Practice guideline update summary: Efficacy and tolerability of the new antiepileptic drugs I: Treatment of new-onset epilepsy


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Abstract

Objective
To update the 2004 American Academy of Neurology (AAN) guideline for treating new-onset focal or generalized epilepsy with second- and third-generation antiepileptic drugs (AEDs).

Methods
The 2004 AAN criteria were used to systematically review literature (January 2003–November 2015), classify pertinent studies according to the therapeutic rating scheme, and link recommendations to evidence strength.

Results
Several second-generation AEDs are effective for new-onset focal epilepsy. Data are lacking on efficacy in new-onset generalized tonic-clonic seizures, juvenile myoclonic epilepsy, or juvenile absence epilepsy, and on efficacy of third-generation AEDs in new-onset epilepsy.

Recommendations
Lamotrigine (LTG) should (Level B) and levetiracetam (LEV) and zonisamide (ZNS) may (Level C) be considered in decreasing seizure frequency in adults with new-onset focal epilepsy. LTG should (Level B) and gabapentin (GBP) may (Level C) be considered in decreasing seizure frequency in patients ≥60 years of age with new-onset focal epilepsy. Unless there are compelling adverse effect–related concerns, ethosuximide or valproic acid should be considered before LTG to decrease seizure frequency in treating absence seizures in childhood absence epilepsy (level B). No high-quality studies suggest clobazam, eslicarbazepine, ezogabine, felbamate, GBP, lacosamide, LEV, LTG, oxcarbazepine, perampanel, pregabalin, rufinamide, tiagabine, topiramate, vigabatrin, or ZNS is effective in treating new-onset epilepsy because no high-quality studies exist in adults of various ages. A recent Food and Drug Administration (FDA) strategy allows extrapolation of efficacy across populations; therefore, for focal epilepsy, eslicarbazepine and lacosamide (oral only for pediatric use) as add-on or monotherapy in persons ≥4 years old and perampanel as monotherapy received FDA approval.

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This update reviews new evidence for treating certain epileptic disorder types in the United States. In use for decades in Canada, Europe, and Latin America) for approved 2 older AEDs (clobazam [CLB], vigabatrin [VGB]; [RFN]). The US Food and Drug Administration has since second-generation AEDs. The 2004 guidelines examine the tolerability of CLB, VGB, and the 8 second-generation and 6 newer (third-generation) AEDs. This update reviews new evidence for efficacy, safety, and tolerability of CLB, VGB, and the 8 second-generation and 6 third-generation AEDs. The 2004 guidelines examine the mechanisms of action, common and serious adverse events (AEs), and pharmacokinetic properties of the second-generation AEDs. A companion guideline update examines the evidence in treatment-resistant epilepsy. This article summarizes the guideline findings, conclusions, and recommendations. The complete guideline, including appendices e-1 to e-6 and tables e-1 and e-2, is available as a data supplement at links.lww.com/WNL/A565 and links. Wlvw.com/WNL/A566.

**Description of the analytic process**

The AAN and AES convened an expert panel to develop this guideline in accordance with the 2004 AAN process manual. The complete guideline (data supplement) describes the literature search strategy and evidence review process. Recommendations are based on Class I, II, and III studies; Class IV studies are not discussed.

**Analysis of evidence**

**For adults and children with newly diagnosed epilepsy, are CLB, ESL, EZG, FBM, gabapentin (GBP), lamotrigine (LTG), levetiracetam (LEV), LCM, oxcarbazepine (OXC), PER, PGB, RFN, tiagabine (TGB), topiramate (TPM), VGB, and zonisamide (ZNS) effective as monotherapy, and how does their efficacy and tolerability compare with those of older AEDs?**

The original practice guidelines included studies that enrolled patients with a mixed group of syndromes. With the 2004 criteria, ratings were lowered from Class I to Class II for the 3 LTG studies and the 1 GBP study, and from Class I to Class III for the 2 TPM studies. The 4 OXC studies remain Class I. Thus, GBP and TPM are considered possibly effective (Level C) and LTG probably effective (Level B); the OXC recommendation level remains unchanged (Level A).

**Monotherapy in adults with new-onset epilepsy with focal epilepsy or unclassified tonic-clonic seizures**

Since the 2004 publications, 2 Class I, 5 Class II, and 2 Class III studies have been published. One study was conducted in patients aged ≥60 years and one in patients aged ≥65 years.

