Anthem

Clinical UM Guideline

Subject: Electroencephalography and Video Electroencephalographic Monitoring
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Description

This document addresses electroencephalography (EEG) with and without video monitoring in the ambulatory setting and attended video EEG in a healthcare facility.

Clinical Indications

Ambulatory EEG

Medically Necessary:

Ambulatory EEG with or without video monitoring is considered **medically necessary** for **any** of the following indications:

- To diagnose a seizure disorder when either the clinical history or examination is suggestive of epilepsy, but routine EEG is non-diagnostic; **or**
- To classify seizure type in individuals with epilepsy after a routine EEG is non-diagnostic and classification will be used to select drug therapy; **or**
- To differentiate between paroxysmal non-epileptic events and seizures; **or**
- To document seizures precipitated by naturally occurring cyclic events or extraneous stimuli (for example, flashing lights, loud sounds, sudden movements) that are not reproducible in the hospital or laboratory setting; **or**
- To evaluate seizures or syncope suspected to be cardiogenic in etiology when cardiac evaluation has not been diagnostic; **or**
- To quantify the number of electrical seizures in individuals who experience frequent seizures.

Not Medically Necessary:

Ambulatory EEG with or without video monitoring is considered **not medically necessary** in **all** of the following circumstances including, but not limited to:

- Use in unattended, uncooperative individuals.
- Localization of seizure focus in individuals with medically refractory epilepsy who are candidates for epilepsy surgery.
- Antiseizure medication treatment withdrawal or modification in individuals where the risk of seizure precipitation would require immediate medical intervention.
- When an above criterion is not met.

Attended EEG Video Monitoring in a Healthcare Facility

Medically Necessary:

Attended EEG with video monitoring in a healthcare facility is considered **medically necessary** for **any** of the following indications:

- Antiseizure medication withdrawal or modification in individuals where risk of seizure precipitation would require immediate medical intervention; **or**
- Presurgical evaluation for epilepsy surgery for localization of epileptic foci; **or**
- Differentiating epileptic from nonepileptic seizures; **or**
- Status epilepticus; **or**
- Non-convulsive status epilepticus.

Not Medically Necessary:

Attended EEG with video monitoring in a healthcare facility is considered **not medically necessary** when an above criterion is not met and for all other indications.

Coding

The following codes for treatments and procedures applicable to this guideline are included below for informational purposes. Inclusion or exclusion of a procedure, diagnosis or device code(s) does not constitute or imply member coverage or provider reimbursement policy. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage of these services as it applies to an individual member.

When services may be Medically Necessary when criteria are met:

CPT	
95700	Electroencephalogram (EEG) continuous recording, with video when performed, setup, patient education, and takedown when performed, administered in person by EEG technologist, minimum of 8 channels
	EEG, technical services
95705	Electroencephalogram (EEG), without video, review of data, technical description by EEG technologist, 2-12 hours; unmonitored
95706	Electroencephalogram (EEG), without video, review of data, technical description by EEG technologist, 2-12 hours; with intermittent monitoring and maintenance
95708	Electroencephalogram (EEG), without video, review of data, technical description by EEG technologist, each increment of 12-26 hours; unmonitored
95709	Electroencephalogram (EEG), without video, review of data, technical description by EEG technologist, each increment of 12-26 hours; with intermittent monitoring and maintenance

	VEEG, technical services
95711	Electroencephalogram with video (VEEG), review of data, technical description by EEG technologist, 2-12 hours; unmonitored
95712	Electroencephalogram with video (VEEG), review of data, technical description by EEG technologist, 2-12 hours; with intermittent monitoring and maintenance
95713	Electroencephalogram with video (VEEG), review of data, technical description by EEG technologist, 2-12 hours; with continuous, real-time monitoring and maintenance
95714	Electroencephalogram with video (VEEG), review of data, technical description by EEG technologist, each increment of 12-26 hours; unmonitored
95715	Electroencephalogram with video (VEEG), review of data, technical description by EEG technologist, each increment of 12-26 hours; with intermittent monitoring and maintenance
95716	Electroencephalogram with video (VEEG), review of data, technical description by EEG technologist, each increment of 12-26 hours; with continuous, real-time monitoring and maintenance
	EEG and VEEG, professional services
95717	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation and report, 2-12 hours of EEG recording; without video
95718	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation and report, 2-12 hours of EEG recording; with video (VEEG)
95719	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, each increment of greater than 12 hours, up to 26 hours of EEG recording, interpretation and report after each 24-hour period; without video
95720	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, each increment of greater than 12 hours, up to 26 hours of EEG recording, interpretation and report after each 24-hour period; with video (VEEG)
95721	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation, and summary report, complete study; greater than 36 hours, up to 60 hours of EEG recording, without video
95722	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation, and summary report, complete study; greater than 36 hours, up to 60 hours of EEG recording, with video (VEEG)
95723	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation, and summary report, complete study; greater than 60 hours, up to 84 hours of EEG recording, without video
95724	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation, and summary report, complete study; greater than 60 hours, up to 84 hours of EEG recording, with video (VEEG)
95725	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation, and summary report, complete study; greater than 84 hours of EEG recording, without video
95726	Electroencephalogram (EEG), continuous recording, physician or other qualified health care professional review of recorded events, analysis of spike and seizure detection, interpretation, and summary report, complete study; greater than 84 hours of EEG recording, with video (VEEG)
95999	Unlisted neurological or neuromuscular diagnostic procedure [for example, set-up by someone who is not an EEG technologist, services with fewer than eight channels]

