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TELEMEDICINE AND DIGITAL SEIZURE TRACKING FOR EPILEPSY IN INDONESIAN PRIMARY HEALTHCARE: A NARRATIVE REVIEW OF OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Epilepsy affects approximately 50 million people worldwide, predominantly in low- and middle-income countries (LMICs), where treatment gaps remain substantial. In Indonesia, uneven specialist distribution and limited diagnostic resources may constrain epilepsy care. International studies indicate that telemedicine improves access, patient satisfaction, and appointment attendance, although improvement in seizure control is less consistently demonstrated. App-based seizure diaries improve recording precision compared with paper diaries in specialist settings, whereas wearable seizure detection is supported mainly for tonic-clonic seizures. Indonesian evidence indicates limitations in diagnostic resources and uneven healthcare workforce distribution, while national internet-use statistics suggest opportunities for digital health development. No Indonesian trial of telemedicine or digital seizure tracking for epilepsy was identified in this review. A hybrid model combining teleconsultation, clinician-reviewed seizure and medication records, paper and telephone alternatives, and assisted digital access is proposed as a starting point. Implementation should proceed through phased feasibility research that evaluates clinical safety, accessibility, acceptability, cost, and workflow integration within Indonesian primary healthcare before wider adoption. This narrative review, without systematic screening, examines the feasibility and potential benefits of telemedicine and digital seizure tracking in Indonesian primary healthcare, drawing on international evidence and Indonesian contextual data.

Keywords: Epilepsy; Telemedicine; Seizure Diary; Mobile Health; Primary Healthcare; Indonesia

1 INTRODUCTION

Epilepsy is a brain disease defined by at least two unprovoked seizures occurring more than 24 hours apart, one unprovoked seizure with a high risk of recurrence, or an epilepsy syndrome [1]. The World Health Organization (WHO) estimates that approximately 50 million people live with epilepsy, nearly 80% in low- and middle-income countries

(LMICs). People with epilepsy face up to three times the risk of premature death compared with the general population, often from preventable causes such as drowning, burns, falls, and prolonged seizures [2].

Although effective, low-cost antiseizure medication (ASM) is available, roughly three quarters of people with epilepsy in LMICs may receive no treatment, while average public-sector availability of generic ASMs remains below 50% [2]. Specialist shortages, stigma, and fragmented health systems widen this gap [3]. WHO-highlighted pilot programmes in Ghana, Mozambique, Myanmar, and Viet Nam demonstrate that epilepsy diagnosis and treatment can be integrated into primary healthcare [4]. A cluster-randomised trial in Punjab, India, found that home-based care by primary-care-level workers, supported by medication supply and adherence reinforcement, improved adherence, reduced seizures, and lowered trial attrition compared with clinic-based care [5]. Long-term epilepsy care therefore relies on reliable medication supply, follow-up, and a workforce able to act on clinical information, rather than advanced technology alone.

Two digital approaches may support follow-up. Telemedicine provides remote consultation, review, or health education, while digital seizure tracking records seizure-related information over time, typically through smartphone diaries completed by patients or caregivers. Retrospective recall is error-prone, and people with epilepsy frequently underreport or inaccurately report seizures [6]. A scoping review of 201 studies by the International League Against Epilepsy (ILAE) Telemedicine Task Force found telemedicine to be a feasible adjunct to conventional care, although approximately 70% of studies came from high-income settings. The review also identified limitations in diagnostic accuracy, technology access, and physical examination [7]. A recent systematic review concluded that telemedicine can support epilepsy follow-up and medication adherence and may reduce costs while improving access. However, evidence for improved seizure control remained limited: only 5 of 29 studies reporting seizure outcomes demonstrated improvement [8]. Seizure control should therefore remain a central outcome in future trials.

Indonesia is a relevant but under-researched setting. The country comprises 16,771 islands, and its public primary healthcare centres (*Puskesmas*) operate within the national health insurance system, Jaminan Kesehatan Nasional (JKN), introduced in 2014 [9]. Official statistics indicate that 72.78% of residents accessed the internet and 68.65% owned a mobile phone in 2024, suggesting potential for telemedicine and digital seizure tracking [10]. However, these national figures mask regional, age-related, and device-type variation. Epidemiological studies of epilepsy in Indonesia remain scarce, with no population-based studies available [11]. No Indonesian trial of telemedicine or digital seizure tracking for epilepsy has been identified.

