



## Perspectives on seizure clusters: Gaps in lexicon, awareness, and treatment



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### ABSTRACT

Seizure clusters in epilepsy can result in serious outcomes such as missed work or school, postictal psychosis, emergency room visits, or hospitalizations, and yet they are often not included in discussions between health-care professionals (HCPs) and their patients. The purpose of this paper was to describe and compare consumer (patient and caregivers) and professional understanding of seizure clusters and to describe how consumers and HCPs communicate regarding seizure clusters. We reviewed social media discussion sites to explore consumers' understanding of seizure clusters. We analyzed professional (medical) literature to explore the HCPs' understanding of seizure clusters. Major themes were revealed in one or both groups, including: communication about diagnosis; frequency, duration, and time frame; seizure type and pattern; severity; and self-management. When comparing discussions of professionals and consumers, both consumers and clinicians discussed the definition of seizure clusters. Discussions of HCPs were understandably clinically focused, and consumer discussions reflected the experience of seizure clusters; however, both groups struggled with a common lexicon. Seizure cluster events remain a problem associated with serious outcomes. Herein, we outline the lack of a common understanding and recommend the development of a common lexicon to improve communication regarding seizure clusters.

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### 1. Introduction

The Centers for Disease Control and Prevention estimates that 5.1 million people in the United States have had a diagnosis of epilepsy or a seizure disorder [1]. Epilepsy is an episodic neurological disorder characterized by the spontaneous and unpredictable manifestation of seizures [2]. The unpredictability of seizures, a hallmark of epilepsy, has led many investigators to explore ways to identify and track patterns of seizure occurrence. Haut et al. reported that in addition to overall seizure frequency, the temporal distribution of seizures as either random or predictable events, including clustering, has clinical relevance [3,4]. For instance, a patient who experiences one or two seizures per year may be viewed as having fairly well-controlled disease. However, if the patient experiences a cluster of seizures on

each of those days that require intervention to abort, the condition becomes more serious from both the consumer (includes both patient and caregiver) and health-care professional (HCP) perspectives.

Recognizing patterns of seizure occurrence may be helpful in preventing untoward consequences of seizures that occur in series because seizure clusters lead to frequent emergency rooms visits or hospitalizations [4,5]. When left unchecked, seizure clusters may be associated with postictal psychosis or can potentially proceed to status epilepticus [4,6], a life-threatening neurologic disorder. Increased seizure occurrence in one day is likely to lead to other distressing events, such as lost work, missed school days, and other physical symptoms [7,8]. Despite the potential for poor outcomes in people with epilepsy who also experience seizure clusters, there has been limited research related to seizure clusters or their outcomes.

Seizure clusters, acute repetitive seizures, and serial seizures are not part of the International League Against Epilepsy (ILAE) Commission on Classification and Terminology [9,10]. Interest in testing

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potential treatments for seizure clusters resulted in the US Food and Drug Administration (FDA) convening an advisory panel to define these episodes. The published report from the Peripheral and Central Nervous System Drugs Advisory Committee [11] offered a conceptual definition that was later translated into an operational definition used in clinical trials to evaluate rescue treatments. The conceptual definition offered by the committee stated that acute repetitive seizures are a recognized chronobiological entity that can be defined as a form of seizures that are severe; are a predictable component of the patient's seizure disorder; are historically distinct from the patient's other seizures in type, frequency, severity, or duration; have an onset that is easily recognized by the family and physician; demonstrate patient recovery between seizures; have a consistent component (such as an aura, prodrome, or characteristic single or multiple seizures) that is predictably and temporally linked to subsequent seizures; and are a constellation of seizures variously referred to as cluster, acute repetitive, multiple recurrent, serial, or crescendo seizures.

Building upon the conceptual work of the FDA Advisory Committee on seizure clusters, a consensus statement was provided to offer a simplified operational definition for use in clinical trials. Accordingly, the statement indicated that seizure clusters can occur across multiple seizure types, are a recognizable entity, and contain the following key features: a form of seizure that is severe, has a recognizable onset, is distinct from the patient's usual seizure type and frequency, and demonstrates recovery between seizures [12]. Two decades later, however, the definition of seizure clusters remains unclear.

