

Validation of cough monitoring by Albus Home, a contactless bedside device for nocturnal monitoring

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Introduction and Aims

- Objective cough frequency is a key clinical endpoint but existing wearable monitors are limited to 24-hour recordings, which may be impacted by day-to-day variability.
- Albus Home uses **contactless** motion, acoustic and environmental sensors to monitor **multiple metrics**, including respiratory rate and cough, at night-time for as long as required without burdening patients.
- The aim of this study was to evaluate the performance of Albus Home compared to human manual counts for detecting spontaneous coughs in subjects with respiratory conditions.



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

Methods

- Adults with respiratory conditions underwent overnight monitoring using Albus Home in their usual bedroom environments. Participants set-up the plug-and-play device themselves.
- For reference counts, each audio recording was counted by two annotators, and cough defined as explosive phases audio-visually labelled by both.
- In parallel, recordings were processed by a proprietary Albus system, comprising a deep-learning algorithm with a human screening step for verifying coughs or excluding occasional events that mimic cough.
- Performance of the Albus system in detecting individual cough events and reporting hourly cough counts was compared against reference counts.
- Accuracy results were reported as sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV).
- In addition, agreement in hourly cough frequencies were analysed using Bland-Altman analysis and Intra-class Correlation Coefficient between Albus system and reference counts.

Results

Conclusions

- 30 nights from 10 subjects (COPD=5, asthma=3, sarcoidosis=1, CF=1) comprised 375 hours(h) of recording. Albus counts were accurate across hours with high and low cough frequencies, with median **sensitivity, specificity, PPV and NPV of 94.8, 100.0, 99.1 and 100.0%** respectively.
- Agreement between Albus and reference was strong (**Intra-class Correlation Coefficient 0.99**; 95%CI 0.99-0.99; $p < 0.001$) and equivalent to agreement between observers and reference counts (ICC 0.98, 0.99 respectively).

Fig. 2A. Bland-Altman plot on agreement in hourly cough counts between Albus system and manual reference counts. Each point shows one hour (n=375)

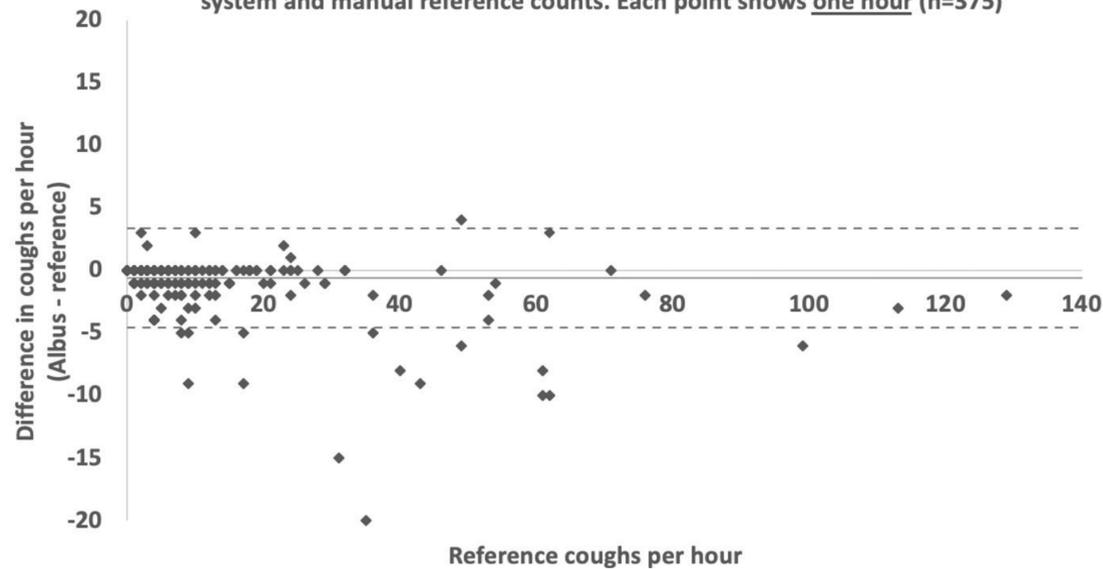


Fig. 2B. Bland-Altman plot on agreement in nightly *mean* coughs/hour between Albus system and manual reference counts. Each point shows one night (n=30)

