Seizure Control as an Indicator of Therapeutic Usefulness

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ABSTRACT: Seizure control, in addition to quality of life, is an important outcome after epilepsy surgery. However, seizure measurement is not straightforward. We explore some important difficulties in obtaining unbiased, reliable estimates of seizure frequency, and discuss aspects of data analysis as it pertains to validity and clinical meaningfulness. As seizure severity is an integral component of seizure outcome assessment, we discuss aspects of measurement of this outcome. Suggestions for improving validity are offered, based on the literature and on methodological common sense. Finally, we look at the Canadian perspective and the potential for adopting methodology that allows for data pooling and for more powerful analyses.

RÉSUMÉ: Le contrôle des crises comme indicateur de l'utilité du traitement. En plus de la qualité de vie, le contrôle des crises est un résultat important de la chirurgie de l'épilepsie. Cependant, l'évaluation des crises n'est pas simple. Nous explorons certaines des difficultés importantes dans l'obtention d'un estimé non biaisé et fiable de la fréquence des crises et nous discutons des aspects de l'analyse des données concernant leur validité et leur signification clinique. Comme la sévérité des crises est une composante intégrale de l'évaluation du traitement, nous discutons des aspects qui y sont pertinents. Nous offrons des suggestions pour améliorer la validité, basées sur la littérature et sur le bon sens méthodologique. Finalement, nous considérons la perspective canadienne et la possibilité d'adopter une méthodologie qui permet de combiner des données et d'utiliser des analyses plus puissantes.

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To assess the usefulness of interventions, clinicians must focus on the most relevant outcomes. Adequately measured health related quality of life (HRQOL) can assess aspects of therapy that patients consider important and that would be largely missed by limiting therapeutic assessment to seizure frequency.[1] Therefore, some suggest using HRQOL as the primary outcome in studies of epilepsy therapy.[2] Although patient-centred HRQOL is paramount in estimating therapeutic usefulness, seizure measurement is still relevant for several reasons. First, seizures are the most important pathophysiological substrate of epilepsy surgery, which aims at removing seizure-producing tissue. Second, because epilepsy is seizures that recur, their control is a logical outcome of epilepsy therapy. Third, freedom from seizures determines a patient's ability to drive or perform certain types of work. Fourth, seizure outcome is an important determinant of HRQOL.[3,4] As long as seizures recur, patients have difficulty with mastery and locus of control.[5] Even auras impair HRQOL.[6] Finally, seizure severity is at least as important as seizure frequency in determining patient well-being.[7] Therefore, accurate measurements of seizure frequency, type and severity are necessary to judge therapeutic effectiveness.

Measuring seizures: not as simple as it looks

Seizures appeal to clinical researchers as outcome measures because of clinical relevance and apparent ease of quantification. Over 350 randomized controlled trials (RCTs) of antiepileptic drugs (AEDs)[8] and reports of over 8,000 epilepsy surgery procedures[9] use seizures as the main or only outcome measure. Despite widespread use, seizure measurement is not as straightforward as it appears. It poses significant methodological problems, particularly after epilepsy surgery.[10,11] The following sections consider some of these problems.

Seizure reporting

Validity

Validity refers to actually measuring what is intended to be measured. Thus, are clinicians confident that actual seizures are

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being measured postoperatively and that no seizures are being missed? The objectivity and accuracy of postoperative seizure recognition and reporting are susceptible to a large number of biases. For example, seizure phenomena may change post-operatively and may go unrecognized. Patients or caregivers may under-report because they do not want to disappoint the doctor (obsequiousness bias), because of strong preoperative expectations and beliefs (expectation bias), or because they feel compelled to justify the large psychological, physical or financial investment required by surgery (investment bias). At the opposite end of the spectrum are patients who depend on the sick role for emotional and financial support and who are likely to over-report seizures or to develop postoperative pseudo-seizures. Clinicians are equally susceptible to expectation, obsequiousness, investment and other biases, depending on their role in individual patients'care. The unavoidable consequence of invalid seizure counts is a spuriously inflated or deflated therapeutic effect (depending on the prevailing biases), and the production of authoritarian rather than authoritative results. Validity is most threatened in retrospective, uncontrolled studies without systematic outcome assessment. It is least threatened in double blind RCTs where patients and clinicians remain truly blinded to treatment group. In the latter, inaccurate seizure measurement is distributed equally among treatment groups (the confounder is balanced).

