Brief Report

Application of SIRS Criteria to a Paediatric Surgical Population in Malawi

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Summary

Introduction: Little is known regarding systemic inflammatory response syndrome (SIRS) criteria and mortality in developing countries. We evaluated the utility of the SIRS criteria to predict death among a paediatric surgical population in Lilongwe, Malawi.

Methods: Age, SIRS variables (temperature, heart rate, systolic blood pressure, respiratory rate and leucocyte count), diagnosis, surgical procedure and outcome were analysed for paediatric surgical patients during 2012. Age-specific criteria for SIRS variables were then applied to the data.

Results: Using published SIRS criteria, temperature was the only variable that correlated with mortality. When norms for an African population were used, leucocyte count also correlated with mortality.

Discussion: With the exception of temperature, published SIRS criteria were not predictive of mortality. Leucocyte count became predictive of death using norms specific to an African population. SIRS and its component data are a worthwhile area of future prospective research in developing countries.

Introduction

Mortality from sepsis in developing countries remains unacceptably high in paediatric populations [1].

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Paediatric surgical patients are no exception [2]. To improve outcomes among paediatric surgical patients, especially those who present with critical illness, we must be able to accurately identify the patients who are most at risk for death [3]. Despite this, evidence-based emergency care and triage are poorly understood in developing countries [4].

To address the lack of knowledge regarding emergency triage of critically ill paediatric patients, we sought to determine the utility of applying systemic inflammatory response syndrome (SIRS) criteria for predicting death in our paediatric surgical population. Specifically, we sought to evaluate (i) how frequently SIRS variables were documented in patient records, (ii) determine whether these variables correlated with in-hospital mortality and (iii) using published literature, derive leucocyte norms specific to an African population and then correlate this categorization with mortality.

Methods

We analysed retrospective data from a paediatric surgery population at Kamuzu Central Hospital in Lilongwe, Malawi, for the year 2012. These data...
included 1072 subjects. Data on age, SIRS variables (temperature, heart rate, systolic blood pressure, respiratory rate and leucocyte count) and outcome were analysed. Age-specific criteria for SIRS variables were then applied to the data set using commonly accepted norms as well as norms specific to an African population (Table 1) [5–7]. Basic descriptive data were reported. For comparing the surgically to non-surgically treated subjects, chi-square analysis was used for abnormal temperature and leucocyte count, and logistic regression was used for heart rate, systolic blood pressure and respiratory rate. Chi-square analysis was used to determine the correlation between meeting SIRS criteria (for temperature, leucocyte count, heart rate, systolic blood pressure and respiratory rate) and in-hospital mortality. The representative ethics review boards approved this study for all authors.

**Results**

The median age was 6 years (range: 0 days to 17 years) and 62% were male. Thirty-five percent underwent surgery during the admission. The most common procedure categories were skin and soft tissue (25%), orthopaedic and abdominal surgery (17% each), burn surgery (13%) and herniorrhaphy (10%).

The mortality rate was lower as age increased \(p < 0.001\), as shown in Table 2. The mortality rate was lower among the 391 subjects who underwent surgery compared with the 681 who did not (3.6 vs. 9.7%, respectively; \(p < 0.001\)). There was no statistically significant difference between operated and non-operated subjects with regard to admission heart rate, systolic blood pressure, respiratory rate or abnormal temperature. An abnormal leucocyte count was noted more frequently in non-operated vs. operated subjects (51.2 vs. 27.6%, respectively; \(p = 0.012\)).

Of the 1072 subjects, only a minority had a documented temperature \((n = 203)\), heart rate \((n = 220)\), respiratory rate \((n = 136)\), systolic blood pressure \((n = 113)\) or leucocyte count \((n = 112)\). Temperature and leucocyte count (using norms specific to an African population) were predictive of mortality, whereas respiratory rate, heart rate, systolic blood pressure and leucocyte count (using published SIRS criteria) were not predictive (Table 3).