**GBP vs LTG vs carbamazepine**

A Class II double-blind randomized study compared efficacy and tolerability of GBP (≤1,500 mg/d), LTG (≤150 mg/d), and immediate-release carbamazepine (CBZ-IR) (≤600 mg/d) in patients aged ≥60 years; the primary outcome was retention in the trial for 12 months on the basis of seizure recurrence or AEs despite dose adjustments. Drug discontinuation was less frequent among patients randomized to LTG than to GBP or CBZ-IR because of better LTG tolerability. The most frequently occurring AEs included a higher occurrence of weight gain and water retention with GBP than with LTG or CBZ, of rash with CBZ than with LTG, and of hyponatremia with CBZ than with GBP. The 3 AEDs did not differ with respect to neurologic AEs.

**LTG vs controlled-release carbamazepine**

The differences between LTG and CBZ-IR identified in the study just described were not reproduced in a Class I study comparing LTG efficacy and tolerability (100–500 mg/d) and controlled-release carbamazepine (CBZ-CR) (400–2,000

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**Glossary**

AAN = American Academy of Neurology; AE = adverse events; AED = antiepileptic drug; AES = American Epilepsy Society; CBZ = carbamazepine; CBZ-CR = controlled-release carbamazepine; CBZ-IR = immediate-release carbamazepine; CLB = clobazam; ESL = eslicarbazepine; ETS = ethosuximide; EZG = ezogabine; FBM = felbamate; GBP = gabapentin; GE = generalized epilepsy; GTC = generalized tonic-clonic; JME = juvenile myoclonic epilepsy; LCM = lacosamide; LEV = levetiracetam; LTG = lamotrigine; OXC = oxcarbazepine; PER = perampanel; PGB = pregabalin; PHT = phenytoin; RCT = randomized controlled trial; RFN = rufinamide; SANAD = Standard and New Antiepileptic Drugs; TGB = tiagabine; TPM = topiramate; VGB = vigabatrin; VPA = valproic acid; VPA-ER = extended-release valproic acid; ZNS = zonisamide.
mg/d) in treating focal epilepsy among patients ≥65 years.7 Retention in the trial was the primary outcome and was based on seizure recurrence and AE occurrence. In the trial’s final 20 weeks, the seizure-free rates were the same (52% for LTG vs 57% for CBZ-CR). AE occurrence leading to withdrawal was higher for CBZ-CR (14% for LTG vs 25% for CBZ-CR), but this difference did not reach statistical significance. The most common AEs included dizziness, headache, and fatigue with LTG use and rash, headache, dizziness, and somnolence, and fatigue with CBZ-CR use.

**LEV vs CBZ-CR**

A Class II study compared the efficacy and tolerability of LEV 1,000–3,000 mg/d and CBZ-CR 400–1,200 mg/d.8 Seizure-free rates were almost identical for LEV and CBZ-CR at 6 months and 1 year. Depression and insomnia occurred significantly more frequently with LEV use and back pain and weight gain with CBZ-CR use. For both AEDs, headache, fatigue, somnolence, and dizziness were the most frequent AEs.

**ZNS vs CBZ-CR**

A double-blind Class II study compared efficacy and tolerability of ZNS 300–500 mg/d and CBZ-CR 600–1,200 mg/d in patients with focal-onset (74%) or unknown (26%) epilepsy.9 Primary outcome was percentage of patients achieving seizure freedom for 26 weeks. Seizure-free rates for 26 weeks were nearly identical for ZNS and CBZ-CR. Decreased appetite and weight loss occurred more frequently with ZNS use and dizziness with CBZ-CR use. Headache, dizziness, and somnolence were the most frequent AEs in both AEDs.

**LTG vs GBP vs TPM vs OXC vs carbamazepine**

Standard and New Antiepileptic Drugs (SANAD)—Arm A is a Class III randomized unblinded trial in children and adults, 89% of whom had focal epilepsy.10 The clinician chose initial doses, formulation, and titration rate. Primary outcomes were time to treatment failure and time to 12-month remission. For the former outcome, LTG outperformed carbamazepine (CBZ), GBP, and TPM and had a nonsignificant advantage over OXC. For the latter outcome, CBZ outperformed GBP and had a nonsignificant advantage over LTG, OXC, and TPM. LTG was non-inferior to CBZ for 12-month remission at 2 and 4 years (secondary outcomes). AE intolerability leading to discontinuation was less frequent with GBP and LTG than with OXC and TPM. Although the frequency of tiredness and fatigue was comparable across the AEDs, rash was more frequent with CBZ and OXC; weight gain, dizziness, and ataxia were more frequent with GBP; and psychiatric symptoms, weight loss, and paresthesia were more frequent with TPM.