Most recently, Pellock et al. [13] and Haut [4] reviewed the published literature and reported a knowledge gap in defining seizure clusters. Health-care professionals have been using inconsistent terminology to describe these events, including terms such as acute repetitive seizures and cyclical, serial, repetitive, crescendo, and recurrent seizures. To provide appropriate abortive therapy, recognition of seizure clusters is necessary, but the consumers' ability to communicate their experience with seizure clusters to an HCP is challenging because of the lack of clarity surrounding the definition. Further, accurate recognition depends on the ability of consumers and professionals to recognize seizure patterns, including those that are distinct from other seizures in terms of type, frequency, severity, or duration [14]. Lack of recognition of seizure clusters and the subsequent failure of consumers' communication of their existence hinder both accurate seizure tracking and consumers' timely receipt of abortive therapy.

Based on a review of the medical literature and an analysis of social media, the purpose of this paper was to describe and compare consumer and professional understanding of seizure clusters, and to describe how consumers and HCPs communicate regarding seizure clusters.

## 2. Methods

### 2.1. Social media review

Internet discussions were chosen to better describe consumer understanding of seizure clusters. Using this method allowed for a large search of existing data from public websites that reveal real-life descriptions. Websites offering consumer dialogues, such as community forums, were reviewed. Only a few websites provided public community forums allowing users to share experiences and perspectives. Websites of the Epilepsy Foundation, the Lennox–Gastaut Syndrome Foundation, the Tuberous Sclerosis Alliance, the Dravet Syndrome Foundation, Seizure Tracker®, and Patients Like Me were reviewed from August to September 2014 and from December 2014 to January 2015 for accessibility, availability, and the number of posts by consumers pertaining to seizure clusters. The website of the Epilepsy Foundation, [www.epilepsy.com](http://www.epilepsy.com), was selected as the sole source for review of consumer perspectives for further quantitative analysis because at the time of the review, the other patient sites did not offer a sufficient number of posts on the topic to be included. The website of the Epilepsy Foundation had the largest community forum devoted to epilepsy that contained posts about seizure clusters. In addition, this site was the most frequently used for posts referring to seizure clusters using a Google search.

In 2014, [www.epilepsy.com](http://www.epilepsy.com) had 5.5 million unique visitors, with approximately 24% of users visiting its community forums. The majority of users live in the United States (3.5 million unique users), with large representations from other mainly English-speaking countries, such as the United Kingdom (500,000), Canada (280,000), and India (200,000). The [epilepsy.com/connect](http://www.epilepsy.com/connect) section includes a real-time chat room and community forums, where people can post questions, challenges, or personal stories. Registered users of this website respond to each other and provide a rich source of users' perspectives [15].

Using the search engine, the community forums of [epilepsy.com](http://www.epilepsy.com) were examined for posts with the following terms: “acute repetitive seizures”, “ARS”, “acute seizures”, “bouts of seizures”, “clusters”, “cluster seizures”, “Ativan”, and “Diastat”. Table 1 shows the number of posts relating to each search term. Posts were reviewed for content specifically relating to how people define or describe seizure clusters and their perspectives. Ten pages of results for each search term were reviewed. This process included both original posts and any responses to the original posts. The number of responses per search term reviewed ranged from 100 to 250 posts per term. The search terms “clusters”, “cluster seizures”, and “seizure clusters” appeared to be the most consumer-friendly terms based on the relevance of posts found using these terms.

**Table 1**  
Number of responses per search term [15].

Search term	Number of posts	Comments
Acute repetitive seizures	>17,000	<ul style="list-style-type: none"> <li>• High number of posts related to the use of the term “seizures”</li> <li>• Posts that relate to ARS discuss repetitive movements in seizures or acute illnesses that could lead to seizures</li> <li>• Majority unrelated to topic or share experiences only and were excluded</li> <li>• Some relate to community talks or marketing and were excluded</li> </ul>
ARS	240	<ul style="list-style-type: none"> <li>• Majority link to unrelated articles</li> <li>• Most that are relevant share personal experiences</li> </ul>
Clusters, cluster seizures	>16,000	<ul style="list-style-type: none"> <li>• Few ask questions about causes, prevention, or certain treatments, responses not appropriate or correct</li> <li>• Most frequently used term that pertained to topic area</li> <li>• When the term cluster was used alone, usually referred to headaches or migraines and were excluded</li> </ul>
Ativan or lorazepam	>700	<ul style="list-style-type: none"> <li>• Some comments pertaining to doctors not willing to prescribe</li> </ul>
Rectal diazepam	438	<ul style="list-style-type: none"> <li>• Posts included use of diazepam in any form, experiences with rectal diazepam, difficulties affording or using medication in schools, experiences and questions about status epilepticus or cluster</li> </ul>
Diastat	282	<ul style="list-style-type: none"> <li>• Questions or experiences with Diastat, seizure emergencies</li> </ul>

ARS = acute repetitive seizures.

