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CRITICAL REVIEW

Defining the end point of status epilepticus: A scoping review and framework for standardization

Fawad A. Khan[1,2] | **Margaret T. Gopaul**[3] | **Samuel L. Carter**[4] | **Anil Chimakurthy**[5] | **Summer Skelton**[6] | **Lawrence J. Hirsch**[3] | **Eugen Trinka**[7,8,9]

[1]International Center for Epilepsy at Ochsner, Ochsner Neurosciences Institute, Ochsner Health, New Orleans, Louisiana, USA

[2]University of Queensland Medical School, Brisbane, Queensland, Australia

[3]Department of Neurology, Comprehensive Epilepsy Center, Yale University School of Medicine, New Haven, Connecticut, USA

[4]Division of Neurocritical Care, Ochsner Neuroscience Institute, Ochsner Health, New Orleans, Louisiana, USA

[5]Department of Neurology, Decatur Morgan Hospital, Decatur, Alabama, USA

[6]M3D Lab, Ochsner Neuroscience Institute, Ochsner Health, New Orleans, Louisiana, USA

[7]Department of Neurology, Neurocritical Care, and Neurorehabilitation, Christian Doppler University Hospital, Center for Cognitive Neuroscience, member of European Reference Network EpiCARE, Paracelsus Medical University, Salzburg, Austria

[8]Neuroscience Institute, Christian Doppler University Hospital, Center for Cognitive Neuroscience, Paracelsus Medical University, Salzburg, Austria

[9]Karl Landsteiner Institute for Clinical Neurosciences, Salzburg, Austria

Correspondence
Fawad A. Khan, International Center for Epilepsy at Ochsner, Ochsner Neurosciences Institute, Ochsner Medical Center, 1514 Jefferson Highway, New Orleans, LA 70121, USA.
Email: fakhan@ochsner.org

Margaret T. Gopaul, Yale NORSE Program, Yale School of Medicine—Department of Neurology, 15 York Street, New Haven, CT 06510, USA.
Email: margaret.gopaul@yale.edu

Abstract

Status epilepticus (SE) is a life-threatening neurological emergency with consensus-driven definitions for onset but no standardized criteria for its end point. This gap creates uncertainty in research and clinical practice. We conducted a scoping review to evaluate how end points have been defined in SE research and to identify key areas of variability. Comprehensive searches of MEDLINE, Embase, and CENTRAL (Cochrane Central Registry of Controlled Trials; 1980–2025) yielded 3940 citations (1674 unique). After screening, 207 studies met the inclusion criteria and were charted using scoping review methodology (Preferred Reporting Items of Systematic Reviews and Meta-Analyses, extension for scoping reviews). Data were extracted on terminology, electroencephalography (EEG) use, temporal thresholds, and definitions of therapeutic success across retrospective and prospective designs. Five domains of heterogeneity were identified: (1) semantic terminology (e.g., "resolved," "controlled," "terminated," "cessation"); (2) EEG confirmation of the SE end point (reported in 54% of studies, with variable criteria); (3) whether time was included in defining the end point; (4) how quickly seizures were judged to have stopped, based on clinical signs, EEG findings, or both; and (5) how long seizure freedom had to be maintained to count as a

Fawad A. Khan and Margaret T. Gopaul share co-first authorship.

successful end point. No consistent global or time-based patterns were identified, and overlapping terminology further limited comparison across studies. Despite established consensus definitions for SE onset, the end point remains variably defined, undermining methodological rigor and limiting cross-study synthesis. A unified, consensus-driven framework is urgently needed to standardize SE end points through the use of standard terminology and methodologies, thereby strengthening clinical trial design and facilitating regulatory evaluation of novel therapies.

KEYWORDS

consensus definitions, EEG, end point, refractory SE, scoping review, seizure cessation, superrefractory SE, therapeutic response

1 | INTRODUCTION

Status epilepticus (SE) is one of the most severe neurological emergencies, associated with substantial morbidity, mortality, and poor outcomes, representing a critical public health concern.[1,2] Over the past 3 decades, consensus guidelines from professional societies and international agencies have refined definitions of SE, refractory SE (RSE), and superrefractory SE (SRSE), improving consistency in both clinical practice and research.[3–6] These consensus-driven efforts, grounded in clinical observation, electroencephalographic (EEG) findings, and the experience of leading centers worldwide, have unified medical terminology and reduced diagnostic ambiguity, earning broad acceptance and practical utility across the field.

From a conceptual and epistemological standpoint, a reductionist model might posit, axiomatically, that the onset and cessation of SE represent discrete, mutually exclusive, and temporally complementary phenomena. In principle, onset is defined at the point when SE satisfies established diagnostic thresholds,[7] either at its true clinical inception or the best estimate based on clinical history, observation, and corroborative EEG data.[8–10] Conversely, the delineation of SE termination or resolution is inherently more complex and lacks uniform consensus. Terms such as "terminated," "abated," "controlled," "resolved," "suppressed," "interrupted," or "freedom from SE" are employed inconsistently across studies, and clinical vernacular remains largely nonstandardized, not only across international contexts but also among English-language publications within the same country.

Operational criteria for defining SE resolution or termination remain markedly variable, reflecting heterogeneity in study methodology, reporting standards, investigator interpretative thresholds, EEG utilization, and institutional resource availability.

Key points

- The end point of SE remains inconsistently defined across the published literature.
- Heterogeneity was observed across five domains, including semantic terminology, EEG confirmation, and time-related criteria pertaining to the earliest recognized end point and sustained seizure freedom in the temporal context of response to therapy.
- Lack of standardization undermines cross-trial comparability, meta-analyses, and regulatory evaluation of therapies.
- Consensus-based standardized definitions are urgently needed to harmonize SE research and ultimately to guide clinical practice.

In this scoping review, we examine the spectrum of definitional variability used to determine the end point of SE in relation to therapeutic intervention, as operationalized within study designs across the medical literature. This encompasses global terminological differences and the diverse criteria applied to key variables within individual studies, including timing components, clinical observations, and EEG findings, as they relate to the assessment of treatment efficacy. Accordingly, our review is restricted to treatment-assessment trials evaluating therapeutic response in retrospective and prospective studies published over the past 4 decades (1980–2025). Building on these observations, we propose a structured framework to guide future standardization efforts in SE research.

2 | MATERIALS AND METHODS

2.1 | Search methods

On July 23, 2024 and again on June 18, 2025, a trained medical librarian conducted thorough searches of the following databases: MEDLINE (Ovid), Embase (Ovid), and the Cochrane Central Registry of Controlled Trials (CENTRAL; Wiley). The searches were limited to English publications and covered the period from January 1, 1980 to June 1, 2025.

The search period from 1980 onward was chosen to capture treatment-era studies, reflecting the availability of intravenous agents for SE management and key advances in therapeutic practice, including the landmark study by Leppik et al. in the early 1980s.[11]

All search strategies are outlined in Appendix S1, and a flowchart according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines is presented in Figure 1.

The final search retrieved a total of 3940 references, which were uploaded to Covidence (www.covidence.org) for deduplication and screening.

