MEDICAL POLICY

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Medical Policy Title	**Transcranial Magnetic Stimulation and Cranial Electrotherapy Stimulation**
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Our medical policies are guides to evaluate technologies or services for medical necessity. Criteria are established through the assessment of evidence based, peer-reviewed scientific literature, and national professional guidelines. Federal and state law(s), regulatory mandates and the member's subscriber contract language are considered first in the determination of a covered service. (Link to Product Disclaimer)

POLICY STATEMENT(S)

Major Depressive Disorder (MDD)

I. An initial course of transcranial magnetic stimulation (TMS) is considered **medically appropriate** as a treatment for MDD, severe when **ALL** of the following have been met:

A. TMS is administered by a U.S. Food and Drug Administration (FDA) cleared device in accordance with the FDA labeled indications;

B. Member is 15 years or older;

C. Documented diagnosis of major depressive disorder, severe (single or recurrent), without psychosis, confirmed by standardized rating scales that reliably measure depressive symptoms;

D. During the current episode of depression, there is a documented failure of **both** of the following:

1. An adequate trial of an evidence-based psychotherapy known to be effective for major depressive disorder, without clinically significant improvement; **and**

2. An adequate trial of medication, as documented by **one (1)** of the following:

a. For adults (age 18 years or older), failure to respond to **both** of the following:

i. Two (2) or more separate and distinct trials of antidepressant medication from two different classes, each at minimum therapeutic dose for at least 8-weeks, unless there is a documented serious side effect; **and**

ii. One (1) augmentation with a different class of antidepressant or another agent known to improve depression outcomes, at or above the minimal therapeutic dose for at least 8-weeks, unless there is a documented serious side effect; **or**

b. For adolescents (age 15 to 17 years), failure to respond to two (2) or more trials of FDA-approved anti-depressant medications at or above the minimal therapeutic dose for at least 8-weeks, unless there is a documented serious side effect;

E. Absence of an absolute contraindication to TMS, and relative contraindications (if applicable)

were assessed and deemed safe for administering TMS (see Policy Guideline I.).

II. TMS retreatment is considered **medically appropriate** for the treatment of MDD, severe when **ALL** of the following criteria are met:

A. TMS is administered by an FDA-cleared device in accordance with the FDA labeled indications;

B. All criteria for an initial course of TMS treatment were met (See Policy Statement I.);

C. A new episode of major depression, severe is documented by standardized rating scales;

D. The member responded to prior treatments, as evidenced by a greater than 50% improvement in standard rating scale measurements for depressive symptoms;

E. It has been at least three (3) months since the end of the initial TMS treatment course.

Obsessive-Compulsive Disorder (OCD)

III. An initial course of transcranial magnetic stimulation (TMS) is considered **medically appropriate** as a treatment for OCD when **ALL** of the following have been met:

A. TMS is administered by an FDA-cleared device, in accordance with the FDA labeled indications;

B. Member is 18 years or older;

C. Documented diagnosis of OCD as defined by the most recent edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM);

D. Resistance to treatment evidenced by persistent OCD symptoms is documented by a Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) score after **both** of the following:

1. An adequate trial of evidenced-based psychotherapy known to be effective for OCD, without clinically significant improvement (e.g., exposure response prevention [ERP], cognitive behavioral therapy [CBT], acceptance and commitment therapy [ACT]); **and**

2. Two (2) or more separate and distinct trials of psychopharmacologic medications known to treat OCD, each at the minimum therapeutic dose for at least 8 weeks, unless there is a documented serious side effect;

E. Absence of any absolute contraindication to TMS, and relative contraindications (if applicable) were assessed and deemed safe for administering TMS (see Policy Guideline I.).

IV. TMS retreatment is considered **medically appropriate** for the treatment of OCD when **ALL** of the following criteria are met:

A. TMS is administered by an FDA-cleared device, in accordance with the FDA labeled indications;

B. All criteria for initial course of TMS treatment were met (see Policy Statement III.);

C. The member responded to prior treatments, as evidenced by **both** of the following:

1. At least a 30% reduction in the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS)

score; **and**

2. It has been at least three (3) months since the end of the initial TMS treatment course.

Not Medically Necessary

V. TMS is considered **not medically necessary** for **EITHER** of the following:
   A. As a treatment for major depressive disorder or obsessive-compulsive disorder that does not meet all the above criteria;
   B. Reassessment of motor threshold following the first TMS treatment session, unless medical records document a clinical concern indicating a potential change in stimulation requirements (e.g., medication adjustments).

Investigational

VI. TMS is considered **investigational** for **ANY** of the following:
   A. TMS sessions beyond the standard course of 36 sessions, as continuation of the initial course or as maintenance/preservation therapy;
   B. TMS as a treatment for all other psychiatric and/or neurological disorders, including but not limited to: bipolar disorder, borderline personality disorder, schizophrenia, substance use or addictive disorders substance use or addictive disorders (e.g., alcohol, caffeine, cannabis, tobacco, gambling), migraine headaches (via single-pulse), stroke);
   C. Use of any TMS device or stimulation protocol not FDA-cleared, including but not limited to: bilateral stimulation, EEG-synchronized TMS, low-frequency protocols, Magnetic e-Resonance Therapy (MeRT), precuneus-targeted magnetic stimulation, priming techniques, and quadripulse stimulation);
   D. Magnetic resonance imaging (MRI)-guided TMS, including but not limited to functional connectivity MRI (fc-MRI)-guided stimulation;
   E. Accelerated treatment protocols, delivering more than one (1) TMS session per day, including the Stanford Accelerated Intelligent Neuromodulation Therapy (SAINT) protocol;
   F. Adjunct use of ketamine with TMS;

VII. Cranial electrotherapy stimulation (CES) (also known as transcranial electrical stimulation [tES] or cranial electrical stimulation) is considered **investigational** for **ALL** indications, including but not limited to anxiety, depression, and insomnia.