### 2.1.1. Inclusion criteria for social media review

Posts were reviewed if they were found using one of the search terms described above. The two treatments (lorazepam [Ativan] and rectal diazepam gel [Diastat]) were included to capture user perspectives on circumstances pertaining to the use of these medications, since they are currently commonly used treatments for seizure clusters.

### 2.1.2. Exclusion criteria

Posts were excluded if they reported seizure occurrence without reference to seizure patterns, clusters, or acute repetitive seizures; included personally identifiable information; were representative of treatment plans; offered solely emotional content about their experience; solely discussed status epilepticus; or, in the reviewer's clinical judgment, discussed clusters using descriptions of status epilepticus.

Content that was included was subjected to further analysis. A qualitative content review methodology was used to identify major themes.

## 2.2. HCP literature review

A search of the literature using PubMed and MEDLINE was completed for the dates of January 1968 to June 2015. The search terms “cluster seizures” and “acute repetitive seizures” (ARS) produced over 635 citations. Articles were included if content referred to seizure clusters, cluster seizures, or ARS. In addition, reviews and abstracts were included if they described other topics such as status epilepticus and postictal psychosis. In review of the literature, emphasis was placed on the definition of the entity and effects on consumers' quality of life. Animal studies and studies primarily addressing prevention were excluded. The final review included 38 published papers.

### 2.3. Comparison of consumer and HCP themes

Themes identified from the review of consumer posts and themes identified from the professional literature were compared. Common themes that most closely described references to seizure clusters from the two groups were chosen.

## 3. Results

### 3.1. Consumer perspectives on seizure cluster

A qualitative review of consumer posts identified the following themes: diagnosis and communication; frequency, duration, and time frame; seizure type and pattern; severity; impact; when to treat and self-management; and risk factors. A description and examples of each follow (Table 2).

#### 3.1.1. Diagnosis and communication

This theme refers to the consumers' understanding of how physicians hear their reports and give a name to their condition. This section includes communication with HCPs. How clusters are diagnosed was unclear to some people. Some consumers expressed confusion about what the diagnosis of clusters meant and the role and meaning of electroencephalography findings. Interestingly, some consumers felt that their HCPs did not believe them when they related information about seizure clusters. This represented a small group of posts but could be reflective of a larger communication gap between consumers and HCPs. Consumer posts also suggested that the cluster events could have a psychological basis or be nonepileptic events. A key piece to diagnosis was how the seizure cluster events were communicated and understood by HCPs. Consumer posts reflected confusion about what the diagnosis of seizure clusters meant. Further,

**Table 2**

Consumer themes and examples.