Two independent reviewers evaluated the titles, abstracts, and full text of the eligible articles.

2.2 | Study selection

The literature search yielded 3940 citations (MEDLINE: 1341; Embase: 1405; CENTRAL: 1194; Figure 1). After removing duplicates, 1674 unique citations remained. Of these, 1279 were excluded during title and abstract screening. A total of 395 articles were retrieved in full text and assessed for eligibility.

At the full-text review stage, 188 articles were excluded for the following reasons: conference abstract only ($n = 46$), wrong clinical setting ($n = 3$, e.g., prehospital treatment of SE), wrong outcomes ($n = 24$, e.g., studies assessing therapeutic interventions but focusing on survival or functional outcomes rather than seizure cessation or treatment effectiveness), paper not retrievable ($n = 3$), analysis of study ($n = 31$, e.g., studies that did not detail the course of treated SE and its end point and instead examined outcomes such as tolerability or cost of care), wrong study design ($n = 21$, e.g., epidemiological studies comparing treatment protocols or assessing therapies for concurrent conditions), wrong patient population ($n = 2$, e.g., patients with seizure clusters rather than SE), and study proposals without reported results ($n = 58$).

After these exclusions, 207 articles met the eligibility criteria and were included in this scoping review. Agreement between the two independent reviewers was complete (100%) at the full-text stage with no discrepancies requiring arbitration.

2.3 | Data extraction

Several data points were extracted from each eligible article, including year of publication, age range of study subjects, number of patients, study type (retrospective or prospective), study setting (in-hospital or prehospital), country and continent of study sites, type of SE (convulsive and/or nonconvulsive), severity of SE (including RSE, SRSE), and therapeutic intervention studied. Regarding extracting descriptive data from individual studies, we collected information on:

- Definition of SE employed in each study.
- EEG criteria applied, when applicable.
- Operational definition of the SE end point, including description of how treatment response was determined in relation to the end point.
- Time-based parameters contextualizing the end point, capturing both the earliest achievement of success and the durability of seizure cessation.

Each study applied its own definition of treatment success corresponding to its determination of the SE end point, which was then used to assess the effectiveness of the therapeutic intervention. For our analysis, we extracted these definitions as reported. This approach aligned with our objective to characterize heterogeneity in reported outcomes, acknowledging that in real-world clinical practice, treatment goals often diverge from formal end point definitions. We also evaluated whether studies specified the time to SE cessation (e.g., within 20 min of study medication administration), defined a period of sustained seizure freedom without recurrence (e.g., seizure-free for 48 h), and incorporated these temporal parameters into their analyses. When available, we further reviewed how studies reported the diagnosis and management of SE recurrence following initial treatment.

Descriptive statistics were used for all extracted variables. Inferential statistical testing was applied only to compare EEG utilization between prospective and retrospective study designs.

3 | RESULTS

In our analysis of 207 published articles meeting the scoping review criteria, we observed substantial variability and a lack of standardized approaches for defining the end point of SE across retrospective and prospective

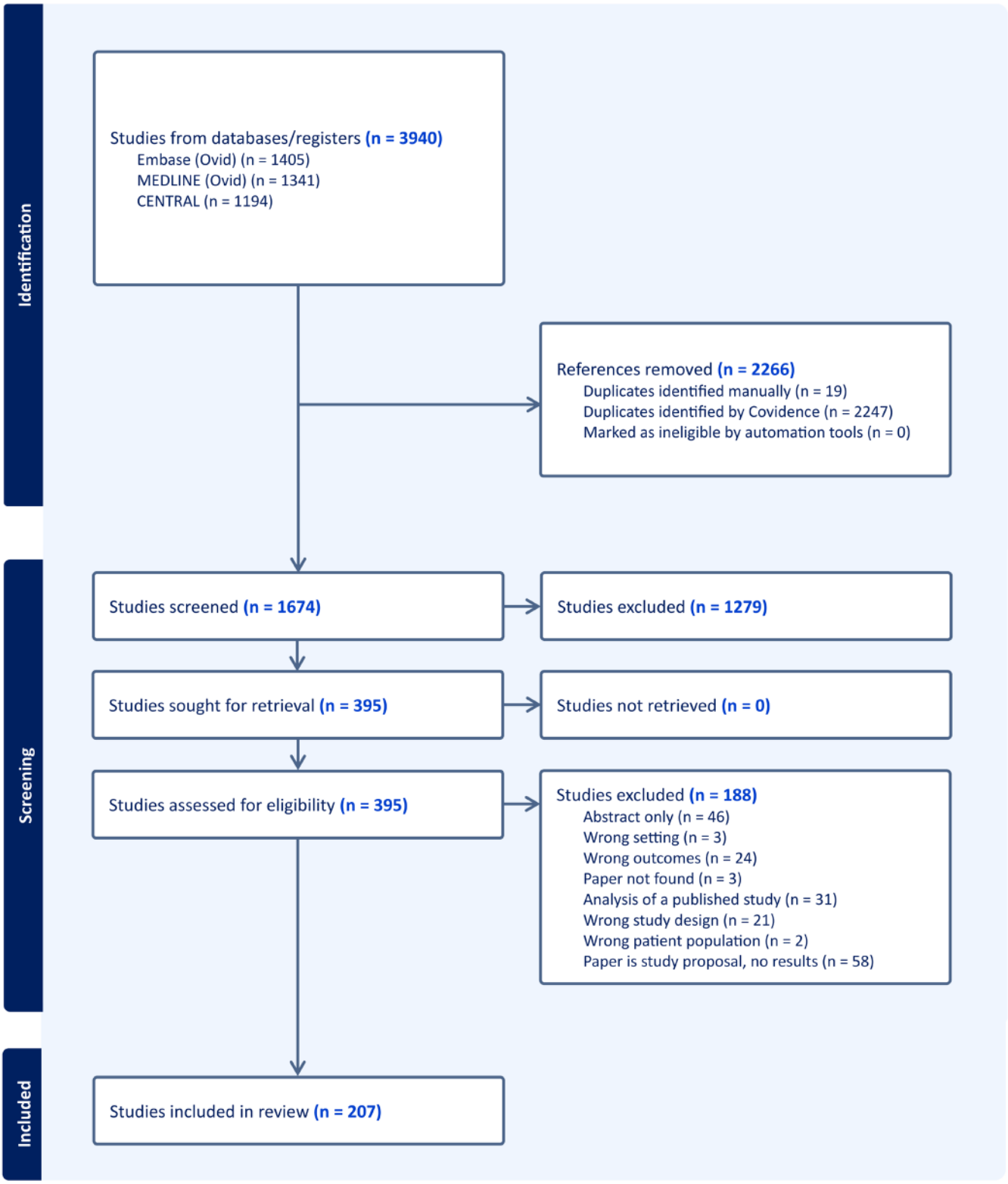

FIGURE 1 PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram, depicting the search and selection of studies. CENTRAL, Cochrane Central Registry of Controlled Trials.

clinical studies. This variability clustered around five key themes: (1) the semantic definitions used to convey the SE end point as a measure of therapeutic success; (2) confirmation of the end point through EEG data; (3) incorporation of time as a variable in determining the SE end point; and two additional attributes that contextualize the definition of the SE end point in relation to therapeutic intervention success: (4) the earliest

recognized time point at which the SE end point was identified, either clinically, electrographically, or both; and (5) specification of a sustained seizure-free period—without clinical or EEG evidence of recurrence—used to define the durability of the SE end point, reflecting the persistence of treatment response in the included studies.

