

**CRITICAL REVIEW****Users' perspectives and preferences on using wearables in epilepsy: A critical review**

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**Abstract**

Seizure detection devices (SDDs) offer promising technological advancements in epilepsy management, providing real-time seizure monitoring and alerts for patients and caregivers. This critical review explores user perspectives and experiences with SDDs to better understand factors influencing their adoption and sustained use. An electronic literature search identified 34 relevant studies addressing common themes such as usability, motivation, comfort, accuracy, barriers, and the financial burden of these devices. Usability emerged as the most frequently discussed factor, with patients and caregivers also emphasizing the importance of ease of use, long battery life, and waterproof design. Although validated devices showed high user satisfaction, technical challenges, false negatives, and false positives need much improvement. Motivation to use SDDs was driven by enhanced safety, symptom tracking, and health care professional recommendations. Comfort and wearability were also critical aspects, with users favoring lightweight, breathable, and discreet designs for long-term wear. Users reported the devices as “comfortable” and preferring wrist or arm-worn devices for the long term. Accuracy—particularly minimizing false positives and false negatives—was a priority for users. Barriers to adoption included device cost, limited insurance reimbursement, discomfort, and concerns about data privacy. Despite these challenges, many users were willing to use SDDs. Recommendations from health care professionals significantly increased user motivation. This review highlights the need for SDD designs that address user concerns regarding usability, comfort, looks, and accuracy, while also reducing financial and technical barriers. Enhancing clinical involvement and tailoring devices to specific patient needs may be crucial to promoting wider SDD adoption. Further research is needed to evaluate the impact of SDDs on quality of life and to explore ways to mitigate challenges in long-term use.

**KEYWORDS**

epilepsy, seizure detection, users' perspectives, wearable devices

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## 1 | INTRODUCTION

Seizure detection devices (SDDs) are increasingly recognized as valuable tools in the management of people with epilepsy (PwE), providing real-time monitoring of seizures and offering alerts to patients, caregivers, and health care providers. As technology advances, these devices have the potential to reduce injuries and anxiety, increase the quality of life (QoL) for PwE, and potentially reduce the risk of sudden unexpected death in epilepsy (SUDEP).<sup>1-3</sup>

The development of non-invasive, wearable SDDs marks a significant leap forward in epilepsy management. These devices can monitor a range of physiological signals, including heart rate, movement, and electrodermal activity, which contribute to both seizure detection and the provision of early warnings. The currently available SDDs are validated for tonic-clonic seizures, but further developments are needed for the detection of the other seizure types.<sup>1,2,4</sup> Although the technological capabilities of these devices are promising, user adoption and long-term engagement with SDDs are dependent on more than just functionality. Factors such as usability, comfort, reliability, and cost all play a crucial role in shaping user experiences and long-term engagement.

Understanding how patients and caregivers view and interact with these devices is essential for improving their design and functionality. Because user satisfaction directly influences the adoption and continued use of these technologies, it is critical to explore these dimensions to identify and address the potential barriers.

Since previous reviews were published,<sup>5-10</sup> new findings have emerged, and thus it is timely to extend the literature search. This review provides a comprehensive analysis of users' perspectives and experiences with SDDs, with an emphasis on recent advancements. By synthesizing findings from various studies, we explore common themes of the existing literature. In doing so, and to better meet the needs of PwE and their caregivers, this narrative review offers insights into factors influencing the acceptance of SDDs and highlights areas for future development.

## 2 | METHODS

Electronic database searches were conducted on PubMed with combinations of English-language keywords including epilepsy, seizure detection, wearable, user experience, user perspective, non-invasive, survey, questionnaire, interview, and monitoring. Articles published until September 1, 2024 were considered. We reviewed titles and abstracts of all identified articles. We excluded review articles and studies about invasive,

### Key points

- This critical review explores user perspectives and experiences with seizure detection devices (SDD). We included 34 studies addressing common themes: usability, motivation, comfort, accuracy, barriers, and financial burden of these devices.
- Although validated devices showed high user satisfaction, technical challenges, false negatives, and false positives need much improvement.
- Enhancing clinical involvement and tailoring devices to specific patient needs may be crucial to promoting wider SDD adoption.

non-ambulatory, and seizure prediction devices, as they were out of scope of this review. We analyzed the articles, extracted findings related to the topic of the review, and then performed thematic synthesis by clustering the findings into subtopics.