<p><i>Theme: diagnosis and communications</i> Examples:</p> <ul style="list-style-type: none"> <li>• “As a unique or different type of seizure...”</li> <li>• “It's like partial seizures; my body doesn't get the sensation; I get it in my brain.”</li> <li>• “It feels like nerves in my head are shaking.”</li> </ul> <p><i>Theme: frequency</i> Examples:</p> <ul style="list-style-type: none"> <li>• “Sometimes get them 3 to 8 in row... it's like a wave.”</li> <li>• “Every few months I get them [simple partial seizures] back-to-back...”</li> <li>• “Repetitively over 3 to 4 days, then they do not happen again... for a month or 6 weeks.”</li> <li>• “He just seems to have occasional bad days... cycles of every other week... with multiple seizures.”</li> <li>• “May occur only 4 to 6 times a year... with cluster of at least a dozen and more over 24 h.”</li> <li>• “A predictable period of time when seizures occur...”</li> <li>• “If he has a seizure on a given day, it is pretty likely to continue with activity throughout the day.”</li> <li>• “Something to do with repetitiveness of seizures... my seizures did not seem to be getting worse, just coming over and over and over...”</li> </ul> <p><i>Theme: seizure type and pattern of seizure occurrence</i> Examples:</p> <ul style="list-style-type: none"> <li>• “It's a group of them that are too hard to stop... usually hours, a day or so.”</li> <li>• “Same kind of seizure hitting me seconds after the [first]”</li> <li>• “Not sure if you mean one right after another or if space in between... mine always had space... an hour or hours in between.”</li> <li>• “Mine are periodic, with[in] a period of a little less than a month...”</li> <li>• “Once one starts, I anticipate over a course of a few days... may have many more... so I prepare, sort of... the nocturnal ones giving the worst issues... Those are completely hit-or-miss within the clustering or sometimes in between.”</li> </ul> <p><i>Theme: impact</i> Examples:</p> <ul style="list-style-type: none"> <li>• “[Seizure cluster] leaves me exhausted, depressed, needing a day off from work to [recover].”</li> <li>• “Seizures evolved in intensity and type over decades... usually start with unique simple partials as I doze off into sleep... I can stop their return as long as I stay awake... without taking stronger doses of AEDs, seizures will progress... eventually meeting definitions of status epilepticus...”</li> <li>• “Clusters are the worst... rapidly repeating shocks, disrupted thoughts/confusion and involuntary head nodding... they require intervention to stop, so I have a rescue medication.”</li> <li>• “He's out of it for the day... bothers me because it's like he lost a day of his life...”</li> </ul> <p><i>When to treat</i> Examples:</p> <ul style="list-style-type: none"> <li>• “Am to take it [treatment] after the second seizure to prevent a grand mal.”</li> <li>• “Ativan seems to take care of it.”</li> <li>• “Clusters are the worst... so I have a rescue medicine”</li> <li>• “It's gotten to the point where even if he has one seizure, we give an Ativan in hopes of preventing [others]”</li> </ul>
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AED = antiepileptic drug.

consumers expressed a lack of confidence that the HCP acknowledged their concerns about seizure clusters.

#### 3.1.2. Frequency, duration, and time frame

This theme refers to the understanding of or the definition of seizure clusters as understood by people with epilepsy based on their own experience with seizures. Content from these posts simply addressed how often people had seizure clusters relative to the baseline number of seizures. Users described clusters by the number of seizures occurring together; for example “3 to 8 in a row” or “occurred repetitively over a course of 3 to 4 days”. Some users described frequency by how often the seizure clusters occurred; for example, “every few months”, or “every 4 to 6 weeks” or “a few times a year”. However, when seizures did occur infrequently, they tended to occur as clusters with multiple seizures in one day.

### 3.1.3. Seizure type and pattern

This theme was defined as a person's understanding of the kind of seizure that occurs in a cluster and the manner in which it occurs. Posts that defined seizure clusters referred to a unique or different type of seizure, a predictable period of time during which seizures occur, or a pattern of seizure occurrence. Consumers discussed how clusters felt or were experienced, their understanding of what constituted a seizure cluster, or what seizure cluster meant to them. Patterns identified were similar to triggers of any seizures, some of which related to treatment issues and others that may be modifiable by behavior changes. Examples of patterns identified in user posts included sleep (before, during, or upon awakening), activity on weekends, intercurrent illness, stress, menses, pregnancy, and changes in medication. These examples suggest that some consumers describe seizure clusters as different from their usual seizures, and that a pattern of seizure clusters has a significant impact.

### 3.1.4. Severity

This theme is defined as a patient's perception of the seriousness of the seizures. Consumers shared their thoughts about how the repetition and progression of seizures affected their sense of severity. One consumer stated, "My seizure [sic] are periodic. The intensity of seizures evolves, starting with simple partial". Another person stated that seizures progress from simple partial to generalized tonic-clonic seizures, and that, if not stopped, the seizure would progress to status epilepticus. Based on these examples, recurrent seizures contribute to a heightened sense of severity, and misperceptions of what seizure clusters are or status epilepticus can be confusing.

### 3.1.5. Impact

This theme is defined as the overall outcome of seizure clusters on consumers and family life. Seizure clusters created distress for the consumer and/or the family. One consumer stated, "They leave me exhausted, depressed, and needing a day off work." Posts also discussed the predictability, with one consumer stating, "The clustering is disconcerting at best. But once they start, I anticipate that over the course of the next few days I will have many more." Finally, posts reflected timing, with one consumer stating, "It's the nocturnal seizures that are giving me the worst issues." These posts suggest that seizure clusters and their aftermath have a significant effect on consumers' lives.