The greatest potential for invalid seizure assessment and biased estimates of effectiveness occur with epilepsy surgery, where blinding is not possible, vested interests are high and no RCTs exist.[12,13] A feasible solution is blinded external adjudication of events. This removes bias by submitting all new events to blinded assessment by experienced epileptologists. The procedure is being successfully utilized at the London Health Sciences Centre.[14] A conceivable minimum standard to improve validity in clinical practice would be to measure seizures systematically in all patients, eg., at similar intervals, with similar depth, and by similar personnel.

Reliability

Reliability refers to precision of measurement, i.e., the same result is obtained when measured at different times by different people.[15] Thus, are patients, care-givers and clinicians consistent in their reporting of postoperative events? This aspect of seizure measurement is largely determined by seizure knowledge and understanding. Unreliable seizure estimates increase measurement error, eg., increased "noise" in the "signal-to-noise" ratio, thereby decreasing precision and confidence of the measure. Research is sparse in this regard. Nonetheless, it is reassuring that in the two available studies, seizure reporting by patients and caregivers is consistent, both retrospectively and prospectively, within a one-day[16] or a two-month period.[17] Thus, the evidence indicates that, in practice, seizures seem to be reliably reported.

Counting seizures

Who should count?

The question of who should measure seizure outcome has to do with validity of reporting. Clinicians perceive that patients may report seizures with varying degrees of accuracy to different interviewers (personal communication: Drs. Parrent, Sahjpaul, Blume and Girvin). For example, they may under-report seizures to the treating neurosurgeon and neurologist (obsequiousness bias) and give more valid reports to more "neutral" personnel, such as nurses or research assistants. On the other hand, clinicians with a vested interest in surgical outcome may potentially introduce bias in reporting, eg., by choosing what and how they ask patients (framing bias). The degree and direction of bias inherent in who counts seizures remain empirical questions that require formal exploration. Admittedly, in "real life" clinicians make therapeutic recommendations based on their impressions of seizure frequency and severity. However, if clinicians intend to use seizure counts to inform on effectiveness, validity may be strengthened by having "neutral" personnel count seizures in a standardized manner in all patients. Similarly, explicit description of methods will aid clinicians in interpreting the data.

How should we count? The seizure diary

Surprisingly, little evidence exists regarding the validity of the most widely used method of measuring seizures, ie., the seizure diary. The usefulness of diaries has been assessed in a diversity of medical conditions and populations. Results vary by condition. For example, constipation, cough and smoke exposure are over-reported, daily activities are under-reported, and dietary intake, moderate alcohol use, menopausal symptoms and Parkinsonian symptoms are fairly accurately reported. Only two studies have analysed the validity of seizure diaries. Neugebauer et al[16] found a high correlation (0.95) between patients' prospective and retrospective seizure diaries for a single 24-hour period. Unfortunately, when seizure diaries are given repeatedly to measure the same time period, correlation may overestimate test-retest reliability because of learning effects and a high dependence on between-subject variability.[18] Also, patients may over- or under-report at highly consistent ratios and still show high correlation coefficients. The intra-class correlation coefficient deals with these problems and is the preferable method.[18] Glueckauf et al[17] have examined within- and between-subject agreement in seizure diaries over consecutive 30-day periods. In patients with complex partial seizures, they looked at the consistency of retrospective and prospective seizure frequency reporting by patients and observers. Observers consistently under-reported retrospectively (by 50%) and prospectively (by 88%). The latter figure may be explained by observers being asked to report exclusively witnessed seizures, and not to rely on patient or third party accounts. High within-patient retrospective and prospective consistency occurred. Because patients may not recall seizures that impair consciousness, such high levels of within-patient consistency were unexpected and replication of these findings would be reassuring. In practice, seizure diaries are often completed jointly by patient and caregiver. The reliability of this method has not been investigated. Similarly, it is important to evaluate validity of diaries for different seizure types and time frames, and to identify variables that affect validity.