3.1 | Semantic definitions of the end point of SE

Across the 207 papers analyzed, the terminology used to describe the end point of SE was highly heterogeneous. Frequently used terms included:

- Cessation ($n = 120$ mentions).
- Control/controlled ($n = 115$).
- Termination/terminated ($n = 84$).
- Resolution/resolved ($n = 31$).
- Stopped ($n = 16$).
- End/ended ($n = 11$).
- Responded ($n = 10$).

Less frequently reported descriptors included: seizure suppression ($n = 8$ mentions), seizure freedom ($n = 8$), reduction/reduced ($n = 5$), interruption ($n = 5$), arrest/arrested ($n = 3$), subsided ($n = 2$), aborted ($n = 2$), abated ($n = 1$), no seizure activity ($n = 1$), no relapse ($n = 1$), recovered ($n = 1$), remission ($n = 1$), attenuation ($n = 1$), improved ($n = 1$), seizure interruption ($n = 1$), absence ($n = 1$), and elimination ($n = 1$).

Many studies employed multiple terms interchangeably rather than adhering to a single convention; 23% used only one term, 41% used two distinct terms, 32% used three terms, and 4% used four or more terms.

We mapped the terminology used to define SE end points across studies by country and continent, with multicenter studies contributing data to all relevant regions. Among the 207 studies analyzed, the geographic distribution of study sites was as follows: Europe ($n = 142$), Asia ($n = 115$), North America ($n = 60$), Oceania ($n = 5$), Africa ($n = 3$), and South America ($n = 1$). Within each continent, we calculated the proportion of studies employing specific descriptors for the SE end point (resolution/resolved, control/controlled, abate/abated, termination/terminated, cessation/ceased, end/ended); stopped, responded, and other infrequently used terms, stated above, were grouped under "other," providing a comparative overview of regional semantic preferences in end point reporting. The proportional distributions of these descriptors are depicted in continent-specific pie charts (Figure 2).

3.2 | EEG confirmation of the end point of SE

The incorporation of EEG in defining and determining the end point of SE varied considerably across treatment studies. Overall, 111 of the 207 studies (54%) incorporated EEG monitoring as part of their methodology. Among the 73 prospective studies, 48 (66%) used EEG, compared with 63 of 134 retrospective studies (47%), demonstrating a statistically significant difference in EEG use by study design (Fisher exact test, $p = .013$).

We also analyzed EEG utilization using a distribution model, illustrating the proportion of retrospective and

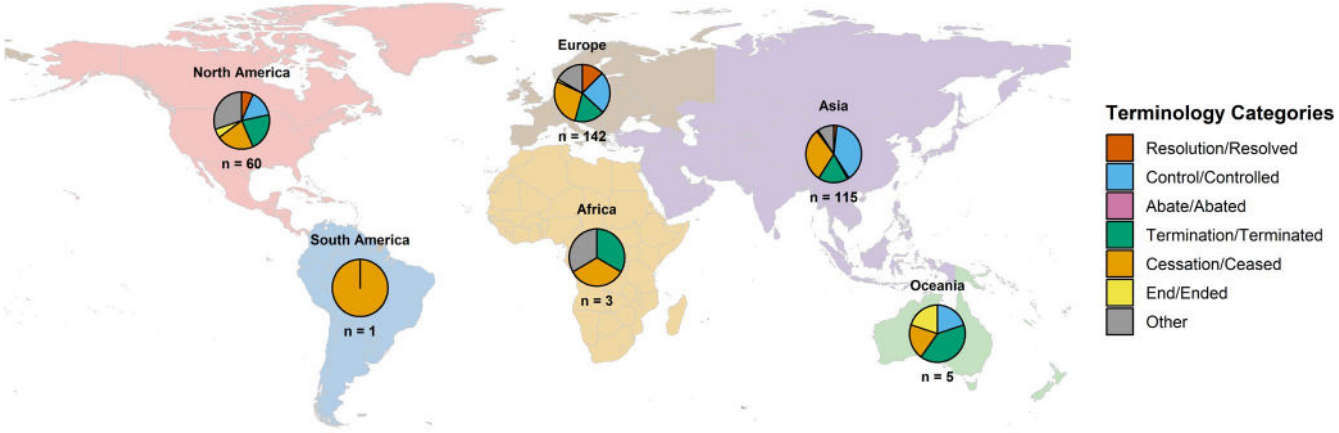

FIGURE 2 Global distribution of terminology defining status epilepticus (SE) end points in published studies, 1980–2025. The map illustrates the global distribution of 207 studies analyzing SE end points. Pie charts indicate the proportion of studies within each continent employing specific descriptors for SE end points: resolution/resolved (orange), control/controlled (blue), abate/abated (pink), termination/terminated (green), cessation/ceased (yellow), end/ended (light yellow), and other (gray). Multicenter studies contributed to all relevant regions. Sample sizes for each continent are indicated (n).

