



Topic Exploration Report ¹

Topic explorations are designed to provide a high-level briefing on new topics submitted for consideration by Health Technology Wales. The main objectives of this report are to:

- Determine the quantity of evidence available for a technology of interest.
- Identify any gaps in the evidence.
- Inform decisions on topics that warrant fuller assessment by Health Technology Wales (HTW).

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| Topic exploration report number | TER526 |
| Topic | At-home video monitoring for the diagnosis and management of epilepsy |
| Summary of findings | <p>Epilepsy is a chronic neurological disorder which affects an estimated 633,000 people in the UK. Diagnosing epilepsy is a lengthy and resource intensive process, often requiring referral to a specialist centre for monitoring over a number of days. At-home video monitoring of people with suspected epilepsy may be an effective alternative to standard practice and may result in faster diagnosis and lower rates of admission to emergency departments. Nelli® was identified by the topic proposer as a specific example of such an intervention.</p> <p>HTW identified two pieces of guidance, a health technology assessment, a systematic review, and meta-analysis, 6 primary studies and one health economic analysis. The evidence suggests that at-home video monitoring may be useful in distinguishing between epileptic seizures and non-epileptic events and may be able to inform clinical decisions and management. The identified health economic analysis estimates that one technology, Nelli®, may be cost saving to the NHS by £432 per person when compared to standard practice of video electroencephalogram.</p> |

¹ [Cyfieithu dogfennau HTW wedi'u cyhoeddi o'r Saesneg i'r Gymraeg](#)
[Translation of published technical HTW documents from English into Welsh](#)

Introduction and aims

Epilepsy is a neurological disorder which affects an estimated 633,000 people in the UK, characterised by recurrent seizures which occur due to bursts of electrical activity in the brain. The effects of epileptic seizures vary according to which part of the brain is affected, but may commonly present as jerking of the body, repetitive movements, and non-motor symptoms, such as unusual physical sensations.

Diagnosis of epilepsy can be a lengthy and resource intensive process, as other conditions such as migraine and panic attacks can cause similar symptoms. People who are suspected of having epilepsy should be referred to a specialist centre where diagnostic tests such as video electroencephalogram (vEEGs) can be carried out. vEEGs and associated tests for epilepsy usually require the person to remain in hospital for a number of days. In some cases, ambulatory EEG (aEEG) monitors may be provided so that the person can be monitored outside of the hospital setting. vEEGs and aEEGs may also be used to monitor people with known epilepsy to assess the efficacy of any treatment changes,

Remote video recording of people suspected of having epilepsy may be an effective alternative to the use of vEEGs and aEEGs in diagnosing the condition, resulting in faster diagnosis and lower rates of admission to emergency departments. Nelli® was identified as a specific example of this technology.

Health Technology Wales researchers searched for evidence on at home video monitoring for epileptic seizure.

Evidence overview

HTW identified two pieces of guidance, one health technology assessment, one systematic review, and meta-analysis, six primary studies and one health economic analysis.

Guidance

NICE Guideline [NG217] (2022) 'Epilepsies in children, young people and adults' recommends that following a first suspected seizure, the affected person, and/or their guardians should be provided with information on how to recognise a further seizure (1.1.8) and that when meeting with a specialist, eyewitness accounts and video footage of the seizure should be provided to inform the assessment (1.2.1).

SIGN Guideline [SIGN159] (2021) 'Epilepsies in children and young people: investigative procedures and management' identified that recorded seizure videos, when reviewed by a clinician with experience in epilepsy, can be 'extremely helpful' in making a fast and accurate diagnosis. The guideline recommended that a secure video transfer service and remote monitoring of epilepsy should be considered (3.3).

Health Technology Assessment

A health technology assessment by the Scottish Health Technologies Group (SHTG) (2022) evaluated the effectiveness of the vCreate Neuro technology for the diagnosis and management of children and adults with epilepsy and other neurological disorders. vCreate Neuro enables patients and/or carers to upload self-recorded videos of suspected seizures and other neurological disorders for review by their clinical team for interpretation and advice within 5 days. The review concluded that there is some evidence to suggest that home-video

Evidence overview

recordings are useful in distinguishing epileptic seizures from non-epileptic seizures, and services such as vCreate Neuro may be effective in speeding up the process of differential diagnoses.