### 3.1.6. When to treat and self-management

This theme refers to how consumers made decisions about when and how to treat with medications and other management techniques used. Knowledge of seizure clusters helps consumers understand when to intervene. Topics of some posts related to when to treat and how to treat (e.g., increase or change existing antiepileptic drugs, when to use rescue therapies, and the most commonly used therapies). Some people stated that when clusters start, they often recognize that an intervention is necessary. For example, one mother shared that when her son had just one seizure, she always gave a rescue medicine to ensure that clusters did not follow.

Consumers frequently wrote about the steps they take to prevent or treat clusters and communication with their HCPs. While these themes are common to epilepsy management in general, the users highlighted their own experiences and what steps they learned to implement in relation to clusters. Included in self-management were consumer discussions of the use of diaries, the use of a formal plan, and when and how to use rescue medications. They also discussed the lack of discussion of action plans with their HCPs and the reluctance of HCPs to prescribe rescue medications.

### 3.1.7. Risk factors

This theme refers to consumers' ability to anticipate or know when clusters may occur to inform his/her decision to treat. In this section, consumers discussed the interrelationship of factors such as catamenial

seizures, illness, and nocturnal seizures. Patterns identified were similar to triggers of any seizures, some of which related to treatment issues and others that may be modifiable by behavior changes, such as sleep, activity, weekends, stress, pregnancy, and changes in medications. They also discussed how their ability or inability to anticipate seizure clusters affected their ability to initiate rescue treatment.

### 3.1.8. Conclusion

These examples suggest that some consumers define seizure clusters as different from their usual seizures and that seizure clusters have a significant impact. Confusion exists regarding terminology.

## 3.2. Professional literature review

Best efforts were made to use similar themes identified in the consumer review. Consumers reported their perception of what happened. As would be expected, professional literature focuses on clinical observation, assessment, and support. The literature review revealed the following themes: frequency, duration, and time frame, risk factors, severity, and prevalence and incidence.

### 3.2.1. Frequency, duration, and time frame

This theme refers to the HCP's understanding of the definition of seizure clusters. In the late 1990s, with the testing of rectal diazepam gel, the epilepsy research community operationally defined the entity of acute repetitive seizures as "episodes of multiple complex partial or generalized seizures occurring within a 24-hour period in adults or a 12-hour period in children, with a pattern distinguishable from the patient's usual seizure pattern, and with the onset readily recognizable by a caregiver, such as a parent" [12]. This operational definition was not uniformly applied in making clinical assessment and/or diagnosis by HCPs after the clinical trial results were published. The literature reveals a lack of consensus about what constitutes a cluster of seizures. Many articles that addressed treatments did not provide a definition of seizure clusters or used a definition in accordance with the rectal diazepam trial [16–20]. Other definitions that have been referenced include episodes of multiple seizures within minutes to up to 24 h [3,21–26]; two seizures within 1 h for study purposes [27]; three seizures within 2 h [22]; and repeat seizures lasting less than 5 min for at least 30 min [28]. In fact, Haut [4] identified seven different definitions and [5] examined patients identified with a clinical definition of seizure clusters (>3 seizures in 24 h) and also used a statistical definition for clustering that is common among people with epilepsy.

### 3.2.2. Risk factors

This theme refers to the HCP's understanding of the underlying causes of seizure clusters. Risk factors were rarely discussed in the professional literature, but Haut et al. [3,4] identified risk factors for clustering that included average seizure frequency, a history of seizure clustering at home, and mesial temporal sclerosis. In addition, having more than one seizure focus was an important finding but did not reach clinical significance. Other studies have identified such risk factors as a history of head trauma, extratemporal foci, and poor seizure control [29,30]. After reviewing seizure diaries, Fisher [26] found that risk factors or triggers included sleep and sleep deprivation, waking, stress, menses, missing or changing medications, illness, alcohol, and nonmedical drugs. These findings reflect consumer-reported data.

### 3.2.3. Severity

This theme is defined as the HCP's perception of the seriousness of the seizures. Their discussions of severity focused on the complications that could occur due to clusters, such as status epilepticus [3,31] or postictal psychosis [4]; these were not widely addressed in the literature.

### 3.2.4. Impact

This theme is defined as the overall outcome of seizure clusters on patient and family life as understood by professionals. Discussions of significant outcomes of seizure clusters included progression to status epilepticus, increased emergency room visits [32], and hospital admissions [3]. Sillanpää and Schmidt [33], in a review of seizure outcomes and mortality, found that the mortality rate in children who experienced clusters was increased more than threefold.