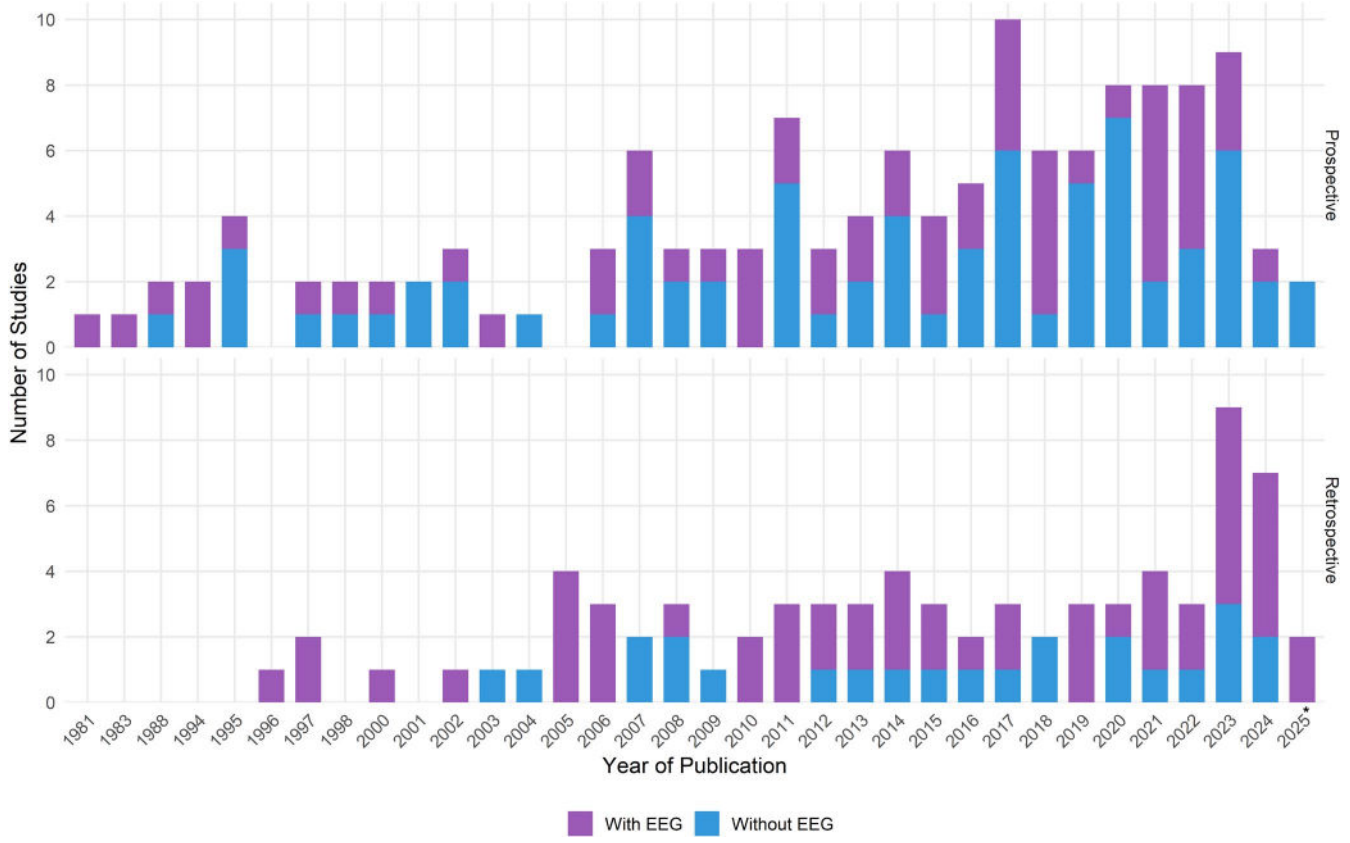

FIGURE 3 Temporal distribution of electroencephalography use for status epilepticus end point definition in published studies, 1981–2025. *Data for 2025 include publications through June 1. The figure displays the number of studies published per year, stratified by study design (prospective, top panel; retrospective, bottom panel) and electroencephalography (EEG) use (purple: with EEG; blue: without EEG). No consistent trend in EEG utilization over time was observed, although the overall number of prospective studies increased in recent years.

prospective studies that used EEG to determine the SE end point versus those that did not (Figure 3). Our analysis did not reveal any clear overall trends in EEG use for defining the SE end point over time, although a progressive increase in the number of prospective studies was observed. Certain years presented outliers, such as 2005, in which all four retrospective studies used EEG, and 2007, when neither of the retrospective studies did. Interestingly, EEG was used as early as 1981 in treatment studies of SE.

The EEG features used to define treatment response varied widely. Reported criteria included electrographic seizure burden, nonconvulsive SE patterns (e.g., repetitive focal or generalized spikes, polyspikes, sharp waves, spike-and-wave or sharp-and-slow wave complexes >2.5 Hz, or similar discharges <2.5 Hz), epileptiform discharges, periodic patterns, ictal–interictal continuum phenomena, and treatment-related changes such as burst suppression. Notably, 16 studies referenced EEG use without specifying the electrographic criteria applied. In studies using seizure burden to determine the SE end point, treatment success was defined relative to the study's SE criteria: if seizure burden met SE criteria, the end point was not achieved; if it fell below the threshold, the intervention was considered effective.

3.3 | Incorporation of time-based criteria in defining the end point of SE

The incorporation and phrasing of time-based parameters within the criteria used to define the end point of SE varied considerably across studies. Of the 207 studies analyzed, 91 (44%) included a temporal element in defining the SE end point (Figure 4). The remaining 116 studies did not explicitly account for time, introducing ambiguity in the assessment of therapeutic effectiveness and durability, particularly with respect to the onset-to-response interval and the duration of sustained seizure cessation.

Among the 91 studies incorporating time-based criteria, three reporting approaches were observed; 26 studies reported only the time to initial SE cessation, 38 reported only the duration of sustained SE cessation without recurrence, and 27 reported both metrics (Figure 4).