Systematic Review and meta-analysis

A systematic review and meta-analysis by Karakas, et al (2023) evaluated the diagnostic value of video alone in differentiating epileptic seizures from non-epileptic spells. Thirteen articles were included, with data from 683 patients included. The review concluded that video alone had a strong ability to differentiate between the two, reporting an area under the curve of 0.9, sensitivity of 82.2% (95% CI 80.2%-84.0%), specificity of 84.7% (95% CI 82.8%-86.5%) and diagnostic odds ratio of 24.7 (95% CI 11.5-52.9). Secondary analysis identified that epileptologists had the highest diagnostic accuracy, with a diagnostic odds ratio of 81.2 (95% CI 90.0%-94.6%). The review concluded that video alone has reliable diagnostic performance in differentiating epileptic seizure from non-epileptic spells but identified high study heterogeneity and the potential for publication bias.

Primary Studies

A retrospective cohort study by Lennard, et al (2023) assessed the clinical utility and acceptability of Nelli ® in people with intellectual disability who were suspected of having epilepsy in a single epilepsy service based in Cornwall. Fifteen participants who had not had their clinical epilepsy diagnoses supported due to inability to receive routine or ambulatory EEGs were included. The study reported that Nelli recorded 707 possible seizure events across the cohort, of which 247 were not recognised or heard by carers. Similarly, carers identified 165 episodes of 'seizure behaviour' which Nelli® did not deem to be seizures. Qualitative interviews revealed that care providers responded favourably to Nelli® with high levels of satisfaction.

A prospective multi-centre validation study by Larsen, et al (2022) assessed the performance of an artificial intelligence for nocturnal seizure detection, Nelli ®, using audio-video streaming. 191 participants aged 1-72 years (median age 20 years) were recruited and were monitored nocturnally over 4,183 hours. The study reported the Nelli® system's sensitivity for major motor seizures at 93.7% (95% CI 69.8%-99.8%) and minor motor seizures of 8.3% (95% CI 5.6%-11.8%).

A retrospective cohort study by Basnyat, et al (2022) assessed the clinical utility of a semi-automated epilepsy monitoring system (Nelli®) in a home setting. 104 participants underwent Nelli® registration for an average of 29 days. The study reports that Nelli® was able to recognise clinically relevant events in 83 participants (80%), of which 67 (65%) were epileptic seizures, and 16 (15%) were nonepileptic events. The study also reported that the number and severity of seizures captured by Nelli® had impact on clinical decision-making, with the need for new therapeutic interventions being identified in 54 (51.9%) participants and the confirmation of therapeutic efficacy in 13 participants (12.5%).

A pilot study by Ojanen, et al (2022) assessed the ability of Nelli® to evaluate baseline frequency and severity of nocturnal seizures in participants with drug-resistant epilepsy and the effect of brivaracetam (BRV) treatment on the number, duration and intensity of seizures observed. Thirteen participants were included and asked to keep a seizure diary in combination with the video monitoring. The study concluded that seizure diaries underestimated the daily average of seizures and overestimated the number of seizure-free nights in 7 of 8 patients when compared to Nelli®

Evidence overview

A prospective cohort study by Peltola, et al (2021) evaluated the accuracy of Nelli® in classifying nocturnal seizures in 40 participants. The study reported that there was a fair agreement in seizure classification between Nelli® and the gold standard (agreement coefficient = .33, 95% CI .20-.47) and that Nelli® was able to correctly identify all tonic-clonic and clonic seizures, and 82% of focal motor seizures. The study reported that there was low accuracy of the Nelli® device in identifying seizure types with more subtle motor phenomena.

Health Economic Analysis

A report by the York Health Economics Consortium (YHEC) (2023) reported the findings of a cost-comparison model developed for Nelli® that incorporated primary and secondary care resource use associated with epilepsy diagnosis and management over a one-year time horizon. The model assumed that Nelli® could be used instead of vEEGs and aEEGs. Under base case assumptions, Nelli® was estimated to be cost-saving to the NHS compared to EEGs. Nelli® was estimated to reduce costs by £432 per person, and to reduce the number of misdiagnoses by 5.5%. Scenario analysis identified that Nelli® would not be cost saving if used in place of aEEGs, assuming no difference in effectiveness.

