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Point-of-Care Electroencephalography in Acute and Translational Neurology: Time to EEG Matters

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ABSTRACT

Electroencephalography (EEG) remains the definitive modality for detecting non-convulsive seizures, characterizing encephalopathy, and interrogating large-scale brain network dysfunction. Time to EEG matters However, conventional EEG workflows are poorly aligned with the temporal, operational, and workforce realities of modern acute and frontline care. As a result, EEG is frequently delayed or unavailable at the moment clinical decisions carry the greatest consequence. Point-of-care EEG (POC-EEG) has emerged to bridge this gap by enabling rapid, bedside neurophysiologic assessment, decentralizing EEG acquisition, and expanding access through automation and tele-neurophysiology. This review synthesizes contemporary evidence on POC-EEG with a primary focus on the NeuroTrace platform, integrating data from acute neurological emergencies, critical care, emergency medicine, and translational outpatient indications. We outline the unmet need driving adoption, examine diagnostic and health-system impact, and identify clinical indications with the greatest demonstrated and emerging benefit. We further situate NeuroTrace within the evolving landscape of high-fidelity, scalable EEG technologies and discuss future directions for biomarker development, guideline-concordant implementation, and outcome-driven validation.

Keywords

Point-of-care EEG, Rapid EEG, BrainView, NeuroTrace, Non-convulsive status epilepticus, Emergency neurology, Critical care EEG, Biomarkers, Translational neurophysiology.

Introduction

Electroencephalography (EEG) remains a cornerstone of neurological diagnosis, providing direct, real-time assessment of cerebral function that is not captured by structural imaging or routine laboratory testing [1-6]. EEG is essential for the detection of non-convulsive seizures and non-convulsive status epilepticus, characterization of encephalopathy, and neuroprognostication in critically ill patients. Reflecting this central role, consensus recommendations from the American Clinical Neurophysiology Society (ACNS), the Neurocritical Care Society (NCS), and the American Heart Association (AHA) emphasize early EEG acquisition for patients with unexplained altered mental status, suspected ongoing seizures, post–cardiac arrest coma, and severe acute brain injury [7-10]. These guidelines consistently underscore that time to EEG matters. earlier monitoring increases seizure detection, informs safer escalation or de-escalation of therapy, and improves the reliability of prognostic assessments [11]. Despite this consensus, real-world implementation frequently fails to meet recommended targets. Across emergency department, intensive care unit, and inpatient settings, time-to-EEG is commonly measured in hours rather than minutes, particularly outside tertiary referral centers, during nights and weekends, or in resource-limited environments [1,12,13]. Large clinical trials and pragmatic registries demonstrate that a substantial proportion of eligible patients either experience significant delays to EEG initiation or never receive EEG at all within the clinically relevant window [14-16]. This persistent gap between guideline imperatives and operational reality has created a diagnostic blind spot at precisely the moment when EEG findings exert the greatest influence on

treatment escalation, de-escalation, neuroprognostication, and downstream resource utilization [17].

Point-of-care EEG (POC-EEG) systems were developed into that response. In contrast to conventional EEG, which is optimized for comprehensive characterization under controlled conditions and relies on specialized personnel and infrastructure, POC-EEG prioritizes rapid deployment, portability, simplified application, and early acquisition of clinically actionable neurophysiologic data [18-20]. Importantly, POC-EEG is not intended to replace conventional EEG, but rather to function as a decision accelerator, enabling early identification of patients who require urgent escalation to prolonged monitoring or tertiary care, while confidently excluding seizures in others and supporting alternative diagnostic pathways [18,21]. When integrated appropriately, POC-EEG complements established EEG workflows by reducing diagnostic latency without compromising clinical rigor [22-24].