ICD-10 Procedure

4A10X4Z	Monitoring of central nervous electrical activity, external approach

ICD-10 Diagnosis

F44.5	Conversion disorder with seizures or convulsions
F48.8	Other specified nonpsychotic mental disorders (psychogenic syncope)
G40.001-G40.919	Epilepsy and recurrent seizures
G40.A01-G40.A19	Absence epileptic syndrome
G40.B01-G40.B19	Juvenile myoclonic epilepsy (impulsive petit mal)
G40.C01-G40.C19	Lafora progressive myoclonus epilepsy
I67.81-I67.89	Other specified cerebrovascular diseases
P90	Convulsions of newborn
R25.0-R25.9	Abnormal involuntary movements
R55	Syncope and collapse
R56.00-R56.9	Convulsions, not elsewhere classified
Z86.73	Personal history of transient ischemic attack (TIA), cerebral infarction w/o residual deficit

When services are Not Medically Necessary:
For the procedure codes listed above when criteria are not met; or when the code describes a procedure or situation designated in the Clinical Indications section as not medically necessary.

Discussion/General Information

According to the Epilepsy Foundation, epilepsy affects approximately 3.4 million people in the United States. Epileptic seizures can be related to a brain injury or genetics, but the cause is unknown for many individuals with epilepsy. The Centers for Disease Control and Prevention estimates epilepsy affects about 470,000 children. The onset rate increases with aging, particularly if an older adult

experiences a stroke or develops a brain tumor or Alzheimer's disease, all of which may result in seizures or epilepsy. Some reports indicate that more than 570,000 adults over the age of 65 suffer from the disorder. The Epilepsy Therapy Project notes that 10% of the population will have a seizure in their lifetime. In addition, it is estimated that over one-third of individuals have epilepsy with drug-resistant seizures (seizures that do not respond to treatment).

An EEG test records continuous and prolonged electrical activity of the brain to assist in the evaluation and diagnosis of seizure disorders, epilepsy syndromes, and other conditions.

Ambulatory EEG monitoring in the outpatient setting (for example, a home environment) is a diagnostic test used to evaluate an individual in whom a seizure disorder is suspected but undefined by the person's medical history, physical examination, or a routine (standard/resting) EEG. Ambulatory EEG recordings are utilized in the evaluation and differential diagnosis of other conditions including cardiac arrhythmias, psychogenic episodes, sleep apnea, syncopal episodes, and transient ischemic attacks if these episodes are not identified by conventional studies. In most instances, a routine EEG performed at a clinic or outpatient epilepsy facility can identify brain activity specific to seizures; however, when routine EEG is inconclusive and the clinical history strongly suggests seizure activity, an ambulatory EEG may be indicated. Routine EEGs and ambulatory EEGs may not capture all the suspected events. In these instances it may be necessary to add video to the EEG. There have been technologic developments for EEG which includes the use of continuous EEG and synchronized video recording in the home or ambulatory setting. The technology is performed to supplement descriptions of seizure activity by care takers. A video EEG records brainwave activity on an EEG and a video of what is going on at the same time. The purpose of this is to compare what is happening when a seizure or event occurs and compare the video to what the EEG records at the same time.

Ambulatory EEG (with or without video monitoring)
Ambulatory EEG testing provides a continuous recording of the brain's electrical activity that can range from several hours to several days (typically 48 hours to 72 hours). In the outpatient setting (physician office, clinic, or in the home setting), a set of electrodes with leads is secured to the person's scalp and a recording unit is attached by a belt to the waist or on a shoulder harness. The technology has evolved such that portable recordings of up to 32 channels can record computer-assisted spike and seizure detection rates over several days. The computer software is designed with the goal to increase the chance of recording an ictal event or interictal (the period of time between seizures) epileptiform discharges (IEDs) during the person's routine daily activities and sleep. The person being monitored and observers (family member, caregiver) have the opportunity to "tag" portions of the recording during clinical events using a push-button device. Some systems can be configured for polysomnography, with inputs available for monitoring simultaneous electrocardiogram (ECG), oximetry, pulse, respiratory, synchronous video recording, and other parameters. The gold standard for evaluating the large amount of data collected by a computer-assisted system is visual analysis at the end of the testing period by a highly trained individual (Foley, 2000; Seneviratne, 2013; Waterhouse, 2003).

