

A Heart Rate Algorithm to Predict High Risk Children Presenting to the Pediatric Emergency Department.

James C. O'Neill, M.D.¹, E. Hunter Brooks, Ph.D., Rebekah Jewell, M.D.¹, and David Cline, M.D.¹

¹Wake Forest Baptist Health

Background. An elevated heart rate at admission is a predictor of illness severity in the pediatric population. Initial triage vital signs have not previously been used as a stand-alone predictor of illness. This study predicts appropriate heart rate based on age and height of fever and then investigates whether outliers have a higher risk for urinary tract infection (UTI) or hospital admission.

Methods. Data was obtained from the translational science database at Wake Forest Baptist Health. IRB approval was obtained for the study. The dataset included every patient under age three with a temperature above 100.4 that presented to the emergency department over an eight year period from 2012-2020, totaling 34,088 patients. The data set included the patient's heart rate, temperature, age, sex, presence of UTI and whether the patient was admitted or discharged. Linear regression was done to obtain an algorithm predicting each patient's heart rate based on age and height of fever. Outliers were one standard deviation above the expected value (20 beats per minute above expected).

Results. The expected heart rate for level of fever was determined by the following equation:

$(\text{pulse} = 5.5 * (\text{temperature in Fahrenheit}) - .72 * (\text{age in months}) - 388.05)$. The mean standard error of the model was 360.2. One standard deviation was 20 beats per minute above the expected algorithm value. 85.94% of the patients were within one standard deviation of the expected value and were labeled the low risk group. 14.06% of patients were one standard deviation above the expected heart rate value and were classified as the high risk group. The low risk group had an admission rate of 10.6% and UTI rate of 1.74% ($p < 0.001$). The high risk group had an admission rate of 21.8% and UTI rate of 3.03% ($p < 0.001$).

Conclusion. Patients that had an initial triage heart rate one standard deviation above the expected value for fever had significantly higher levels of admission and UTI.