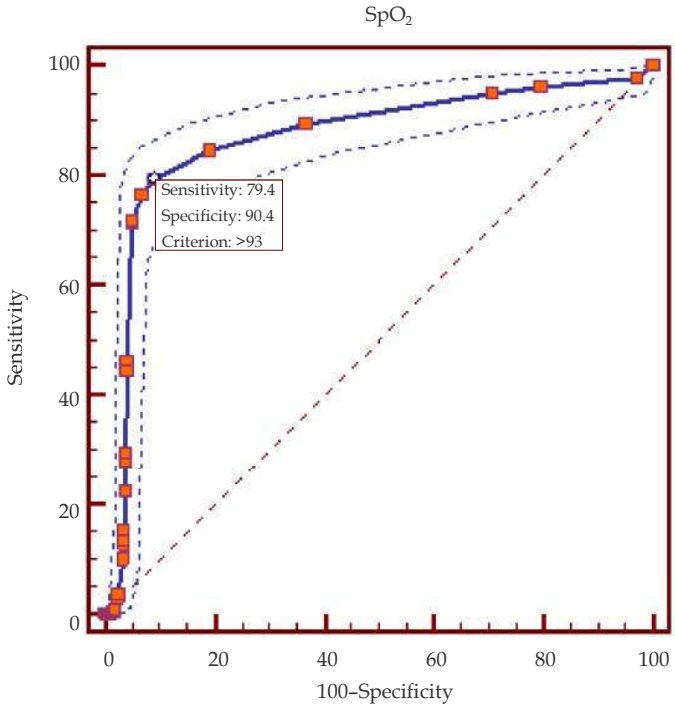

Fig. 2: ROC curve showing validity of SpO_2 in predicting admission to ICU.

In the study, SpO_2 had the highest sensitivity and specificity in predicting the Discharge from ER compared to other vital parameters. SpO_2>Respiraotry rate>Heart rate>SBP>DBP. (Table 5).

In the study, SpO_2 had the highest sensitivity and specificity in predicting the Death in the ER compared to other vital parameters. SpO_2>DBP>SBP>RR>HR. (Table 6)

Table 5: Validity of vital signs in predicting discharge from the emergency room

Area under the curve						
Test result variable (s)	**Area**	**SE**	***p*-value**	**Cut-off**	**Sensitivity**	**Specificity**
Heart rate	0.704	0.018	<0.001*	≤86	70.0%	65.7%
Respiratory rate	0.732	0.017	<0.001*	≤22	84.6%	53.0%
SpO_2	0.751	0.017	<0.001*	>94	87.9%	56.8%
SBP	0.527	0.021	0.203	≤135	87.5%	21.23%
DBP	0.513	0.020	0.555	≤85	89.38%	19.78%

Table 6: Validity of Vital signs in predicting death in emergency room

Area under the curve						
Test result variable (s)	**Area**	**SE**	***p*-value**	**Cut-off**	**Sensitivity**	**Specificity**
Heart rate	0.519	0.105	0.785	≤45	44.4%	99.9%
Respiratory rate	0.787	0.054	<0.001*	>26	72.2%	76.7%
SpO_2	0.984	0.005	<0.001*	≤85	99.1%	92.2%
SBP	0.927	0.036	<0.001*	≤90	77.78%	95.04%
DBP	0.946	0.026	<0.001*	≤60	88.2%	90.5%

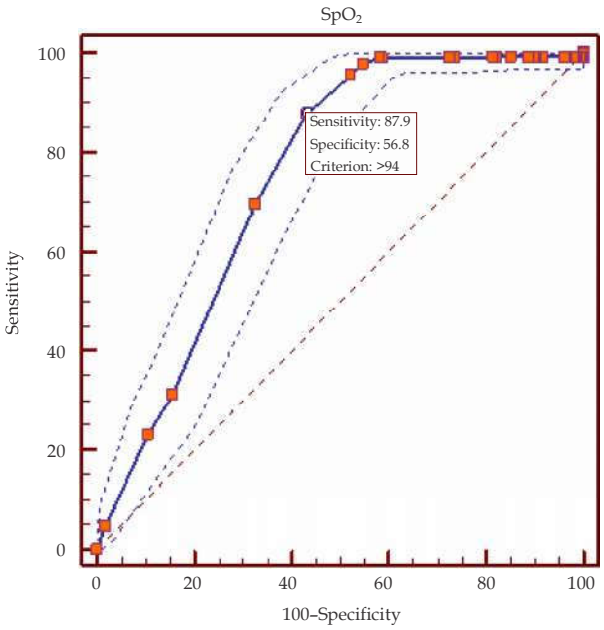

Fig 3: ROC curve showing validity of SpO_2 in predicting discharge from ER.