Seizures vary to such an extent that epilepsy specialists frequently re-classify seizure types. Current classifications include three basic categories: generalized onset seizures, focal onset seizures, and unknown onset. Classifying the type of seizure assists the physician in diagnosing whether or not an individual has epilepsy or another condition and is important in the selection of appropriate anti-epileptic drug treatment. Generalized onset seizures are produced by electrical impulses throughout the entire brain. These seizures affect both sides of the brain at the same time. The most common types of generalized seizures include absence seizures (petit mal), atonic seizures, clonic seizures, generalized tonic-clonic (grand mal), myoclonic seizures, and tonic seizures. In focal onset seizures, the electrical impulses can start in one area on one side of the brain. When an individual is awake and aware during a seizure this is known as a focal aware seizure. Conversely, if an individual is confused or they have impaired awareness during their seizure this is referred to as focal impaired awareness. An unknown onset seizure is when the beginning of the seizure is not known. This may be because the seizure is not witnessed. Seizure syndromes are specific to adults and children of all ages. Epilepsy syndromes in adults include, but are not limited to temporal lobe epilepsy, primary generalized epilepsy, idiopathic focal epilepsy, and progressive myoclonic epilepsy. Epilepsy syndromes in children include, but are not limited to febrile seizures, Landau-Kleffner Syndrome, Lennox-Gastaut Syndrome, and benign occipital epilepsy.

Routine EEG in persons with epilepsy may fail to demonstrate interictal epileptiform activity. Ambulatory EEG is useful in documenting interictal epileptiform activity when routine EEG is non-diagnostic due to the extended sampling period. In those with daily to almost daily seizures, ambulatory EEG with video may be able to capture events. Studies looking at the diagnostic yield of ambulatory EEG indicate that 6% to 15% of ambulatory EEG recordings identify seizures (Waterhouse, 2003). Morris and colleagues (1994) retrospectively studied the ambulatory EEG results of 344 individuals referred to a community-based outpatient EEG service for further diagnostic evaluation using a 16-channel bipolar recording system. Ambulatory EEG was reviewed for the presence of user-identified events, computer identified interictal and ictal abnormalities, and periodic time samples. A push-button recording that signified a clinical event was obtained in 166 individuals (48.3%); 41 (11.9%) of these recordings included a seizure and 125 (36.3%) showed no EEG changes during the habitual event. An EEG abnormality was identified by the computer in an additional 90 recordings (26.2%), for an overall clinical usefulness of 74.4%. Among the 191 individuals referred with previously normal routine EEGs, 129 (67.5%) of these recordings were useful; 48 (25.1%) of these tracings were abnormal and an additional 81 push-button events (42.4%) showed no changes were recorded from background EEG. Tatum and colleagues (2001) retrospectively studied 502 participants evaluated with a computer-assisted 16-channel ambulatory EEG, identifying that 38.3% of seizures went unreported by participants with 8.5% demonstrating seizure activity during the recording period (mean=28.5 hours). Faulkner and colleagues (2012a) studied the value of outpatient ambulatory EEG in the diagnosis and classification of epilepsy. When compared to routine EEG, ambulatory EEG demonstrated a higher yield and diagnostic sensitivity.

In a 2016 retrospective review by Lawley and colleagues, review of 88 ambulatory video EEG studies was completed in order to assess the diagnostic utility. Clinical events (defined in this study as epileptic seizures, physiologic nonepileptic events, or psychogenic nonepileptic seizures) occurred during 55 of the ambulatory video EEG studies (62.5%). In 26 of these, at least one event was also clearly seen on video recording. In 6 of the ambulatory video EEG studies which captured events, a diagnosis of epileptic seizures was confirmed. The remaining 49 studies which captured events had no associated changes in the underlying ambulatory video EEG. The authors noted an overall diagnostic utility of 67%. Results of ambulatory video EEG influenced medical management in 34 cases, including change in antiepileptic medication or adoption of an alternate management strategy when a different diagnosis was suggested. Management strategy was changed in 75.0% of cases where an event occurred but was not seen on video. Two studies were unsuccessful because of technical equipment problems (failure to activate the camcorder). And while this study has limitations which include its retrospective design and potential for selection bias due to referral for ambulatory video EEG, the ambulatory video EEG appears to have a high diagnostic utility and continuing advances in technology may help in the future with technical factors and potential loss of data.