What can be done to improve reliability and validity of seizure diaries? It has been claimed that in epilepsy, no method "no matter how compulsively collected, can ever be considered completely reliable".[11] This is true for all areas of clinical measurement, is not exclusive to epilepsy, and does not imply that improvement is unnecessary or untenable. Therefore, clinicians must eschew nihilism. In clinical practice, patient and

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caregiver education, review of recorded events and fostering patient motivation will likely result in increased reliability.[19] The importance of measuring in a systematic, standardized fashion cannot be overemphasized. In epilepsy surgery research, bias can be minimized by using surrogate masked seizure measuring methods, as described by Wiebe et al[14] in an RCT of temporal lobe epilepsy surgery. Alternative methods such as electronic patient reminders may be considered for research purposes.[20] If the magnitude and direction of systematic error in seizure diaries were known, correction factors could be used accordingly. This remains to be determined by methodological research.

That inroads are being made into validating existing measurement tools, indicates that methodological bridges can be built to improve estimates of surgical effectiveness in practice and research.

Making sense of seizure counts

No amount of validity and reliability during seizure ascertainment will do for poorly presented or analysed data. This is not free of methodological problems and may explain why clinicians tolerate such meaningless seizure outcomes as "50% improvement in 50% of patients".

The issues surrounding analysis of seizure outcome have been long recognized.[21,22] Problems encompass non-randomness of seizure occurrence (seizure clusters),[21] unpredictability of postoperative seizure patterns and change over time, eg., the running down phenomenon,[23] and incorporating measures of seizure severity.

Commonly used analyses

Seizure outcome has been presented in a variety of ways. Common report methods include gross categories (improved, unchanged, worse), percentage change in average seizure frequency over pre-established time periods, number of seizure-free days, the cumulative sum technique, categorical scales (outcome classifications), and time to discontinuation of drugs. In epilepsy surgery, the most frequent methods are percent change in seizure frequency and allocation of patients into various outcome classifications, among which Engel's is the commonest.[24]

Seizure frequency

Percent change in seizure frequency is typically calculated as [(seizures after/seizures before)-1] x 100. The main problem with this approach is its asymmetry. That is, improvement has an upper limit of 100% (seizures totally controlled), but no limit exists for seizure worsening. Consequently, a few patients with seizure worsening would bias the estimates of effectiveness against the treatment under scrutiny. Leppik et al[25] suggest a "truncated" seizure worsening with a maximum of 100% to account for asymmetries. This is useful as long as worsening does not exceed 100%. However, the amount of information lost and the potential for bias are readily apparent. Some AED trials use a "symmetrized response ratio" where worsening can never reach 100%. This is obtained by [(seizures after – seizures before)/(seizures after + seizures before)] x 100. Unfortunately, this calculation considerably biases results in favour of improvement. For example, if a patient with 4 seizures/month improves to 1 seizure/month (decrease by 3/month), this would represent 60% improvement. If the same subject worsened by the same number of seizures (3/month) to 7 seizures/month this would represent only 27% worsening. Even a tenfold increase (eg., from 4 to 40) represents only 82% worsening. Unfortunately, no available seizure frequency method deals with asymmetry or non-random (cluster) seizure occurrence.

Survival analysis

A viable alternative may be survival analysis, a technique that measures the proportion of patients reaching an outcome of interest over time. The method is attractive because it accounts for staggered patient recruitment and variation in length of follow-up. Results are presented graphically as survival curves which can be compared for various interventions or patient groups. Time to seizure recurrence has been advocated by some as the most relevant outcome in surgical and medical trials.[26] It has been used in an RCTcomparing amygdalohippocampectomy versus anterior temporal lobectomy,[27] in studies of seizure recurrence after a first unprovoked seizure,[28] population studies,[12] and RCTs of discontinuation of AEDs.[29,30] Variations of survival analysis techniques include proportion of patients achieving seizure-free periods of pre-established duration, eg., one or two years,[31,32] and time to the 'nth' seizure. Based on a proposal by Shofer and Temkin,[22] Eslava Cobos[33] advocates time to the 'kth'seizure as a patient-centred measure of improvement that is readily applicable to a wide range of seizure frequencies. Bourgeois et al[34] applied this analysis to measure time to fourth seizure in an AED trial. A feature of this technique is that in contrast to seizure frequency analysis, its power to detect between treatment differences remains stable through a wide range of baseline seizure frequencies. On the other hand, power is lower than with seizure frequency methods, therefore requiring larger sample sizes. It can be readily appreciated that with this type of survival analysis the endpoint seizure number 'k' is chosen arbitrarily. On the other hand, the endpoint commonly used in RCTs of AEDs, ie., 50% improvement in 50% of patients, is not only arbitrary but also clinically meaningless. Therefore, if clinically relevant 'ks' could be agreed upon for various seizure types and frequencies, time to 'kth'seizure might be a reasonable option. This remains an empirical question. Finally, completeness of follow-up and avoidance of crossovers are crucial for meaningful survival analyses.