RELATED POLICIES

Corporate Medical Policy

1.01.55 Electrical Stimulation as a Treatment for Pain and Other Medical Conditions

3.01.13 Ketamine Therapy for the Treatment of Psychiatric Disorders

11.01.03 Experimental or Investigational Services

POLICY GUIDELINE(S)

I. Contraindications of TMS include the following:

   A. Absolute:

      1. Presence of ferromagnetic or magnetic sensitive metal in the head or neck areas in close proximity to the TMS coil magnetic fields (e.g., metal/bullet fragments, cochlear implants, brain stimulators or electrodes, aneurysm clips or coils, vagus nerve stimulator);

      2. Presence of acute or chronic psychotic symptoms or disorders (e.g., schizophrenia, schizophreniform or schizoaffective disorder) in the current depressive episode.

   B. Relative:

      1. Implanted cardiac pacemaker or implantable cardiac defibrillator (ICD);

      2. History of seizures with increased risk of seizure);

      3. Neurologic conditions (e.g., epilepsy, cerebrovascular disease, dementia, increased intracranial pressure, history of repetitive head trauma or with primary or secondary tumors in the central nervous system;

      4. Presence of a brain lesion (vascular, traumatic, neoplastic, infectious, or metabolic.

II. TMS must be performed by physicians who are adequately trained and experienced in the specific techniques used. The order for treatment (or re-treatment) should be written by a physician (MD or DO) who has examined the patient and reviewed the record. The treatment must be given under the direct supervision of the ordering physician, i.e., the physician must be in the area and be immediately available.

III. Accelerated TMS delivers multiple TMS sessions per day, completing the full therapeutic dose in days rather than weeks. This approach aims to achieve faster symptom relief for MDD while reducing the treatment burden/barrier of near-daily clinic visits over several weeks.

   A. Accelerated deep intermittent theta burst (iTBS), using the BrainsWay Deep System, is an FDA-cleared treatment protocol for MDD that does not require image-guided targeting or automated session delivery.

   B. Accelerated iTBS, using the Magnus Medical SAINT Neuromodulation System (known as the SAINT protocol), is an FDA-cleared treatment protocol requiring resting-state functional connectivity MRI (fcMRI) and neuronavigation.

IV. When requesting TMS, providers are required to submit documentation of prior medication trials, including the approximate duration (start and end dates), dosing, and side effects. An adequate trial of medication is based on a combination of appropriate duration (typically 4 to 6 weeks), therapeutic dosage, tolerance, and clinical response.

V. Standardized rating scales considered reliable in rating depressive symptoms include validated depression monitoring scales such as: Geriatric Depression Scale (GDS); Personal Health

Questionnaire Depression Scale (PHQ-9); Beck Depression Scale (BDI); Hamilton Rating Scale for Depression (HAM-D); Montgomery Asberg Depression Rating Scale (MADRS); Quick Inventory of Depressive Symptomatology (QIDS); and Inventory for Depressive Symptomatology Systems Review (IDS-SR).

DESCRIPTION

Transcranial Magnetic Stimulation (TMS)

TMS is a noninvasive neuromodulation technique that uses a coil placed on the scalp to deliver rapidly alternating electrical currents. These currents generate a magnetic field that passes through the scalp and skull without resistance, inducing localized electrical activity in the underlying cortical neurons. By modulating neural circuits involved in mood regulation and cognitive function, TMS alters brain activity in targeted regions, making it a valuable therapeutic tool in the treatment of neuropsychiatric conditions such as major depressive disorder (MDD).

Stimulation parameters, including cranial location, stimulation frequency, pattern, duration, intensity, and the state of the brain under the coil can be adjusted to influence excitability in specific cortical regions. The standard figure-8 coil primarily stimulates superficial cortical areas and penetrates only 1.5–2 cm beneath the skull, limiting its ability to reach deeper structures. H-coils were developed to address this limitation, which to enable broader and deeper stimulation (up to 4–5 cm) and are available in different models for specific indications, including: the H1 coil targets bilateral dorsolateral prefrontal cortices for MDD, the H7 coil focuses on medial prefrontal and anterior cingulate regions for obsessive-compulsive disorder (OCD), and other coils (e.g., H4) are used for smoking cessation.

Standard repetitive TMS (rTMS) delivers repeated electromagnetic pulses through a coil positioned on the scalp, typically targeting the dorsolateral prefrontal cortex (DLPFC), a region associated with mood regulation. The therapeutic effect depends on stimulation frequency, with high-frequency rTMS (≥10 Hertz [Hz]) being excitatory and enhances neural activity, while low-frequency rTMS (≤1 Hz) is inhibitory and reduces neural excitability. At total of 30 sessions with an optional 6 session taper are delivered over 20–40 minutes once daily over 4–6 weeks. When both high- and low-frequency stimulation are applied to opposite hemispheres during the same session, the protocol is referred to as bilateral rTMS.

Standard Deep TMS (dTMS) uses an H-coil to deliver magnetic pulses to deeper and broader brain regions, reaching 4–5 cm beneath the skull. Depending on indication, dTMS targets cortical and subcortical structures such as the DLPFC and medial prefrontal cortex. At total of 30 sessions with an optional 6 session taper are delivered once daily over 4–6 weeks.

Theta Burst Stimulation (TBS) is a patterned form of rTMS that delivers bursts of high-frequency pulses designed to mimic the brain's natural theta rhythms associated with learning and synaptic plasticity. The two main subtypes include:

- Standard intermittent TBS (iTBS) is FDA-cleared for MDD and is distinct from accelerated protocols. While not considered accelerated, it is delivered significantly faster than traditional rTMS, targeting the left DLPFC using short bursts of 50 Hz pulses repeated at 5 Hz. A typical

session delivers 600 pulses of iTBS over approximately 3 minutes, administered once daily for a total of 36 sessions (30 sessions plus an optional 6 session taper).

- Continuous TBS (cTBS) has inhibitory effects and delivers bursts continuously 40 seconds (600 pulses total). This protocol is not FDA-cleared at this time.