Recognition of IEDs in the absence of recorded seizures can provide evidence to support a clinical diagnosis of epilepsy. Ambulatory EEG is highly specific in identifying the occurrence of electrical spikes in persons in whom the diagnosis of seizures is being considered. Schachter and colleagues (1998) evaluated the incidence of spikes and paroxysmal rhythmic events (PREs) using a computer-assisted ambulatory EEG monitoring system in a multicenter study of asymptomatic adults (n=135) without a history of migraine or a family history of epilepsy. Spikes and PREs were evident in the overnight ambulatory EEG of only 1 asymptomatic adult (0.7%). The incidences of spikes in 24 other subjects with a history of migraine and/or a family history of epilepsy were 12.5% and

13.3%, respectively. The ambulatory EEGs of these subjects were significantly more likely to show spikes than the ambulatory EEGs of subjects without migraine or a family history of epilepsy. Olson (2001) reviewed ambulatory EEGs of 167 children when seizure-like events occurred at least 3 days per week to determine why the ambulatory EEGs were performed and whether typical seizures were recorded. Most ambulatory EEGs were performed to discriminate between epileptic and non-epileptic seizures. Ten children were recorded to determine if they were having frequent subtle seizures or frequent IEDs. The remaining 157 children had discrete events. A total of 140 children (89%) had their typical spells recorded while 107 of these children (76%) had non-epileptic events. Average duration of recording was 1.9 days. Ambulatory EEG was successful in recording children's seizure-like events when parents reported events occurring at least 3 days per week. The procedure was well tolerated and there were few technical problems with prolonged recording time.

Additional case series and retrospective studies compare and confirm higher yields of epileptiform abnormalities and clinical events captured by ambulatory EEG compared to routine EEG (Saravanan, 2001). Clinicians suggest that ambulatory EEG is superior to routine EEG in identifying both IEDs and seizures. Studies involving children and adults report a moderate to high diagnostic yield with ambulatory EEG in differentiating between seizures and non-epileptic events, quantifying seizure activity, and characterizing seizure type and location (Dash, 2012; Faulkner, 2012b; Hussain, 2013; Wirrell, 2008). Stefan and colleagues (2009; 2011) proposed the utility of outpatient ambulatory EEG (using a portable video camera in a domestic environment) as a more reliable, objective method of measuring seizure frequency to evaluate response to antiepileptic drug therapy in persons with medically refractory epilepsy.

Some persons in whom epilepsy is suspected have a normal routine or sleep-deprived EEG. An ambulatory EEG may increase the chance of detecting an epileptiform abnormality in these individuals and significantly impact clinical management. An estimated 12% to 25% of individuals who previously had a normal or non-diagnostic routine EEG have epileptiform activity on ambulatory EEG (Waterhouse, 2003). Liporace and colleagues (1998) conducted a multicenter prospective study comparing the usefulness of a sleep-deprived EEG versus a computer-assisted 16-channel ambulatory EEG in individuals with historical information consistent with epilepsy but with a normal or non-diagnostic initial routine EEG. A total of 46 participants had both a 30 to 60 minute sleep-deprived EEG and a computer-assisted ambulatory 24-hour EEG. Sleep-deprived EEG improved detection of epileptiform discharges by 24%, where ambulatory EEG improved detection of epileptiform discharges by 33%. Ambulatory EEG detected seizures in 7 of 46 (15%) participants, and in 3 participants the seizures were solely detected by the computer. Ambulatory EEG is invaluable in assessing nocturnal or sleep-related events because of its capacity to record an entire night of sleep and children can be monitored at home (Foley, 2000). In addition, an individual’s medical history may not reliably differentiate sleep-related events or disorders from epilepsy. An ambulatory EEG may record frequent arousals, suggesting sleep apnea, sustained daytime somnolence, or decreased rapid eye movement sleep latency (as in narcolepsy) and can assist in differentiating between an unsuspected sleep-related disorder and epilepsy (Waterhouse, 2003).

Ambulatory EEG is helpful at identifying seizures that are unrecognized or unreported by the individual and is easily accomplished on an outpatient basis. In both absence and focal seizures, individuals may experience brief alterations in the level of consciousness and impaired reaction time yet be unaware they are experiencing a seizure (Waterhouse, 2003). Keilson and colleagues (1987) studied 15 children, ages 5 to 16 years, with absence epilepsy using an 8-channel ambulatory cassette EEG. All 15 children demonstrated multiple paroxysms of generalized spike-and-wave discharges, most of which were asymptomatic. Therefore, ambulatory EEG may be useful in documenting the success or failure of a therapy in the treatment of absence seizures. In these situations, an ambulatory EEG of an untreated individual may show numerous daily seizures, yet normalize with adequate treatment.

Clinical events known as Psychogenic Non-epileptic Seizures (PNES) are non-epileptic seizures where the person perceives altered movement, emotion, sensation, or an experience similar to those involved with epilepsy. These events are without an EEG documented ictal association. PNES occur in as many as 20% of persons evaluated at inpatient epilepsy monitoring centers and in 5% to 20% of outpatient populations. Both PNES and epileptic seizures are concurrent in an estimated 10% to 60% of individuals with epilepsy (Waterhouse, 2003). In a retrospective review conducted by Morris and colleagues (1994), 36% (125 of 344) of participants in an outpatient study of ambulatory EEG activated the ambulatory event marker for events that were not associated with EEG changes. However, since some seizures are associated with minimal EEG changes or with movement and muscle artifacts that obscure the EEG, an ambulatory EEG is considered clinically appropriate as the initial screening procedure for non-epileptic events. Inpatient video EEG remains the gold standard to definitively diagnose non-epileptic PNES (LaFrance, 2013; Waterhouse, 2003).