Among contemporary platforms, NeuroTrace and BrainView represents a distinctive approach that integrates clinical-grade EEG and event-related potential acquisition with scalable deployment, cloud-enabled workflows, and AI-assisted analytic support across both acute and translational settings. By combining rapid bedside access with remote expert review and standardized quantitative reporting, NeuroTrace addresses many of the structural barriers that have historically limited EEG availability. This review examines how NeuroTrace aligns with unmet needs in neurological care, situates its role within the evolving point-of-care EEG landscape, and evaluates the clinical and health-system contexts in which its impact is most pronounced.

Unmet Need for Point-of-Care EEG

The unmet need for POC-EEG arises from a fundamental temporal and structural mismatch between the dynamics of acute neurological deterioration and real-world access to conventional EEG. Non-convulsive seizures and non-convulsive status epilepticus (NCSE) are now well established as common and clinically consequential phenomena in critically ill and acutely encephalopathic patients, with modern continuous EEG cohorts consistently reporting electrographic seizures in approximately 10–30% of monitored populations, the majority of which lack overt motor manifestations. Across diverse etiologies, including (but not limited to) post–convulsive states, metabolic encephalopathy, stroke, traumatic brain injury, and post–cardiac arrest coma, electrographic seizure activity frequently persists despite apparent clinical improvement, rendering bedside examination and behavioral assessment insufficient for determining true seizure cessation. Numerous observational studies demonstrate that delayed EEG initiation is associated with prolonged seizure burden, increased secondary neuronal injury, higher morbidity, and worse functional outcomes, underscoring that time-to-EEG is not a neutral operational metric but a biologically and clinically meaningful variable [17,20,25].

Despite clear consensus recommendations from neurocritical care, clinical neurophysiology, and resuscitation societies emphasizing urgent EEG initiation when ongoing seizures or unexplained impairment of consciousness is suspected, conventional EEG workflows remain poorly aligned with these temporal imperatives. Standard EEG acquisition depends on specialized technologists, complex equipment logistics, and neurologist availability, resulting in systematic delays that are amplified during nights, weekends, and in non-tertiary settings. Even within controlled clinical trials and well-resourced academic centers, median time-to-EEG is commonly measured in hours rather than minutes, and a substantial proportion of eligible patients never receive EEG within recommended windows. These delays persist despite the recognition that the diagnostic yield of EEG is time dependent and that early electrographic data frequently alters immediate management.

Workforce constraints further compound this gap. Shortages of trained neurodiagnostic technologists and the operational difficulty of sustaining 24/7 EEG coverage are now recognized as structural limitations across health systems [26]. These constraints disproportionately affect community hospitals, rural and resource-limited settings, and international contexts, where access to continuous EEG and on-site neurophysiology expertise may be intermittent or absent. Reliance on in-person staffing models constrains scalability, limits equitable access to guideline-concordant care, and perpetuates disparities in neurological outcomes that are driven not by disease severity but by geography and infrastructure. In the absence of timely EEG data, clinicians are frequently forced into a binary and imperfect decision framework [27]. That is, empiric treatment with sedatives and anti-seizure medications or watchful waiting in the face of diagnostic uncertainty. Both strategies carry substantial risk. Undertreatment may allow ongoing electrographic seizures to persist unchecked, contributing to cumulative neuronal injury and worse neurological recovery, while overtreatment exposes patients to unnecessary medication toxicity, prolonged mechanical ventilation, ICU admission, and extended hospitalization. These downstream consequences represent not only clinical harm but also significant resource misallocation.

POC-EEG directly addresses this uncertainty by enabling rapid, bedside acquisition of objective neurophysiologic data early in the care pathway, supporting timely differentiation between patients who require urgent escalation and those in whom seizures can be confidently excluded, thereby aligning neurological decision-making with both biological urgency and health-system sustainability.

