Pediatric Nocturnal Respiratory Rate Monitoring Using a Non-Contact and Passive Bedside Device: Accuracy of the Albus Home Research Device (RD)

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RATIONALE: There is an increasing need for remote monitoring in childhood respiratory disease, however many tools rely on active adherence, technique, or subjectivity. Respiratory rate (RR) is an important and objective sign, yet is underutilized; no reliable methods for long-term monitoring exist. Current gold-standards - wearable polysomnography devices (PSG) - measure nocturnal RR using uncomfortable sensors such as effort belts and nasal cannulae and are suitable only for discrete, single-night recordings, particularly in children. In the post-COVID-19 era, reliable and accepted RR monitoring in the home will have significant potential for improving respiratory clinical care and research. METHODS: In a healthy pediatric population, we evaluated accuracy of a passive, non-contact bedside device (Albus Home RD) that uses wireless motion sensors to capture RR, as compared to a gold-standard, wearable PSG (SOMNOtouch™ RESPIRATORY, by Somnomedics). The table-top Albus Home RD was positioned adjacent to participants in their home bedroom environment. Sleeping conditions were normal and varied in bed-size, presence of bed- or room-sharers, clothing, and bedding. Gold-standard PSG RR data were recorded using manual count of the raw respiratory traces derived from thoracoabdominal respiratory-effort belts. 10-minute periods from each hour of monitoring were chosen, where sufficient data were available and free from confounding movement and artefacts. Data from Albus Home RD were then analyzed using proprietary signal processing algorithms to output corresponding 30-second RR segments (as breaths/minute). RR results for each device for the selected segments were time-synchronized and compared for each 30-second segment. As per previous respiratory rate validation literature, accuracy was reported as proportion of RR measurements within +/-10% or +/-2 breaths/minute of the PSG RR. RESULTS: 9 healthy children (6 males, 3 females) participated in overnight monitoring; ages and BMI ranged 6-16 years and 13.3-20.0 respectively. Albus Home RD RR measurements for 1220 thirty-second RR segments were compared against the gold-standard with overall accuracy of 93%. Mean Absolute Percentage Error was 0.05 (SD=0.06). CONCLUSIONS: Albus Home RD passively measured nocturnal RR with 93% accuracy in 610 minutes of analysis in real-world environments compared to the current gold-standard. Using wireless sensors and proprietary signal processing algorithms, the Albus Home RD is a valid bedside, non-contact monitor of RR for children aged 6-16 years-old. The non-touch, passive nature of this monitor could enable previously infeasible longitudinal home monitoring in clinical care and research. This low-burden system has significant potential to facilitate longer-term, remote monitoring in pediatric respiratory disease.

Figure 1. Example pediatric use-case and placement of Albus Home RD

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