Syncope or near-syncopal episodes may be evaluated with an ambulatory EEG if an ECG lead replaces one of the EEG channels (Lai, 1981). Although the underlying pathophysiological processes are distinct, seizures and syncope share some clinical characteristics which may lead to diagnostic confusion in addition to the fact that seizures and syncope may coexist in a given individual (Zaidi, 2000). Although arrhythmias have been diagnosed with continuous ambulatory EEG/ECG recording, a retrospective record review of epileptiform abnormalities in 500 individuals found epileptiform abnormalities in 1.5% of individuals with syncope and in none without a clear history of episodic complaints (Bridgers and Ebersole, 1985).

Evaluating adequate ictal and interictal EEG data is vital in facilitating localization of seizures in localization-related epilepsy (Kelly, 2011). The peer-reviewed literature reviewing the use of outpatient ambulatory EEG monitoring as the sole EEG modality in the presurgical evaluation of persons with medically refractory epilepsy consists of a single case study (Schomer, 1999) and a small case series (Chang, 2002) from the same treatment center. Chang and colleagues (2002) reported on 7 persons who underwent surgery for temporal lobe epilepsy after presurgical EEG monitoring was performed exclusively in the home setting. When compared to a group of 14 persons with similar characteristics (including age, epilepsy, duration, seizure frequency and number of antiepileptic drugs tried before evaluation) who underwent inpatient video EEG monitoring, the number of seizures captured and mean recording duration were less in the 7 persons who were evaluated with ambulatory EEG. The small, nonrandomized sample from a single institution and the retrospective design of the study make it difficult to draw conclusions regarding optimal criteria for selecting persons for ambulatory EEG in the presurgical workup.

A retrospective chart review by Primiani and colleagues (2021) reports on the yield of ambulatory EEG with video monitoring. The records of 200 individuals were reviewed. Participants younger than 12 years of age were excluded from the study. The initial reasons for ambulatory EEG with video monitoring was to capture an event in question (179/200 participants), interictal characterization (6/200 participants), and indeterminate reason (15/200 participants). There were 110 studies (55%) with clinical events recorded and 101 studies (92%) capturing recorded events on camera. Based on the video monitoring, final diagnoses were as follows: clear epileptic seizures with EEG correlate (18/200, 9%), nonepileptic events with no EEG correlate (76/200, 38%), event recorded without video capture (8/200, 4%), atypical event without EEG correlate (4/200, 2%), and no event but with clear interictal epileptiform abnormalities (22/200, 11%). Several individuals had diagnoses which were deemed inconclusive; no events and normal EEG (61/200, 30.5%) and no events with nonepileptic abnormal EEG (11/200, 5.5%). While this study has limitations including lack of information about medical management following the study, ambulatory EEG with video monitoring may be appropriate as an alternative to inpatient video EEG.

Ambulatory EEG is an outpatient test measuring the electrical activity in the brain and has been used for many years in the evaluation and diagnosis of seizure disorders, epilepsy syndromes, and other conditions. It is considered a safe procedure in the home setting and the test causes no discomfort to the individual as the electrodes only record activity and do not produce any electrical current.

Attended EEG Video Monitoring in a Healthcare Facility

Inpatient video EEG monitoring is considered the preferred mode and gold standard of practice in presurgical EEG testing by most epilepsy treatment centers because it accurately differentiates epileptic from non-epileptic events and provides data to localize the epileptogenic zone in candidates for epilepsy surgery (Seneviratne, 2013; Wirrell, 2008).

In a 2009 study by Moien-Afshari and colleagues, 50 participants had video EEG and were monitored in an inpatient setting for the discontinuation of antiepileptic drugs. In 90% of the participants, neurological exam was normal and 24% of participants had a normal routine EEG prior to admission. During the admission and video EEG, 31 participants had recorded epileptic events and 23 were identified as candidates for epilepsy surgery. The mean hospital stay for monitoring was 4.4 days. Despite the medical management being changed in 74% of the participants, this study is limited by the lack of control group.

In a 2013 study by Kumar-Pelayo, the charts of 100 participants were reviewed to determine the goal of inpatient video EEG and analyze the outcome. The reasons for admission were to characterize events as either epileptic or nonepileptic (n=41), to localize epileptic foci (n=23), to characterize the epilepsy syndrome (n=32), and to attempt safe antiepileptic drug adjustment (n=4). For classification of the events as either epileptic or nonepileptic, determination was made in 29 of the participants. Localization of an epileptic focus was achieved in all 23 of the participants admitted for that purpose. Of the 23 participants admitted for seizure localization, 15 proceeded with surgical evaluation and 5 of those underwent craniotomy within 6 months. Epilepsy syndrome was characterized in 22 participants. Medication adjustment was made in 3 participants. Inpatient length of stay ranged from 1 to 8 days.