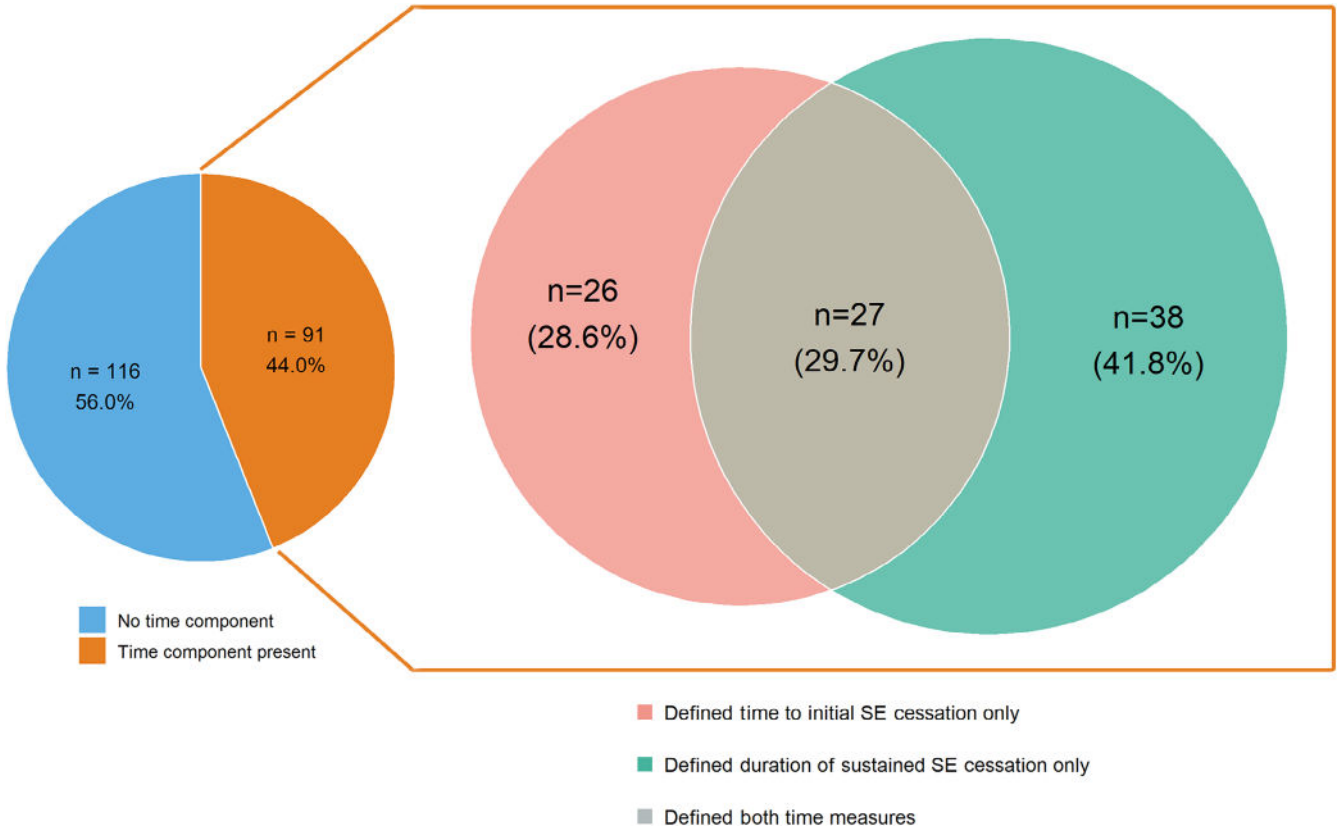

FIGURE 4 Integration of temporal parameters and timing-related contextual attributes in defining status epilepticus (SE) end points across treatment studies. The pie chart shows that of 207 studies, 116 (56%) did not include a temporal component in their SE end point definitions (blue), whereas 91 (44%) incorporated at least one time-based element (orange). The Venn diagram further classifies the 91 studies that included time-based measures; 26 (28.6%) defined only the time to initial SE cessation (pink), 38 (41.8%) defined only the duration of sustained SE cessation (green), and 27 (29.7%) incorporated both temporal measures (overlap, gray). This variation underscores the lack of standardization in how temporal dimensions are operationalized when defining the end point of SE and determining, in context, the efficacy and durability of SE treatment.

3.3.1 | Time to initial SE cessation

Time to initial SE cessation represents the earliest indicator of therapeutic response and is particularly relevant for agents administered intravenously or as a bolus, where a rapid onset of effect is anticipated. In phase 2 and 3 neurosteroid trials, for instance, the primary end point was defined as cessation of SE within 30 min of drug administration.[12,13] From a methodological perspective, this interval made sense as a choice to mitigate the effects of regression to the mean and reduce potential confounding factors that may obscure true treatment response.

Reported time thresholds varied widely across studies. Of the 26 studies measuring initial cessation, 21 defined successes as occurring within 1 h, and 17 specified a more stringent threshold of within 30 min. Two studies applied an even shorter criterion of 10 min, whereas one study extended the window to as long as 72 h (Figure 5).

3.3.2 | Duration of sustained seizure/ictal cessation

This measure reflects the durability of treatment response, providing critical insight into whether seizure activity remains suppressed beyond initial cessation of SE. Given the progressive nature of SE and its tendency to recur or become refractory, sustained cessation of SE serves as a clinically meaningful indicator of therapeutic efficacy and plays a vital role in guiding treatment decisions. In phase 2 and 3 neurosteroid trials, the secondary end point evaluated the durability of response, defined as no progression to intravenous anesthesia for 36 h following study drug initiation, with additional assessments extending to 72 h to further characterize the prolonged effect of the intervention.[12,13]

Reported periods varied considerably across studies. Of the 38 studies incorporating this measure, 28 required a minimum cessation of SE duration of 24 h, the most frequently used threshold. Nine studies specified a duration of

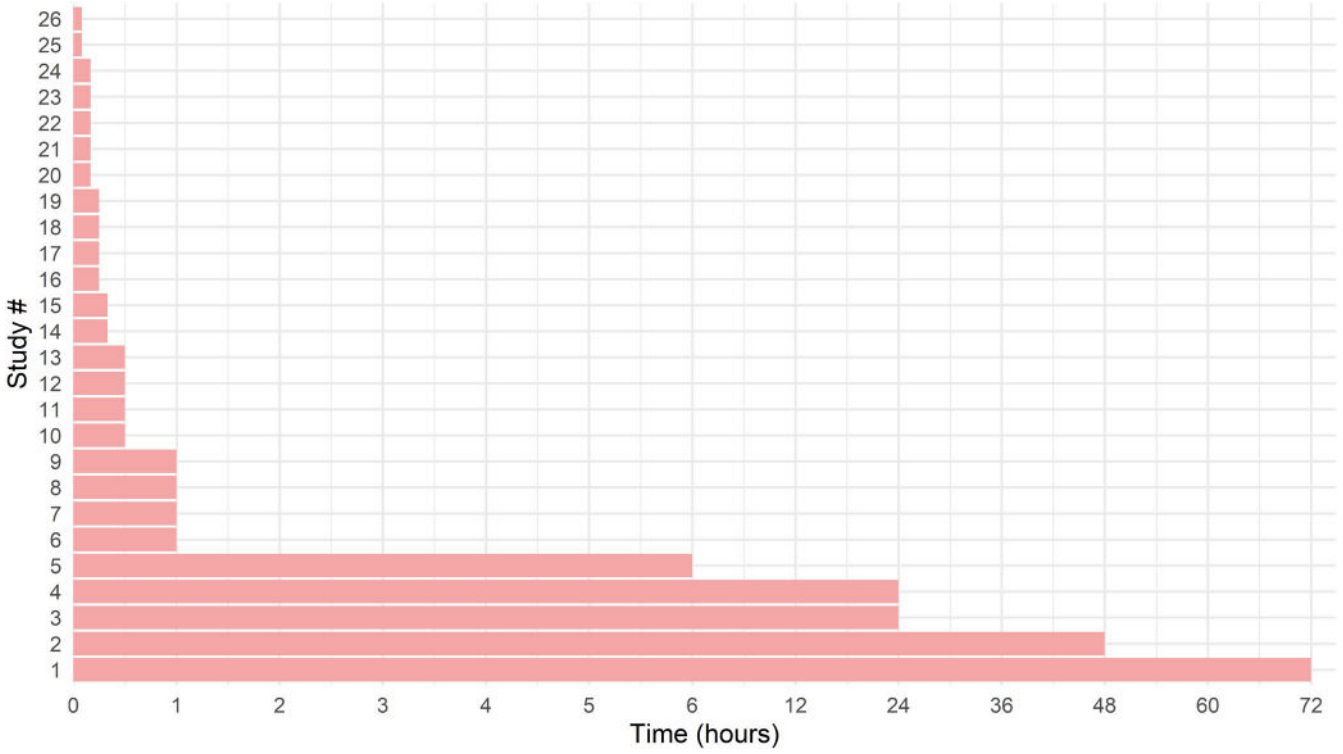

FIGURE 5 Study-specific time thresholds for initial status epilepticus (SE) cessation following therapeutic intervention. The chart displays individual studies (y-axis) plotted against their reported time thresholds for SE cessation in hours (x-axis). Most studies defined cessation within 1 h, although reported thresholds ranged widely from 10 min to 72 h, reflecting variability in defining early treatment response.

48 h, whereas one study applied a markedly shorter duration of only 20 min to define treatment success (Figure 6).

3.3.3 | Incorporation of dual time-based criteria

Variability was observed among studies reporting both the time to initial SE cessation and the duration of sustained seizure/ictal cessation (Figure 7). In the figure, both measures are aligned from the point of treatment initiation, with the time to initial cessation contained within the total duration of sustained cessation to satisfy criteria for successful treatment durability. Despite wide heterogeneity, most studies defined initial SE cessation within 1 h, and sustained seizure cessation typically extended beyond 12 h.

