Development of an Electronic Decision-Assisting Tool for the Evaluation of the Likelihood of Lennox-Gastaut Syndrome (LGS) Diagnosis

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Overview

QUESTION

Can the ILAE definition of Lennox-Gastaut syndrome (LGS) be utilized to create an electronic decision-assisting tool to aid providers in clinical practice in attaining an LGS diagnosis?

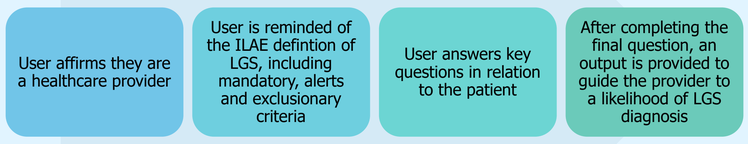
INVESTIGATION

- Ten epilepsy experts convened to determine questions and answers to include in the rules-based questionnaire
- A progressive web application (PWA) was developed as an electronic decision-assisting tool that reflects the criteria in the ILAE definition

RESULTS

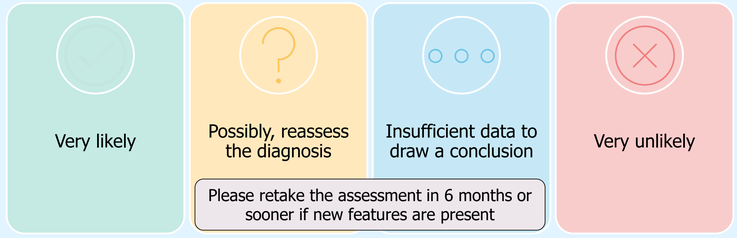
- In the PWA, users, who must confirm they are a healthcare provider, are reminded of the ILAE criteria, then guided to answer the questions agreed upon by experts related to the clinical status and history of the patient; after submitting their answers, an output is provided (See **Figure A**)
  - Key questions were built into the PWA using mandatory, alerts, and exclusionary criteria from the ILAE position paper
  - One of 4 scenario outputs result based on responses captured in the questionnaire (**Figure B**)
  - Any output requires validation by a physician for a diagnosis of LGS

Figure A. Overview of PWA Use for LGS Diagnosis



ILAE, International League Against Epilepsy; LGS, Lennox-Gastaut syndrome; PWA, progressive web application.

Figure B. Four Scenario Outputs



CONCLUSIONS

Use of this LGS decision-assisting tool that aligns with the ILAE definition may aid clinicians in arriving at an LGS diagnosis. A prompt diagnosis may subsequently contribute to positive outcomes for patients and their caregivers.

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Introduction

- Lennox-Gastaut syndrome (LGS) is a developmental and epileptic encephalopathy characterized by early onset, severe, pharmacoresistant seizures of multiple types[1]
  - LGS accounts for about 1%-2% of all epilepsy types[2] and is associated with etiological heterogeneity[3]; of all LGS cases, 65%-75% have an identifiable cause and the cause is unknown in the remaining 25%-35%[4,5]
  - Onset is usually between 18 months and 8 years of age, with a peak onset occurring at 3-5 years old[2,3]
    - LGS persists into adolescence and adulthood[3,6]
  - All patients with LGS also experience cognitive and behavioral impairments[2,3]
- Due to the variable presentation, characteristic features that may change over time, and overlap with other DEEs, diagnosing LGS remains complex and challenging[1,3]
  - Also, due to the evolution of the condition, LGS is often underdiagnosed or delayed[6]
- Early diagnosis is instrumental to ensure adequate treatment and outcomes that may impact quality of life
  - General treatment plans include valproate as the first-line agent with concomitant use of lamotrigine or clobazam[5]
  - There are 7-8 anti-seizure medications (ASMs) approved to manage seizures associated with LGS in Europe and the United States, respectively[7]
- In 2022, the International League Against Epilepsy (ILAE) defined diagnostic criteria for various epilepsy syndromes, including LGS (**Table 1**)[2]

Table 1. ILAE Definition and Criteria Used for Lennox-Gastaut Syndrome Diagnosis

	Mandatory	Alerts	Exclusionary
Age at onset	<18 years	>8 years	n/a
Seizures	Tonic Seizures + ≥1 additional seizure type that may include: • Atypical absences • Atonic • Myoclonic • Focal impaired awareness • Generalised tonic-clonic • Nonconvulsive status epilepticus • Epileptic spasms	n/a	n/a
EEG	Generalised slow spike-and-wave complexes of <2.5 Hz (or history of this finding on prior EEG) Generalized paroxysmal fast activity in sleep (or history on prior EEG)	Photoparoxysmal response at low frequencies	Persistent focal abnormalities without generalized spike-and-wave pattern

EEG, electroencephalogram; ILAE, International League Against Epilepsy; n/a, not available.
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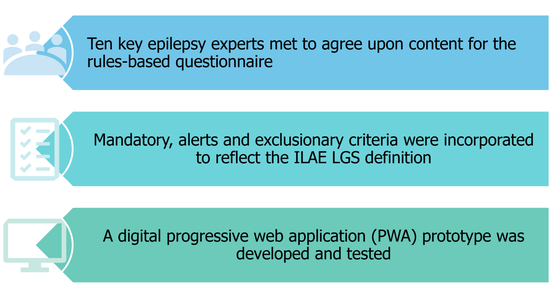
Objective

Here we describe the development of an electronic decision-assisting tool that aligns with the ILAE definition of LGS designed to help clinicians in practice evaluate likelihood of LGS diagnosis.