This review evaluates the feasibility and potential benefits of telemedicine and digital seizure tracking in Indonesian primary healthcare and identifies the conditions needed for effective implementation. It integrates international evidence with the Indonesian context, distinguishes opportunities, barriers, and implementation considerations, and separates observed findings from proposals.

2 MATERIALS AND METHODS

This narrative review examined the clinical evidence, health-system context, and policy considerations relevant to implementing telemedicine and digital seizure tracking for epilepsy in Indonesian primary healthcare. A web-based search was performed using a general web search tool, identifying sources from PubMed, DOAJ, Garuda, publisher websites, university repositories, the World Health Organization, the International League Against Epilepsy, and Statistics Indonesia (BPS). Search concepts included epilepsy, telemedicine, telehealth, teleneurology, mobile applications, seizure diaries, wearable seizure detection, and Indonesian healthcare contexts, including Puskesmas, JKN, referral systems, stigma, healthcare workforce, and internet access. Evidence considered included systematic and scoping reviews, clinical trials, observational and validation studies, guidelines, official statistics, and policy documents. Evidence from Indonesia was distinguished from findings extrapolated from other settings, while proposed implementation models were identified as author-proposed recommendations. The search was not exhaustive, individual primary telemedicine programme studies were not systematically retrieved, and the review did not claim adherence to PRISMA guidelines.

3 RESULTS

3.1 Epilepsy: Clinical Burden and the Need for Improved Care

3.1.1 Clinical Overview

Epilepsy diagnosis relies on clinical history, often from witnesses, supported by EEG and neuroimaging when available. Seizure mimics, including syncope and non-epileptic events, can cause diagnostic errors; therefore, digital or self-reported records cannot replace clinical assessment. Indonesian validation research found that screening terms

required adaptation to local expressions such as kejang, ayan, and step, while eye twitching and fainting caused false positives [11].

3.1.2 Epidemiological Burden

WHO estimates that approximately 50 million people worldwide have epilepsy [2]. A meta-analysis of 216 population-based studies estimated global prevalence at 7.57 per 1,000, with the lowest rate in Asia (5.20 per 1,000) [12]. A 2024 Asian meta-analysis reported pooled active and lifetime prevalence of 5.6 and 6.7 per 1,000, respectively [13]. Earlier Asian reviews reported a median lifetime prevalence of approximately 6 per 1,000, consistent with estimates cited in a 2019 review [14,15]. Indonesian estimates remain uncertain. Reviews have identified a lack of population-based prevalence studies [16]. Reported estimates of 4.3–8 per 1,000 derive mainly from single-centre hospital studies susceptible to selection bias [11]. The Global Burden of Disease 2021 analysis modelled Indonesia's age-standardised prevalence at 460 per 100,000, among the lowest worldwide; this is a modelled estimate rather than a direct national measurement [17]. Reliable national data on epilepsy-related mortality, healthcare utilisation, and educational and employment outcomes remain unavailable.

3.1.3 Treatment Gap and Care Challenges

WHO estimates that approximately three quarters of people with epilepsy in LMICs may receive no treatment, although an Indonesia-specific treatment-gap estimate has not been identified [2]. Indonesian evidence on care constraints is indirect. A 2023 convenience survey of 349 paediatricians and general practitioners across 38 provinces identified limited diagnostic tools as the leading challenge (57.3%). CT was available to 49% of respondents, EEG to 26.9%, and MRI to 18.6%; 56.4% reported that their last continuing education on childhood epilepsy was over a year earlier. The sample was not nationally representative and focused on paediatric care [18]. Ministry of Health data list 6,418 neurologists nationwide, with 3,854 (60.05%) concentrated in Java. Regional comparisons of epilepsy care remain unavailable [19].

3.1.4 Stigma and Social Consequences

WHO identifies stigma as a potential barrier to treatment-seeking [4]. Indonesian studies, mostly small cross-sectional surveys, report differences in attitudes by ethnicity, with Javanese respondents showing poorer attitudes than Sundanese and Minahasan respondents, particularly in the personal domain [20]. Research in two Padang Puskesmas found urban–rural differences in knowledge and perceived stigma but not attitudes [21]. Another survey associated stigma with domicile and education [22]. Although attitudes among medical students, resident doctors, and nurses in three cities were generally positive, stigmatising beliefs persisted, particularly regarding marriage [23]. Whether stigma affects willingness to use digital epilepsy services in Indonesia remains unknown.