4 | DISCUSSION

Our study elucidates substantial heterogeneity across multiple domains in operationalizing the end point of SE. Even with the application of established conceptual frameworks in both retrospective and prospective investigations, clinical and research practices remain tacitly discordant, underscoring a critical gap between theoretical consensus and real-world application. This variability highlights the urgent need to reframe SE nomenclature and nosology as it pertains to the end point of SE to promote greater consistency, reliability, reproducibility, applicability, and translational utility.

The revision of temporal thresholds for defining SE has created a significant ripple effect, facilitating earlier recognition, particularly of nonconvulsive and focal presentations. In a prospective population-based study from Germany, lowering the operational threshold from 30 min to 5 min markedly increased the crude incidence rate and captured numerous patients who would have been missed under the previous criterion.[8] Similarly, standardizing the determination of SE end points indisputably holds the potential to transform epidemiology, clinical practice, and research by providing more precise and clinically relevant criteria.

As a corollary, the implications of reframing SE end point nomenclature must be considered within the context of real-world clinical practice. Although some studies and therapeutic trials equate the SE end point with empirical treatment success, this interpretation may be overly reductive. In managing SE, RSE, and SRSE, successful treatment encompasses more than attaining a narrowly defined end point.[14] Broader clinical outcomes—including seizure reduction, stabilization of neurological status,

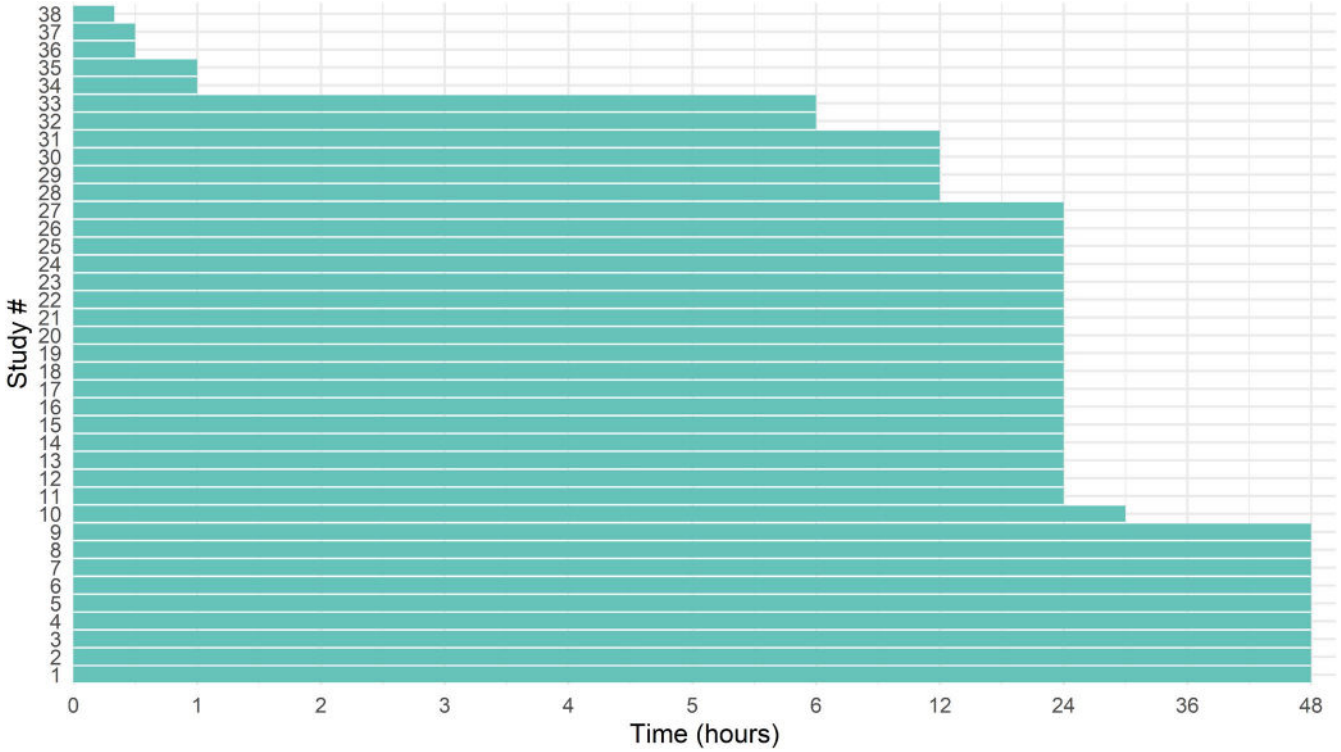

FIGURE 6 Study-specific duration thresholds for sustained status epilepticus (SE) cessation. The chart displays individual studies (y-axis) plotted against their reported duration thresholds for sustained SE cessation in hours (x-axis). Among the 38 studies that incorporated this measure, 28 required seizure freedom for at least 24 h, nine specified a 48-h duration, and one applied a markedly shorter threshold of 20 min. This wide variation highlights the lack of standardized criteria for defining sustained SE cessation and assessing the durability of therapeutic response.

and mitigation of complications—contribute to the overall concept of therapeutic success, even when the formal end point is not fully achieved, as exemplified by best practices in the management of epilepsia partialis continua.

4.1 | Call for standardization

A growing emphasis on standardization has progressively codified the approach to diagnosing and managing SE, enabling clinicians to navigate complex clinical data more efficiently, reduce reliance on individual heuristics, and minimize cognitive bias in both diagnostic and therapeutic decision-making.[15] Modern definitions now incorporate standardization across four key domains: (1) diagnostic terminology, (2) EEG criteria, (3) time-based definitions of ictal duration or EEG ictal burden, and (4) temporal thresholds for persistent activity. Within diagnostic terminology, the American Clinical Neurophysiology Society (ACNS) has established consistent EEG and clinical definitions of electrographic and electroclinical SE that enable uniform clinical application.[16] In parallel, the Salzburg criteria (incorporated into and refined in the ACNS criteria) provide a structured approach to identifying EEG features consistent with SE diagnosis.[17–19] The International League Against Epilepsy (ILAE) has further refined time-based definitions, clarifying optimal thresholds for ictal duration and EEG ictal burden.[20] Additionally, the ILAE has set consensus-driven temporal thresholds for persistent epileptiform activity required to classify an event as SE.[3] Collectively, these frameworks enable earlier and more accurate identification of SE, guide timely therapeutic interventions, and provide a standardized foundation for consistent clinical practice and research.[21,22]

From a research perspective, standardized definitions are integral to evidence-based medicine, providing a rigorous framework that enhances credibility, external validity, and interpretability of findings from both retrospective and prospective clinical studies.[23,24] Moreover, they establish a consistent and quantifiable paradigm for evaluating treatment response and therapeutic efficacy, facilitating meaningful cross-trial comparisons of strategies for managing SE.