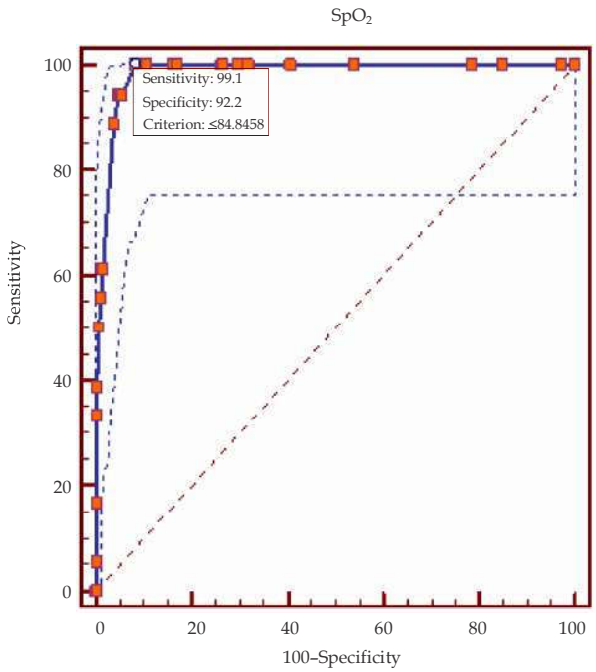

Fig. 4: ROC curve showing Validity of SpO_2 in predicting death in ER.

In the study, SpO_2 had the highest sensitivity and specificity in predicting the poor outcome compared to other vital parameters. SpO_2> HR>RR>SBP>DBP. (Table 7).

Table 7: Validity of vital signs in predicting poor outcome (Death and admission to ICU)

Area under the curve						
Test result variable (s)	**Area**	**SE**	***p*-value**	**Cut-off**	**Sensitivity**	**Specificity**
Heart rate	0.611	0.020	<0.001*	≤98	86.36%	33.39%
Respiratory Rate	0.600	0.020	<0.001*	≤25	87.88%	31.96%
SpO2	0.633	0.020	<0.001*	>93	86.4%	42.9%
SBP	0.510	0.021	0.633	>119	58.71%	48.39%
DBP	0.504	0.021	0.842	≤81	82.2%	22.32%

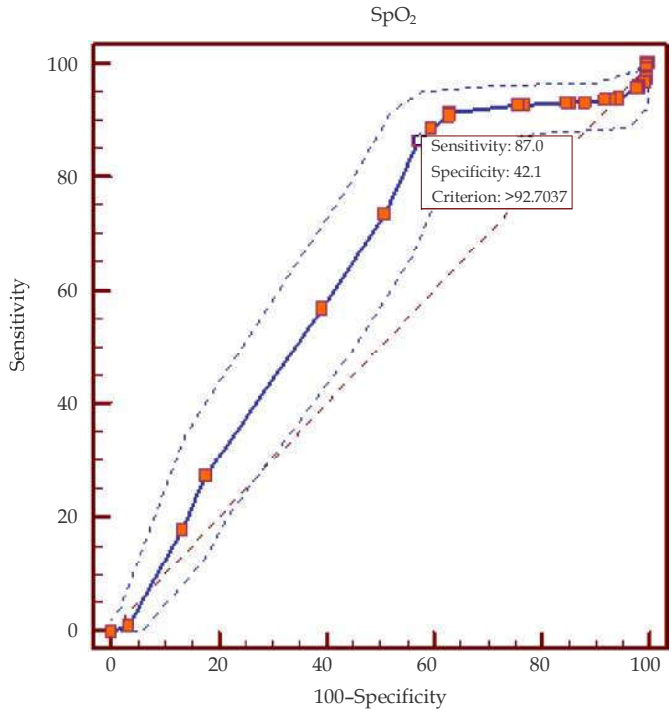

Fig. 5: ROC Curve showing the validity of SpO_2 in predicting the poor outcome (Death and admission to ICU).