### 3.2.5. Prevalence and incidence

This theme refers to the number of people who experience clusters in population-based studies. In 2009, Martinez et al. [34] conducted one of the few population-based studies looking at the prevalence of acute repetitive seizures. Using information from the United Kingdom General Practice Research Database, they found that 3% of the population with epilepsy and 0.02% of the population at large were affected by ARS. The study also reported that those with catastrophic epilepsies had the highest prevalence of seizure clusters, with a prevalence of 7.2/1000 and an incidence of 50/100,000. Haut et al. [3] suggested that the prevalence rate was 14% to 61%, but when a statistical model for identifying clusters was used, the prevalence was 22%. Haut et al. [3] concluded that seizure clustering is common among people with epilepsy, but the incidence is likely lower if a statistical definition as opposed to patient-reported data is used. Others indicate that the rates can range from 13% to 76% in outpatient studies [29,35–37] and from 18% to 61% in epilepsy monitoring unit studies [38–42]. Fisher et al. [26] reviewed persons who utilized My Epilepsy Diary. Information was downloaded from 28,697 patients with 546,768 patient days for an average of 70 diary days per unique user. Among those, Fisher et al. [26] found that days with two to five seizures accounted for 24% of total seizure days. Those who had more than one seizure in 24 h also had increased seizure frequency.

### 3.3. Common themes: consumer and HCPs

Findings from consumer perspectives (websites) and HCP published literature suggest multiple themes from the understanding of both consumers and HCPs that do not always intersect. Table 3 provides a comparison of consumer and HCP themes.

Both consumers and clinicians discussed the definitions of seizure clusters. Discussions of HCPs were understandably operationally and clinically focused. When considering definitions, they focused on the number of seizures and the period of time in which they occurred. One clinician also looked at a deviation from the normal pattern of seizures.

By contrast, consumers focused on how seizure clusters applied to their lives without understanding the exact meaning of clusters or being certain of their frequency. When discussing frequency, consumers did report the number of seizures they had over a short period of time, but their definitions of seizure clusters were also related to the significance of the events in their lives. Their discussions suggest recognition of established seizure patterns and the difference between those events and clusters of seizures. They described multiple understandings of the timing of events and that they might occur in minutes, days, or weeks. However, most described seizures that seemed to repeat quickly.

Health-care professionals studied and reported the prevalence of seizure clusters, but consumers understandably did not discuss prevalence. In fact, consumer discussions seemed to indicate a lack of understanding that seizure clusters are a recognized phenomenon that happens to many other individuals with seizures; instead, consumers thought that their experience was unique.

As might be expected, consumers focused on the personal impact of seizure clusters and, unlike clinicians, did not discuss risk factors. Anticipatory fear of having seizure clusters was a common experience among consumers. In contrast, the professional literature presented the effect

**Table 3**  
Comparison of themes between HCP and consumer.

Themes	HCP	Consumer
<i>Diagnosis and communication</i> refers to understanding of how physicians hear patient/family reports and give a name to their condition. This section includes communications with HCPs.	No discussions found	Confusion about diagnostic process; Sometimes communicated as a nonepileptic event. Perception that HCP did not understand the severity of the event or even believe the patient/family report.
<i>Frequency, duration, and time frame</i> refers to the understanding of or definition of seizure clusters as understood by people with epilepsy.	Time frame: 12-hour period for children, 24 for adults. 1 to 2 per day. Duration: over a relatively short period of time, usually less than 24 h. Entire episode persists for at least 30 min. Frequency: multiple seizures, usually 3 or more. Increase in seizures compared with baseline.	Time frame: varies in relation to pattern/risk factors. Can range from daily to once a year. Duration: length variation may range from a few days to a few weeks. Frequency: no specific number of seizures that occur in clusters.
<i>Seizure type and pattern</i> defined as the understanding of the kind of seizure that occurs in a cluster and the manner in which it occurs.	Unique seizure type.	Unique: different from normal events.
<i>Severity</i> is defined as perception of the seriousness of the seizures.	Postictal psychosis Status epilepticus Requires intervention to stop.	Need for rescue therapy Concern for safety such as with nocturnal seizures.
<i>Impact</i> is defined as the overall outcome of seizure clusters on patient and family life as understood by professionals and consumers.	Effect of seizures and treatment on patient health.	Effect on daily general health and daily functioning such as weakness, cognitive and language problems, exhaustion, and psychosis. Included are discussions of effect on work, school, and family. Concern about how clusters affect the brain and body.
<i>When to treat and self-management</i> refers to how consumers made decisions about when and how to treat and other management techniques they used. Included in consumer discussions were actions plans.	Administer abortive treatment after first seizures.	Identify triggers; how to use and when to use rescue medications; when to seek emergency help; activities to decrease likelihood of clusters such as sleep, hygiene, pacing activities, managing illnesses or other medical triggers of clusters, stress, changes in medications. Action plans that include when and how to use rescue therapies, etc.
<i>Risk factors</i> have different definitions for consumers and professionals. HCPs refer to risk of developing seizures. Consumers refer to the ability to anticipate or know when clusters may occur that informed their decisions to treat.	Catastrophic epilepsies, head trauma, catamenial, extratemporal onset seizures.	During sleep/awakening, changes in activities on the weekends, illness, menses, pregnancy.
<i>Prevalence and incidence</i> refers to the number of people who experience clusters in population-based studies.	Occurrence of seizure clusters.	Not discussed.