**Discussion**

We evaluated the ability of SIRS criteria to predict death in paediatric surgical patients to gain a better understanding of the utility of such criteria in our population. We found that temperature was a useful predictor of death, whereas leucocyte count was useful only when African norms were applied to the data set.

There are currently no accepted treatment algorithms for SIRS and sepsis in developing countries [8]. It is imperative to begin research on this important topic, given the success and popularity of such interventions in the developed world [9]. Once we have identified the most useful clinical criteria for SIRS, rational algorithms are possible. Our findings suggest that temperature is valuable, whereas systolic blood pressure was rarely recorded in those subjects who died, which is a limitation of our data set. Prior research in developing countries also found that systolic blood pressure was not a particularly useful criterion for stratification; Maitland et al. [10] stratified a large prospective randomized study into two

<table>
<thead>
<tr>
<th><strong>Age-group</strong></th>
<th><strong>Survived</strong></th>
<th><strong>Died</strong></th>
<th><strong>Mortality rate (%)</strong></th>
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<tbody>
<tr>
<td>Birth to 1 week</td>
<td>61</td>
<td>40</td>
<td>39</td>
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<tr>
<td>1 week to 1 month</td>
<td>5</td>
<td>2</td>
<td>29</td>
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<tr>
<td>1 month to 1 year</td>
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<td>11</td>
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<tr>
<td>1–5 years</td>
<td>317</td>
<td>14</td>
<td>4</td>
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<tr>
<td>5–12 years</td>
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<td>3</td>
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<td>12 and older</td>
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<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>997</td>
<td>80</td>
<td>7</td>
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</table>
groups based on blood pressure, and only 29 of the 3170 subjects had severe hypotension. However, the utility of blood pressure as a mortality predictor should not be dismissed based on these findings. It may be that with future prospective research, the mere inability to obtain a blood pressure portends the worst prognosis of all.

Our findings also stress the importance of conducting research to validate clinical principles developed in high-income countries before application in developing countries. It is not unusual for commonly held dictum to fall short when evaluated in a new setting. For example, children in Africa with severe febrile illness who received bolus fluids had worse outcomes when compared with those who did not receive a bolus, which is contrary to common practice in developed countries [10].

A majority of subjects were missing data for the SIRS criteria. Our findings also cannot be applied to all paediatric patients because we evaluated only the subset with surgical diagnoses admitted to the surgical service. Even so, our population is still a heterogeneous group, with a broad range of diagnoses and inconsistent use of operative management. Cause of death was also not available, nor were there enough data for meaningful subgroup analyses.

In conclusion, the results of this study suggest that temperature and leucocyte count are the most useful SIRS variables when triaging paediatric surgical patients. Additionally, it is important to use African norms for leucocyte count. Future research might evaluate the SIRS criteria prospectively, including the possibility that the lack of a recorded blood pressure may be the most predictive factor of all. Studying a more homogenous population (such as typhoid or appendicitis) might also provide a useful initial understanding before applying broad sepsis guidelines across all paediatric age-groups and diagnoses. Developing validated SIRS criteria that are simple and appropriate for this environment will be useful in guiding clinicians on many factors, such as empiric antibiotic therapy, further diagnostic evaluations such as a sepsis workup and choice of acuity level when intermediate or intensive care is available.

### References


### Table 3

<table>
<thead>
<tr>
<th>SIRS variable</th>
<th>SIRS criteria met</th>
<th></th>
<th>SIRS criteria not met</th>
<th></th>
<th>p-value</th>
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<tbody>
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<td></td>
<td>Survived</td>
<td>Died</td>
<td>Mortality rate (%)</td>
<td>Survived</td>
<td>Died</td>
</tr>
<tr>
<td>Temperature</td>
<td>26</td>
<td>19</td>
<td>42</td>
<td>133</td>
<td>23</td>
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<td>WBC (standard)</td>
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<td>18</td>
<td>66</td>
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<tr>
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<td>65</td>
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