The NeuroTrace Platform: Technical and Workflow Overview

NeuroTrace is an FDA 510(k)-cleared Class II EEG system engineered for rapid deployment across acute, inpatient, and outpatient clinical environments. The platform supports clinical-grade acquisition of resting-state EEG, quantitative EEG (qEEG), and task-based ERP paradigms, enabling assessment of neural oscillatory activity, functional connectivity, and time-locked cognitive processing within a single, integrated workflow. Its scalable channel configurations allow flexibility across use cases, ranging from rapid bedside screening and triage to extended monitoring

when clinically indicated. Automated impedance checking and streamlined electrode application reduce setup complexity and permit deployment by trained non-specialist staff, addressing a major operational barrier to timely EEG access. NeuroTrace further incorporates cloud-enabled data transmission that supports remote review, tele-neurophysiology, and hub-and-spoke care models, facilitating centralized expertise across distributed clinical sites. AI-assisted detection and quantitative analytic tools, aligned with standardized EEG terminology, augment clinician interpretation while preserving compatibility with expert review and established neurophysiology standards. In contrast to early point-of-care EEG devices that prioritized minimal electrode arrays at the expense of signal fidelity, NeuroTrace is explicitly designed to preserve clinically meaningful data quality while maintaining operational speed. This design philosophy supports application across a broad spectrum of indications, spanning emergent seizure detection and critical care monitoring to longitudinal outpatient phenotyping and biomarker development, and positions the platform as a versatile bridge between research-grade electrophysiology and real-world clinical implementation.

Representative BrainView interface illustrating simultaneous visualization of raw multichannel EEG, quantitative trends, automated detection overlays, and hemispheric amplitude-integrated EEG (aEEG) summaries. The right panel displays multichannel EEG in standard longitudinal bipolar montage with preserved signal fidelity, showing organized posterior-dominant alpha rhythm across bilateral channels (highlighted), without electrographic seizure activity. Automated annotations identify rhythmic activity and flagged events in real time. The left panel demonstrates synchronized quantitative trend analytics, including hemispheric aEEG traces, spike-detection heat maps, signal quality indicators, and time-aligned event markers. Color-coded density mapping reflects spatial distribution of detected epileptiform activity over time. This integrated display exemplifies the platform's capacity to combine rapid bedside acquisition, automated quantitative analytics, and remote-ready interpretation within a single operational workflow. Such multimodal visualization supports early seizure detection or exclusion, triage decisions, and longitudinal monitoring in emergency, critical care, and outpatient environments.

High-Impact Clinical Indications

Non-Convulsive Status Epilepticus and Acute Altered Mental Status

The most mature and robust evidence base supporting POC-EEG deployment lies in patients with suspected non-convulsive status epilepticus (NCSE) and unexplained acute altered mental status (AMS). Across heterogeneous emergency department (ED) and intensive care unit (ICU) populations, electrographic seizures