Areas of uncertainty

Further information is required in the following areas:

- Whether at-home video recording for diagnosis and management of epilepsy is currently used in Wales, and how it would integrate with current NHS systems
- Privacy and information governance regarding the remote nature of the video camera and microphone technology in the home/bedside setting.
- Comparative evidence comparing the diagnostic accuracy of at-home video monitoring with artificial intelligence to standard practice.
- How much training is required for clinicians and users to be able to use this device and associated software.

Literature search results

| Health technology assessments and guidance | |
|---|--|
| NICE. (2022). Epilepsies in children, young people and adults [NG217]. | |
| SIGN. (2021). Epilepsies in children and young people: investigative procedures and management [SIGN159] | |
| SHTG. (2022). vCreate Neuro for the diagnosis and management of adults and children with epilepsy and other neurological disorders. | |
| Evidence reviews and economic evaluations | |
| Karakas C, Ferreira LD, Haneef Z. (2023). Use of video alone for differentiation of epileptic seizures from non-epileptic spells: A systematic review and meta-analysis. <i>Seizure</i> . 110: 177-87. doi: 10.1016/j.seizure.2023.06.022 | |
| Individual studies | |
| Not searched. | |
| Evidence supplied by topic proposer | |
| Armand Larsen S, Terney D, Osterkjerhuus T, et al. (2022). Automated detection of nocturnal motor seizures using an audio-video system. <i>Brain Behav</i> . 12(9): e2737. doi: 10.1002/brb3.2737 | |
| Basnyat P, Makinen J, Saarinen JT, et al. (2022). Clinical utility of a video/audio-based epilepsy monitoring system Nelli. <i>Epilepsy Behav</i> . 133: 108804. doi: 10.1016/j.yebeh.2022.108804 | |
| Lennard S, Newman R, McLean B, et al. (2023). Improving nocturnal event monitoring in people with intellectual disability in community using an artificial intelligence camera. <i>Epilepsy Behav Rep</i> . 22: 100603. doi: 10.1016/j.ebr.2023.100603 | |
| Ojanen P, Zabihi M, Knight A, et al. (2022). Feasibility of video/audio monitoring in the analysis of motion and treatment effects on night-time seizures - Interventional study. <i>Epilepsy Res</i> . 184: 106949. doi: 10.1016/j.eplepsyres.2022.106949 | |
| Peltola J, Basnyat P, Armand Larsen S, et al. (2023). Semiautomated classification of nocturnal seizures using video recordings. <i>Epilepsia</i> . 64 Suppl 4: S65-S71. doi: 10.1111/epi.17207 | |
| YHEC. (2023). Economic Evaluation of Nelli for Adults Experiencing Suspected Nocturnal Seizures with Suspected or Confirmed Epilepsy. | |

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| Date of search | February 2024 |
| Concepts used | Video monitoring, video recording, hybrid recording, video, audio, hybrid recording, epilepsy, epileptic, epilepsies, seizure, Nelli |

Proposed research question and evidence selection criteria (if selected)

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| Proposed Research question | What is the clinical and cost effectiveness of at-home video monitoring for the diagnosis and management of epilepsy? |
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| | Inclusion criteria | Exclusion criteria |
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| Population | Adults and children with suspected epilepsy | |
| Intervention | At-home video monitoring for epilepsy | |
| Comparison/ Comparators | Standard practice (video electroencephalograms, ambulatory encephalograms) | Other wearables for the detection of seizures |
| Outcome measures | <ul style="list-style-type: none"> • Diagnostic accuracy • Time to diagnosis • Adverse outcomes • Economic outcomes where they relate to cost and use of resources • Health related quality of life • Prolonged /recurrent clustered seizures requiring emergency treatment • Seizure-related injury • Seizure type and frequency, | |

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| Proposed speciality | Nervous system |
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