## 3 | RESULTS

We screened 1562 articles, included 32 studies, and then identified and clustered the common themes, as shown in [Figure 1](#).

Usability was the most common topic, followed by motivation, accuracy, comfort, and wearability. Distribution of study types are shown on [Figure 2](#). The devices\* are shown in [Figure 3](#) and the main findings summarized below.

### 3.1 | Usability (20 studies)

Usability was the most frequently discussed aspect, appearing in 10 user perspective and 10 user experience reports. Of the latter, six were conducted in epilepsy monitoring units (EMUs) and four in the home environment. Patients and caregivers prioritized ease of use,<sup>11,12</sup> with preferences for both daily or less-frequent battery charging,<sup>12-15</sup> and for mobile notifications about low battery.<sup>15</sup> Waterproof design was also frequently requested.<sup>14-16</sup>

Concerns about usability were moderate, with worry levels rated at 3.5/5 for PwEs and 3.3/5 for caregivers.<sup>17</sup> NightWatch (7.3/10 for user-friendliness), Empatica (90% success in proper device usage), and Epi-Care (7/7 for ease of learning) were well rated,<sup>18-20</sup> although connection issues and lack of waterproofing were challenges, as anticipated by user perspective studies.<sup>19,21</sup> Indeed, waterproof designs were also frequently requested.<sup>14-16</sup>