Composite indices

A composite index that incorporates seizure frequency and severity and treatment side-effects would be very useful. Such an index was developed by Cramer et al,[35] used in the VA study of AED monotherapy,[36] and further validated.[37] However, the index's cumbersomeness has prevented widespread use. The development of simpler indexes remains a worthwhile research endeavour.

Measuring seizure severity

Clinicians often encounter patients whose response to medical and surgical therapy is a change in seizure "intensity" with or without concurrent change in seizure frequency. The relevance of seizure intensity or severity makes sense clinically. Patients may be affected by gaining a warning so they can take precautions, or by recovering faster, having less disruptive automatisms and experiencing no falls or injuries. Accordingly,

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Smith et al[38] have found that after correcting for psychosocial factors, seizure severity is an independent and stronger determinant of HRQOL than seizure frequency. Therefore, seizure severity should be incorporated when measuring seizure outcomes.

Seizure severity scales

In adults, two philosophical approaches to assess seizure severity have yielded two different instruments:

The Liverpool Seizure Severity Scale (Appendix A)

This attempts to capture the patient's perception of seizure severity. It is a self-administered 20-item instrument divided into two 10-item sections, one (termed "ictal") measuring ictal-postictal phenomena and one (termed "percept") measuring predictability or control of seizures.[39] The reliability, cross-sectional validity and responsiveness of the scale, particularly the "ictal" subscale, have been demonstrated.[39]

The National Hospital Seizure Severity (Chalfont) Scale (Appendix B)

This group considered patient-centred assessment of seizure severity to be too "subjective" and designed an "objective," physician-centred scale of seizure severity.[40] The most recent, 7-item version is completed by the clinician with the assistance of a witness. It has demonstrated reliability and validity, and its responsiveness is being tested.[41] Their developers point out that although patient-centred health status measures (eg., quality of life) are important, seizure severity is better assessed by external observers than by the patients. Both measures have adequate measurement properties, but head-to-head comparisons are necessary to determine their relative usefulness.

Seizure severity in children

In children, parents'assessment of seizure severity by means of the Hague seizure severity scale (HASS) has been shown to correlate with other severity measures and to be a better indicator than physician assessment of severity.[42] The usefulness of this instrument in clinical studies remains to be determined.

A word of caution

It is strongly recommended that clinicians use previously validated scales to assess seizure severity, unless compelling reasons exist not to do so. Equally important is that scales are used as per developers' instructions. A mere "distaste" for existing validated instruments should be tempered by the fact that using non-validated questionnaires concocted on the spot, yields irreproducible results whose interpretation is difficult or impossible. If crucial elements are felt to be missing from existing scales, the alternative is to design and validate a new instrument, which is no small job, or to use additional valid instruments that tap into the domains of interest.

THE CANADIAN PERSPECTIVE

In an era of increasing demands for evidence to support practice, clinicians involved in epilepsy surgery face the challenge of providing scientifically sound data on the benefits and risks of these interventions. The many biases and threats to validity that befall epilepsy surgery (and the published evidence) leave much room for concern. This requires rethinking of the methods used to measure outcome with emphasis on developing scientifically rigorous standards. Ideally, these standards should be conceptualized and implemented at an international level. This faces the formidable hurdles of differences in practice patterns, health care systems, and cultural and philosophical viewpoints.

Because of their many commonalities (eg., health care system, practice patterns, ideology), Canadian epilepsy clinics and surgical centres are a step closer to developing such a concerted effort. Canadian national workshops such as this serve as platforms for exchanging ideas, identifying practice patterns and improving methodology. For example, during this workshop, it was recognised that standard measurements would apply not only to RCTs but also to prospective studies and descriptive case series. In this manner, standardization of prospective measurement for specific questions across centres could provide much needed information about prognosis and risk factors in a relatively short period of time. Specific endeavours, including standardized, systematic seizure measurement and data gathering, integration into a national database[43] and consideration of a core set of instruments are no longer utopian goals but actual ongoing efforts. It is conceivable that the Canadian Epilepsy Database and Registry (CEDaR)[43] could incorporate specific seizure severity scales and perform analyses of seizure measurement methods using its large cohort of epilepsy clinic patients. Similarly, the Canadian Epilepsy Consortium (CEC) could make recommendations to the pharmaceutical industry regarding seizure measurement in drug trials. Jointly, national organizations such as CEC, Canadian League Against Epilepsy and Epilepsy Canada, could suggest a "core" set of standardized measures to which clinicians and researchers could add as their particular hypothesis required. The set core would serve as a "reference case" for purposes of comparison (and data pooling) across studies. This approach has been successfully assembled for economic evaluations in the US Public Health Service.[44] Finally, collaborative research efforts with robust methodology would go a long way towards increasing our understanding of the surgical treatment of epilepsy.