3.1.5 Relevance to Primary Healthcare

Evidence from other LMICs supports primary care in epilepsy recognition, medication supply, adherence support, education, and follow-up [4,5]. First seizures, diagnostic uncertainty, drug-resistant epilepsy, status epilepticus, pregnancy-related concerns, and suspected non-epileptic events may require specialist assessment [24–27]. Telemedicine could strengthen primary-care capacity through specialist consultation, clinical guidance, and referral support. Primary healthcare is therefore a proposed setting for digital epilepsy tools, with the scope of practice determined locally by clinicians and policymakers.

3.2 Telemedicine for Epilepsy Care: International Evidence

3.2.1 Definition and Models

Telemedicine refers to clinical care delivered remotely through synchronous video or telephone consultations, asynchronous messaging, remote follow-up and education, or specialist-supported clinician consultations (tele-neurology). Direct-to-patient and clinician-to-clinician models serve different purposes, with the latter particularly relevant to Puskesmas–specialist collaboration. In resource-limited settings, telemedicine may support diagnosis and review, while telephone consultations or SMS can facilitate ongoing management [28].

3.2.2 International Implementation

The ILAE Telemedicine Task Force scoping review included 201 studies, approximately 70% from high-income settings, and reported diagnostic accuracy of 75–97%, savings of about US$30 per consultation, patient satisfaction of 87–95%, physician satisfaction of 74–94%, and a 45% reduction in missed appointments. These figures describe the included literature rather than pooled effects [7]. A systematic review of 40 studies across 13 countries involving 8,616 people with epilepsy found improvements in medication adherence, visit compliance, and patient satisfaction. However, only

five of the 29 studies reporting seizure outcomes demonstrated improvement, all using multimodal telemedicine interventions [8]. In a cross-sectional survey of 770 people with epilepsy in India, half reported some telemedicine use, but only 4% recalled a telemedicine follow-up consultation. Self-reported outcomes favoured users, although confounding limits interpretation [29]. Thus, telemedicine use does not necessarily indicate structured follow-up.

3.2.3 Clinical and Healthcare Delivery Outcomes

Evidence is strongest for feasibility, satisfaction, and attendance, weaker for cost, and weakest for seizure control [7,8]. Improved access should not automatically be interpreted as improved seizure outcomes. A 2025 narrative article suggested that video or telephone visits can support medication titration, adverse-effect monitoring, diary review, and care coordination for established paediatric patients, but are unsuitable for new diagnoses, acute neurological changes, or red flags [30]. These recommendations represent expert synthesis rather than trial evidence. The Indian primary-care-level home-care trial did not evaluate telemedicine; it used in-person visits and free medication [5].

3.2.4 Advantages and Limitations

Potential benefits include reduced travel, convenience, and continuity during service disruptions [7]. Limitations include incomplete physical examination, diagnostic uncertainty without EEG or imaging, connectivity failures, privacy risks, variable patient suitability, clinician workload, and unequal access. Their magnitude in LMIC primary-care settings remains poorly quantified.

3.3 Digital Seizure Tracking and Remote Monitoring

3.3.1 Concept and Functions

Digital seizure tracking records seizure frequency and characteristics, medication adherence, adverse effects, and possible triggers over time, usually through patient- or caregiver-entered diaries [6]. Automated detection instead uses wearable sensors to identify seizures through movement, muscle activity, or heart rate, particularly tonic-clonic seizures, and is evaluated using sensitivity and false-alarm rates [31]. Tracking documents events for follow-up, detection identifies ongoing seizures, and prediction estimates future seizure risk.

3.3.2 Digital Seizure Diary Applications

Mobile health reviews describe epilepsy self-management applications for education, seizure recording, and clinical decision support [32]. A systematic review of 10 studies searched through 2021 found that five of the seven studies reporting seizure-control outcomes demonstrated improvement, while two found no significant improvement; the remaining three focused on training and knowledge. The small, heterogeneous evidence base limits conclusions [33]. In a non-randomised study of 89 adults with focal epilepsy at two European monitoring units, app-diary users had higher seizure-reporting precision than paper-diary users (85.7% versus 66.9%), partly because paper diaries contained more false-positive reports. Self-selection and the specialist inpatient setting limit generalisability to home-based primary care [6]. Analysis of caregiver-entered records for epileptic spasms in 314 children also identified reporting biases, including counts disproportionately divisible by five and fewer reported nocturnal spasms than expected [34]. An Indonesian university dissertation evaluated FarmaEps, an application designed to improve adherence, self-management, and seizure frequency. Medication adherence improved significantly compared with the control group. Although seizure frequency declined significantly from baseline in the intervention group, the between-group reduction was not statistically significant [35].