Accelerated TMS (aTMS) refers to multiple TMS sessions per day within a condensed timeframe, aiming to deliver the full therapeutic dose in days rather than weeks. This approach addresses two major limitations of standard TMS: delayed antidepressant effect and treatment burden, which often impairs adherence and access. Two accelerated TMS subtypes have received FDA clearance for MDD:

- Accelerated deep TMS with intermittent theta burst stimulation (ad-iTBS), using the BrainsWay Deep TMS System (H1 coil) without neuronavigation, was FDA-cleared in 2025. The protocol utilizes iTBS stimulation delivered in 5 sessions per day for 6 consecutive days (acute phase), followed by 2 sessions per day weekly for 4 weeks (continuation phase), totaling 38 sessions and approximately 75,000 pulses. Each session delivers approximately 1,980 pulses and lasts under 10 minutes.
- Accelerated iTBS (aiTBS) with resting-state functional connectivity MRI (fcMRI) and neuronavigation, using the Magnus Medical SAINT Neuromodulation System, was FDA-cleared in 2022. The SAINT protocol delivers 1,800 pulses per session at 90% of resting motor threshold, adjusted for cortical depth, with 10 sessions per day spaced 50 minutes apart for 5 consecutive days, totaling 50 sessions, each lasting about 3 minutes.

For TMS targeting, the location of stimulation determines TMS effects. For depression, the left DLPFC is commonly targeted, while the medial prefrontal cortex and anterior cingulate cortex are targeted for OCD. Early methods like the “5 cm rule” (and updated 5.5–6 cm rules) fail to account for anatomical variability. Alternatives include scalp-based strategies (Beam F3), anatomical MRI with neuronavigation, and emerging approaches using resting-state fMRI to personalize targeting based on functional connectivity.

Preservation strategies aim to sustain therapeutic response post-acute treatment and include maintenance, continuation, relapse-prevention, and rescue TMS. These approaches are used in clinical practice but are not FDA-approved as formal protocols.

Bilateral TMS applies high-frequency stimulation to the left DLPFC and low-frequency stimulation to the right DLPFC within the same treatment session, either sequentially or simultaneously. This approach is based on the hypothesis that enhancing excitatory activity on the left and reducing hyperactivity on the right may engage complementary mechanisms to improve clinical outcomes. Investigated for conditions like attention deficit hyperactivity disorder (ADHD), Parkinson’s disease, and tinnitus, but remains experimental.

Single-pulse TMS delivers a single magnetic pulse to the cortex to induce a brief neuronal response, for diagnostic and research purposes, assessing cortical excitability and conduction pathways. It does not produce lasting neuromodulatory effects and is not considered a therapeutic intervention.

Cranial Electrotherapy Stimulation (CES)

CES differs from TMS primarily in its delivery method: CES is a non-invasive neuromodulation

technique that applies low-level electrical currents through electrodes placed on the earlobes or scalp, whereas TMS uses magnetic fields to stimulate specific brain regions.

CES is conceptually similar to transcranial electrical stimulation (tES), an umbrella term that includes methods such as transcranial direct current stimulation (tDCS) and transcranial alternating current stimulation (tACS), all of which aim to modulate brain activity through externally applied electrical currents. From a regulatory perspective, the FDA classifies CES devices as Class II (special controls) for indications such as anxiety and insomnia, while depression requires Premarket Approval (PMA). The approved Flow FL-100 device (PMA P230024, December 8, 2025) operates using tDCS technology, but the FDA officially lists it under the CES category. This means that while the mechanism is tDCS, the regulatory classification is CES. CES and tDCS are therefore similar in concept but differ in current intensity, electrode placement, and historical regulatory pathways. CES has been evaluated for conditions including anxiety, insomnia, depression, pain, and functional constipation, with FDA clearance for anxiety and insomnia and PMA approval for major depressive disorder.

SUPPORTIVE LITERATURE

Standard TMS for Adults with Major Depressive Disorder (MDD)

The evidence supporting TMS for patients with treatment resistant MDD is robust. Multiple double-blind, randomized, sham-controlled trials demonstrate that stimulation of the left dorsolateral prefrontal cortex (DLPFC) produces a clinically meaningful reduction in depressive symptoms, with a large effect size (e.g., Ontario Health 2007; O'Reardon 2007; Lam 2008; Avery 2008; Janicak 2010; George 2010; Kedzior 2015; Voigt 2021). Overall, the evidence is sufficient to conclude that rTMS leads to a significant improvement in net health outcomes and is considered an appropriate treatment option for patients with MDD who meet established clinical criteria.

Papakostas et al (2024) identified a critical evidence gap regarding the comparative effectiveness of pharmacological and non-pharmacological augmentation strategies versus switching antidepressants in TRD. To address this, they conducted a multi-site, 8-week, randomized, open-label trial comparing augmentation with aripiprazole or rTMS to switching to venlafaxine XR (or duloxetine for those ineligible for venlafaxine). The primary outcome was the change in Montgomery–Asberg Depression Rating Scale (MADRS) scores. A total of 278 participants with treatment resistant depression (TRD) of at least 12 weeks' duration were randomized in a 1:1:1 ratio to one of the three interventions. Of these, 260 participants (rTMS: n=70; aripiprazole: n=92; venlafaxine/duloxetine: n=98) were included in the modified intention-to-treat (MITT) analysis. Post-baseline assessments occurred at weeks 1, 2, 3, 4, 6, and 8, with MADRS evaluations conducted by raters blinded to treatment assignment. Results showed that rTMS augmentation was significantly superior to switching on MADRS scores ($p = 0.015$), whereas aripiprazole augmentation did not reach statistical significance ($p = 0.069$). Conversely, aripiprazole augmentation was significantly superior to switching on self-reported depressive symptoms ($p = 0.003$), while rTMS showed a trend toward significance ($p = 0.031$). The authors concluded that rTMS augmentation demonstrated moderate-to-large superiority over switching to venlafaxine XR/duloxetine in clinician-rated depressive symptoms. However, the study's open-label design with only blinded raters, and the limited scope of pharmacological

comparators were noted as key limitations.