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APPENDIX A

LIVERPOOL SEIZURE SEVERITY SCALE
QUALITY OF LIFE ASSESSMENT

Your answers to these questions will help us to understand how your epilepsy affects your everyday life and how you are feeling generally. For each of the questions, please ring the number next to the answer that applies to you. Please answer all the questions. Please discuss any problems you may have completing the questions with the member of staff involved in the project. If you are unable to answer a question for some reason, please write this on the questionnaire.

First, please can you tell us about the type of seizures you have.

1. Do you have:
   MAJOR *seizures* only.....1
   MINOR *seizures* only.....2
   Both MAJOR and MINOR *seizures* 3
2. The statements below are about the MAJOR seizures you have. If you do not have major seizures, please go on to Q.3.

Please answer about the seizures you have had in the last four weeks.

PERCEPT SUBSCALE

My attacks are:
- a) Always at a particular time of the day or night.....1
- b) Mostly at one particular time of the day or night.....2
- c) Sometimes at one particular time of the day or night.....3
- d) My attacks can occur at any time of the day or night.....4

When my attacks have happened:
- a) I have always been able to tell when I will have them.....1
- b) I have usually been able to tell when I will have them.....2
- c) I have sometimes been able to tell when I will have them...3
- d) I have never been able to tell when I will have them.....4

Over the past 4 weeks:
- a) I have always been able to fight off my attacks.....1
- b) I have usually been able to fight off my attacks.....2
- c) I have sometimes been able to fight off my attacks.....3
- d) I have never been able to fight off my attacks.....4

Over the past 4 weeks:
- a) I have always had an aura or warning with my attacks.....1
- b) I have usually had an aura or warning with my attacks.....2
- c) I sometimes had an aura or warning with my attacks.....3
- d) I have never had an aura or warning with my attacks.....4

In the past 4 weeks, I feel I have had:
- a) Very good control over my attacks.....1
- b) Fairly good control over my attacks.....2
- c) Little control over my attacks.....3
- d) No control over my attacks 4

When I have had my attacks:
- a) They have always occurred together in clusters with quite long periods between each cluster.....1
- b) They have usually occurred together with quite long periods between each cluster.....2
- c) They have sometimes occurred together in clusters 3
- d) They have never occurred together in clusters.....4

My attacks are:
- a) Always when I am asleep.....1
- b) Usually when I am asleep.....2
- c) Sometimes when I am asleep.....3
- d) Never when I am asleep.....4

My attacks:
- a) Stop me doing all of the things I want to do.....1
- b) Stop me doing a lot of the things I want to do.....2
- c) Stop me doing a few of the things I want to do.....3
- d) Don't stop me doing anything I want to do at all.....4

ICTAL SUBSCALE

In the past year my attacks have mostly been:
- a) Very severe.....1
- b) Severe.....2
- c) Mild.....3
- d) Very mild.....4

Most commonly when I blank out/lose consciousness:
- a) I blank out for less than 1 minute.....1
- b) I blank out for between 1 and 2 minutes.....2
- c) I blank out for between 2 and 5 minutes.....3
- d) I blank out for more than 5 minutes.....4
- e) I never blank out/lose consciousness.....5

When I have an attack, I smack my lips, fidget, or behave in an unusual way:
- a) Always.....1
- b) Usually.....2
- c) Sometimes.....3
- d) Never.....4

When I recover from my attacks:
- a) I feel very confused.....1
- b) I feel fairly confused.....2
- c) I feel slightly confused.....3
- d) I do not feel confused at all.....4

When I recover from my attacks my confusion lasts for:
- a) Less than 1 minute.....1
- b) Between 1 and 5 minutes.....2
- c) Between 6 minutes and 1 hour.....3
- d) More than 1 hour.....4
- e) I never feel confused.....5