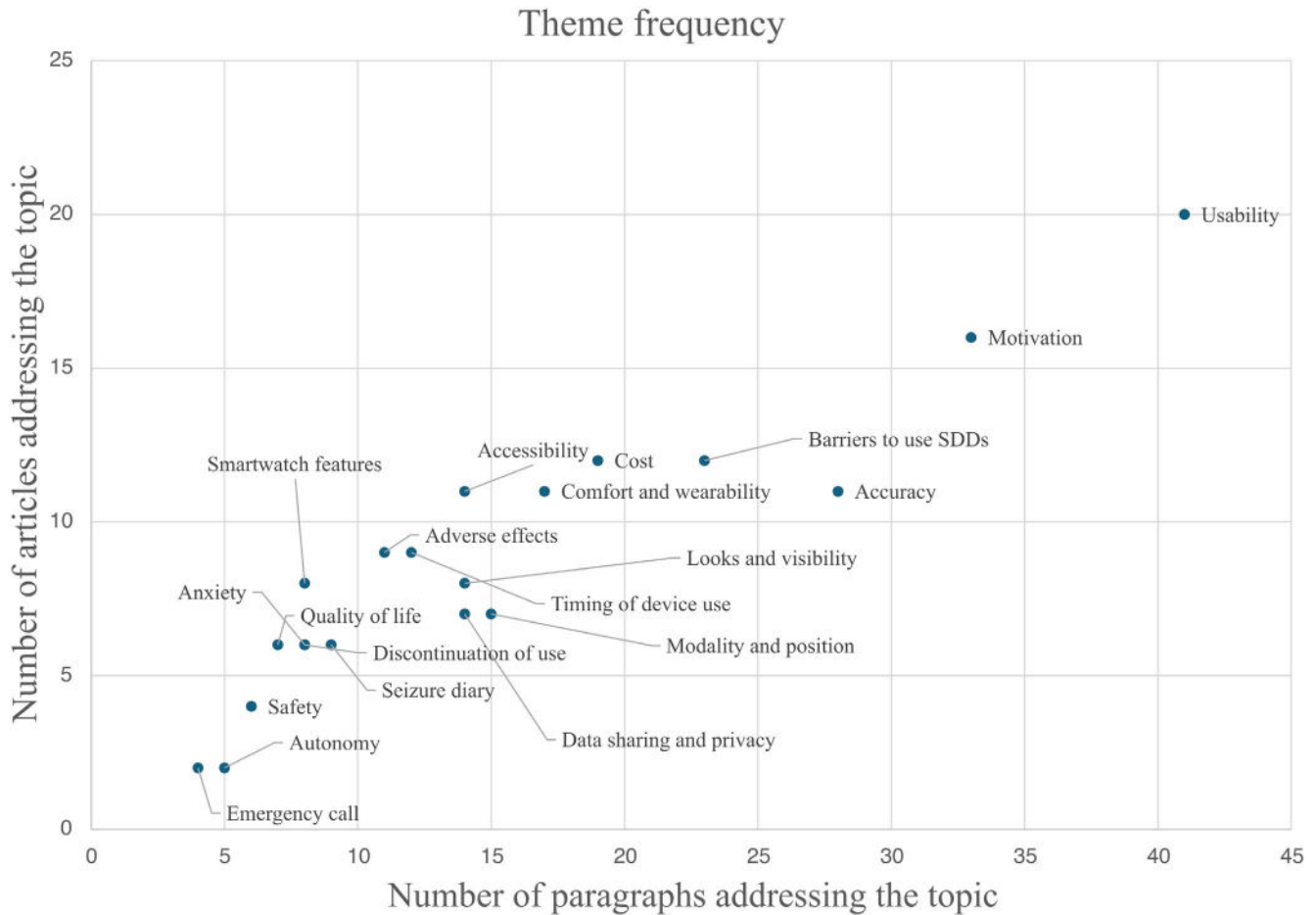


FIGURE 1 Theme frequency bubble chart. SDDs, seizure detection devices.

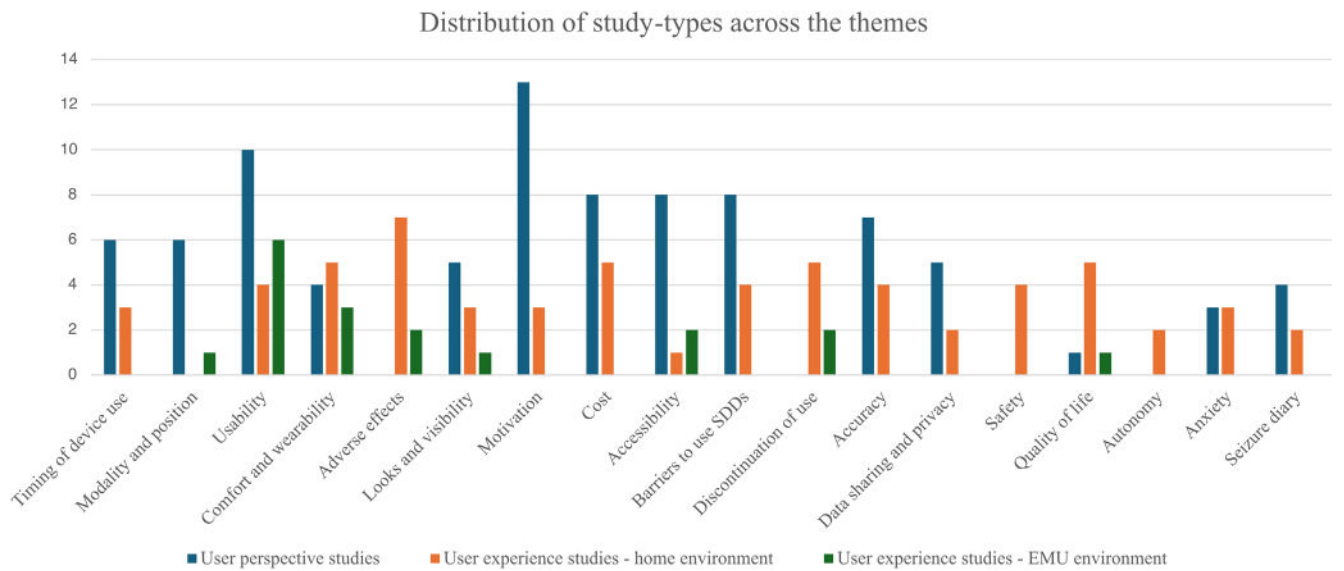


FIGURE 2 Distribution of study types across the themes.

