Balancing sensitivity and specificity: Investigating the effect of age delay and critical illness events on threshold alarms BIOMATH 2024

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In critical care settings, continuously monitoring patient vital signs is crucial for ensuring patient safety and timely intervention. While traditional patient monitor threshold alarm systems have been life-saving, they often generate numerous false alarms, which can overwhelm caregivers and lead to ineffective patient monitoring. The purpose of this study investigate the effect of agespecific thresholds, delay, and critical illness events on threshold alarms to balance their specificity and sensitivity. The data was extracted from an IMPALA project that was conducted at the High Dependency Unit (HDU) at Queen Elizabeth and Zomba Central Hospitals from which we sampled 52 participants. This work designed algorithms and functions to generate alarms, impute agespecific thresholds, Z-test to determine if there was any significant difference between normal threshold alarms and age-specific threshold alarms, categorization of threshold alarms based on their delay using an adaptive delay and multiregression model was used to determine the effects of critical illness events on threshold alarms. The age-specific threshold had a positive influence on the threshold alarms by reducing the total number of threshold alarms generated and there was a greater significant difference between normal threshold alarms and age-specific threshold alarms [mean difference of 307.29 (SE = 0.14), and a Z-value (2200, p < 0.0001)]. A 15-second delay reduced the total number of threshold alarms generated by 73%. Critical illness events such as Blood transfusion (p = 0.001), Malaria treatment (p < 0.000), death (p = 0.059), Respiratory support (p = 0.014), and inotropic support (p < 0.000) had positive effects on the threshold alarm. The t values, standardized and unstandardized coefficient values indicated a drop and increase in the vital sign value during the occurrence of these critical illness events. It is possible to achieve a balance between the sensitivity and specificity of the threshold alarms using age-specific threshold, delay, and critical illness events in such a way we will be able to eliminate non-actionable (false alarms) alarms and focus much on actionable alarms which can be predicted based on the threshold patterns around critical illness events. Further investigation on forecasting for critical illness event alarms is warranted.

Keywords: Critical illness events. Delay. Age-specific thresholds. Thresholds alarms

References

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