4.2 | A framework for defining and determining the end point of SE

Based on insights from our scoping analysis, we identified pragmatic clinical factors that could inform a standardized,

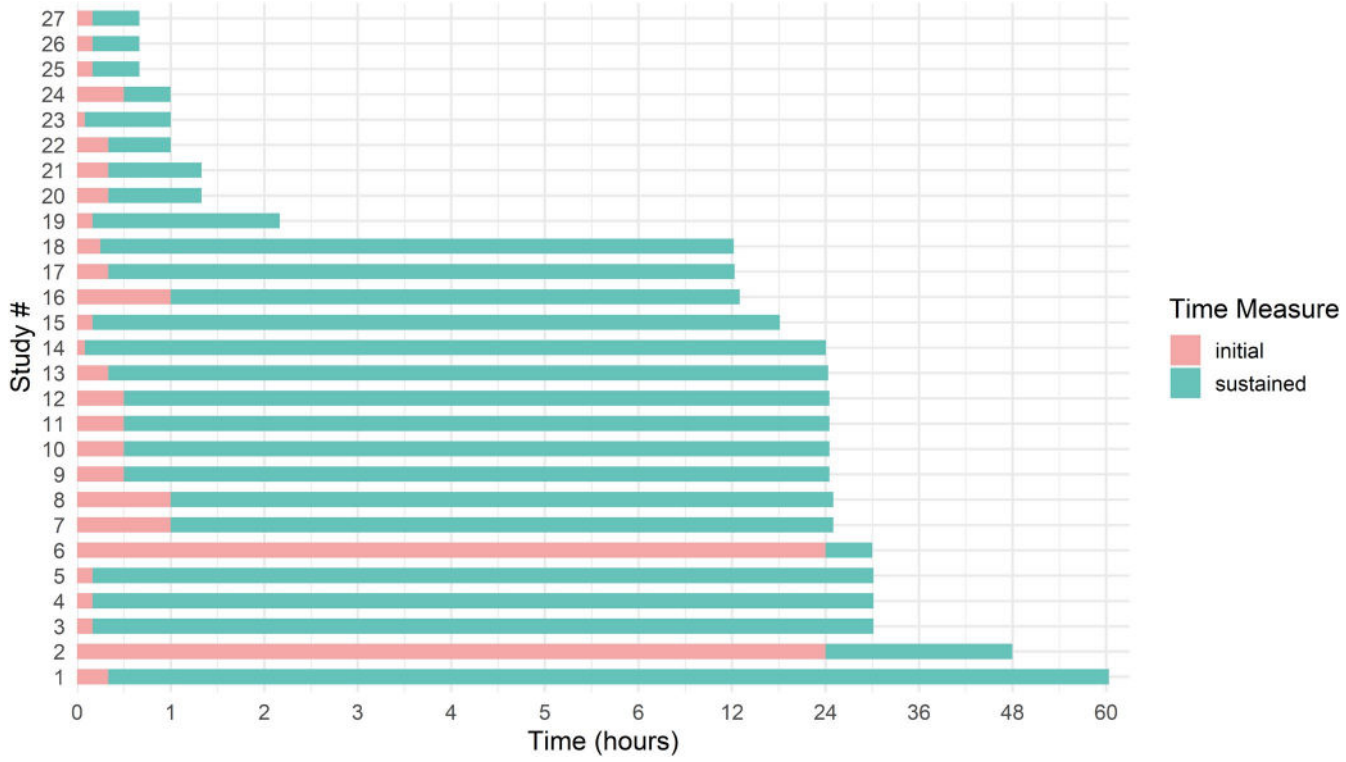

FIGURE 7 Study-specific timelines for both initial status epilepticus (SE) cessation and sustained SE cessation following therapeutic intervention. The chart shows individual studies (y-axis) plotted against their reported time thresholds for SE cessation (x-axis). Pink bars represent the time to initial SE cessation, whereas green bars indicate the duration of sustained SE cessation. Both measures are aligned from the point of treatment initiation, with the initial cessation occurring within the total duration of sustained cessation to reflect treatment durability. Most studies defined initial SE cessation within 1 h, whereas sustained seizure cessation often extended beyond 12 h, although considerable heterogeneity was observed across studies.

globally applicable set of criteria for determining SE end points in future consensus efforts, in line with approaches from other studies on developing specific and nonspecific guideline recommendations.[25,26] Rather than proposing formal recommendations or constituting a consensus model itself, this scoping review provides an empirical foundation to support subsequent Delphi processes or consensus development.

A Delphi consensus model—a structured, iterative method for achieving expert agreement—would be particularly well suited for developing best-practice recommendations, engaging stakeholders from both clinical and scientific communities worldwide.[27] This methodology allows for anonymous, nonadversarial input from multiple stakeholders, capturing iterative expert opinion to establish consensus, a particularly valuable approach given the limited existing literature guiding the specific elements of SE end point criteria and the need to achieve agreement across diverse clinical practices.[28]

Being mindful of the limitations of the Delphi methodology, it is important to recognize that the composition of the expert panel—its capabilities and resource-directed practices—can substantially influence the outcomes. To mitigate this, a representative distribution of experts from both resource-rich and resource-limited settings is recommended. Furthermore, in some areas, full consensus may not be practically achievable despite multiple rounds of review. To address this, a two-tiered consensus approach could be adopted, distinguishing between "minor agreement" and "strong agreement" based on percentage concordance, with explicit caveats regarding divergence between high- and low-resource settings. This approach balances methodological rigor with practicality and helps prevent inadvertently discouraging research in resource-constrained environments.

This scoping review can inform further development of evidence-based recommendations. Based on our findings, several commonly used terms would benefit from clarification in future consensus efforts, including the following: cessation, termination, resolution, control, seizure freedom, suppression, interruption, relapse, and recurrence. An important consideration in this process is ensuring consistent understanding of these terms across regions with different language predominance, including both English-dominant and non-English-dominant contexts, and always clarifying the associated time frames and

whether the terms are based on clinical observations, EEG findings, or both.

4.2.1 | Flying without radar

The EEG remains the gold standard tool for quantifying, characterizing, and detecting nonmotor seizure activity, providing an objective means to assess brain physiological status, evaluate risk and prognosis, and guide therapeutic interventions.[29–31] Continuous EEG is increasingly adopted as the standard of care in many intensive care units for the management of acute brain disorders.[32] Despite widespread recognition of its clinical importance, our data reveal substantial heterogeneity and inconsistency in EEG use across both retrospective and prospective studies for evaluating treatment response, consistent with prior reports.[33,34] In patients who do not return fully to baseline, EEG is essential not only for accurately determining the SE end point but also for evaluating therapeutic success based on intended treatment goals and for concluding treatment efficacy.

Moreover, the ictal–interictal continuum (IIC) represents an evolving concept of abnormal EEG activity, often characterized by epileptiform discharges that can precede seizures and may progress to overt SE. Evidence indicates that the IIC carries a risk of neuronal injury and clinical deterioration, underscoring the critical role of EEG in its recognition and monitoring to mitigate its burden.[35–39] EEG provides the only objective measure of this dynamic pathological spectrum, allowing clinicians to evaluate treatment efficacy and confirm the successful termination or resolution of ictal activity.[40,41] Equivocal EEG patterns, including those on the IIC, add interpretive complexity and should be integrated into future discussions to refine end point determination.