A prospective study by Carlson and colleagues (2018) compared home video telemetry to inpatient video telemetry in 62 children. All participants were under the age of 18 and had video telemetry duration of 24-72 hours. Participants were excluded if they had undergone anti-epileptic drug withdrawal. There were 29 children in the inpatient video telemetry group and 33 children in the home video group. During the inpatient video telemetry, 62% of studies captured ictal events compared to 64% of studies captured ictal events during the home video telemetry recordings. The reasons for requesting both home and inpatient video telemetry were similar in both groups, with the majority of both studies being done for diagnostic purposes. With no significant difference observed between the two methods, overall, both the home video telemetry and inpatient video telemetry studies answered the question asked of them (59% and 70%, respectively). For both groups, the most common type of ictal event captured was an epileptic event. The quality of the EEG was satisfactory among both groups. In the inpatient video telemetry group, the night video quality was higher. When the attacks were captured, all were visualized in 39% of the studies. At least some attacks were recorded in 78% of the studies and all attacks were missed in 22% of the recordings. Equipment difficulties occurred in 38% of the studies and were largely due to incorrect camera position. This resulted in lost diagnostic information in 28% of the inpatient video telemetry studies. During the home video telemetry studies, when the attacks were captured, all were visualized in 33% of the studies. At least some of the attacks were recorded in 71% of the studies and all attacks were missed in 22% of the recordings. Equipment difficulties were reported in 51% of the studies and included issues regarding camera placement and activation of the infrared camera capability, which resulted in a loss of diagnostic video information in 15% of the home video telemetry studies. While this study has limitations including the lack of randomization of study participants and the subjective nature of recording quality assessment by a variety of clinical physiologists, home video telemetry provides results similar to inpatient video telemetry in terms of technical and diagnostic quality.

The peer-reviewed literature discussing the selection process of appropriate candidates for temporal lobe epilepsy resection surgery consistently recommends that surgery is only undertaken after long-term video EEG monitoring in an epilepsy unit. Ambulatory EEG in the outpatient setting provides insufficient information for localizing both interictal and ictal onset zones and does not allow for the person to be subjected to provocative measures such as medication tapering or reinstitution, sleep deprivation, hyperventilation, or photic stimulation in a controlled environment, all techniques that increase the likelihood of capturing reliable presurgical epileptiform activity (Mansouri, 2012).

Status epilepticus is a condition in which individuals have prolonged seizures or when seizures occur too close together for them to recover in between episodes. However, not all seizure activity occurs in the same way. Due to a lack of convulsions, nonconvulsive status epilepticus may be difficult to diagnose. This is even more difficult for individuals who are comatose with unexplained and continued altered consciousness. Continuous video EEG is a way to capture these types of seizures. In a 2004 study by Claassen and colleagues, a total of 572 individuals were reviewed for detection of subclinical seizures or evaluated for an unexplained decrease in their level of consciousness. Using continuous video EEG monitoring, seizures were found in 110 individuals. Of the 110 individuals found to have seizure activity, 101 of them were noted to be nonconvulsive. The majority of the individuals (88%) had seizures detected within the first 24 hours of EEG monitoring. A 2013 literature analysis by the European Society of Intensive Care Medicine (Claassen, 2013) sought to establish recommendations on the use of EEG in the intensive care unit setting. With 42 studies included in the review, the consensus was to recommend EEG in status epilepticus and in ruling out nonconvulsive status epilepticus. This technology can be important in managing and directing care.

In a 2014 study by Goodwin and colleagues, 130 participants who had previous ambulatory EEG testing were offered video EEG to be done in the home setting. A total of 45 participants accepted the offer of video EEG in the home setting to study the nature of undiagnosed paroxysmal events. Of the 45 participants who used the video EEG in the home setting, an ictus occurred in 34 participants. Of those 34 participants, 17 had a habitual attack which was captured by video. A total of 14 participants who had a recorded attack had information which was useful in interpreting the ambulatory EEG. Failure to capture attacks on video was attributed to failure to operate the equipment successfully and events being too brief to set up the video in time. The quality of the video was deemed to be satisfactory in all 17 instances in which an attack was captured on video. While this study provides useful information from the home video recordings, there are limitations to outpatient video EEG including some families have less familiarity with the technology and certain participants are more or less likely to be observed closer by family members therefore there is a varying chance of capturing data on video.