In an international survey, users rated device usability at 6/7, with validated devices (Epi-Care, Empatica, and NightWatch) scoring higher than non-validated

ones.<sup>22</sup> In a comparative study, Biovotion ranked highest for ease of manipulation, followed by Empatica-E4 and GENEActiv.<sup>23</sup>



**FIGURE 3** Devices appearing in the articles included in this review. Byteflies Sensor Dots may not be used only on the head; different locations are possible. Devices starting from the top and going clockwise: (1) Brain Seizure Detection (BrainSD): Lehnen J et al. 2024; (2) Byteflies Sensor Dots: [byteflies.com](https://byteflies.com); (3) Epitel Epilog: Frankel MA et al. 2021; (4) Activinsights GENEActiv: [activinsights.com](https://activinsights.com); (5) Empatica: [empatica.com](https://empatica.com); (6) Epi-Care: [danishcare.dk](https://danishcare.dk); (7) Biovotion Everion: Gashi S. et al. 2024; (8) Bespoke sensor armband (IMEC): [imec-int.com](https://imec-int.com); and (9) NightWatch: [nightwatchepilepsy.com](https://nightwatchepilepsy.com). ACC, accelerometry; EDA, electrodermal activity; EEG, electroencephalography; EMG, electromyography; HR, heart rate; PPG, photoplethysmography. \*Except SmartWatch by SmartMonitor, where picture was not available.

For long-term use, Sensor Dots was rated at 7/10 for daily usability,<sup>24</sup> and over 80% of patients found another behind-the-ear EEG system (the Brain Seizure Detection) easy to use.<sup>25</sup>

Patients and caregivers expressed a need for technical support. Preferences varied: written guides or video tutorials were popular among PwE and caregivers,<sup>14</sup> whereas health care providers favored in-person training. Patients who had experience with wearables reported less need for assistance.<sup>14</sup> Although some caregivers would accept hospitalization for the setup period,<sup>26</sup> this was negatively received by others.<sup>27</sup> Telephone support post-setup was seen as reassuring by some patients.<sup>15</sup> In user experience studies, some patients needed help with tasks like fitting, switching on, and charging devices.<sup>28</sup> In another study, around half of participants were fully independent, one-third required additional support, and 13.3% needed constant supervision.<sup>20</sup> In a study with the Sensor Dots, nobody reported having had issues for which help was needed.<sup>29</sup> South African patients, some of them new to electronic devices, reported challenges such as difficulty operating mHealth devices and limited access to mobile data.<sup>30</sup>

### 3.2 | Motivation to use (16 studies)

The theme appeared in 13 user perspective studies and three user experience studies conducted in the home environment.

Professional recommendations from and collaborations with health care professionals increased PwE's trust in SDDs, whereas key motivators to use the devices included their safety, external confirmation of their seizures, and how they reduced stress levels.<sup>13–17,26,29,31–33</sup>

Caregivers played a key role in motivating patients to use SDDs,<sup>21,31</sup> and although alarming relatives during seizures was a popular feature,<sup>26,34</sup> a patient's SUDEP risk did not significantly increase their motivation.<sup>12,13,35</sup>

Some users reported limited immediate benefits from SDD use.<sup>35</sup> Patients living alone reported a higher need for SDDs.<sup>36</sup>

### 3.3 | Comfort and wearability (11 studies)

The theme appeared in four user perspective studies and four user experience studies conducted in the home environment. Two were in the EMU and one was in both environments. Comfort was crucial for SDD use, particularly for individuals who were also wearing one at night,<sup>16,17,37</sup> with preferences for soft, easy-to-clean, lightweight, and breathable materials.<sup>15</sup> Jewelry-like designs were also popular.<sup>15</sup> Bulky batteries and tight-fitting devices were seen as uncomfortable.<sup>15</sup> In comparative studies, body wearables were seen as more convenient than EEG head sensors.



