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## Efficacy of Yale observation scale to detect serious bacterial infection in febrile children aged one to 36 months

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### ABSTRACT

**Introductions:** In most children aged 1-36 months, the cause of a febrile illness is a self limiting viral infection. It is very difficult to distinguish these from serious bacterial infection. Objective of this study is to assess the efficacy of the Yale Observation Scale (YOS) to detect serious bacterial infection in febrile children aged 1-36 months.

**Methods:** YOS scores were assigned as a part of a cross-sectional study in 100 children presenting in Tribhuvan University teaching hospital with fever to divide the child into well- looking if YOS  $\leq 10$  or ill- looking if YOS  $> 10$ . Then the history, examination and necessary investigation was performed to come to a diagnosis of non- serious illness and serious bacterial infection.

**Results:** Serious bacterial infection was found in 33(33%) of the patients. The sensitivity, specificity, positive and negative predictive values for a YOS score greater than 10 to detect serious bacterial infection were 45.45%, 88.05%, 65.21% and 76.62%, respectively.

**Conclusions:** A YOS  $\leq 10$  predicts non-serious illness while a YOS  $> 10$  does not necessarily indicate serious bacterial infection and should undergo further evaluation to confirm serious bacterial infection.

**Keywords:** febrile children, serious bacterial infection, yale observation scale

### Plain Language Summary

This study was done to see efficacy of Yale observation score in detecting serious bacterial infection. Lower score was helpful in predicting no serious bacterial infection however higher score was not helpful in predicting serious bacterial infection.

## INTRODUCTIONS

Fever is a common presenting complaint<sup>1,2</sup> and cause of acute hospital admission<sup>3</sup> in children aged 1 to 36 months. Fever is usually benign but serious bacterial illness may be present. Difficulty to distinguish may lead to unnecessary investigations, admissions, irrational use of antibiotics as well as serious consequences when diagnosis is delayed or missed.<sup>4</sup> Observation scales help to predict the risk of significant illness. The Yale Observation Scale (YOS) is an illness severity scale using simple observations which is easily applicable.<sup>5-12</sup>

The objective of this study was to observe the efficacy of YOS in detecting serious bacterial infection in febrile children 1 to 36 months of age. Permission was taken from hospital authority.

## METHODS

This was a hospital based cross-sectional study conducted in the emergency, pediatric out-patient and pediatric in-patient department of Tribhuvan University Teaching Hospital over six months period from January 1 to June 30, 2010. Children aged 1 to 36 months with fever of less than or equal to seven days were included in the study. Children who received antibiotics or immunization 48 hours prior to presentation, who received sedatives before 24 hours of presentation and whose parents did not give consent were excluded. Before start of treatment children were scored in the six components of YOS.<sup>7</sup>

**Table 1. Components of Yale Observation Scale (YOS)<sup>7</sup> for severity of illness**

Observation item	1(Normal)	3(Moderate impairment)	5(Severe impairment)
Quality of cry	Strong with normal tone or content and not crying	Whimpering or sobbing	Weak or moaning or high pitched
Reaction to parent stimulation	Cries briefly then stops or content and not crying	Cries off and on	Continual cry or hardly responds
State variation	If awake, stays awake or if asleep and stimulated, wakes up quickly	Eyes close briefly awake or awakes with prolonged stimulation	Falls to sleep or will not rouse
Color	Pink	Pale extremities or acrocyanosis	Pale or cyanotic or mottled or ashen
Hydration	Skin and eyes normal and mucous membrane moist	Skin and eyes normal and mouth slightly dry	Skin doughy or tented & dry mucous membrane & or sunken eyes
Response (talk, smile) to social overtures	Smiles or alert(≤2mo)	Brief smile or alerts briefly(≤2mo)	No smile or face anxious, dull, expressionless or no alerting (≤2mo)

The cause of the fever was diagnosed with the help of history, physical examination and necessary investigations. The final diagnosis was divided into serious and non-serious illness. Serious bacterial infections included diseases like bacterial meningitis, septicaemia, bacteremia, pneumonia, urinary tract infection, septic arthritis/osteomyelitis, bacillary dysentery. Other illnesses besides these illnesses were termed non-serious illness. The SPSS 16 was used for data entry and analysis. The sensitivity, specificity, positive predictive value and negative predictive value were calculated. Mean of continuous variables between two groups were analyzed using Students' t-test. P value < 0.05 was considered significant.

## RESULTS

There were total 100 children aged 1 to 36 months with fever. Twenty eight were in age group 7 to 12 months. Male were 59. Fifty six children were from out-patient department. Fifty eight had symptoms involving respiratory tract. There was only one significant blood culture positive with staphylococcus aureus.

**Table 2. Severity of illness in children (n=100) with fever**

Severity of illness	Diagnosis	Frequency
Serious (33)	Bacterial meningitis	1
	Bronchiolitis with secondary bacterial infection	1
	Enteric fever (Culture negative)	1
	Infective endocarditis	1
	Pneumonia	19
	Sepsis( Assumed)	2
	Septic arthritis	1
	Urinary tract infection	7
Non-serious (67)	Abscess	2
	Acute tonsillitis	5
	Aseptic meningitis	2
	Atropine induced hyperpyrexia	1
	Bronchiolitis	9
	Cellulitis	1
	Superficial skin infection	3
	Acute gastroenteritis- viral	8
	Non-specific febrile illness	19
	Upper respiratory tract infection- viral	17

**Table 3. YOS versus serious bacterial infection**

YOS score	Serious bacterial infection	Non-serious illness	Total
≤10	18	59	77
>10	11-15	5	14
	≥16	3	9
<b>Total</b>	<b>33</b>	<b>67</b>	<b>100</b>

The mean YOS score in children with serious illness was  $10.58 \pm 3.929$ . In children with non-serious illness, mean YOS was  $7.88 \pm 3.150$ . The mean difference of YOS between children with serious bacterial infection and non-serious illness was significant ( $p=0.001$ ). The sensitivity, specificity, positive predictive value and negative predictive value of YOS >10 to detect serious bacterial illness in febrile children aged 1-36 months was 45.45%, 88.05%, 65.21% and 76.62%, respectively.