Standard TMS for Adolescents with Major Depressive Disorder (MDD)

In 2024, the FDA cleared TMS as a first-line adjunctive treatment for MDD in adolescents aged 15 and older, based on a real-world study of 1,120 patients aged 15–21 treated at 35 U.S. centers (Trapp 2025). Participants completed 36 sessions over approximately 4–6 weeks using either high-frequency deep TMS or iTBS stimulation. The PHQ-9 was administered at baseline and immediately after the treatment course, which showed an average 12-point reduction, a 66% response rate, and notable improvements in anxiety symptoms, with a safety profile consistent with adult TMS use and no new concerns. No long-term follow-up beyond the treatment period was reported.

Croarkin et al (2021) conducted the largest randomized, double-blind, sham-controlled trial to date investigating TMS for TRD in adolescents. The study assessed the feasibility, safety, and efficacy of 10 Hz left prefrontal TMS monotherapy across 13 sites, enrolling 103 participants aged 12 to 21 years who had failed one to four adequate antidepressant trials. Participants were randomized to receive either active TMS (n=48) or sham treatment (n=55) over 30 sessions across six weeks. Treatments were administered using the NeuroStar XPLOR TMS Therapy System (Neuronetics, Inc.), with coil placement guided by the 5-cm rule. Stimulation was delivered at 120% of the resting motor threshold (reducible to 110% for tolerability during the first week), at 10 Hz for 4 seconds per train, with a 26-second intertrain interval, totaling 3,000 pulses per 37.5-minute session. The primary outcome was change in the Hamilton Depression Rating Scale (HAM-D-24) score. Both groups showed similar symptom improvement (P=0.8), with response rates of 41.7% (active) and 36.4% (sham), and remission rates of 29.2% and 29.0%, respectively. No new safety or tolerability concerns were identified. While TMS produced clinically meaningful reductions in depressive symptoms, it did not significantly outperform sham treatment. The authors highlighted the need for future research to address high placebo response rates and refine dosing strategies for adolescents with TRD.

Systematic reviews and meta-analyses have evaluated the efficacy and safety of rTMS in adolescents with MDD. Cao et al (2023) analyzed randomized controlled trials (RCTs) of rTMS combined with antidepressants in children and adolescents, reporting significant improvements in depressive symptoms compared to medication alone, with no major safety concerns. Sun et al (2023) focused on first-episode adolescent MDD and found adjunctive rTMS significantly enhanced treatment response and remission rates versus standard therapy. Sigrist et al (2022) pooled data from 10 individual studies (2 randomized trials) for quantitative synthesis of mainly uncontrolled studies, concluding that rTMS appears well tolerated and associated with a statistically significant overall treatment response rate ($p<0.001$) from baseline to post-treatment. Though evidence quality is limited by small sample sizes and heterogeneity. All three analyses are limited by small sample sizes, high statistical heterogeneity, and methodological weaknesses. Overall, authors concluded that rTMS showed significant treatment effect and response rate compared to antidepressants alone, and larger, high-quality trials are needed to establish optimal protocols and long-term safety.

Garzon et al (2025) conducted the largest long-term follow-up study to date. This six-month, multisite, open-label trial evaluated the durability of TMS in adolescents and young adults with TRD. The study enrolled participants aged 12–21 who achieved at least a partial response (≥25%

reduction on the Hamilton Depression Rating Scale-24 [HAMD24]) during a prior randomized controlled trial of sham or active TMS. Those experiencing partial relapse (≥1-point increase on Clinical Global Impression–Severity) received retreatment with daily 10 Hz TMS sessions until symptoms returned to baseline or after 30 treatments. Of 84 eligible participants, 66 enrolled and 41 completed the six-month follow-up; 42% required retreatment, with a mean of 22 sessions. At six months, depressive symptoms remained improved (mean HAMD24 = 5.24) compared to baseline at entry into follow-up (mean HAMD24 = 8.21). Higher baseline severity predicted relapse risk, while prior TMS exposure did not. TMS was well tolerated, and the authors concluded that these findings support the feasibility and clinical benefit of a structured retreatment protocol following an initial course of TMS in adolescents with TRD.

Roth et al (2025) conducted the largest naturalistic post-marketing outcomes study to date evaluating the safety and efficacy of deep TMS (dTMS) for MDD in younger populations. The study analyzed data from 1,257 patients treated between January 2012 and November 2024 across 56 geographically diverse clinical sites in the United States. Eligible participants were aged 11–21 years and met criteria for treatment-resistant MDD, having failed to respond to an average of 4.5 antidepressant medications. All patients received dTMS using the BrainsWay H1 Coil (BrainsWay, Jerusalem, Israel), delivered via either the Magstim Rapid2 stimulator (Magstim, Spring Gardens, UK) or the BrainsWay 104 stimulator. Treatment protocols included either 18 Hz or intermittent theta burst stimulation (iTBS), with a mean of 35.6 sessions administered. At baseline, 76% of participants exhibited moderate to severe depressive symptoms (PHQ-9 ≥15). Following treatment, only 16% remained in this severity range, while 65% met criteria for mild or subthreshold depression. Statistically significant improvements were observed across all clinical measures. The treatment was well tolerated, with an adverse event profile comparable to that observed in adult populations. Despite certain limitations, the authors concluded that dTMS represents a safe and effective therapeutic option for adolescents and young adults with treatment-resistant MDD, contributing significantly to the growing empirical support for this therapeutic modality.

Buyuktaskin et al (2025) conducted an exploratory RCT to assess the effects of rTMS frequency on suicidal ideation in adolescents with MDD. Given the elevated suicide risk in youth and limitations of current treatments, including the potential for increased suicidal thoughts with antidepressants, this study compared low-frequency (1 Hz) and high-frequency (10 Hz) TMS protocols. A total of 41 adolescents between the ages of 12 and 18 were randomized to receive either 1 Hz (n=22) or 10 Hz (n=19) TMS, and scheduled for 30 sessions over six weeks, with a mean of 28.00 sessions completed (range: 8–30). Treatment was delivered over the left DLPFC using the NeuroStar system, with localization achieved via the Beam F3 method. Suicidal ideation intensity was measured weekly using the Columbia Suicide Severity Rating Scale (C-SSRS). Over the treatment period, both TMS protocols were associated with a significant reduction in suicidal ideation intensity, approximately 24.6% for 10 Hz TMS ($p = 0.0015$) and 22% for 1 Hz TMS ($p = 0.0016$), independent of changes in depression severity. However, when adjusting for depression severity, these reductions were no longer statistically significant (10 Hz: $p = 0.572$; 1 Hz: $p = 0.844$). No significant differences were found between the two protocols in their impact on suicidal ideation ($p > 0.7$), and treatment group assignment did not moderate outcomes ($p > 0.95$). The findings suggest that TMS may be a promising intervention for suicidal ideation in adolescent depression, with comparable effects across

stimulation frequencies. This study contributes to the growing body of research on TMS as a potentially safe and effective intervention for suicide prevention in adolescents, highlighting the need for further investigation into optimal stimulation parameters.