Wristwatches and armbands were more comfortable compared to devices requiring wires.<sup>28</sup> In a study comparing five devices (Biovotion Everion, Byteflies Sensor Dots, Epitel Epilog, Empatica E4 and Activinsights GENEActiv), the GENEActiv device showed the best results for long-term comfort and sleep comfort. Epi-Care and the Sensor Dot were also rated as comfortable.<sup>19,24</sup> Wearable scalp EEG devices were generally rated as comfortable,<sup>24,25,29</sup> but in some cases, long-term use was hindered by discomfort.<sup>24</sup> Adolescents using SmartWatch reported discomfort and frustration, given interference with daily activities and the need to remove it to avoid water damage.<sup>21</sup>

### 3.4 | Accuracy, reliability, false negatives and false positives (11 studies)

The theme appeared in seven user perspective and four user experience studies conducted in the home environment.

Patients expected at least 90% sensitivity,<sup>12,16,21</sup> with acceptable false alarm rates varying from 1 to 2 per week to 1 to 2 per month, or <25% false-negative and false-positive rate,<sup>12,32</sup> with <30s detection latency.<sup>12,17,32</sup> False alarms and missed seizures led to device discontinuation.<sup>22</sup>

Sensitivity was more important to patients than predictive value, although caregivers preferred different notifications for different seizure types, especially when caring for multiple patients.<sup>17,26,27,32,34,37</sup>

Validated devices (Empatica, Nightwatch, and Epi-Care) had high user satisfaction regarding accuracy, but both false negatives and false positives remained an issue of concern for some patients.<sup>19,22,34</sup> Adolescents using SmartWatch experienced both frequent false alarms, leading some to ignore them, and high false-negative rates, discouraging use.<sup>21</sup>

### 3.5 | Barriers to use (12 studies)

The topic appeared in eight user perspective and four user experience studies conducted in the home environment.

Common barriers included the additional burden of using devices<sup>14,17,22,35,36</sup> and uncertainty about their usefulness.<sup>13,15,16,35,36</sup> Concerns about comfort and appearance were raised occasionally.<sup>13,29,35</sup> False alarms, sleep disruption, and anxiety were anticipated by some,<sup>16,35</sup> and technical difficulties (such as charging issues) were noted as challenges.<sup>35</sup> A fear of being observed, being reminded of epilepsy daily, of crime concerns (fear of being attacked because of the device), and a distrust of private companies or feeling watched, further hindered adoption.<sup>12,15,18,30,38</sup>

Financial barriers are discussed in Section 3.8, “Cost.”

### 3.6 | Modality and position (seven studies)

The theme appeared in six user perspective and one experience study in the EMU.

Preferences for wrist and arm-worn devices were clear,<sup>13,15,17,28,35</sup> with less interest in head-mounted sensors or invasive devices.<sup>13,14,37</sup> Multimodal devices were favored for their perceived greater reliability.<sup>13,26</sup>

### 3.7 | Data sharing and privacy (seven studies)

The theme appeared in five user perspective and two experience studies in the home environment.

Although privacy concerns were noted, they did not significantly hinder device adoption.<sup>11,13,16,17,38,39</sup> Most users appreciated real-time data sharing with health care providers<sup>11,13,16</sup> but health care professionals raised concerns about data overload.<sup>11</sup> Adolescents had mixed feelings about sharing data with family members; they reported the difficulty of balancing autonomy with family support.<sup>11</sup> Transparent regulations on data access were seen as essential for maintaining data integrity.<sup>15</sup>

### 3.8 | Cost (12 studies)

The topic of cost appeared in seven user perspective and five user experience studies in the home environment.