## DISCUSSIONS

In the present study, serious bacterial infection was 33% but bacteremia was only 3.5% as only 28% had their blood culture sent according to the hospital protocol. Earlier studies have shown the prevalence of serious bacterial infection to be 11 to 29%<sup>13-15</sup> and that of bacteremia to be 2.9 to 28%<sup>1,9,16-18</sup> in children less than 36 months. So the present study looked into the efficacy of YOS in detecting serious bacterial infection rather than bacteremia which is similar to a study done by McCarthy et al.<sup>5</sup> McCarthy in 1980s first attempted to quantify clues of sickness by devising an observational scoring system known as Yale Observation Score to detect serious bacterial illness<sup>7</sup> and various studies have compared diagnostic use of YOS (Table 4).

In our study, children from in-patient ward, out-patient and emergency department were included. Bang et al did the study in the admitted patients<sup>16</sup>, while Baker and Teach et al did the study in admitted and patients

presenting to emergency<sup>15,17</sup> while McCarthy, Baker RC and Jamuna et al included patients from the out-patients and emergency department.<sup>7,8,12</sup>

In the present study, 59% of the children were males which is similar to another study by Bang et al.<sup>16</sup> Since male is the preferred gender in our part of the world and more number of these male children are brought to health care services, it might be the reason of higher preponderance of male over female in the present study.

Out of the 100 cases, about half of the children presented with fever due to involvement of the respiratory tract system. The most common disease in respiratory tract was pneumonia. This was similar to a study conducted by N. Nepali et al.<sup>19</sup> The cause of high prevalence of infections of the respiratory tract might be because of various socio-demographic risk, nutritional and environmental risk factors.<sup>20</sup> Out of the 33% of serious bacterial illness, the commonest cause of serious bacterial illness was pneumonia which is comparable to a study done by McCarthy et al.<sup>7</sup> The high prevalence of serious bacterial infection in the study might be because of the fact many children with serious illnesses are referred here from all over the country for management and also that most of the non-serious illnesses are managed outside the hospitals in private clinics and other health care centers.

Our study had lower sensitivity than other studies. The reason for a low sensitivity might be because of unequal distribution of patient from the emergency, out-patient department and in-patient ward. Antipyretics before YOS<sup>21</sup> and referral of serious cases from ER to other centres might have decreased the sensitivity. The specificity is similar to other studies and is higher than sensitivity. The predictive value of the present study is similar to a study done by Bang et al<sup>16</sup> but is high when compared to other studies.<sup>9,12,15-17</sup> As predictive value

**Table 4. Comparison of studies using YOS**

Author (Year)	Sample size (Site of study)	Study population	Outcome assessed	Sensitivity	Specificity	PPV	NPV
McCarthy et al (1982) <sup>7</sup>	206(ER)	≤24 Months	Serious illness	75%	74%	10%	99%
	106(OPD)		(11.8%)	93%	60%	28%	98%
Baker MD et al (1990) <sup>15</sup>	126 (ER)	29-56 days	Bacterial disease (9.5%)	33%	73%	11%	91%
Baker RC et al (1989) <sup>12</sup>	154 (OPD+ER)	3-24 months	Bacteremia (12.3%)	68%	77%	30%	-
Teach et al (1995) <sup>17</sup>	6611 (OPD)	3-36 months	Occult bacteremia (2.9%)	5.2%	96.7%	4.5%	97.1%
Jamuna et al (2000) <sup>9</sup>	100 (OPD+ER)	3-36 months	Occult bacteremia (4%)	100%	41.6%	6.6%	100%
Bang et al (2009) <sup>16</sup>	219 (In-patients)	3-36 months	Bacteremia (28.2%)	87.9%	83.8%	68%	94.7%
Present Study	100 (OPD+ER+ In-patients)	1-36 months	Serious Bacterial illness (33%)	45.45%	88.05%	64.2%	76.6%

Note- (OPD- out-patient department, ER- Emergency, PPV-Positive Predictive value, NPV- Negative predictive value)

depends upon the prevalence of outcome assessed (serious bacterial infection) which in case of study by Bang et al<sup>16</sup> and in my study is high. Similar to previous studies done by other authors, the negative predictive value of YOS >10 to detect serious bacterial illness was better than the positive predictive value.<sup>7,9,15-17</sup> This indicates that YOS is better at ruling out serious bacterial infection and bacteremia.

The limitation of our study could be inadequate sample size and the unequal distribution of cases from different sites. We also could not send blood cultures of all the cases so bacteremia could not be studied. Few of our patients had antipyretics before YOS leading to decrease in sensitivity. We could not enroll very sick children who could have been referred directly from the emergency due to unavailability of intensive care unit in our institute which might have affected the result.

## CONCLUSIONS

Serious bacterial illness is present in 1/3<sup>rd</sup> of the febrile children aged 1 to 36 months. A febrile child with YOS less than or equal to 10 is less likely to have serious bacterial illness but an elevated YOS cannot be used as predictor of serious bacterial illness.

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