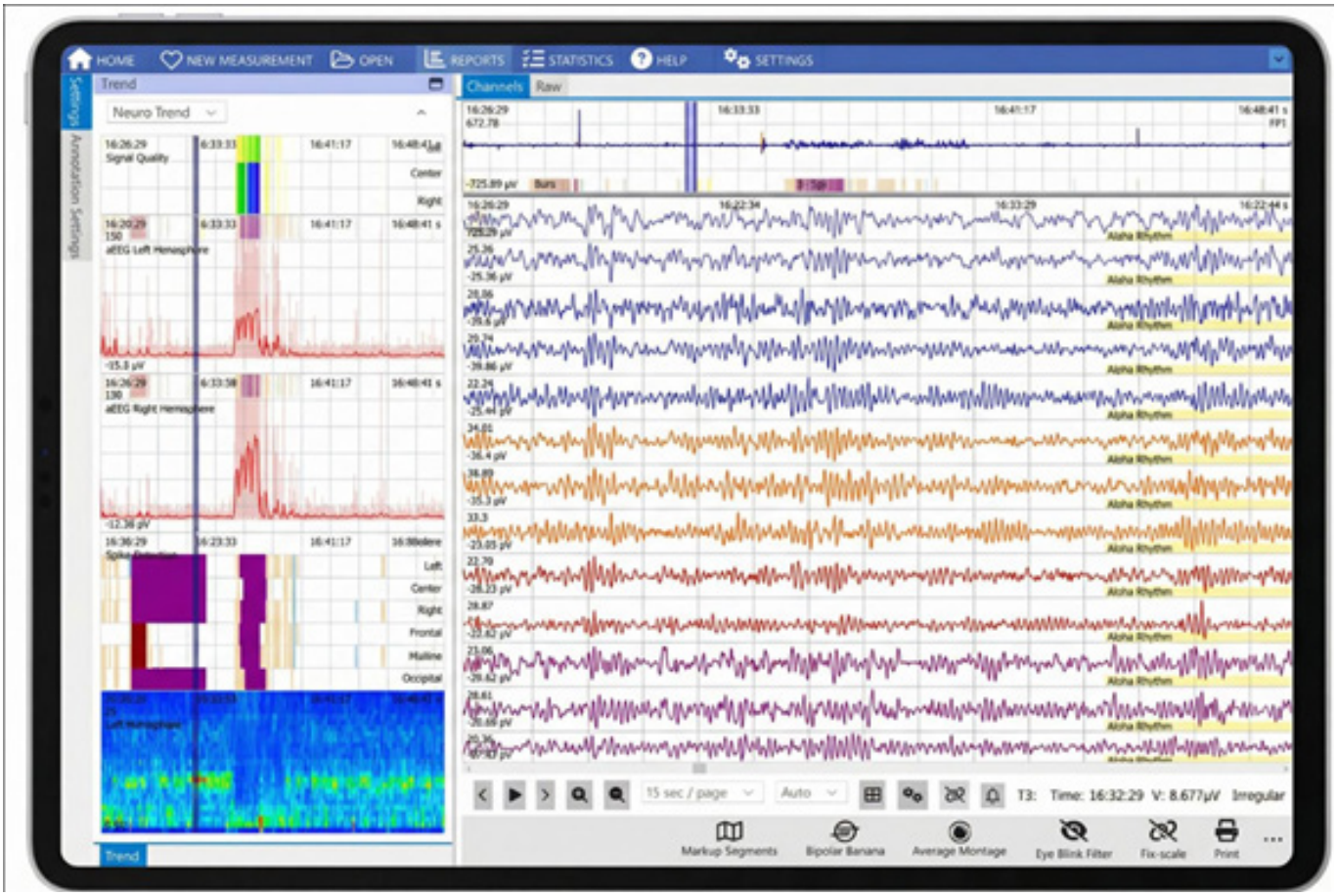

Figure 1: Integrated BrainView point-of-care EEG interface demonstrating multimodal real-time neurophysiologic assessment.

are detected in approximately 10–30% of monitored patients, with the majority lacking overt clinical correlates [28-30]. Large continuous EEG (cEEG) series consistently demonstrate that clinical examination alone is insufficient to exclude ongoing seizure activity, particularly after apparent termination of convulsive seizures or sedation administration.

Prospective and retrospective studies of rapid and POC-EEG systems demonstrate marked reductions in time-to-EEG initiation, often from several hours to minutes, when compared with conventional EEG workflows. Earlier access translates into higher electrographic seizure detection rates relative to clinical assessment alone and meaningfully alters clinical management in approximately 20–60% of cases, including both escalation and de-escalation of anti-seizure therapy. Importantly, multiple studies report that rapid EEG frequently rules out seizures, allowing clinicians to avoid unnecessary benzodiazepine administration, anesthetic escalation, intubation, or prolonged ICU monitoring when electrographic evidence does not support seizure activity.

Consensus guidance from the Neurocritical Care Society (NCS), American Clinical Neurophysiology Society (ACNS), and allied organizations emphasizes urgent EEG initiation for patients with suspected NCSE or persistent unexplained impairment of consciousness, with ideal initiation within the first hour when feasible [7]. However, real-world implementation studies repeatedly show median delays measured in hours rather than minutes, even in well-resourced centers, due to technologist availability, equipment logistics, and off-hours constraints. The ability to rapidly deploy NeuroTrace architecture, simplified electrode application, and cloud-enabled remote interpretation directly address these structural barriers, enabling earlier EEG access that aligns more closely with guideline intent rather than theoretical capability.