Income distribution among SDD users skewed higher than among non-users, although the difference was not statistically significant.<sup>40</sup> In another study, although there was a correlation between patients with lower self-reported prosperity and a reported need for seizure monitoring devices, more than half of these patients wanting a device were not able to afford one.<sup>36</sup> The validated SDDs currently available on the market were listed for prices between \$1530 and \$1785 USD. Half of the patients willing to purchase a device would spend under \$200 USD but multimodal devices may be accepted with higher prices as well.<sup>17,37</sup> One study found that 39% of patients were opposed to a monthly fee<sup>37</sup> but a leasing option was preferred by many.<sup>12,34</sup>

Despite limited health insurance reimbursements, caregivers spent an average of €174 annually on monitoring devices.<sup>31</sup> High device costs discouraged some patients, many waiting and hoping for future reimbursement.<sup>16–18,35</sup> Although many sought reimbursement,

some were open to sharing costs.<sup>14</sup> In a recent survey it was shown that full reimbursement was provided in 4% of the questioned countries and another 7% offered partial reimbursement.<sup>41</sup>

### 3.9 | Accessibility (11 studies)

The theme of accessibility appeared in eight user perspective studies; two user experience studies were conducted in the EMU and one in the home environment.

#### 3.9.1 | Age

Findings on age and SDD use varied. Some studies found no age influence on willingness to use or manage technology.<sup>13,20</sup> Others showed that younger users were more likely to use SDDs and had better feedback on usability.<sup>40</sup> In one study, half of those unwilling to use SDDs were over 60 years of age.<sup>14</sup>

#### 3.9.2 | Gender

Gender did not significantly affect user perspectives or experiences with SDDs.<sup>12,13,19,23</sup> Minor differences included female patients disliking electrodes glued to the skin or skull.<sup>14</sup>

#### 3.9.3 | Epilepsy-related variables

Health care professionals expected higher acceptance among patients with severe epilepsy,<sup>15</sup> and patients with frequent seizures valued automated seizure diaries more.<sup>14</sup> People with a self-reported “more severe epilepsy” reported a higher need for seizure monitoring devices.<sup>36</sup> However, studies showed that disease duration, type, and frequency did not affect willingness to use SDDs or usability scores.<sup>13</sup> Patients taking three to five antiseizure medications (ASMs) had higher usability scores, but those with higher disease burden showed worse performance. Two-thirds of those uninterested in SDDs had longer epilepsy duration.<sup>14</sup>

#### 3.9.4 | Digital exclusion

Digital exclusion is a concern, as some individuals need more confidence in using smartphones and apps.<sup>16,30</sup> Living in high-crime areas is correlated with lower potential for use.<sup>30</sup>

#### 3.9.5 | Education

In one study, patients uninterested in SDDs had lower academic achievement,<sup>14</sup> but technology self-management did not differ by education level in another study.<sup>15</sup>

### 3.10 | Looks and visibility (eight studies)

The theme appeared in five user perspective studies; and in two studies about user experience conducted in the home environment and one study with both in-home and in-hospital results.

Aesthetic concerns varied, with some patients preferring discreet devices to avoid stigma,<sup>11,13,16,38</sup> whereas others feeling that visible devices normalized epilepsy, much like hearing aids.<sup>33,42</sup> Overall, appearance was a minor concern compared to functionality.<sup>17,24</sup>

### 3.11 | Timing of device use (nine studies)

The theme appeared in six user perspective studies and in three studies about user experience conducted in the home environment. Timing preferences varied. Although most patients favored continuous use,<sup>13</sup> some wished to only use the device during periods of medication changes or when alone.<sup>14,17,25,29,33–35</sup> Some preferred intermittent use, especially for nocturnal seizures.<sup>14,25</sup> Indeed, night-time monitoring was generally considered more important than daytime alarms.<sup>12</sup> PwE wearing the Sensor Dot were willing to wear it for 1-week periods, when necessary.<sup>29</sup>

### 3.12 | Adverse effects (eight studies)

The theme appeared in one user experience study in the hospital environment, six at-home studies, and one including both cohorts.

Adverse effects were rare and mild. Skin irritation was the most common issue,<sup>18,19,22,24,25,28,29,39</sup> and was often resolved easily with some troubleshooting.<sup>18,39</sup> False alarms caused anxiety and sleep deprivation for some users.<sup>31</sup>

### 3.13 | Discontinuation of use (six studies)

The theme appeared in four user experience studies conducted in the home environment, one in the EMU, and one included both cohorts.