**VGB vs CBZ-IR**

One Class I study11 and 1 Class III study12 compared the safety and efficacy of CBZ-IR and VGB. The primary outcome of the Class I study was time to withdrawal due to lack of efficacy or AEs; secondary outcomes included time to 6-month seizure remission, time to first seizure after reaching the initial target dose (≤600 mg/d CBZ-IR and ≤2 g/d VGB), and AE development. Although there were no differences between the 2 AEDs regarding time to withdrawal due to lack of efficacy, time to 6-month remission was significantly shorter and time to first seizure significantly longer for CBZ-IR than for VGB. VGB was more frequently associated with psychiatric symptoms and weight gain; rash occurred more frequently with CBZ-IR.

In the Class III study, there were significantly more patients seizure-free on CBZ-IR than VGB. Serious rash occurred with CBZ-IR; VGB was associated with a significantly higher frequency of scintillating visual disturbances and myoclonic jerks.

**PGB vs LTG**

In a Class II double-blind study,13 the primary outcome was the proportion of patients seizure-free for 6 continuous months during the efficacy phase. Doses could be adjusted for the first 24 weeks and then were fixed. A majority of patients received PGB 150 mg/d or LTG 100 mg/d when doses were fixed. Secondary outcomes included withdrawal due to lack of efficacy, time to first seizure, and time to seizure freedom after dose escalation. Seizure freedom was achieved by significantly more patients taking LTG than PGB, as LTG use saw a comparatively greater reduction in patients experiencing only secondarily generalized tonic-clonic (GTC) seizures. Weight gain occurred more often among patients receiving PGB. Other frequent AEs did not differ in frequency between the 2 AEDs and included headaches, dizziness, somnolence, and fatigue. Moreover, the 2 AEDs differed only slightly in frequency of AE-related withdrawal (8% of those taking PGB vs 7% of those taking LTG).

**Table 1 Summary of the 2004 American Academy of Neurology guideline Level A or B recommendations regarding the use of new antiepileptic drugs (AEDs) in treatment of new-onset epilepsy**

<table>
<thead>
<tr>
<th>AED</th>
<th>Monotherapy focal/mixed (focal + IGE)</th>
<th>Childhood absence epilepsy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabapentin</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Lamotrigine</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Topiramate</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Tiagabine</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Oxcarbazepine</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Levetiracetam</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Zonisamide</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Abbreviation:** IGE = idiopathic generalized epilepsy.
Conclusions
1. LTG use should be considered to decrease seizure frequency (Level B).
2. LTG use should be considered (Level B) and GBP use may be considered (Level C) to decrease seizure frequency in patients aged ≥60 years.
3. LEV use may be considered to decrease seizure frequency (Level C).
4. ZNS use may be considered to decrease seizure frequency (Level C).
5. VGB use appears to be less efficacious than CBZ-IR use and may not be offered (Level C); furthermore, toxicity profile precludes VGB use as first-line therapy.
6. PGB use at 150 mg/d is possibly less efficacious than LTG use at 100 mg/d (Level C).
7. Evidence is insufficient to consider GBP, OXC, or TPM instead of CBZ (Level U).
8. Evidence is insufficient to consider TPM instead of PHT in urgent treatment of new-onset or recurrent focal epilepsy, unclassified GTC seizures, or GE presenting with GTC seizures (Level U).
9. Data are lacking to support or refute use of third-generation AEDs, CLB, FBM, or VGB in treating new-onset epilepsy (Level U).
10. Data are lacking to support or refute use of newer AEDs in treating unclassified GTC seizures (Level U).

Monotherapy in children with new-onset epilepsy with either focal epilepsy or unclassified GTC seizures

High-dose vs low-dose TPM
In 1 Class II study of children and adolescents,\(^\text{18}\) the Kaplan-Meier survival analyses for time to next seizure favored the higher dose (400 mg/d), and the probability of seizure freedom was significantly higher among patients randomized to high-dose than low-dose TPM (50 mg/d) (90% and 78%, respectively, at 6 months; 85% and 62%, respectively, at 12 months). AEs occurred in 4% of children taking 50 mg/d and in 14% of those taking 400 mg/d. The most frequent AEs included headache, decreased appetite, weight loss, somnolence, dizziness, paresis, and problems with concentration or attention (or both).

