Monitoring Respiratory Rate in Neonates Using the Rrate Mobile App

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Introduction: Monitoring the respiratory rate (RR) is an important part of the clinical assessment of neonates.[1] However, accurate RR measurement in clinical settings has been elusive. RR measurement is especially challenging in neonates because of their irregular and periodic breathing. There is no reference standard for RR measurement, and proposed methods like visual counting and the Acute Respiratory Infection timer do not yield readily reproducible results.[2] Capnography, though not the gold standard, attempts to give a reflection of physiological breathing by measuring expired carbon dioxide. There remains a need for a low-cost, simple and accurate tool to monitor RR in neonates. We undertook a study to evaluate the agreement between the RRate[3] mobile app timer and Masimo Rad97 capnography for RR measurement in neonates.

Methods: The study was conducted in the neonatal unit of Aga Khan University Hospital, Nairobi, where following informed consent, eligible neonates were enrolled. Data collected included gestational and current age, sex, diagnosis, anthropometric measurements, and socio-demographic details of the mother. Paired observations were made by 3 trained observers using the RRate mobile app, counting each neonate's RR over a full minute. Each neonate was also simultaneously connected to a Masimo Rad97 monitor and the capnography waveform continuously recorded. The capnography wave forms were digitized and recorded with a custom software application. These were then printed out and the breaths manually counted. All data were entered into a Microsoft Excel (Microsoft Excel, Washington, USA) spreadsheet. Bland-Altman analysis[5] for replicated measurements was used to calculate bias and limits of agreements between the average of the paired RRate observations and the manual counts from the capnography waveforms. The root mean square deviation was also calculated.

Results: Between June and August 2019, 27 neonates were enrolled into the study. A total of 130 paired observations were done but 7 were excluded from the final analysis: 5 were missing a paired RRate reading and 2 were identified as outliers by the interquartile range method.[4] 123 paired observations were analysed and a Bland Altman plot generated (Figure 1). The bias between the RRate measurements and the capnography breath counts was 1.88 (95% CI -1.17, 2.59) breaths per minute with limits of agreement of -9.75 (95% CI -8.53, -10.97) to 5.99 (95% CI 7.21, 4.77)breaths per minute. The root-mean-square deviation (RMSD) was ±4.4 (9.3%) breaths per minute.

Discussion: There appears to be good agreement (< 10% RMSD) between the RRate mobile app breath counts and Masimo Rad97 capnography. A few extreme outliers were observed on the Bland Altman plot where the RRate counts were undercounted, especially at higher rates. A larger study is needed to confirm these findings before the RRate Mobile App could be adapted as a clinical tool to measure RR in neonates.

References: **1**. Margolis P, Gadomski A. Does This Infant Have Pneumonia? *JAMA.* 1998;279(4) **2.**Folke, M &Cernerud, L &Ekström, Mikael &Hök, Bertil (2003). Critical

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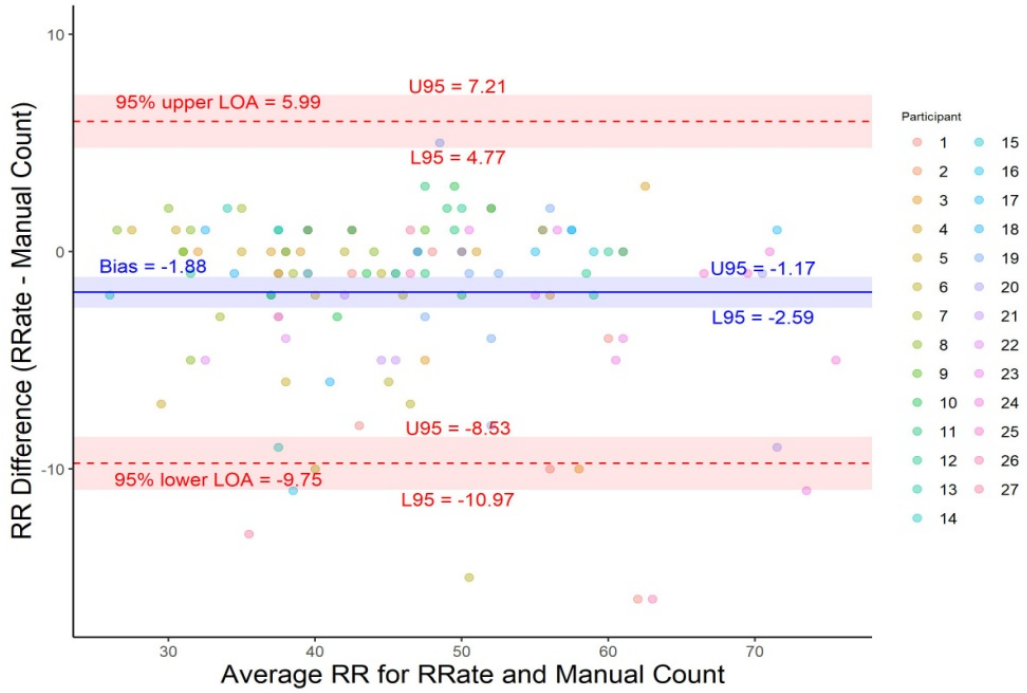

Figure 1. Bland-Altman plot comparing RRs measured using RRate mobile app to those measured using manual counts from the Masimo Rad97 capnography print out. Each dot represents a single observation with repeat observations in the same colour.