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Multimodal nocturnal seizure detection in a residential care setting

A long-term prospective trial

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Study objective

To determine whether a device that measures heart rate and movement can reliably detect nocturnal epileptic seizures.

Summary results

The device can reliably detect nocturnal epileptic seizures.

What is known and what this paper adds

Automated seizure detection systems could provide a useful measure of nocturnal seizure activity and prevent sudden unexpected death in epilepsy. This study shows that a recently developed system that measures heart rate and movement can reliably detect nocturnal seizures.

Participants and setting

This study recruited 28 patients with epilepsy (10 women; mean age, 29.1 years; age range, 15–67 years) who experienced ≥2 major nocturnal seizures per month and resided in various Dutch epilepsy centers between September 1, 2015, and January 9, 2017.

Design, size, and duration

The participants wore Nightwatch upper arm bracelets (LivAssured BV; Vught, the Netherlands) that recorded heart rate and accelerometry data. The participants slept while wearing the bracelet and being filmed with an infrared-sensitive camera. Trial nurses reviewed the video footage to detect and classify seizures, and these evaluations constituted the reference test. An algorithm analyzed the bracelet-recorded data for real-time seizure detection, and a true positive was defined as an alarm raised within 3 minutes before or 5 minutes after the start of a major seizure. The algorithm's sensitivity was compared to a bed sensor's sensitivity in 14 participants who already used a bed sensor.

Table Seizure type-specific detection rates with the multimodal sensor

Seizure type	Detection rate (95% CI)
Tonic-clonic	96% (80%–100%)
Generalized tonic with >30 s duration	89% (33%–100%)
Hyperkinetic	73% (50%–100%)
Other major seizures	84% (50%–100%)

Main results and the role of chance

For major seizures, the algorithm had a median sensitivity of 86% (95% confidence interval [CI], 77%–93%), a positive predictive value of 49% (95% CI, 33%–64%), and a false alarm rate of 0.03 per night (95% CI, 0.01–0.05 per night). The algorithm's sensitivity was superior to the bed sensor's sensitivity ($p < 0.001$).

Bias, confounding, and other reasons for caution

This study did not use video-EEG as a reference test (only video).

Generalizability to other populations

The patient sample excluded individuals with abnormal movements or dark skin tones. This may limit the generalizability of the results to such persons.

Study funding/potential competing interests

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A draft of the short-form article was written by M. Dalefield, a writer with Editage, a division of Cactus Communications. The authors of the full-length article and the journal editors edited and approved the final version.

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