3.3.3 Wearables and Automated Detection

Seizure prediction analyses individual seizure patterns or preictal changes to estimate seizure likelihood before onset. A 2024 meta-analysis of 43 algorithms evaluated in 419 patients reported a mean area under the receiver operating characteristic curve (AUC) of 0.71, indicating moderate discrimination with substantial variation across studies [36]. The ILAE–International Federation of Clinical Neurophysiology guideline found strong evidence for wearable detection of generalised tonic-clonic and focal-to-bilateral tonic-clonic seizures. It conditionally recommended validated devices for selected patients as clinical adjuncts but did not recommend current devices for other seizure types, citing the need for further evidence on clinical utility [37]. Wearables do not replace diaries, which can capture adherence, adverse effects, and other patient-reported information, and they are not diagnostic tools.

3.3.4 Benefits and Clinical Limitations

Digital tracking may provide structured longitudinal records, improve patient–clinician communication, prompt adherence, and support caregiver participation. However, inaccurate or incomplete reporting [6] and systematic

reporting biases remain limitations [33]. Whether improved documentation translates into better clinical outcomes is uncertain.

3.3.5 Acceptability, Usability, and Equity

Digital literacy, language, disability, age, caregiver dependence, device ownership, and connectivity may affect uptake. These factors have not been adequately studied for epilepsy diaries in Indonesia.

3.4 Epilepsy Care and Digital Health Readiness in Indonesia

3.4.1 Telemedicine Regulation

Indonesia has a regulatory framework relevant to telemedicine. Law No. 17 of 2023 on Health consolidated and superseded several earlier laws, leaving detailed provisions to implementing regulations [38,39]. Government Regulation No. 28 of 2024 further established a framework for health services, including telehealth and telemedicine, and revoked 31 earlier regulations [40,41]. Minister of Health Regulation No. 20 of 2019 provides a framework for inter-facility telemedicine, including tele-electrocardiography, tele-ultrasound, teleradiology, and teleconsultation [42]. These provisions support the possibility of remote clinical collaboration but do not establish operational capacity at individual Puskesmas. A 2025 doctoral dissertation reported that the 2019 regulation remained unchanged after the 2023 Health Law [43]. None of these instruments specifically addresses epilepsy telemedicine or digital seizure tracking. Applicable requirements for medical records, informed consent, data protection, and clinical accountability should be verified against current official regulations before implementation.

3.4.2 Sociocultural Context

Indonesian studies document epilepsy-related stigma and misconceptions [20–23]. Telemedicine could facilitate remote education and counselling, while digital diaries could help patients document seizures and discuss concerns with clinicians. Remote consultations may also offer a more discreet way to seek advice. However, these potential benefits depend on reliable, private communication, and digital interventions alone may not overcome broader community stigma. Their effects on epilepsy-related knowledge, attitudes, and engagement with care in Indonesia remain untested.

3.5 Implementation Opportunities in Indonesian Primary Healthcare

3.5.1 Applicability to Indonesia

Specialist-led virtual clinics may be difficult to deliver in remote Puskesmas because neurologists are scarce and concentrated in Java [19], while internet access may be insufficient for stable video consultations in remote areas [44]. Telephone consultations and low-bandwidth messaging may be more adaptable, provided that emergency and in-person diagnostic pathways remain available. These models have not been evaluated for epilepsy in Indonesia.

3.5.2 Healthcare Digital Readiness

Indonesia's expanding electronic medical record (EMR) infrastructure may support digital interventions in primary care. By July 2026, 42,337 healthcare facilities were integrated with the national SATUSEHAT platform to support EMR interoperability [45]. This could facilitate continuity and coordination between primary-care providers and specialists, although integration does not necessarily indicate full operational readiness. Uneven infrastructure and regional disparities remain important considerations. Existing communication practices may also provide a foundation for digital health services.