Discussion

There are many triage levels used to categorize the patient, which include many variables. The main objective of the present study was to create a data base from the vital sign in which data can easily be retrieved. There is no international consensus about which outcome variables must be used when evaluating different triage systems.[6] Our results demonstrate that patients presenting to the ED with illness or injury initial vital signs can be equally useful for predicting severe illness or injury. For example, hypotension, tachycardia, hypoxia, and high or low respiratory rate were associated with increased risk of ED death/ICU admission. In total, however, the presence or absence of one or many abnormal initial vital sign, as defined in our study, is a reliable marker for severe illness or injury in the patient. The positive and negative likelihood ratios associated with most of the initial vital sign abnormality arevery important to predict severe illness and require ICU admission.

In the present study, out of 824 subjects enrolled, the majority of subjects were in the age group 31 to 40 years (23.7%), the mean age was 41.4 ± 19.7 years. 58.3% were males and 41.7% were females, mean Heart rate was 89.80 ± 20.11, mean Respiratory rate was 23.40 ± 6.65, mean SpO_2 was 92.73 ± 7.09, mean

SBP was 119.74 ± 20.79 and mean DBP was 75.08 ± 12.43.

In the study, SpO_2 had the highest sensitivity in predicting the admission to ward, in predicting the admission to ICU, in predicting the discharge from the Emergency room, in predicting the death in the emergency room and in predicting the poor outcome compared to other vital parameters.

The study done by Charlotte Barfodin 2012 showed that most commonly associated vital signs related to admission to ICU were SPO_2, GCS and RR respectively and also study done by Geoffrey K. Lighthall showed using the Hospital's Medical Emergency team criteria used to define normal/ abnormal thresholds for vital signs, abnormal vital signs were found in 16% of patients; of these; 35% experienced a critical event. In 2012 study done by Malcolm Elliott and Alysia Coventry et al. showed that monitoring of eight vital signs PR, BP, RR, SPO_2, TEMP, pain assessment, GCS & urine output is an important parameter to monitor to identify those who are clinically deteriorating. The study done by G.K. Lighthall et al. in 2009 the most common recorded abnormality was decreased blood pressure, followed in order by abnormal heart rates, respiratory rates, and decreased oxyhemoglobin saturation.[8] In our study, no evaluation of inter observer agreement was done. This variation could, however, be significant.[7] Very few studies have assessed the inter-rater variability and the quality of the studies is poor.[4] Even single recordings of signaled abnormal vital signs increased risk for critical events in hospital ward patients.

Conclusion

The Abnormal vital signs are strongly associated with adverse outcomes; low SpO_2 had the high estsensitivity and specificity of patients admitting to ICU of all the vital signs.

References

1. Meek R, Phiri W. Australasian Triage Scale: Consumer perspective. Emerg Med Australas 2005;17(3):212–17.
2. Manchester Triage group. Emergency triage: Manchester Triage Group. London: BMJ Publishing Group, London, UK; 1997.
3. Beveridge R, Clarke B, Janes N. Canadian emergency department triage and acuity scale; implementation guidelines. Can J Emerg Med 1999;1:2–28.
4. Farrohknia N, Castren M, Ehrenberg A, et al. Emergency department triage scales and their components: A systematic review of the scientific evidence. Scand J Trauma Resusc Emerg Med 2011;30(19):42.
5. Barfod C, Lauritzen MMP, Danker JK, et al. The formation and design of 'The Acute Admission Database' - a database including a prospective, observational cohort of 6279 patients triaged in the Emergency Department in a larger Danish hospital. Scand J Trauma Resusc Emerg Med. 2012 Apr 10;20:29.
6. Fitzgerald G, Jelinik G, Scott D, Gerdtz MF. Emergency department triage revisited. Emerg Med J. 2010 Feb;27(2):86-92.
7. Jorsboe H, Schroder M, Barylak M, et al. Inter-observer variation in the triage-process. Scand J Trauma Resusc Emerg Med 2010;18:P16.
8. Lighthall GK, Markar S, Hsiung R. Abnormal vital signs are associated with an increased risk for critical events in US veteran inpatients. Resuscitation 2009 Nov;80(11):1264–9.