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Original Research Article

Evaluation of Signs of Inflammation that Can Kill score in predicting mortality in an urban tertiary care centre for children in South India

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ABSTRACT

Background: Mortality in critically ill children is maximum in the first 24 hours. Need of the hour is a rapid clinical scoring system that predicts mortality on admission. This study aims at using the Signs of Inflammation that Can Kill (SICK) score in a tertiary care pediatric hospital in India, to evaluate its usefulness in predicting mortality on admission.

Methods: The study design is a hospital based prospective study for evaluation of diagnostic test for a duration of one year. The assessment using SICK score was done on arrival prior to initiation of treatment for children admitted through the emergency room and paediatric ward. The variables of SICK score - temperature, heart rate, respiratory rate, systolic BP, oxygen saturation, CRT, sensorium by AVPU scale were measured using standard guidelines.

Results: The study includes a population of 369 children. Children between 1 month to 12 years were included in the study. Out of 369 children studied 24 died. The mortality in the study is 6.5%. The area under the ROC curve is 0.94, which indicates the scores based on regression could predict mortality in 94% subjects correctly. Further a score of 2.5 showed maximum discrimination with a sensitivity of 87.5% and specificity of 87.2%.

Conclusions: The assessment of SICK score in the population will provide objective measure of severity of illness on admission, prediction of mortality, early triage of patients, effective allocation of resources and personnel, enables early intervention, which helps in reducing mortality.

Keywords: Early intervention, Golden hour, Mortality, ROC, SICK score, Triage

INTRODUCTION

There has been an exponential development in paediatric critical care in the last 50 years in terms of therapy, equipment, monitoring and care of critically ill children. Early identification and proper triage of patients, judicious allocation of resources and personnel, appropriate stratification based on severity of illness is essential for effective management of critical illness. Mortality in critically ill children is maximum in first 24 hours. Timely intervention and management in the first few golden hours can bring about dramatic reduction in mortality rate. To achieve this, proper assessment of severity of illness on admission is mandatory. In paediatrics, scoring systems have been developed to predict mortality in ICU admissions. The physiology stability index is the first physiological scoring system for children which was derived as a subjective score from the worst of 34 values from routinely measured variables over the first day on the Paediatric Intensive Care Unit (PICU).[1] The PRISM (the Paediatric Risk of Mortality Score) has only 14 variables but still used laboratory results and so was cost and labour intensive and not assessable on presentation.[2]

PRISM III score has 17 variables subdivided into 26 ranges, which is a valid predictor of mortality in intensive care unit. Considering the fact that mortality depends on the quality of care received in the first 24 hours of being critically ill, this window of opportunity to act aggressively in the first 24 hours is lost by the time PRISM score is available.[3,4]

The World Health Organization has developed emergency triage, assessment and treatment (ETAT) guidelines for triage in developing countries but the limitation is that it requires is that it requires a specific training program before implementation for both staff and doctors.[5]

Thompson and colleagues have demonstrated that vital signs can identify sick children in paediatric emergency care with comparable sensitivity to more complex triage systems.[6] They however did not develop a scoring system for use in triage. In view of this Kumar et al, from All India Institute of Medical Sciences developed a score based on physical criteria alone.[7] SICK score is a clinical scoring system consisting of 7 variables based on SIRS and APLS guidelines.

The "Signs of Inflammation in children that can kill" (SICK score) is a validated clinical scoring system with a prediction accuracy equal to the PRISM scoring.[8] The SICK score the utilises the abnormal physical variables of the systemic inflammatory response syndrome and its continuum - the multiorgan dysfunction syndrome.[8-10] This study aims at using the SICK score to evaluate its usefulness in prediction of mortality on admission and also in helping us in assessing work load in managing sick patients.

METHODS

This study is a hospital based prospective study conducted in The Institute of Child Health and Hospital for Children (ICH and HC), Chennai, Tamilnadu which is tertiary care centre for children for a duration of one year in the year 2007.

Children who fulfilled the inclusion and exclusion criteria were enrolled in the study. A total of 369 children were studied. The results are presented in the following order. The assessment using SICK score was done on arrival prior to initiation of treatment for children admitted through the emergency room and paediatric ward. The data was collected on a predesigned proforma.

The following variables were measured using standard guidelines.