HCP = health-care professional.

of seizure clusters on consumers from the perspective of adverse clinical consequences, such as status epilepticus and hospitalizations [3,43], and emphasized the importance of rapid treatment. While there were some similarities among consumers and clinicians, such as accounts of repetition and change in seizure patterns related to when to treat, consumers seemed to be confused by the difference between a seizure cluster event and the progression to status epilepticus.

Both groups struggled with a common lexicon, but consumers and HCPs discussed the fact that the clusters tended to be different from a “normal” or expected seizure(s) and that they tended to occur in a set amount of time, though that exact amount was not defined. Common terms used by both consumers and HCPs included “acute repetitive seizures”, “seizure clusters”, and “clusters”. Both groups discussed the severity of the events. Consumers, as expected, discussed how disrupting these events were. Neither group discussed how clinicians and consumers communicate regarding this impactful experience.

#### 4. Discussion

These findings suggest a significant gap in the understanding of seizure clusters both from HCP and consumer perspectives. One concern is related to the gap both within and between groups and the lack of clear discussion points. Our analysis suggests that clusters were not perceived equally among consumers, suggesting that the simplistic clinical definition of two to three seizures per day [5] may not fully reflect the uniqueness of patient experience of seizure clusters. Because of these gaps, initiating a meaningful discussion could be difficult. An accepted, simple working definition of clusters that can be translated into consumer-friendly language is needed. This requires a common clinical lexicon to describe seizure clusters to facilitate communication among consumers as well as between consumers and clinicians.

This review yielded some interesting findings. While there were some common themes among HCPs and consumers such as terminology and definitions and timing, there were differences in how seizure clusters were viewed by each group. Health-care professionals viewed seizure clusters as a clinical event and discussed them in terms of how often they occurred, what the term meant, and how to treat them. This is an understandable clinical response and necessary for diagnosis, but for consumers, the discussion focused on the meaning of the event and the impact of seizure clusters. For example, consumers discussed how multiple seizures in a day affect their ability to complete their activities of daily living. A common and important discussion was that the seizure cluster events looked different from a person’s “normal” or expected seizure events. Both groups included this phenomenon in their definitions.

An alarming finding was consumers’ reference to how HCPs did not understand the severity of the event when they described it. In some instances, the HCP did not believe the patient or family’s report of the event. Trust is key in any professional and consumer relationship. Professionals, while seeking evidence to confirm a patient/family report, should provide validation that they both heard what was reported and will continue to evaluate the situation in an effort to address the patient’s need for answers and possibly intervention. Furthermore, the experience and fear of repetitive seizures can result in restrictions on lifestyle and quality of life [44].

Both groups perceived seizure clusters as severe, but for somewhat different reasons. Health-care professionals focused on clinical consequences, while consumers were concerned about what to do (e.g., how to identify triggers, when to seek help, how to use rescue therapies, and how to ensure their safety such as if a cluster was during sleep). This highlights the need for everyone to have a seizure action plan that addresses the possibility of clusters. Consumers should understand the chronological seizure spectrum (i.e., isolated seizure, unprovoked recurrent, clusters, prolonged, and status) so that, at each potential event, they have a plan tailored to their individual situation.