When I have had my attacks:
- a) I have always fallen to the ground.....1
- b) I have usually fallen to the ground.....2
- c) I have sometimes fallen to the ground.....3
- d) I have never fallen to the ground.....4

When I recover from my attacks:
- a) I always have a headache.....1
- b) I usually have a headache.....2
- c) I sometimes have a headache.....3
- d) I never have a headache.....4

When I recover from my attacks:
- a) I always feel sleepy 1

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APPENDIX A

LIVERPOOL SEIZURE SEVERITY SCALE

QUALITY OF LIFE ASSESSMENTcontinued

b) I usually feel sleepy.....2
c) I sometimes feel sleepy.....3
d) I never feel sleepy.....4

When I recover from my attacks:
a) I always find that I have wet myself.....1
b) I usually find that I have wet myself.....2
c) I sometimes find that I have wet myself.....3
d) I never find that I have wet myself 4

When I recover from my attacks:
a) I always find that I have bitten my tongue.....1
b) I usually find that I have bitten my tongue.....2
c) I sometimes find that I have bitten my tongue.....3
d) I never find that I have bitten my tongue.....4

When I recover from my attacks:
a) I always find that I have injured myself (other than biting my tongue).....1
b) I usually find that I have injured myself (other than biting my tongue).....2
c) I sometimes find that I have injured myself (other than biting my tongue).....3
d) I never find that I have injured myself (other than biting my tongue).....4

When I have my attacks I can usually return to what I am doing:
a) In less than 1 minute.....1
b) In between 1 and 5 minutes.....2
c) In between 6 minutes and 1 hour.....3
d) In more than 1 hour.....4
(Please see Q.3)

3. The statements below are about the MINOR seizures you have. If you do not have minor seizures, please **do not** answer these statements.

Please answer about the seizures you have had in the last four weeks.

My attacks are:
1. Always at a particular time of the day or night.....1
2. Mostly at one particular time of the day or night.....2
3. Sometimes at one particular time of the day or night.....3
4. My attacks can occur at any time of the day or night.....4

When my attacks have happened:
a) I have always been able to tell when I will have them.....1
b) I have usually been able to tell when I will have them.....2
c) I have sometimes been able to tell when I will have them...3
d) I have never been able to tell when I will have them.....4

Over the past 4 weeks:
a) I have always been able to fight off my attacks.....1
b) I have usually been able to fight off my attacks.....2
c) I have sometimes been able to fight off my attacks.....3
d) I have never been able to fight off my attacks.....4

Over the past 4 weeks:
a) I have always had an aura or warning with my attacks.....1
b) I have usually had an aura or warning with my attacks.....2
c) I have sometimes had an aura or warning with my attacks..3
d) I have never had an aura or warning with my attacks.....4

In the past 4 weeks, I feel I have had:
a) Very good control over my attacks.....1
b) Fairly good control over my attacks.....2
c) Little control over my attacks.....3
d) No control over my attacks.....4

When I have had my attacks:
a) They have always occurred together in clusters with quite long periods between each cluster.....1
b) They have usually occurred together with quite long periods between each cluster.....2
c) They have sometimes occurred together in clusters 3
d) They have never occurred together in clusters.....4

My attacks are:
a) Always when I am asleep.....1
b) Usually when I am asleep.....2
c) Sometimes when I am asleep.....3
d) Never when I am asleep.....4

My attacks:
a) Stop me doing all of the things that I want to do.....1
b) Stop me doing a lot of the things I want to do.....2
c) Stop me doing a few of the things I want to do.....3
d) Don't stop me doing anything I want to do at all.....4

In the past year my attacks have mostly been:
a) Very severe.....1
b) Severe.....2
c) Mild.....3
d) Very mild.....4

Most commonly when I blank out/lose consciousness:
a) I blank out for less than 1 minute.....1
b) I blank out for between 1 and 2 minutes.....2
c) I blank out for between 2 and 5 minutes.....3
d) I blank out for more than 5 minutes.....4
e) I never blank out/lose consciousness.....5

When I have an attack, I smack my lips, fidget, or behave in an unusual way:
a) Always.....1
b) Usually.....2
c) Sometimes.....3
d) Never.....4

When I recover from my attacks my confusion lasts for:
a) Less than 1 minute.....1
b) Between 1 and 5 minutes.....2
c) Between 6 minutes and 1 hour.....3
d) More than 1 hour.....4
e) I never feel confused.....5