Emergency Department Neurology

Emergency departments represent a particularly high-yield environment for POC-EEG implementation. Patients presenting with transient loss of consciousness, post-ictal confusion, suspected seizures, stroke mimics, intoxication, metabolic encephalopathy, or unexplained AMS frequently pose diagnostic ambiguity during early evaluation [31]. In this context, EEG findings can critically influence disposition decisions, consultation urgency, and treatment escalation [32].

ED-based rapid EEG studies demonstrate that early EEG access improves diagnostic confidence, increases detection of non-convulsive seizures and highly epileptiform patterns, and supports more efficient triage [33]. Implementation studies have shown reductions in inter-hospital transfers, decreased reliance on empiric anti-seizure medication, and trends toward shorter ED and hospital length of stay when EEG data are available during initial decision-making [4]. Notably, a substantial proportion of seizures detected by rapid EEG in ED cohorts occur after hours, underscoring the importance of systems that do not depend on immediate in-person neurodiagnostic staffing [35].

NeuroTrace is well suited to ED workflows because it minimizes setup time, supports application by non-specialist personnel, and integrates EEG data into rapid clinical decision-making without introducing meaningful throughput delays. As a screening and triage modality, NeuroTrace enables emergency clinicians to more accurately distinguish patients who require urgent neurology consultation, prolonged EEG monitoring, or transfer from those who can be safely managed locally or discharged with appropriate follow-up.

Post–Cardiac Arrest and Critical Care Prognostication

In *comatose patients following cardiac arrest*, EEG serves dual and complementary roles in seizure detection and neuroprognostication [36,37]. Electrographic seizures and rhythmic or periodic patterns on the ictal–interictal continuum are common in this population and are frequently clinically silent. American Heart Association (AHA) resuscitation and postarrest care guidelines emphasize early EEG monitoring as part of standardized post–return-of-spontaneous-circulation (ROSC) pathways, both to guide treatment and to inform prognostication timelines [9]. Delayed EEG acquisition compromises these objectives, potentially allowing ongoing seizure activity to persist untreated and reducing the reliability of prognostic assessments. Continuous or serial EEG monitoring provides essential longitudinal information during temperature management, sedation weaning, and recovery of consciousness. NeuroTrace's continuous acquisition options and cloud-based remote review capabilities facilitate earlier integration of EEG into postarrest care bundles, supporting timely identification of electrographic seizures, detection of malignant EEG patterns, and ongoing assessment without dependence on immediate bedside neurophysiology resources.

qEEG metrics derived from frontal and hemispheric recordings have demonstrated sensitivity to structural brain injury, cerebral hypoperfusion, and network disruption following *traumatic brain injury* (TBI) and acute ischemic stroke [38]. In mild TBI, EEG abnormalities (e.g., alterations in spectral power, coherence, phase synchrony) have been associated with injury severity and recovery trajectories, raising interest in EEG as an adjunct to clinical assessment and neuroimaging.

In *stroke*, qEEG markers such as hemispheric asymmetry indices, delta–alpha ratios, and connectivity measures have shown promise in identifying large-vessel occlusion and differentiating stroke from common mimics. While EEG cannot replace neuroimaging, POC-EEG offers complementary physiological insight that may enhance early risk stratification, particularly in prehospital, ED, or resource-limited settings where imaging access may be delayed [17]. NeuroTrace-enabled qEEG provides a practical mechanism for integrating these physiological signals into early decision-making pathways while preserving compatibility with downstream imaging-based diagnostics.