In recent years, phase 2 and 3 studies of investigational therapies in SE have highlighted EEG as essential for both diagnosis and monitoring therapeutic efficacy.[11,12] As a corollary, recent studies have emphasized its importance in enabling real-time tracking of treatment response and supporting timely clinical escalation during rapid patient deterioration.[42–48]

An important caveat is that the adoption of EEG to define the end point of SE requires careful consideration of resource utilization—including infrastructure for continuous EEG, costs of setup and maintenance, availability of trained technologists or use of emerging point-of-care rapid EEG devices, and opportunities for neurophysiologists to maintain interpretive expertise—as well as the need for accurate interpretation of pharmacological effects, underlying brain pathologies, and the dynamic progression of SE, including intermediate ictal–interictal states.[49,50] Although recent ACNS guidelines and other clinical tools provide frameworks for describing intensive care unit EEG patterns and scoring ictal burden, additional guidance is needed to comprehensively determine end points across the spectrum of SE, RSE, and SRSE.[15,39]

Deep learning tools, powered by neural networks, can accelerate EEG analysis by reducing review time, filtering artifacts, and supporting real-time SE management through immediate, actionable insights.[51–53] However, these tools require expert oversight to prevent misdirected clinical decision support, avoid harm from misdiagnosis, and ensure that overreliance on automation does not cause deskilling or impede the training of future EEG specialists.[54–56]

In consensus development efforts, including Delphi-based approaches, it would be valuable to ensure stratified representation of panelists based on available EEG resources, ranging from restricted utilization (e.g., once-daily routine monitoring) to multiday continuous video-EEG monitoring. Consideration should also be given to the types of EEG resources available, including standard full-montage electrodes, modified electrode configurations, modern rapid EEG devices with limited montages, and computational deep learning–based analytic algorithms. Such stratification would facilitate the development of recommendations that are both clinically rigorous and adaptable to locally available resources.

4.2.2 | It is really a matter of time (pun intended)

SE represents a neurological emergency in which time to treatment is a critical determinant of outcomes, including both mortality and permanent functional impairment.[57] Treatment protocols that incorporate clearly defined temporal thresholds offer an objective framework for clinical decision-making, standardizing assessment of therapeutic response, and guiding escalation or de-escalation of care.[58–60] They also enable evaluation of treatment efficacy in controlling disease progression and managing recurrent events. Systematic integration of precise time metrics into treatment protocols is therefore essential for ensuring consistency and generating reliable data to inform evidence-based practice.[61–64] More recent studies investigating novel therapeutic agents in SE have increasingly adopted structured, time-interval-based approaches to end point assessment.[65]

An important consideration is that, even after achieving the SE end point, the brain may remain pathophysiologically altered, with residual epileptogenic activity and impaired inhibitory control persisting despite seizure

cessation.[66,67] Therefore, the treated state does not necessarily indicate full recovery or a return to baseline. The duration of SE—reflecting the extent of injury and metabolic stress—should be carefully incorporated into end point definitions, as neuronal injury progression is inherently time-sensitive.[68–70]

4.3 | Limitations

This study carries inherent limitations of a scoping review, including the potential omission of relevant studies and reliance on reported methodological details. To minimize selection and abstraction bias, two independent reviewers screened all included studies and resolved discrepancies through mutual consensus, with all data extraction points subsequently verified by the lead authors.

Protocol registration was not performed for this scoping review, although not required per se. We recognize that this limits the ability to distinguish between a priori methodological decisions and post hoc analytical refinements, which may influence readers' confidence in the findings.

Several additional limitations were identified in our literature search and analysis. First, non-English language studies were excluded. Although this approach avoided potential inconsistencies arising from translation, it is possible that relevant descriptions of SE end points and resolution criteria were present in non-English publications, which, if translated, could have contributed valuable information to the analysis.

Second, case reports and small case series (fewer than three patients) were excluded. This decision was made to better capture how centers defined and applied SE criteria across study populations, rather than relying on individual case descriptions based on nonstandardized definitions used by the authors.

Third, clinical study proposals and unpublished trials were excluded to avoid confounding effects from evolving definitions and analytical methods that may have been revised between study design and final publication. Our review focused exclusively on treatment assessment trials evaluating therapeutic response in SE. Outcome studies discussing methodological aspects were not included, as they fell outside the scope of this analysis.

Fourth, data abstraction was primarily based on the methods sections of the included studies. Study authors were not contacted for additional details to clarify or cross-reference information reported in the published articles.

Fifth, an important limitation of our approach, as agreed upon by author consensus, was the decision to focus only on the six most frequently used terms and their variants, grouping all remaining terminology under the category of "other." Although this strategy allowed for a broad overview of prevalent terminology, it did not capture nuanced language that may have been meaningful in specific studies or institutional contexts. In addition, we did not examine whether terminology use correlated with factors such as study size, care setting, nature of therapy, or clinical outcomes—each of which could have influenced both vernacular choices and operational definitions. Variability in end point definitions may also reflect differences in resource availability, particularly access to continuous EEG monitoring. Consequently, studies from low- and middle-income countries or resource-limited hospitals may be underrepresented, limiting the generalizability of our findings across diverse global settings.

5 | CONCLUSIONS

The absence of uniform treatment end points and standardized terminology poses significant challenges to regulatory agencies such as the US Food and Drug Administration, the European Medicines Agency, and their international counterparts.[71,72] These inconsistencies hinder the evaluation of treatment efficacy, obscure the determination of whether clinical trials have fulfilled their primary and secondary end points, and affect regulatory decisions governing the safe approval and use of emerging therapies. Without clear operational definitions of SE cessation and treatment success, the translation from clinical research to regulatory approval remains fragmented.[63,73,74]

Establishing globally endorsed, consensus-driven definitions represents an urgent imperative and is critical to harmonize research, guide clinical care, and optimize patient outcomes.

AUTHOR CONTRIBUTIONS

All authors had full access to the data and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Fawad A. Khan and Margaret T. Gopaul. *Acquisition, analysis, or interpretation of data:* All authors. *Drafting of the manuscript:* Fawad A. Khan and Margaret T. Gopaul. *Figures:* Summer Skelton. *Critical revision of the manuscript for important intellectual content:* All authors.

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CONFLICT OF INTEREST STATEMENT

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ORCID

Fawad A. Khan https://orcid.org/0000-0003-0486-5004
Margaret T. Gopaul https://orcid.org/0000-0002-1329-3258
Samuel L. Carter https://orcid.org/0000-0002-5881-9348
Anil Chimakurthy https://orcid.org/0000-0003-0764-6253
Summer Skelton https://orcid.org/0009-0006-9496-1284
Lawrence J. Hirsch https://orcid.org/0000-0002-6333-832X
Eugen Trinka https://orcid.org/0000-0002-5950-2692

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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