Device discontinuation occurred for reasons both related to and not related to the device.

Reasons related included difficulty in using the device, discomfort, adverse effects, too many false alarms, too many missed seizures, damaged device, or lack of perceived benefit.<sup>18,19,22,28,39</sup> The retention rate for validated devices was higher than for non-validated ones.<sup>22</sup>

Side effects and interference with daily routines were the main reasons for discontinuation of the Sensor Dots.<sup>24</sup>

### 3.14 | Impact on safety, autonomy, quality of life, and anxiety

#### 3.14.1 | Quality of life (six studies)

The theme appeared in one user perspective study, four user experience studies conducted in the home environment, and one study covering both hospitalized and in-home cohorts. Mixed findings were noted on QoL improvements. Although subjective improvements were reported in user experience surveys,<sup>22</sup> formal tests failed to demonstrate significant changes.<sup>18,21,24,40</sup> For instance, although one study identified a medium-impact on QoL, it lacked statistical significance.<sup>21</sup> Notably, PwE who reported a need for SDDs had lower QoLs than those not desiring an SDD.<sup>36</sup>

#### 3.14.2 | Anxiety (six studies)

The theme of anxiety was addressed in three user perspective and three at-home user experience studies. Although some health care professionals worried that SDDs might increase patient anxiety, user perspective studies revealed that, despite concerns about potential undetected seizures, patients and caregivers anticipated that SDDs would provide some comfort.<sup>11,32,43</sup>

In two user experience studies, most users reported that SDDs reduced their anxiety about unexpected seizures.<sup>34,40</sup> Conversely, one-third of caregivers in another study said false alarms heightened their anxiety.<sup>31</sup>

#### 3.14.3 | Safety (five studies)

Safety was addressed in five at-home user experience studies. Users reported that SDDs led to quicker responses and reduced injuries,<sup>19,22,31,39</sup> without increasing the overall burden of care.<sup>39</sup>

#### 3.14.4 | Autonomy (two studies)

Two user experience studies were conducted in the home environment. One study found that few patients

gained independence but that caregivers experienced more freedom,<sup>39</sup> whereas another indicated that adolescents with epilepsy might achieve greater autonomy with SDDs.<sup>21</sup>

### 3.15 | Seizure diary (six studies)

The theme appeared in four user perspective and two user experience studies conducted in the home environment. An automated seizure diary was seen as an important feature,<sup>12,14,15,30</sup> with some studies reporting that users experienced improved accuracy in seizure tracking.<sup>19,22</sup>

## 4 | DISCUSSION

The findings of this review provide important insights into user perspectives and experiences with SDDs, revealing a complex interplay of usability, motivation, comfort, and technical challenges affecting adoption and long-term use. Several key themes emerged, offering a comprehensive understanding of what drives user engagement and what factors may hinder wider acceptance.

Usability was the most dominant theme across the studies, underscoring its critical role in the successful adoption of SDDs. Most patients and caregivers valued ease of use—with preferences ranging from battery life to device customization options. Although consistent positive feedback regarding the usability of validated devices suggests that user-friendly designs are already meeting patient expectations in many cases, technical difficulties such as charging issues and software updates remain barriers for some patients. These challenges, if left unaddressed, could limit the long-term use of otherwise effective devices.

The studies also highlighted the importance of being able to individualize devices and apps, with a need to accommodate the specific needs of patients with device sensitivity and both cognitive (e.g., memory) and physical (e.g., motor) impairments. Thus, future development should focus on further enhancing the accessibility and adaptability of these devices.

Motivation to adopt SDDs was linked primarily to safety and symptom tracking, with many users viewing these devices as tools for reducing stress and improving epilepsy management. Recommendations from health care professionals (particularly neurologists) significantly increased user motivation, suggesting that clinical endorsement plays a key role in encouraging device adoption. However, concerns about usefulness—particularly among individuals with less frequent seizures—indicate

that the benefits of SDDs may not always be immediately apparent to all potential users.