Delirium is a common and underdiagnosed cause of acute cognitive dysfunction in hospitalized patients and is independently associated with increased mortality, prolonged hospitalization,

institutionalization, and long-term cognitive decline [39]. Clinical delirium screening tools, while valuable, are limited by subjectivity, fluctuating symptomatology, and dependence on patient cooperation. EEG-derived markers provide objective correlates of delirium severity and subtype [40]. Studies demonstrate that EEG abnormalities may precede or outlast clinically apparent delirium, suggesting a role for EEG in both detection and monitoring. POC-EEG enables bedside assessment without reliance on patient participation, making it particularly suitable for critically ill or non-cooperative patients. In this context, NeuroTrace offers a practical adjunct to clinical screening tools, supporting objective assessment of encephalopathy and informing management decisions in complex hospitalized populations.

Translational and Outpatient Extensions: From Acute Decision Support to Longitudinal Neurophysiologic Phenotyping

Beyond acute and critical care, the clinical utility of NeuroTrace extends into translational and outpatient domains where objective neurophysiologic biomarkers are urgently needed but largely absent from routine practice. Across neurology, otolaryngology, psychiatry, rehabilitation medicine, and cognitive neuroscience, a central challenge is the reliance on subjective symptom reporting and coarse behavioral measures to diagnose, stratify, and monitor disorders that are increasingly understood as network-level brain dysfunctions. EEG and ERPs uniquely address this gap by providing direct, temporally precise measures of neural oscillations, functional connectivity, and task-evoked cognitive processing that are not captured by structural imaging or standard clinical tests.

Illustration depicting rapid bedside application of a simplified EEG headband in a supine patient undergoing neurophysiologic monitoring. The electrode array is secured using a streamlined frontal montage designed for expedited placement by trained non-specialist personnel. EEG signals are transmitted in real time to a portable tablet interface displaying multichannel tracings with time-locked waveform activity. This schematic emphasizes the operational model of point-of-care EEG: minimal setup time, reduced dependency on specialized technologists, and immediate access to interpretable neurophysiologic data at the bedside. Such deployment supports early seizure detection or exclusion, triage decisions, and initiation of time-sensitive interventions in emergency departments, intensive care units, and resource-constrained environments.

Biomarker Discovery and Phenotyping in Tinnitus and Auditory–Vestibular Disorders

Tinnitus exemplifies a prevalent, high-burden condition for which

Figure 2: Bedside deployment of point-of-care EEG in an acute care setting.

no validated objective biomarker currently exists. Contemporary neurophysiologic models conceptualize tinnitus not as a purely peripheral auditory phenomenon, but as a disorder of maladaptive central gain, thalamocortical dysrhythmia, and aberrant coupling between auditory, salience, attentional, and limbic networks. EEG studies consistently implicate alterations across alpha, theta, and gamma frequency bands, as well as disrupted functional connectivity extending beyond primary auditory cortex.

NeuroTrace-enabled EEG and ERP paradigms support scalable investigation of these mechanisms in clinical populations by standardizing acquisition, preprocessing, and normative comparison. Importantly, emerging evidence suggests that multivariate EEG features, particularly network and connectivity-derived metrics, outperform single-band spectral measures in discriminating tinnitus presence, distress severity, and phenotypic subtypes. Large classification studies demonstrate that EEG-based models can differentiate tinnitus patients from controls and further distinguish high-distress from low-distress tinnitus, supporting the use of EEG as a probabilistic stratification tool rather than a binary diagnostic marker.

Post-COVID auditory and vestibular syndromes further underscore the need for objective central nervous system assessment. Patients with persistent tinnitus, dizziness, or balance dysfunction following SARS-CoV-2 infection often demonstrate discordance between subjective symptoms and peripheral audiovestibular testing [41]. EEG and ERP provide a mechanism to interrogate central network dysfunction, attentional processing abnormalities, and altered sensory integration that may contribute to symptom persistence [42]. NeuroTrace's outpatient-compatible workflow enables repeated assessments over time, facilitating differentiation between peripheral recovery and ongoing central dysfunction, as well as longitudinal monitoring of treatment response.