- Temperature
- Heart rate
- Respiratory rate
- Systolic BP
- Oxygen saturation
- CRT
- Sensorium by AVPU scale

Inclusion criteria

- Authors have included all children aged 1 month to 12 years

Exclusion criteria

Authors have excluded all children;

- Below the age of one month,
- Patients leaving the hospital against medical advice,
- Patients admitted in the surgical side and
- Patients dying in the emergency room

Normal values were assigned a score of 0 and abnormal values assigned a score of 1. The children were followed up every day till discharge or death the hospital discharge status (death/survival) was the primary outcome variable (Table 1).

Table 1: Scoring of abnormal clinical variables.

Variable	Abnormal range
Temperature	>38°c
	<36°c
Heart rate	Infant >160 per minute
	Child >150 per minute
Respiratory rate	Infant >60 per minute
	Child >50 per minute
Systolic blood pressure	Infant <65 mmHg
	Child <75 mmHg
Spo2	90%
Capillary refill time	≥3 seconds
A Alert	Anyone except A
V Responds to voice	
P Responds to pain	
U Unresponsive	

Statistical analysis

Authors used SPSS software package for statistical analysis. Quantitative data differences between children who died and children who were discharged from the hospital were analysed using student independent t- test. Cut off point of SICK score for mortality was arrived using Receiver Operating Curve (ROC).

RESULTS

This study consisted of 369 children. The results are presented in the following order.

Age distribution

Children between the ages 1 month to 12 years were included in the study. The mean age in the study was 39.7±4.01 months as depicted in Figure 1.

Sex distribution

In this study of 369 children, 225 were males and 144 were females as depicted in the Figure 2.

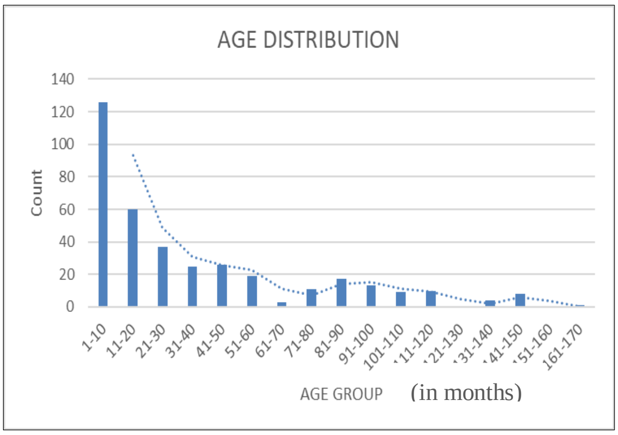

Figure 1: Age distribution of children.

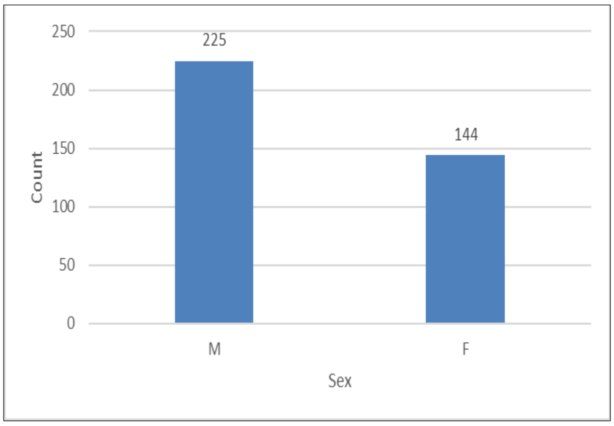

Figure 2: Sex distribution.

Overall SICK Score

The SICK score was studied relation to distribution in the study population, its relation to mortality and its ability to predict mortality using Receiver Operating Curve.

Distribution of SICK score

The minimum SICK score in this study is 0 and the maximum score is 7 with a mean of 1.08. The median is 0 and the mode is 0. Clustering of cases is seen at scores 0 and 1 (Table 2).

Table 2: Distribution of SICK score.

Score	Frequency	Percent
0	186	50.4
1	87	23.6
2	31	8.4
3	27	7.3
4	28	7.6
5	6	1.6
6	3	0.81
7	1	0.27
Total	369	100.0

SICK score and mortality

Out of 369 children studied 24 died. The mortality in the study is 6.5%. Mortality risk was found to be increasing with increase in the score. There was no death in patients with 0 score (Table 3). The mortality increased with increase in the SICK score.