In 2021, a Clinical Practice Guideline regarding SDDs was issued.<sup>1,2</sup> They found high levels of evidence for the accuracy of automated detection of bilateral tonic-clonic seizures and recommended the use of SDDs as a safety measure. Although some users emphasized the importance of real-time alerts and diagnostic capabilities, the absence of SUDEP-related motivation suggests that despite its seriousness, this risk was not a central concern for many patients. This may reflect a lack of awareness or perceived personal relevance, highlighting a potential area for further education and awareness-raising efforts.

Comfort and wearability emerged as crucial factors for long-term use, with users preferring soft, breathable materials and lightweight designs, particularly for devices worn overnight. Bulkiness and discomfort were frequent complaints, particularly for head-based or wired devices, emphasizing the need for discreet, comfortable wearables that integrate seamlessly into daily life. The reviewed studies suggest that wrist-worn devices (such as watches) are generally preferred over head-mounted EEG devices or sensors (requiring more invasive application). But, contrary to user perspective studies, sensors put on the head were generally rated comfortable in the short term, showing that monitoring for 1–2 weeks is acceptable for PwE.

It emerged that patients instinctively place greater trust and monetary value in multimodal devices. Accuracy (especially regarding false positives and false negatives) remains a critical concern for users. Although most studies reported acceptable accuracy rates for validated devices, high false-alarm rates were cited as a major reason for discontinuation in some cases. Users generally preferred higher sensitivity over predictive value, prioritizing the detection of all seizures—even at the expense of occasional false alarms. However, some users (particularly caregivers), expressed a desire for devices to differentiate between seizure types, underscoring the need for more personalized detection algorithms that could improve both sensitivity and user satisfaction.

Several barriers to SDD adoption were identified, including concerns about device usefulness, cost, technical challenges, and comfort. The financial burden associated with SDDs (exacerbated by the lack of insurance reimbursement) was a recurring theme. Although many PwE were willing to pay for devices, the high upfront costs, maintenance fees, and uncertainty about long-term benefits likely deter some users from adopting or continuing use.

Concerns about data privacy and security, although noted, did not significantly impact willingness to use SDDs, especially when weighed against the benefits of seizure detection and monitoring. Still, ensuring transparent

data-sharing policies and offering users control over data will be essential for maintaining trust in these technologies.

The findings from this review suggest several avenues for improvement in SDD design and deployment. First, enhancing usability through longer battery life, waterproof design, and better technical support could address key barriers to long-term use. In addition, tailoring devices to meet the needs of diverse patient populations—including those with cognitive impairment, frequent seizures, or high anxiety—will be crucial to ensure that SDDs are accessible to all.

Finally, addressing cost concerns through insurance coverage or alternative payment models—such as leasing options—could help alleviate the financial burden on PwE and caregivers. Increased clinical involvement in recommending and supporting the use of SDDs, coupled with clear communication about their benefits and limitations, will likely further enhance adoption rates and improve patient outcomes.

Although there is an increasing number of studies including QoL questionnaires, results still pose some controversies. There are no data yet showing an improvement in QoL in PwE using SDDs. Further research is needed to investigate these aspects and to explore which specific applications have an impact on QoL in PwE.

In conclusion, although SDDs have a significant potential to improve the lives of PwE and their caregivers, substantial challenges remain. Addressing the identified barriers and refining devices according to user feedback are a substantial steps in enabling a wider adoption of SDDs in epilepsy management and SUDEP prevention.

#### **AUTHOR CONTRIBUTIONS**

L.H.: conceptualization, visualization, writing—original draft preparation. T.R.: writing—review and editing. E.B.: writing—review and editing. M.R.: writing—review and editing. S.B.: conceptualization, writing—original draft preparation, supervision.

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#### **CONFLICT OF INTEREST STATEMENT**

None of the authors has any conflict of interest to disclose.

#### **DATA AVAILABILITY STATEMENT**

Data sharing is not applicable to this article as no data sets were generated or analyzed during the current study.



## ETHICS STATEMENT

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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