Cognitive–Affective and Neuropsychiatric Applications

A growing body of literature implicates large-scale network dysregulation in cognitive-affective disorders, including depression, anxiety, post-traumatic stress disorder, and attentional dysfunction [43]. Alterations in resting-state oscillatory balance, functional connectivity, and task-evoked ERP components such as the P300 have been associated with attentional control, emotional salience processing, and executive function across these conditions [44]. However, translation of these findings into routine clinical care has been limited by variability in EEG methodologies and lack of clinically deployable platforms. NeuroTrace and BrainView addresses these barriers by enabling standardized EEG/ERP acquisition with automated normative comparisons, supporting objective phenotyping in outpatient and interdisciplinary settings. ERP paradigms provide time-locked measures of sensory encoding, attention allocation, and cognitive control that complement resting-state EEG metrics. These measures are well suited for tracking treatment-related change, including pharmacologic interventions, neuromodulation, cognitive-behavioral therapy, and rehabilitation strategies, where subjective symptom improvement may not align with underlying neurophysiologic normalization.

Longitudinal Monitoring and Precision Medicine Frameworks

An essential evolution highlighted by NeuroTrace's translational applications is the shift from cross-sectional EEG assessment toward longitudinal neurophysiologic monitoring. While group-level EEG signatures often demonstrate variability across cohorts, within-subject trajectories of spectral power, connectivity, and ERP metrics may prove more stable and clinically actionable. Repeated NeuroTrace assessments allow clinicians and investigators to evaluate whether symptomatic improvement corresponds to measurable changes in brain network function, supporting the development of objective treatment-response biomarkers. This longitudinal capability aligns with emerging precision medicine paradigms across neurology and psychiatry, in which treatment selection and adjustment are guided by individual-level biomarkers rather than population averages alone. By integrating EEG data with clinical phenotypes, behavioral measures, and relevant peripheral testing, NeuroTrace supports multimodal stratification approaches that can inform prognosis, optimize intervention selection, and reduce trial-and-error care.

Bridging Research-Grade Electrophysiology and Real-World Clinical Deployment

Historically, the translation of EEG biomarkers from research laboratories into clinical practice has been impeded by methodological heterogeneity, lack of normative reference frameworks, and impractical workflows. NeuroTrace occupies a critical translational niche by preserving key elements of research-grade electrophysiology while embedding them within a clinically feasible, scalable platform. Standardized acquisition protocols, automated reporting, and normative comparisons enable data harmonization across sites and disciplines, supporting registry-based research, multi-center validation, and iterative biomarker refinement. In this capacity, NeuroTrace functions not merely as a diagnostic device, but as an infrastructure for translational neuroscience, enabling bidirectional flow between discovery science and clinical implementation.

Collectively, these applications illustrate how point-of-care EEG is evolving beyond its origins in acute neurologic emergencies toward a broader role in longitudinal phenotyping, treatment monitoring, and biomarker-driven care across multiple disciplines. NeuroTrace's design and deployment model position it at the intersection of neurology, psychiatry, otolaryngology, rehabilitation, and cognitive neuroscience, supporting a unified neurophysiologic framework that can be operationalized in real-world clinical environments.

Health-System and Economic Impact

The health-system and economic implications of point-of-care EEG extend beyond incremental diagnostic improvement to address structural inefficiencies in contemporary neurological care delivery [20]. Across emergency department, intensive care unit, and inpatient implementation studies, POC-EEG has been shown to reduce unnecessary inter-hospital transfers, shorten ICU and overall hospital length of stay, and optimize utilization of scarce neurodiagnostic and specialist resources. Earlier access to EEG

data enables more precise triage, allowing clinicians to identify patients who genuinely require escalation to tertiary centers or prolonged continuous EEG while safely managing others locally. This targeted approach reduces downstream costs associated with avoidable transfers, excess imaging, empiric pharmacologic escalation, prolonged mechanical ventilation, and extended critical care admissions.