This would address the uniqueness of clusters for each person and mirror the clinical trial design for rectal diazepam gel.

Reconciling the two groups’ approaches to understanding seizure clusters is critical. Clinicians view a seizure cluster event in terms of numbers and timing. Consumer posts reflected the experience of seizure clusters as a part of daily life. The FDA advisory committee’s conceptual definition of seizure cluster was translated into an operational definition for the purposes of clinical studies; over time, HCPs have applied this operational definition to diagnose seizure clusters without considering consumer perspectives based on experience outside the clinic. A conceptual framework for seizure cluster should include both the HCP and consumer viewpoints. Seizure clusters should be thought of in terms of both timing and meaning of the events. Viewing seizure clusters in this manner can drive future research that will be designed to help build a common lexicon.

Much still needs to be learned about seizure clusters in terms of how they differ from other patterns of discrete seizures and how these differences contribute to treatment, prognosis, and quality of life. The need for a definition has been addressed over the past decade, and we propose that a combination of professional and lay perspectives can identify the important elements to be included. The information provided above, both in terms of the lay perspective and the view of HCPs, can serve as a starting point for common ground in describing seizure clusters and implications for care.

#### 5. Clinical recommendations

Despite the fact that our investigation did not yield a clear consensus on the definition of clusters, we recommend increased communication between HCPs and consumers about seizure types and frequencies. Consumers may view seizure clusters from their perspective; HCPs should provide clinical information by consistently asking about changes in seizure pattern and discussing the impact of these events. Health-care professionals can better clarify the existence of clusters by encouraging patients to keep a diary. Although there are many online diaries available, even a simple paper and pencil diary is better than no record keeping at all.

Finally, every patient should have a seizure action plan that includes the use of rescue medications. This means that each patient and patient support system should know exactly what to do if there is more than one seizure over a defined period of time and how to intervene. If this includes available rescue medications, then the education should include instructions on how to use those medications. The plan would differentiate between seizure clusters and other seizure emergencies and help in deciding when to seek emergency intervention. These three simple steps (discussion of multiple seizure events and the impact on daily life, keeping a diary, and a seizure action plan including appropriate treatment intervention) have the potential to decrease the negative outcomes related to seizure clusters.

#### 6. Limitations and research implications

There are clear limitations to this study. All patient information is based on consumer perception as it was reported in social media. Therefore, we had no way of determining the existence of actual clusters or if patients had epileptic or nonepileptic seizures. Further, professional response was based on the professional literature and not on actual HCP perceptions. For these reasons, our preliminary findings support the need for further research to clarify consumers’ understanding of clusters and their interpretation of impact and HCPs’ interpretation of seizure clusters. While multiple methodologies could be applied, we recommend that information be gathered both from HCPs and from patients and their families. We recommend a mixed methodology to study seizure clusters and point to a common lexicon. Mixed methods are used to study complex phenomena. In this case, we recommend that surveys be conducted to establish the scope of the problem. If a survey

were conducted on highly used websites, many persons with epilepsy, their families, and clinicians could be queried to clarify their understanding and identify commonalities. We then recommend that qualitative methodology be used to explore patient and clinician understanding of the phenomenology of seizure clusters in greater depth. This could be done through one-on-one consumer interviews or through the use of focus groups with consumers who are identified to have seizure clusters.

After a thorough examination of the phenomenon of seizure clusters, we recommend that a linguistic expert be engaged to analyze the language used by both consumers and professionals, categorize the themes, and suggest terminology to be tested with both groups for clarity. Once a common lexicon is identified, a test of reliability and validity of the terms should be launched. These terms could then be incorporated into a tool designed to guide discussions regarding seizure clusters, and the tool could then be tested using intervention methodology.

The authors believe that these recommendations would be an excellent start to improve outcomes related to seizure clusters; however, future work is also necessary. We recommend that the epidemiology of seizure clusters be established. We believe that the International Classification of Diseases should include a code for seizure clusters. Finally, we would recommend that the ILAE evaluate the inclusion of seizure clusters in the League's Classification and Terminology.

## 7. Conclusion

Seizure cluster events remain a problem associated with serious outcomes. In this paper, we have outlined the lack of a common understanding and recommend the development of a common lexicon regarding seizure clusters.

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## Conflicts of interest/disclosures

Janice M. Buelow is an employee of the Epilepsy Foundation at the time of this study.

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