Conclusions
TPM monotherapy at 400 mg/d is possibly more effective than at 50 mg/d in treating children and adolescents with new-onset focal seizures or generalized-onset GTC seizures (1 Class II study). The higher dose is associated with more AEs and is not used in these patients in clinical practice. Of note, this study was
done for regulatory and not clinical purposes, and the doses used are not clinically relevant. Therefore, the study data are nonapplicable to clinical practice.

**Recommendation**
Although the data from this study would suggest that TPM monotherapy is possibly more efficacious at 400 mg/d than at 50 mg/d for treating children and adolescents with new-onset focal epilepsy or generalized-onset GTC seizures (1 Class II study), no recommendations can be made regarding TPM use at the studied doses, particularly in new-onset epilepsy and pediatric patients.

**Monotherapy in adults and children with new-onset GE or unclassified GTC seizures**

**LTG vs TPM vs valproic acid**
A Class III multicenter, randomized, open-label, parallel study, SANAD–Arm B, was conducted in 716 outpatient children and adults with seizure disorders (of whom almost 90% had focal epilepsy) in whom a clinician “regarded valproate the better standard treatment option than carbamazepine.”

The clinician chose initial doses and formulations. Patients had to have been diagnosed with new-onset epilepsy (87.7% of patients enrolled), have a seizure disorder failing to remit with a previous monotherapy regimen (excluding the AEDs studied in this trial [8.4%]), or have a seizure disorder that was in remission but relapsed after AED discontinuation (3.9%). GE was diagnosed in 63% of patients and focal epilepsy in 7.3%; 27% had unclassified epilepsy. Patients were randomized to LTG, TPM, or valproic acid (VPA); the treating clinician determined the target doses according to everyday practice doses. Primary outcomes were time to treatment failure (defined as AED discontinuation because of seizures or AEs, or both) and time to 1-year remission. VPA outperformed TPM for time to treatment failure but was comparable with LTG. When the analysis was restricted to GE, VPA was superior to LTG and TPM. For time to 1-year remission, VPA was superior to LTG when all patients were included or when analysis was restricted to only those with GE, but VPA did not differ from TPM in either analysis. Weight gain was the most frequent AE leading to treatment failure with VPA, and fatigue and psychiatric and cognitive symptoms were the most common AEs associated with TPM. Rash was the most common AE leading to LTG discontinuation (4%).

**Conclusion**
Evidence is insufficient to compare efficacy of CBZ-CR, LEV, and VPA-ER in adolescents and adults with new-onset GE and focal epilepsy (1 Class III study).

**Childhood absence epilepsy**
A Class I study compared the efficacy, tolerability, and neuropsychological effects of LTG (12 mg/kg/d), ethosuximide (ETS) (60 mg/kg/d), and VPA (60 mg/kg/d). Study outcomes included freedom from treatment failure after 16 weeks (which could be extended to 20 weeks if necessary) and attention disturbances measured with objective tests (e.g., continuous performance test). Children randomized to ETS and VPA had comparable freedom from failure rates, which were significantly higher than the LTG rates. Attention disturbances were significantly more common with VPA than with ETS. These seizure control and cognitive AE differences were maintained at a 12-month follow-up evaluation study.

**Conclusion**
LTG is probably not as effective as ETS or VPA for treating absence seizures in children with childhood absence epilepsy (1 Class I study). Attention disturbances are more common with VPA use.

**Clinical context**
ETS use is limited to patients with childhood absence epilepsy without associated GTC seizures.
Among second-generation AEDs, only OXC has evidence from ≥1 epilepsy in persons pediatric age group) as add-on or monotherapy for focal epilepsy. A recent Food and Drug Administration strategy allows extrapolation of efficacy across populations and granted approval of eslicarbazepine and lacosamide (oral only for comparison of e...

Clinical context
The studies examined here on treating new-onset epilepsy were limited to comparisons between first- and second-generation AEDs (and VGB). Therefore, recommendations can be made related only to those medications and cannot be generalized to comparisons involving other AEDs. The data reviewed apply to treatment of focal epilepsy and limit the ability to make recommendations regarding these drugs for unclassified GTC seizures.

The single study wherein the majority of patients had GTC seizures secondary to GE was Class III, so no recommendations can be made regarding the second-generation AEDs (LTG, TPM) used in treating this epilepsy type. The Class I study of children with absence epilepsy suggested that LTG is probably not as effective in this epilepsy type as the 2004 guideline suggests.