Formal economic analyses and real-world implementation reports increasingly suggest a favorable return on investment for POC-EEG adoption, driven by a combination of avoided transfer costs, reduced dependence on after-hours technologist staffing, shorter lengths of stay, and improved diagnostic precision that limits both under- and overtreatment [20]. Importantly, these economic benefits are realized without compromising clinical rigor, as POC-EEG functions as a triage and decision-support layer rather than a replacement for comprehensive EEG when indicated. By enabling earlier exclusion of non-convulsive seizures in a substantial proportion of patients, POC-EEG prevents unnecessary exposure to costly and high-risk interventions, while simultaneously accelerating care for those who do require escalation.

Scalability and cloud-enabled tele-neurophysiology model, as in NeuroTrace, further amplify these system-level benefits by supporting redistribution of expertise rather than duplication of infrastructure. Remote review and centralized neurophysiology oversight allow health systems to extend EEG capability across networks of community, rural, and resource-limited hospitals without replicating full neurodiagnostic teams at each site. This hub-and-spoke approach aligns with modern health-system strategies focused on networked care delivery, workforce sustainability, and equitable access to specialty services. In this context, NeuroTrace functions not only as a diagnostic technology but as an enabler of system-level redesign, supporting more efficient allocation of human capital, improved consistency of neurological care, and sustainable expansion of EEG access across diverse clinical environments.

Limitations and Future Directions

Limitations and future directions for point-of-care EEG warrant careful consideration to ensure appropriate interpretation, integration, and continued scientific advancement. Despite strong and growing evidence supporting the value of POC-EEG for rapid screening, triage, and early decision support, important limitations remain. Compared with full-montage conventional EEG, many POC-EEG implementations offer reduced spatial resolution, which may limit precise localization of epileptiform activity or characterization of complex focal patterns. In addition, variability in algorithmic performance underscores the need for cautious interpretation and continued reliance on expert oversight. These constraints highlight that POC-EEG should be viewed as a complementary layer within a broader neurodiagnostic ecosystem rather than a standalone diagnostic replacement, and they reinforce the importance of ongoing validation against expert consensus standards and clinically meaningful outcome measures.

Looking forward, several priorities are critical for the maturation of the field. Point-of-care EEG represents a critical evolution in neurological diagnostics, addressing long-standing gaps between clinical urgency and neurophysiologic insight. Prospective, multicenter studies are needed to directly link early POC-EEG–guided clinical decisions with neurological outcomes, including seizure burden, functional recovery, length of stay, and mortality, thereby moving beyond process metrics toward outcome-based validation. Parallel efforts should focus on expanding analytic frameworks beyond binary seizure detection to incorporate multivariate EEG biomarkers encompassing spectral features, functional connectivity, network dynamics, and event-related potentials, which may better capture the complexity of acute and chronic brain dysfunction. Equally important is the development and dissemination of standardized clinical pathways that embed POC-EEG within guideline-concordant care models, clarifying when rapid EEG should trigger escalation to continuous monitoring, specialist consultation, or alternative diagnostic strategies. A modular architecture, scalable deployment model, and integration of quantitative analytics provide a practical foundation for pursuing these advances; however, rigorous, transparent validation across diverse populations and care settings ultimately determine its long-term role in neurological practice and its contribution to evidence-based, equitable neurodiagnostic care.

Conclusion

POC- EEG represents more than an incremental technological refinement. It reflects a structural recalibration of how neurophysiologic data are delivered within time-critical systems of care. For decades, the clinical value of EEG has been unquestioned, yet its impact has been constrained by delays, workforce limitations, and infrastructural asymmetries that decouple diagnostic capability from biological urgency. POC-EEG narrows that gap by repositioning neurophysiology at the bedside, enabling earlier detection of covert seizure activity, more informed triage decisions, and timelier escalation or de-escalation of therapy in environments where minutes meaningfully influence neuronal survival and functional recovery. Importantly, its role is not substitutive but integrative: functioning as a decision-enabling layer that complements comprehensive and continuous EEG while reducing diagnostic latency and uncertainty.

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