When I have had my attacks:
a) I have always fallen to the ground.....1
b) I have usually fallen to the ground.....2
c) I have sometimes fallen to the ground.....3
d) I have never fallen to the ground.....4

When I recover from my attacks:
a) I always have a headache.....1
b) I usually have a headache.....2

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APPENDIX A
LIVERPOOL SEIZURE SEVERITY SCALE
QUALITY OF LIFE ASSESSMENT Continued

c) I sometimes have a headache.....3
d) I never have a headache.....4

When I recover from my attacks:
a) I always feel sleepy 1
b) I usually feel sleepy.....2
c) I sometimes feel sleepy.....3
d) I never feel sleepy.....4

When I recover from my attacks:
a) I always find that I have wet myself.....1
b) I usually find that I have wet myself.....2
c) I sometimes find that I have wet myself.....3
d) I never find that I have wet myself 4

When I recover from my attacks:
a) I always find that I have bitten my tongue.....1
b) I usually find that I have bitten my tongue.....2
c) I sometimes find that I have bitten my tongue.....3
d) I never find that I have bitten my tongue.....4

When I recover from my attacks:
a) I always find that I have injured myself (other than biting my tongue).....1
b) I usually find that I have injured myself (other than biting my tongue).....2
c) I sometimes find that I have injured myself (other than biting my tongue).....3
d) I never find that I have injured myself (other than biting my tongue).....4

When I have my attacks I can usually return to what I am doing:
a) In less than 1 minute.....1
b) In between 1 and 5 minutes.....2
c) In between 6 minutes and 1 hour.....3
d) In more than 1 hour.....4

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APPENDIX B

THE NATIONAL HOSPITAL SEIZURE SEVERITY SCALE - NHS3

Patient's Name:

Date:

Instructions for completion:

1.
Define how many different types of seizure occur (e.g. aura, complex partial, generalized convulsion ...). Call these type 1-3 arbitrarily.

2.
Apply questions 2-8 to each seizure type **separately**. As the NHS3 indicates current seizure severity, **define the time frame**: e.g. 1-3 months or time since the last clinic visit. Use clinical judgement whether each factor occurs in the seizure type (i.e. the physician decides if there is a convulsion after questioning the patient). Allow the patient to judge the frequency of each event. Then tick the box opposite the response options. The number in the box is the score for that question.

Note:
Q.3. Only actual falls are recorded, i.e. if the seizures could cause falls but have not because they all occurred while in bed, then the score is 0.

Q.7. Refers to the time until the patient feels fully functional.

Note the specific scoring instructions for Q4 and 6

3.
The column totals give the seizure severity score.

		Type 1	Type 2	Type 3
1. Record the name of the seizure types that occur under headings "type 1,2,3..." Since the last visit:				
2. Does the patient have a generalized convulsion during this type of seizure?				
	Yes	4	4	4
	No	0	0	0
3. How often has the patient fallen to the ground in this type of seizure?				
	Nearly always or always	4	4	4
	Often	3	3	3
	Occasionally	2	2	2
	Never	0	0	0
4. Has this type of seizure caused any of the following? (Score only the worst)				
	Burns, scalds, deep cuts, fractures	4	4	4
	Bitten tongue or severe headaches	3	3	3
	Milder injuries or mild headaches	2	2	2
5. How often has the patient been incontinent of urine in this type of seizure?				
	Nearly always or always	4	4	4
	Often	3	3	3
	Occasionally	2	2	2
	Never	0	0	0
6. If the seizure causes loss of consciousness, is there a warning long enough for the patient to protect him/herself? (No loss of consciousness or seizures only while asleep scores 0)				
	Never	2	2	2
	Sometimes	1	1	1
	Nearly always or always	0	0	0
7. How long is it until the patient is really back to normal after the seizure?				
	Less than 1 minute	0	0	0
	Between 1 and 10 minutes	1	1	1
	Between 10 minutes and 1 hour	2	2	2
	Between 1 and 3 hours	3	3	3
	More than 3 hours	4	4	4
8. Do the following events occur in this type of seizure?				
	Seriously disruptive automatisms (e.g. shouting, wandering, undressing)	4	4	4
	Mild automatisms or focal jerking	2	2	2
	None	0	0	0
Add 1 point to each column		1	1	1
TOTALSCORE OF EACH SEIZURE TYPE		___	___	___

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