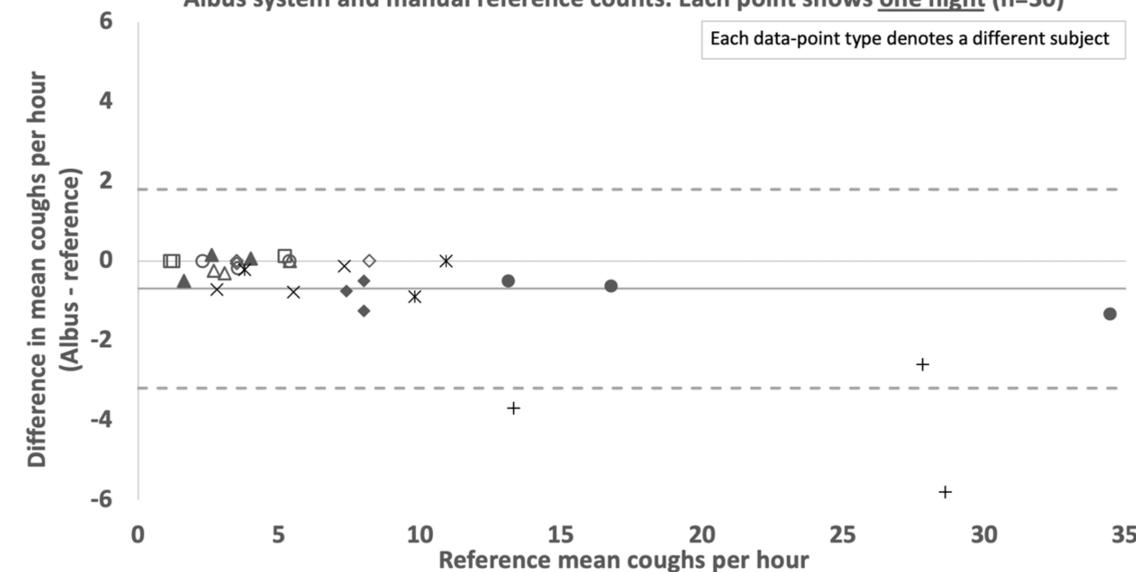
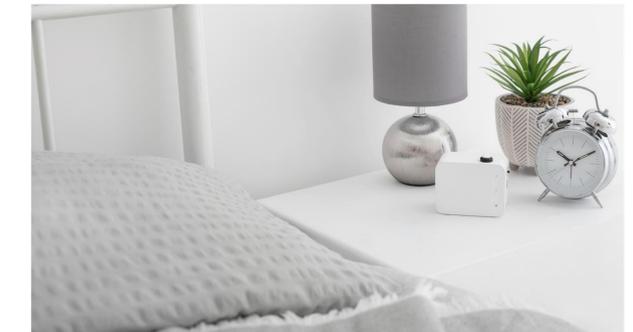


Fig. 2. Bland-Altman plots showing agreement in cough counts between Albus system and human reference counts. Solid lines show mean difference. Dotted lines show 95% limits of agreement ($1.96 \times SD$). A) Comparison of hourly cough counts for each hour of validation set (n=375; multiple hours may overlap in count and difference). Mean difference (-0.6 coughs/h; SD=2.0 coughs/h). B) Comparison of mean hourly cough counts for each night of validation set (n=30; 3 nights each for 10 subjects). Mean difference (-0.7 coughs/h; SD=1.3 coughs/h).



- Albus Home provides a **contactless** and **accurate** system for nocturnal cough monitoring, with performance evaluated in an **unseen validation set** of subjects with respiratory conditions, monitored **in real-world conditions**.
- With the additional potential to concurrently capture a variety of nocturnal metrics, the multi-sensory Albus system enables nightly collection of high quality data with applications across clinical care and research.