Accelerated Non-Deep Coil TMS for MDD

Theleritis et al (2017) conducted a single-center, parallel-group, randomized, sham-controlled trial (n=98) to evaluate the efficacy of administering one versus two daily sessions of HF-rTMS for treating MDD. Eligible participants were aged 18–59, right-handed, diagnosed with treatment-resistant nonpsychotic MDD, had no prior exposure to TMS, and were free of contraindications. Where clinically appropriate, participants were encouraged to discontinue antidepressants prior to enrollment; otherwise, they remained on a minimal regimen for at least four weeks before study entry. Treatment involved 10 Hz HF-rTMS using a Magstim Rapid stimulator with a figure-8 coil targeting the left DLPFC. Sessions were delivered on weekdays over three weeks: either once daily (A1 group; n=27) or twice daily (A2 group; n=27), totaling 15 or 30 sessions, respectively. Sham stimulation was administered using a rotated coil either once daily (S1 group; n=20) or twice daily (S2 group; n=24). Response was defined as ≥50% reduction in HDRS and CGI-S ≤3; remission was defined as HDRS <8 and CGI-S ≤2. Assessments were conducted at baseline, weekly during treatment, and at five weeks post-treatment. Nine participants discontinued due to protocol violations, headache exacerbation, scheduling conflicts, or illness. Intent-to-treat analysis (n=96) revealed no significant baseline differences between groups. Active treatment groups showed significantly greater improvements in HDRS and CGI-S scores compared to sham ($p<0.001$). Only one participant (2.5%) in the sham groups met HDRS response criteria, versus 29 (59.2%) in the active groups ($p<0.001$). Remission likelihood was significantly associated with baseline severity ($p=0.001$) and number of daily sessions (CGI-S: $p=0.018$; HDRS: $p=0.066$). Adverse events were mild, including scalp discomfort and headache. Study limitations included lack of blinding for treatment administrators, absence of a sham coil mimicking rTMS sensations, no cognitive assessments, short follow-up, and potential confounding from concurrent pharmacotherapy. Further research is warranted to assess the safety and efficacy of multiple daily rTMS sessions.

Fitzgerald et al (2018) conducted a parallel-group RCT comparing accelerated and standard rTMS protocols in patients with MDD. A total of 115 outpatients were randomized to receive either accelerated rTMS (n=58) or standard rTMS (n=57). Stimulation localization followed standard procedures. Both groups received an equal total pulse dose of 63,000. In the accelerated group, each session involved 83–84 trains of 10 Hz rTMS applied to the left DLPFC using 4.2-second trains at 120% of the resting motor threshold, with 15-second inter-train intervals. Sessions were spaced 15–30 minutes apart, delivering 10,500 pulses per day across six treatment days. In contrast, the standard group received 20 sessions over four weeks (five sessions per week), each consisting of 75 trains of 10 Hz rTMS with 25-second inter-train intervals, delivering 3,150 pulses per day. The accelerated group showed earlier symptom improvement within the first two weeks, though overall response rates were similar between groups. No serious adverse events occurred, although the accelerated group reported more discomfort and had a slightly higher dropout rate. Cognitive performance remained stable across both groups. Study limitations included short follow-up, lack of blinding, and potential confounding due to session spacing and individual variability in response. Overall, accelerated rTMS delivered over a condensed three-week schedule produced antidepressant

effects comparable to standard four-week protocols, with slightly increased treatment discomfort but low dropout rates, supporting the need for larger multisite trials to confirm its clinical utility.

Sonmez et al (2019) conducted a systematic review and meta-analysis to evaluate the efficacy of accelerated TMS protocols for MDD. The review included 18 publications describing 11 unique studies, some with overlapping samples. Studies were eligible if they involved more than one rTMS or TBS session per day and targeted depressive disorders. Three RCTs were included in the meta-analysis, yielding a pooled effect size of Hedges' g = 0.39, indicating a modest but statistically significant antidepressant effect of aTMS compared to control. When open-label studies and active arms of RCTs were analyzed separately, the pooled effect size increased to g = 1.27, suggesting stronger symptom improvement in less controlled settings. The review found that accelerated TMS (aTMS) protocols varied widely in terms of stimulation parameters, coil types, and session spacing. Despite this heterogeneity, most studies reported positive clinical outcomes, with some showing rapid symptom reduction within days. Adverse effects were generally mild and transient, including headache and scalp discomfort. Limitations included small sample sizes, lack of blinding in many studies, and variability in protocol design, which may affect generalizability. The authors noted that many of the included studies had short or limited follow-up periods, which limited the ability to assess long-term efficacy and durability of antidepressant effects from accelerated TMS protocols. Concluding that aTMS is a promising approach for treating MDD, the study emphasized the need for larger, well-controlled trials to establish optimal protocols and confirm efficacy.