Table 3: SICK score and mortality.

Score	Status			
	Discharged		Died	
	N	%	N	%
0	186	100	0	0
1	86	98.8	1	1.2
2	29	93.5	2	6.5
3	22	81.5	5	18.5
4	19	67.9	9	32.1
5	2	33.34	4	66.66
6	0	1	2	66.66
7	0	0	1	100

Ranges of SICK score and mortality

Mortality increased with increase in the number of abnormal variables. The score ranges and the odds ratio are given in the table below. The linear trend of increase in mortality with increasing score was significant (p=0.001). Children with more than three abnormal variables (SICK score >3) had 168 times higher mortality risk than children who children who had three or less than three abnormal variables (Table 4).

Table 4: Ranges of SICK score and mortality.

Score	Discharged	Death	Mortality%	OR
0-1	272	1	0.36	1.00
2-3	51	14	21.5	37.3
>3	22	7	24.13	168

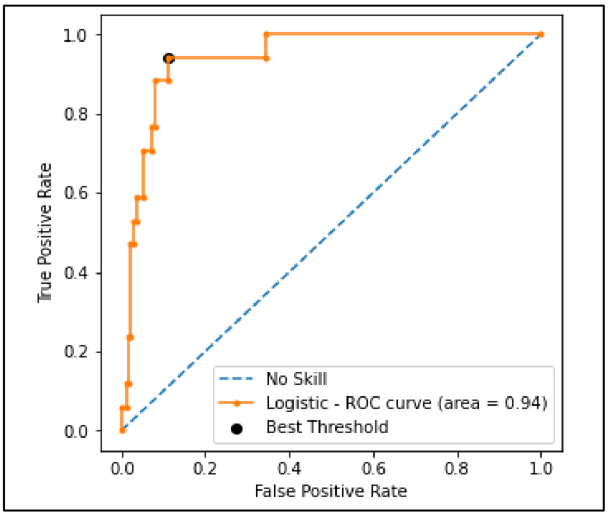

Figure 3: Receiver operating curve.

Receiver operating curve (ROC)

In this study, the area under the ROC curve is 0.94 that is the scores based on regression could predict mortality in 94% subjects correctly. Further a score of 2.5 showed maximum discrimination with a sensitivity of 87.5% and specificity of 87.2%. The SICK score would be considered to be "Excellent" at predicting mortality based on the area under the curve (Figure 3).

DISCUSSION

The predictive ability was tested by looking at the receiver operating characteristics (ROC). The ROC is a graphical representation of the discriminative power of the test. Any biological variable has a range of normal values. Optimal cut off is required where sensitivity and specificity are optimal. For any particular value (a laboratory value or scoring system), various cut off points are plotted as sensitivity against true negatives (1-specificity). The resulting curve is ROC. The curve demonstrates the discriminative power (example to separate recovery from death in a mortality score), at various score points. The test is said to have a good performance if the area under the curve nears 1. A 0.5 result is interpreted as worthless as this could be by pure matter of chance and the laboratory test or scoring system does not have a discriminative power. ROC was used to arrive at the cut-off point of SICK score for predicting mortality. The ROC in the development cohort had been 0.8 (in this validation study it was 0.76.[9,10] The difference in ROC between development and validation samples is similar to a study published on paediatric risk of admission, where ROC was 0.822 in the first study and 0.774 in the validation study.[7,9,10] In this study the ROC was 0.94 the scores based on regression could predict mortality in 94% subjects correctly. Further a score of 2.5 showed maximum discrimination with a sensitivity of 87.5% and specificity of 87.2%. The SICK score would be considered to be "Excellent" at predicting mortality based on the area under the curve. The area under ROC was consistent with the development cohort and the first validation study.[9,10] Its performance in identifying sicker patients makes it ideal to use in emergency triage. An ideal triage scoring system must be available immediately on presentation and the score must accurately describe the severity of illness. The overall goals of triage are to determine if a patient is appropriate for the given level of care and to ensure that hospital resources are utilised effectively.

CONCLUSION

SICK Score is a clinical scoring system predicting mortality on admission. It paves way for intervention in the golden Hour thereby reducing mortality. It is useful in resource poor setting and all levels of healthcare.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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