WhatsApp has been reported to improve coordination and referral speed from remote areas [46], while WhatsApp groups have supported health education and engagement in maternal and child health and chronic disease management [47–49]. These familiar platforms could potentially support epilepsy education, follow-up, and provider communication, subject to safeguards for information reliability and continuity of care.

Indonesia also uses digital surveillance and reporting systems, including the Early Warning Alert and Response System (Sistem Kewaspadaan Dini dan Respons, SKDR) for infectious diseases [50] and the ASIK (Sehat Indonesiaku) application for recording and reporting noncommunicable disease screening [51]. Although neither was designed for epilepsy, both illustrate existing digital infrastructure that could inform future intervention design.

3.5.3 Caregiver and Health-System Roles

Caregivers can support seizure documentation and remote consultations for children and people with cognitive impairment by reporting event characteristics, medication use, and functional changes. However, caregiver-entered

records may be systematically biased [34]. Implementation should consider caregiver burden, observation reliability, consent, privacy, and patient autonomy. Aggregated, de-identified digital-service data could help describe service use, follow-up, and reported seizure trends, addressing some gaps in Indonesian epilepsy service information [11]. However, these data would represent programme users rather than the general population and could not establish population prevalence or total healthcare need. Data quality, privacy, governance, and interpretation require evaluation before use in service planning.

3.5.4 Equity and Implementation

Equitable implementation may require hybrid care combining telephone consultations, low-bandwidth options, assisted digital access, paper diaries, and in-person services. Although this approach has not been evaluated for epilepsy in Indonesia, an Indian trial found that non-digital home-based primary care improved outcomes when it directly addressed patients' needs [5]. Hybrid care should therefore be evaluated locally for safety, acceptability, affordability, workload, and equitable access before wider adoption.

3.6 Barriers and Implementation Challenges

3.6.1 Infrastructure and Financial Barriers

Internet access and mobile phone ownership reached 72.78% and 68.65%, respectively, in 2024 [10], while clinicians report limited access to diagnostic facilities [18]. Regional connectivity, electricity supply, and device quality at Puskesmas remain insufficiently documented. Although a scoping review estimated savings of approximately US$30 per teleconsultation, the evidence mainly comes from higher-income settings [7]. Indonesian costs for devices, data, maintenance, training, and local cost-effectiveness remain uncertain.

3.6.2 Clinical and Organisational Barriers

Limited recent epilepsy training among surveyed clinicians [18] and the concentration of neurologists in Java [19] may constrain clinical capacity and equitable specialist access. Effects on workload, responsibility for reviewing seizure records, and integration with Puskesmas workflows have not been evaluated. Digital diaries may contain reporting errors and recall bias [6,34], remote follow-up may be unsuitable for new diagnoses or warning signs [30], and wearable detection is principally supported for tonic-clonic seizures rather than other seizure types [37]. Without clear review procedures and referral pathways, these limitations could contribute to delayed assessment, false reassurance, or inappropriate reliance on unreviewed data.

3.6.3 Patient and Sociocultural Barriers

Digital literacy, age, disability, language, privacy concerns, reporting fatigue, and consistency of recording have not been adequately studied in Indonesia. Indian evidence shows a gap between reported telemedicine use and recall of structured follow-up, highlighting the need to measure actual engagement and continuity rather than uptake alone [29]. Indonesian studies also report persistent stigma [20,23] and urban–rural differences in epilepsy-related knowledge [21]. Whether these factors affect digital disclosure, data sharing, trust in remote consultations, or preferences for face-to-face care remains unknown.

3.6.4 Regulatory and Sustainability Barriers

Law No. 17 of 2023 on Health and Government Regulation No. 28 of 2024 provide a broader legal framework relevant to telemedicine [39,41]. Before implementation, requirements for informed consent, personal data protection, electronic records, data storage, cybersecurity, and accountability for asynchronously submitted data should be verified against official regulations. Long-term sustainability also remains uncertain because evidence on interoperability with Puskesmas records, duplicate documentation, vendor dependence, funding, and scalability is lacking. Implementation planning should assess clinical responsibility, affordability, equity, regulatory compliance, and integration into routine primary healthcare alongside technical feasibility.