Methods and Results

- An overview of the steps involved in the development of the digital progressive web application (PWA) as the decision-assisting tool is provided in **Figure 1**
  - Questions and respective answers utilized in the questionnaire were designed to be relevant and easily used in clinical practice
  - The prototype was initially developed in English; other languages will follow

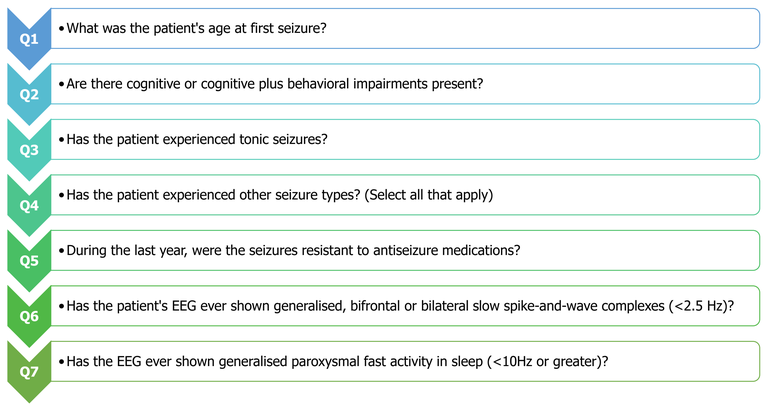
Figure 1. Overview of Development of the Electronic Decision-Assisting Tool for LGS Diagnosis



ILAE, International League Against Epilepsy; LGS, Lennox-Gastaut syndrome.

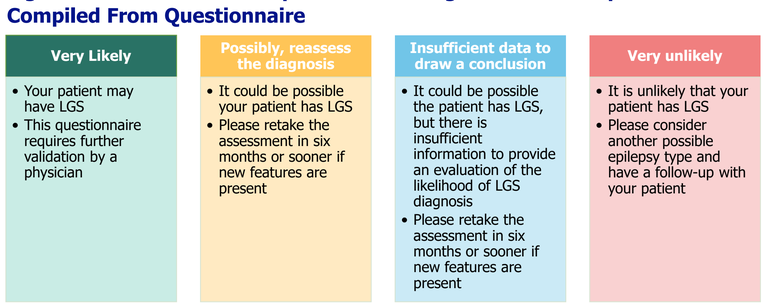
- In the PWA, users must first view the authentication page and confirm they are a healthcare provider
- Users are subsequently guided to the introduction page which provides the ILAE LGS definition utilized for diagnosis (**Table 1**)
- The decision-assisting tool consists of a series of questions related to the patient evaluated (**Figure 2**)
  - Options were customized by the expert providers to reflect clinical practice
  - Answers contributed to the output
- After completing the final question, the user will submit the answers and the PWA will provide one of four scenario outputs consistent with a likelihood of an LGS diagnosis (**Figure 3**)
  - In the scenario where 'possibly' or 'insufficient data' results, the PWA will recommend that the questionnaire be completed again in 6 months or sooner if new features present
- A case example is provided in **Table 2**
- It is important to note that the output provided requires further validation by an expert physician for a confirmatory diagnosis of LGS
- Timely diagnosis and a reduction in the duration of the diagnostic journey may ensure:
  - Faster time to referral to epileptologists
  - A personalized treatment plan, including access to new and experimental drugs as well as clinical trials
  - Increased access to patient/caregiver education
  - Improved monitoring and follow-ups

Figure 2. Key Questions Included in the Decision Tool



EEG, electroencephalogram.

Figure 3. Four Scenario Outputs for LGS Diagnosis After Responses Compiled From Questionnaire



LGS, Lennox-Gastaut syndrome.

Table 2. Case Example: Questionnaire With Highlighted Answers and Final Output

Key Questions		Answer Options
Q1	What was the patient's age at first seizure?	< 8 years 8-18 years >18 years
Q2	Are there cognitive or cognitive plus behavioral impairments present?	Yes No Unknown
Q3	Has the patient experienced tonic seizures?	Yes No Unknown
Q4	Has the patient experienced other seizure types? (select all that apply)	Atypical absence Atonic Myoclonic Focal Generalised tonic-clonic Nonconvulsive status epilepticus Epileptic spasms No additional seizure types Unknown
Q5	During the last year, were the seizures resistant to ASMs?	Yes No Unknown
Q6	Has the patient's EEG ever shown generalized, bifrontal or bilateral slow spike-and-wave complexes (<2.5 Hz)?	Yes No Unknown
Q7	Has the EEG ever shown generalized paroxysmal fast activity in sleep (<10 Hz or greater)?	Yes No Unknown

Output is provided based on highlighted answers: → **Possibly, reassess the diagnosis**

EEG, electroencephalogram.

Conclusions

This PWA that aligns with the LGS definition provided by ILAE may help clinicians consider the likelihood of an LGS diagnosis. After results from the output are validated, a prompt diagnosis may lead to improved clinical outcomes and quality of life for patients and their caregivers.

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