In a 2019 retrospective review, Cho and colleagues analyzed the charts of 1025 cases over a 15-year period to determine the clinical utility and diagnostic yield of video EEG in an epilepsy center. There were 170 cases in which video EEG was normal. All but 291 cases had a prior routine EEG. After reviewing 417 cases with routine EEG, the authors noted 233 concordant results between the routine EEG and video EEG. Psychogenic non-epileptic seizure was found in 99 cases, status epilepticus found in 36 cases, and other diagnoses in 34 cases. A diagnosis of epilepsy was confirmed in 803 cases, of whom 763 had epileptic seizures and 367 had interictal epileptiform discharges. Over the 15-year time period, the numbers of presurgical evaluation was 414 (40.4%), seizure classification was 242 (23.6%), and diagnostic evaluation of paroxysmal events was 369 (36.0%). The sensitivity for diagnosing epilepsy was 95.0% and specificity was 99.6%. The positive value of video EEG was 99.9% with a negative predictive value of 84.7%. The diagnostic yield for epilepsy was 83.4%; however, there were 119 out of 1025 video EEGs in which VEEG alone could not find significant clinical information which led to a diagnostic yield for clinical utility of 88.4%. Over the 15-year period, the proportion of normal video EEG increased from 4.1% to 24.1% while the proportion of epilepsy in total cases of video EEG decreased from 77.2% to 61.4%. While there were 803 cases of epilepsy confirmed by video EEG, the authors note that presurgical evaluation continues to be the main use for video EEG.

A 2016 retrospective comparative study by Biswas and colleagues looked at 28 individuals who had inpatient video EEG and compared the quality of the EEG to 28 individuals who had ambulatory video EEG. Comparisons were made to visibility of body part of

interest, visibility of eyes, time of events captured, level of illumination, contrast (discerning the subject from the environment), sound quality and clarity of picture when amplified to 200%. In the majority of compared variables (the visibility of body part of interest, visibility of eyes, time of the event, and sound quality) there were no statistically significant differences between ambulatory video EEG and inpatient video EEG. When amplified, the picture quality showed to be slightly better on the ambulatory video EEG group. Statistically significant differences were noted in lighting and contrast distributions. The authors contributed this to lights being switched off more often at night in the inpatient setting. It should be noted that participants were excluded from the analysis where no events were captured and it was difficult to find an adequate number of participants with a captured event since the study was based solely on video quality by analyzing captured events.

A 2017 study by Kandler and colleagues reported on a comparison between ambulatory video EEG to inpatient video EEG in terms of diagnostic efficiency and quality of video EEG recording. In this prospective study 41 participants received ambulatory video EEG while 64 participants received video EEG monitoring in the inpatient setting. Neither group of participants were subjected to anti-epileptic medication withdrawal or sleep deprivation and none were being assessed for epilepsy surgery. Of the participants referred to differentiate between epilepsy and non-epileptic attack disorder, the diagnostic question was answered in 10/15 (67%) of ambulatory video EEGs and 27/43 (63%) of inpatient video EEGs. On recordings where attacks occurred, all were clearly seen on video in 19/25 (76%) of ambulatory video EEGs and 22/31 (71%) of inpatient video EEGs. At least some attacks were visualized on 22/25 (88%) of video EEGs and 26/31 (84%) of inpatient video EEGs. The nighttime video was rated as good quality in 35/41 (85%) of video EEGs and in 60/64 (94%) of inpatient video EEGs. Accurate interpretation EEG was achieved in 40/41 (97%) of ambulatory video EEGs and 58/64 (91%) of inpatient video EEGs. Ambulatory video EEG equipment was reported as difficult to use by four participants, but diagnostic information was lost in only one participant. A valid concern regarding the use of ambulatory video EEG is the loss of diagnostic data; however, equipment failure can also occur in a facility setting. In this particular study, the comparisons of diagnostic yield between the two groups was similar.

It should be noted that the published studies of ambulatory video EEG exclude participants where seizure medications are to be withdrawn or modified. Also excluded are participants considered for epilepsy surgery who need localization of the seizure focus. With continued advances in technology of video recording devices and more familiarity of the general population with the use of recording devices, results from ambulatory video EEG continue to improve and show similar results when compared to inpatient video EEG recording.

Definitions

Absence seizure: A staring spell, usually brief (less than 15 seconds) in duration due to abnormal electrical activity of the brain; commonly called a petit mal seizure.

Ambulatory EEG: An EEG recorded over the course of several hours to several days outside of a health care facility.

Electroencephalography (EEG): A test that involves recording of the electrical activity of the brain (brain waves).

Epilepsy: A condition of the brain where an individual is prone to repeated seizures.

Epileptic seizure: A brief occurrence of signs and/or symptoms such as sudden and involuntary jerk of a hand, arm, or whole body, a strange smell (such as burnt rubber), a sensation in the stomach, a ringing sound that keeps increasing in volume, staring into space, or convulsive movements as a result of a primary change to the electrical activity (abnormally excessive) in the brain.

Epileptiform activity: Changes in the brain's electrical activity that are commonly seen in people who have epilepsy.

Focal seizure: A seizure that begins with an electrical discharge in a relatively small area (called the focus) of the brain; previously referred to as a partial or localization-related seizure. In most cases, the cause is unknown, but may be related to a brain infection, head injury, stroke, or a brain tumor.

Generalized seizure: A seizure that begins with a widespread electrical discharge involving both sides of the brain at once.