Prato et al (2025) conducted a single-center, parallel, two-arm, single-blind RCT in Italy comparing aTMS with the standard rTMS protocol for TRD. The standard protocol consisted of one session per weekday for four weeks, delivering 75 trains of 10 Hz to the left DLPFC at 120% motor threshold per session. The accelerated protocol delivered four sessions per day, separated by one-hour breaks, for five consecutive days, using identical parameters. Both arms were designed to deliver the same cumulative pulse count, 60,000 over 20 sessions, to maintain consistency with foundational rTMS trials. rTMS was delivered using the Magstim Rapid2 stimulator and a 70 mm air-cooled double coil. Participants (ages 18–70) had moderate to severe major depressive episodes (unipolar or bipolar) and were nonresponsive to either fluvoxamine or venlafaxine during the current episode. A total of 33 patients were randomized to aTMS (n = 18) or standard rTMS (n = 15, n=13 after two withdrawals). Clinical outcomes were assessed using the MADRS and Beck Depression Inventory II (BDI-II) at baseline, daily during the first week, weekly through week 4, and at week 8. SSI was measured at baseline, day 1, day 5, and weekly thereafter. Response was defined as ≥50% MADRS reduction; remission as MADRS <10. Analysis included 31 patients (18 aTMS; 13 rTMS). Results showed a significantly faster decline in MADRS and BDI-II during the first five days (p = 0.001 and p = 0.048, respectively). At day 56, aTMS patients maintained lower scores than rTMS (MADRS: p = 0.001; BDI-II: p = 0.032). Response rates favored aTMS at day 28 (72% vs. 38.5%, p = 0.040) and day 56 (83.3% vs. 38.5%, p = 0.011). Remission rates were also higher for aTMS at day 28 (67% vs. 15.4%, p = 0.0001) and day 56 (61% vs. 30.8%, p = 0.006). No significant differences emerged for suicidal ideation (p = 0.621), and subgroup analysis showed similar benefits for unipolar and bipolar patients. Despite delivering 300 trains per day in the accelerated arm versus 75 in the standard arm, no serious adverse events occurred, and tolerability was comparable. Limitations included small sample size, single-center design, reliance on self-reported measures, and lack of

sham control. The authors concluded that aTMS may offer a clinically meaningful advantage by achieving rapid symptom improvement within five days without compromising safety or tolerability, addressing the latency challenge of antidepressant therapy.

Accelerated Deep iTBS for MDD (BrainsWay Deep TMS System)

In 2025, the FDA expanded treatment stimulation protocols for MDD to include accelerated deep iTBS (ad-iTBS) stimulation, delivered by the modified BrainsWay Deep TMS System. Accelerated iTBS was supported by unpublished clinical data from a multicenter, randomized, blinded, controlled study (Protocol No. CTP-ACCiTBS-00). The study was designed as a prospective, 6-week trial, in which the accelerated iTBS stimulation protocol was compared to the standard of care HF stimulation protocol for treating MDD. A total of 104 subjects were enrolled, with 89 completing the study and included in the per-protocol analysis. Participants had moderate or greater depression (HDRS-21 ≥ 20), with a mean age of 48.6 years. The primary endpoint was the change in HDRS-21 scores from baseline to six weeks. Both groups showed significant improvement from baseline to week 6. The between-group difference was non-significant ($p = 0.7783$), meeting predefined non-inferiority criteria. Common adverse events included headaches and application site pain; none classified as severe. Two subjects discontinued due to anxiety and hypomania. Overall, the study demonstrated that the accelerated iTBS protocol is safe, effective, and non-inferior to the standard high-frequency protocol for MDD treatment.

Bahun et al (2022) reported that accelerated TMS protocols have shown to be as effective as standard rTMS in reducing depression symptoms and achieving remission; however, comparative studies between different accelerated protocols are limited. To investigate whether two- or three-week accelerated deep TMS (a-dTMS) protocols differ in cognitive outcomes, the authors conducted a randomized controlled pilot study in 32 adult psychiatric inpatients with treatment-resistant MDD). Participants (ages 20–70, all on at least one antidepressant) were assigned to receive dTMS twice daily for either two weeks (10 sessions) or three weeks (15 sessions), using the FDA-approved H1-coil protocol targeting the left DLPFC (20-minute sessions, 18 Hz, 120% motor threshold, 1980 pulses per session). Cognitive function was assessed at baseline and post-treatment using a battery of neuropsychological tests. Statistically significant improvements were observed in most cognitive domains, except numeric short-term memory, verbal fluency, and errors on Benton visual retention test (BVRT) and Trail Making Test (TMT). The 3-week protocol showed greater improvement in psychomotor speed, while the 2-week protocol led to significantly better verbal fluency. These findings suggest the shorter protocol may be more efficient and equally or more beneficial in specific cognitive areas. Limitations of the study include the absence of a control group, small sample size, lack of long-term follow-up, potential placebo effects, use of non-parallel cognitive tests, concurrent pharmacotherapy, and confounding factors such as medication variability and mood-related cognitive changes. The authors concluded that a-dTMS may offer mild to moderate cognitive benefits without adverse effects in TRD patients, but further sham-controlled studies are needed to confirm these findings.

Standard iTBS, without Functional Connectivity MRI

Blumberger et al (2018) conducted the THREE-D trial, which led to U.S. FDA clearance of iTBS for MDD. This multicenter, randomized, non-inferiority study compared high-frequency (10 Hz) rTMS

with iTBS for treatment-resistant MDD. A total of 414 participants were randomized to rTMS (n=205) or iTBS (n=209), administered five times per week over 4–6 weeks. Treatment resistance was defined as failure to respond to at least one adequate antidepressant trial or intolerance to two or more trials. Patients who had failed more than three adequate trials were excluded. Participants continued stable antidepressant regimens during the trial, and medication adjustments were permitted. Prior to treatment, all participants underwent high-resolution anatomical MRI, and neuronavigation targeted the left dorsolateral prefrontal cortex using reverse co-registration from the MNI152 coordinate. rTMS sessions lasted 37.5 minutes, whereas iTBS sessions lasted just over 3 minutes. The primary outcome was change in the 17-item Hamilton Rating Scale for Depression (HRSD-17). Both groups showed similar improvements: rTMS (mean reduction: 10.1 points) and iTBS (10.2 points), with an adjusted difference of 0.01, confirming non-inferiority of iTBS. iTBS was associated with slightly higher self-reported pain (mean score: 3.8 vs. 3.4; p=0.011). Headache was the most common adverse event in both groups (rTMS: 64%; iTBS: 65%). Serious adverse events included one myocardial infarction (rTMS) and three psychiatric events (iTBS), with no significant difference in overall adverse event rates. The study did not include a placebo control group. The authors concluded that iTBS is a safe, well-tolerated, and time-efficient alternative to standard rTMS, with comparable clinical effectiveness for treatment-resistant depression.