4 DISCUSSION

The reviewed evidence supports further feasibility and implementation research on telemedicine and digital seizure tracking in Indonesian primary healthcare, but is insufficient to justify national implementation. Telemedicine evidence is strongest for feasibility, satisfaction, and attendance, mainly in high-income, specialist-oriented settings [7]. Evidence of improved seizure outcomes remains limited [8,33], while digital diaries have primarily been evaluated for reporting accuracy in specialist settings [6] and wearable devices for tonic-clonic seizure detection [37]. No Indonesian evaluations of these technologies were identified. Their effectiveness in routine LMIC primary care, feasibility in Indonesia, and local economic value remain uncertain; existing cost-saving estimates largely derive from higher-income

settings [7]. Indonesian evidence instead highlights implementation challenges, including epidemiological uncertainty [11], clinician-reported resource constraints [18], epilepsy-related stigma [20,21], and national connectivity [10].

Evidence from comparable settings suggests that technology alone cannot address all barriers to epilepsy care. An Indian trial demonstrated benefits from home-based primary healthcare through medication provision, adherence support, and in-person contact rather than digital intervention [5]. In Indonesia, epilepsy management in primary care is shaped by clinical competency standards and referral pathways. The Indonesian Doctor Competency Standards classify epilepsy under initial management and referral, requiring general practitioners to establish a clinical diagnosis, provide preliminary management, and refer patients when indicated [52]. Patients needing specialist assessment may be referred to secondary care and, once stable and eligible, returned to primary care through the *Program Rujuk Balik* (PRB) for monthly medication collection and adherence assessment [53]. This pathway offers opportunities for digital tools to support post-referral follow-up, seizure and adherence monitoring, treatment documentation, and communication with specialists. Their value should be assessed against specific care gaps rather than assumed to exceed telephone consultations, community support, or paper diaries.

Telemedicine and digital seizure tracking may complement each other: diaries provide structured information, while teleconsultations enable clinical interpretation and care guidance. Diaries used without review may generate unused data, whereas consultations without structured records rely on retrospective recall. Combining both approaches also increases demands on connectivity, clinician time, and data governance. A hybrid model with non-digital alternatives and clear referral pathways is therefore appropriate for initial evaluation [30]. Potential pilot sites include well-connected Puskesmas with motivated clinicians, serving adults with established, stable epilepsy or caregivers of children, provided urgent in-person assessment remains accessible. Patients with suspected first seizures, unexplained events, or no reliable telephone access may be unsuitable for initial implementation.

Although telemedicine may improve satisfaction and access, these benefits have not consistently translated into better seizure outcomes [7,8]. Differences in outcome measures, follow-up duration, intervention design, and publication bias may contribute, but their relative influence remains unclear. Future research should progress from epidemiological assessment, workflow mapping, and stakeholder co-design to feasibility studies and adequately powered effectiveness trials. Pilot studies could use the RE-AIM framework (reach, effectiveness, adoption, implementation, and maintenance) [54]. Clinicians should define remote-care limits and emergency escalation procedures; administrators should assign responsibility for reviewing patient-generated data; and policymakers should clarify telemedicine, data-protection, and medical-record requirements, including those for asynchronous data. Medication availability and referral performance should be evaluated alongside technological outcomes. Overall, digital epilepsy care in Indonesian primary healthcare warrants further investigation, but its nationwide effectiveness remains unestablished.

5 CONCLUSIONS

The available evidence supports further exploration, rather than national implementation, of telemedicine and digital seizure tracking for epilepsy care in Indonesian primary healthcare. The most plausible early applications are structured follow-up for stable, previously diagnosed patients, specialist-supported teleconsultation for primary-care clinicians, and clinician-reviewed seizure and medication diaries within a hybrid model that retains telephone, paper, and in-person options. Prerequisites include verified regulatory compliance, defined review responsibility, reliable medication supply, clinician training, and explicit emergency escalation. Remaining barriers include connectivity inequality, workforce capacity, data governance, cost, stigma, and the absence of Indonesian effectiveness data. The next step should be a co-designed, safety-monitored feasibility study with pre-specified implementation, equity, and safety outcomes, informed by improved regional epilepsy epidemiology.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Author contributions

- Ibrahim Hanif Rizkiliano: Conceptualization, Investigation, Writing and editing the review
- Edward Timothy Setio: Investigation, Writing and editing the review
- Shafira Meidyana: Supervision, Writing and editing the review

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The authors used an AI-based language model (Claude) for limited language refinement and drafting assistance. All content was reviewed and verified by the authors, who take full responsibility for the manuscript's accuracy, originality, and integrity.

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