A recent Food and Drug Administration strategy allows extrapolation of efficacy across populations and granted approval of eslicarbazepine and lacosamide (oral only for pediatric age group) as add-on or monotherapy for focal epilepsy in persons ≥4 years old and perampanel as monotherapy for focal epilepsy.

FBM and VGB are not recommended in new-onset epilepsy for clinical use due to serious AEs, as there are other agents that are both safe and efficacious.

Recommendations for future research
GBP, LEV, LTG, OXC, and ZNS are second-generation AEDs that can be considered for new-onset focal epilepsy. Change from Class I to Class III of 2 TPM studies reviewed in the 2004 guideline suggests that TPM may be possibly effective and its efficacy should be reinvestigated in a randomized controlled trial (RCT) with doses commonly used in clinical practice.

No data are available on efficacy and tolerability of TGB or any third-generation AEDs and CLB in treating new-onset focal epilepsy. The trial with PGB should be repeated using higher doses to determine whether PGB can be considered efficacious.

Among second-generation AEDs, only OXC has evidence from a Class I study suggesting efficacy in new-onset focal epilepsy. No studies exist on efficacy of second-generation AEDs in new-onset GE with GTC seizures in children or adolescents with juvenile absence epilepsy or juvenile myoclonic epilepsy (JME). Data are unavailable about efficacy of third-generation AEDs in new-onset epilepsy in children. The need is clear for RCTs in pediatric patients with new-onset epilepsy.

No data exist on use of second- and third-generation AEDs, CLB, or VGB in treating adults with new-onset GE with GTC seizures or in JME. Such studies should be included in future research.

Third-generation AEDs found equivalent to LTG or to CBZ-CR or VPA (or both CBZ-CR and VPA) for treating new-onset focal epilepsy and GE, respectively, should undergo head-to-head comparisons with third-generation AEDs in double-blind, controlled, parallel studies for efficacy.

Author contributions
Dr. Kanner: study concept and design, acquisition of data, analysis or interpretation of data, drafting/revising the manuscript, critical revision of the manuscript for important intellectual content, study supervision. Dr. Ashman: study concept and design, acquisition of data, analysis or interpretation of data, drafting/revising the manuscript, critical revision of the manuscript for important intellectual content, study supervision. Dr. Gloss: acquisition of data, analysis or interpretation of data, drafting/revising the manuscript, critical revision of the manuscript for important intellectual content, study supervision. Dr. Harden: analysis or interpretation of data, drafting/revising the manuscript, critical revision of the manuscript for important intellectual content, study supervision. Dr. Bourgeois: study concept and design, acquisition of data, analysis or interpretation of data. Dr. Bautista: study concept and design, acquisition of data, analysis or interpretation of data. Dr. Abou-Khalil: study concept and design, acquisition of data, analysis or interpretation of data. Dr. Buragazi-Dalkilic: study concept and design, acquisition of data, analysis or interpretation of data. Dr. Llanas Park: study concept and design, acquisition of data, analysis or interpretation of data. Dr. Hirtz: study concept and design, acquisition of data, analysis or interpretation of data. Dr. Stern: study concept and design, acquisition of data, analysis or interpretation of data. Dr. French: study concept and design, acquisition of data, analysis or interpretation of data. Dr. Faught: study concept and design, acquisition of data, analysis or interpretation of data.

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Disclosure

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Conflict of interest

The American Academy of Neurology (AAN) and the American Epilepsy Society (AES) are committed to
producing independent, critical, and truthful clinical practice guidelines (CPGs). Significant efforts are made to minimize the potential for conflicts of interest to influence the recommendations of this CPG. To the extent possible, the AAN and AES keep separate those who have a financial stake in the success or failure of the products appraised in the CPGs and the developers of the guidelines. Conflict of interest forms were obtained from all authors and reviewed by an oversight committee prior to project initiation. The AAN and AES limit the participation of authors with substantial conflicts of interest. The AAN and AES forbid commercial participation in, or funding of, guideline projects. Drafts of the guideline have been reviewed by at least 3 AAN committees, 3 AES committees, a network of neurologists, Neurology peer reviewers, and representatives from related fields. The AAN Guideline Author Conflict of Interest Policy can be viewed at aan.com.

For complete information on this process, access the 2004 AAN process manual.

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