The 2025 consensus review from the National Network of Depression Centers Neuromodulation Task Group acknowledged that the THREE-D trial employed MRI-guided neuronavigation and a larger B70 figure-8 coil to enhance targeting precision (Trapp 2025). Although these elements are not considered standard clinical practice in the United States and are not required for adherence to the FDA-cleared once-daily iTBS protocol, the clinical efficacy of iTBS has been replicated with protocols that do not utilize neuronavigation guidance and confirmed through meta-analyses of sham-controlled trials.

Accelerated iTBS with Functional Connectivity MRI- (SAINT)

Cole et al (2020) conducted an open-label clinical trial evaluating the Stanford Accelerated Intelligent Neuromodulation Therapy (SAINT) protocol, which uses iTBS guided by functional connectivity MRI (fcMRI) targeting. The study included 21 participants with major depressive disorder. Each participant received 60 cycles of ten bursts of three pulses at 50 Hz, delivered in ten sessions per day (18,000 pulses/day) over five consecutive days. This represents a total pulse dose that is five times greater than the FDA-cleared iTBS protocol (which delivers 18,000 pulses over six weeks).

On average, participants met standard response criteria within 2.3 days of treatment, approximately 23 ten-minute sessions. Despite the small sample size, significant reductions in suicidality was observed, as measured by the Columbia Suicide Severity Rating Scale (C-SSRS) suicidal ideation subscale ($p < 0.001$). The response rate, defined as a ≥50% reduction in depressive symptoms, was 90.48% and all responders achieved remission immediately post-treatment, with 70% maintaining remission at one month. Intent-to-treat analysis showed 86.4% remission, with 80–100% sustained at one-month follow-up. Participants with prior nonresponse to conventional rTMS required more time to respond but 83% achieved response by day five. No adverse events or cognitive impairments were detected on neuropsychological testing. The authors concluded that SAINT appears preliminarily safe, feasible, and associated with high remission rates in treatment-resistant depression,

recommending larger randomized controlled trials to confirm these findings.

Cole et al (2022) conducted a double-blind, randomized, sham-controlled trial to assess the antidepressant efficacy of the accelerated Stanford Neuromodulation Therapy (SNT) protocol, also known as the SAINT protocol, combines intermittent theta burst stimulation (iTBS) with individualized targeting based on functional connectivity MRI (fcMRI). The study enrolled 29 participants with major depressive disorder (MDD), randomized to active (n=14) or sham (n=15) treatment groups. Before treatment, all participants underwent structural and resting-state functional MRI to identify individualized stimulation targets using fcMRI. The intervention consisted of 10 daily sessions over five consecutive days, delivering 1,800 pulses per session (18,000 pulses per day) at 90% of the resting motor threshold, adjusted for cortical depth. The trial was stopped early after a planned interim analysis revealed a large effect size (Cohen's d > 0.8) favoring active treatment. At four-week follow-up, 79% of active participants (11 of 14) achieved remission compared to 13% (2 of 15) in the sham group. No serious adverse events occurred, though headaches were more frequent in the active arm. Limitations included small sample size, single-site design, and comorbid psychiatric conditions in 45% of participants. The authors concluded that SNT produced significantly greater symptom reduction than sham stimulation and highlighted the need for larger trials to confirm efficacy and clarify the role of fcMRI-guided targeting.

Geoly et al (2025) conducted a prospective observational follow-up study evaluating the durability of response and remission in participants who previously underwent Stanford Neuromodulation Therapy (SNT, also known as SAINT) in open-label or randomized controlled trials conducted by Cole et al (2020, 2022). SNT is an accelerated, high-dose, resting-state functional connectivity–guided intermittent theta burst stimulation (iTBS) protocol that achieves high acute remission rates after five days of treatment; however, durability beyond four weeks without continuation therapy has been unclear. This study included 46 adults with TRD from prior SNT trials (21 open-label, 14 active RCT, 11 sham crossover). Each participant received five days of SNT (10 sessions/day, 18,000 pulses/day at 90% rMT, depth-adjusted) or sham, with individualized targeting of the left dorsolateral prefrontal cortex most anticorrelated with the subgenual anterior cingulate cortex using resting-state fMRI. The 6-item Hamilton Depression Rating Scale (HDRS-6) scores were collected biweekly for up to 24 weeks and relapse was defined as two consecutive HDRS-6 scores ≥5. Results revealed that 70% (32/46) achieved remission the week following treatment and 33% (15/46) remained in remission at 12 weeks. Limitations include small sample size, lack of follow-up beyond 12 weeks, and limited generalizability due to demographic and clinical characteristics. Findings suggest that SNT's antidepressant effect is durable, with 12-week remission rates comparable to ECT and potentially exceeding acute outcomes of standard iTBS.

Preservation / Maintenance TMS for Adults with Major Depressive Disorder

A variety of maintenance schedules are currently being studied, with the role of maintenance TMS not been fully established and high heterogeneity in administration between studies.

Fitzgerald et al (2013) reported a prospective, open-label trial of clustered maintenance rTMS for patients with treatment-resistant depression. All patients had received a second successful course of rTMS following relapse and were then treated with monthly maintenance therapy consisting of five rTMS treatments over a 2.5-day period (Friday evening, Saturday, and Sunday). Of 35 patients, 25

(71%) relapsed at a mean of 10.2 months (range, 2- 48 months).

Dunner et al (2014) reported one-year follow-up with maintenance therapy from a large, multi-center observational study (42 sites) of rTMS for patients with treatment-resistant depression. A total of 257 of the 307 patients initially studied who were treated with rTMS agreed to participate in the follow-up study. Of these, 205 patients completed the 12-month follow-up, and 120 patients met the Inventory of Depressive Symptoms-Self Report response or remission criteria at the end of treatment. Ninety-three of the 257 patients (36.2%) who enrolled in the follow-up study received additional rTMS (mean, 16.2 sessions). Seventy-five of the 120 patients (62.5%) who met response or remission criteria at the end of the initial treatment phase (including a two-month taper phase) continued to meet response criteria through follow-up.