Lennox-Gastaut Syndrome: An epilepsy syndrome with an age of onset of 3-10 years characterized by multiple seizure types (including atonic, tonic, tonic-clonic and atypical absence seizures), cognitive impairment and specific EEG features of diffuse slow spike and wave as well as paroxysmal fast activity during sleep.

Medically refractory (intractable) epilepsy: Failure of an adequate trial of two tolerated antiepileptic drug schedules to achieve sustained seizure freedom. These should be appropriately chosen and can be monotherapy or in combination.

Myoclonic seizure: Sudden, brief (less than 100 millisecond) and almost shock-like involuntary single or multiple jerks due to abnormal or excessive or synchronous neuronal activity; associated with polyspikes on EEG.

Nonconvulsive status epilepticus: Refers to a prolonged seizure that manifests as an altered mental state as opposed to convulsions seen in tonic-clonic seizures.

Primary generalized seizure: A seizure that results from abnormal electrical activity of both sides of the brain at the same time.

Psychogenic Non-epileptic Spells: A non-epileptic event that imitates a seizure and may include rhythmic movements, unresponsiveness, or other symptoms similar to those caused by epilepsy, but without an electrographic association.

Seizure: An excessive surge of electrical activity in the brain, usually lasting from a few seconds up to a few minutes, causing a wide range of symptoms or effects depending on which parts of the brain are involved in the abnormal electrical activity.

Status epilepticus: A condition in which a seizure lasts too long or when seizures occur close together and the individual doesn't recover between seizures.

Tonic seizures: An epileptic seizure characterized by abrupt generalized muscle stiffening than can result in a fall, usually lasting less than a minute with rapid recovery.

Tonic-clonic seizure: A seizure of sudden onset involving generalized stiffening and subsequent rhythmic jerking of the limbs.

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History

Status	Date	Action
Reviewed	02/15/2024	Medical Policy & Technology Assessment Committee (MPTAC) review. Revised References and Websites for Additional Information sections.
	09/27/2023	Updated Coding section with 10/01/2023 ICD-10-CM changes; added G40.C01-G40.C19.
Reviewed	02/16/2023	MPTAC review. Updated References section.
Revised	02/17/2022	MPTAC review. Revised “antiepileptic drug treatment” to “antiseizure medication” in Clinical Indications. Changed “because” to “where” in Ambulatory EEG NMN statement. Updated Discussion/General Information, Definitions, and References sections.
Reviewed	08/12/2021	MPTAC review. Updated Discussion/General Information and References sections.
Reviewed	08/13/2020	MPTAC review. Updated Discussion/General Information and References sections. Reformatted Coding section.
	12/31/2019	Updated Coding section with 01/01/2020 CPT changes; added codes 95700, 95705-95706, 95708-95709, 95711-95726 replacing 95950, 95951, 95953, 95956 deleted 12/31/2019.
Reviewed	08/22/2019	MPTAC review. Updated Discussion/General Information and References sections.
Revised	09/13/2018	MPTAC review. Title change. Revision to the ambulatory EEG MN statement to include with or without video monitoring. Revision to NMN statement of ambulatory EEG by adding “Antiepileptic drug treatment withdrawal or modification in individuals because the risk of seizure precipitation would require immediate medical intervention.” Revision to the MN statement for attended EEG video monitoring in a healthcare facility by adding “withdrawal. ” Updated Description, Discussion/General Information, Definitions and References sections. Updated Coding section; added CPT 95999.
Revised	11/02/2017	MPTAC review. Added outpatient video EEG to scope of document. Updated Description, Discussion/General Information, and References sections. Title changed to “Ambulatory Electroencephalography and Video Electroencephalography.” The document header wording updated from “Current Effective Date” to “Publish Date.”
Reviewed	08/03/2017	MPTAC review. Updated References section.
Reviewed	08/04/2016	MPTAC review. Updated Discussion/General Information and References sections. Updated formatting in Clinical Indications section. Removed ICD-9 codes from Coding section.
Revised	08/06/2015	MPTAC review. Clarification to Medically Necessary Statement.
Revised	05/07/2015	MPTAC review. Added Medically Necessary indication for “Non-convulsive status epilepticus or status epilepticus” for video EEG. Updated Discussion/General Information, Definitions, and References sections.
Revised	02/05/2015	MPTAC review. Expanded scope of document to include video EEG, inpatient and observation status. Added Medically Necessary and Not Medically Necessary criteria for inpatient and observation status for video EEG. Title changed. Clarification to Not Medically Necessary statement regarding Ambulatory EEG. Updated Description, Coding, Discussion/General Information, and References.

Reviewed	05/15/2014	MPTAC review. Updated Discussion/General Information, References, and Websites for Additional Information sections.
	08/08/2013	Clarified Discussion and Definitions concerning pseudoseizures. Updated References and Websites for Additional Information sections.
New	05/09/2013	MPTAC review. Initial document development.