Two RCTs investigated outcomes of maintenance TMS sessions, concluding that periodic TMS appears feasible in some cases, but once-monthly TMS is not superior to “watchful waiting” (Philip 2016) and rTMS could represent a novel strategy for preventing relapse in treatment resistant depression (Benadhira 2017). Further studies are needed to confirm the benefits of rTMS maintenance and to clarify effectiveness and feasibility.

D’Andrea et al (2023) conducted a systematic review to evaluate maintenance TMS protocols for MDD and TRD. Fourteen studies were included (3 randomized sham-controlled trials, 8 open-label studies, 2 case reports, 1 case series). Most studies suggested maintenance TMS may reduce relapse risk, but protocols varied widely in timing (starting 1 week to 1-month post-acute treatment), duration (12 weeks to >1 year), and structure (cluster, tapering, continuous, rescue), making it difficult to identify optimal parameters. Cluster and continuous approaches appeared to show lower relapse risk, though evidence remains inconclusive. Relapse risk was highest after five months post-acute treatment, and no superiority was observed among left, right, or bilateral DLPFC stimulation. Limitations included small sample sizes (n=1–281), heterogeneity, and risk of bias (3 low, 4 moderate, 3 severe). Overall, despite methodological limitations, the authors concluded that maintenance TMS is a promising strategy to sustain antidepressant effects and reduce relapse, but standardized protocols and high-quality trials are needed.

Yamazaki et al (2023) published a study protocol for a multicenter open-labelled parallel-group trial with a planned recruitment of 300 patients with MDD who have responded or remitted to acute rTMS therapy. This study aims to evaluate whether maintenance rTMS is effective in maintaining the treatment response in patients with MDD with a large sample size and feasible study design. The protocol of maintenance rTMS therapy is once a week for the first six months and once biweekly for the second six months.

<u>TMS for Adults with Obsessive-Compulsive Disorder (OCD):</u>

Carmi et al (2018) conducted a double-blind pilot study comparing low-frequency deep TMS (LF-dTMS; 1 Hz), high-frequency deep TMS (HF-dTMS; 20 Hz), and sham stimulation in patients with obsessive-compulsive disorder (OCD). A total of 41 adults with a score of 20 or more on the Yale Brown Obsessive Compulsive Scale (YBOCS) were recruited at the Chaim Sheba Medical Center in Israel and randomized to one of three groups to receive one Hz stimulation (LF), 20 Hz stimulation (HF), or a sham stimulation. All participants received five sessions per week for five weeks (25

sessions total). Final analysis included only the HF group (n=16) and sham group (n=14) due to lack of response in the LF group. After five weeks, 43.8% of HF participants (7/16) met predefined response criteria compared to 7.1% of sham participants (1/14). However, at one-month follow-up, significance was lost, with four HF participants and none in the sham group classified as responders. The authors concluded that HF-dTMS is safe, tolerable, and potentially effective for reducing OCD symptoms, but emphasized the need for larger trials. Limitations included small sample size, single-center design, and short follow-up.

Carmi et al (2019) conducted a multicenter randomized double-blind placebo-controlled evaluating HF-dTMS in OCD. A total of 94 eligible patients were randomized to active high-frequency (n=47) or sham (n=47) dTMS for six weeks. Clinical response was assessed using the Yale-Brown Obsessive-Compulsive Scale (YBOCS). At six weeks, Y-BOCS scores decreased significantly in both groups (active: −6.0 points; sham: −3.3 points), with a between-group difference of 2.8 points (p=0.01; effect size = 0.69). Full response rates at follow-up were 45.2% (19/42) for active treatment versus 17.8% (8/45) for sham (p=0.006). Partial response rates were 59.5% vs. 42.2% (p=0.106). Clinical Global Impressions–Improvement (CGI-I) analysis showed 49% of active participants reported moderate to "very much" improvement compared to 21% in sham (p=0.011). CGI-Severity scores also favored active treatment (61% vs. 32.6%; p=0.022). No serious adverse events occurred. Limitations included lack of control for symptom provocation and absence of brain activity recording, limiting mechanistic insights. The authors concluded that HF-dTMS should be considered as an adjunctive treatment for OCD when response to standard psychological or pharmacological interventions is inadequate.

Fitzsimmons et al (2022) conducted a systematic review and pairwise/network meta-analysis to evaluate the efficacy and safety of rTMS as a treatment option for OCD. Eligible studies were peer-reviewed, randomized, sham-controlled trials enrolling patients with a primary OCD diagnosis and delivering any rTMS protocol with at least five treatment sessions. A comprehensive database search through February 2021 identified 21 studies involving 662 participants (368 active rTMS; 294 sham). Across these trials, 11 different stimulation protocols were investigated. The certainty of evidence was rated Moderate, primarily due to potential publication bias. Meta-analysis of post-treatment Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) scores demonstrated a significant improvement with active rTMS compared to sham (Hedges' g = -0.502). Dropout rates did not differ between active and sham groups. For comorbid depression, scores on the HDRS and MADRS showed a small but statistically significant benefit for active rTMS (g = -0.21); however, due to limited reporting, subgroup and network meta-analyses were not performed for this outcome. CGI-S scores revealed a large and significant improvement favoring active rTMS (g = -0.86). Limitations included missing primary outcome data in three studies, moderate heterogeneity, and variability in methodology (12 different stimulation protocols). The authors concluded that rTMS is an efficacious treatment for OCD, producing an average 4-point reduction in Y-BOCS scores compared to sham, and noted that these findings align with prior systematic reviews and meta-analyses supporting rTMS efficacy for OCD.

Steuber and McGuire (2023) conducted a meta-analysis of RCTs to evaluate the therapeutic benefit of rTMS in patients with OCD and to identify moderators of treatment effects. The analysis included 25 RCTs published through December 2022, encompassing 860 participants. Using a random-effects model, effect sizes for treatment efficacy and response were calculated based on clinician-rated Y-

BOCS scores. Across studies, rTMS demonstrated a moderate effect on OCD symptom severity (Hedges' g = 0.65; p < .001) and a large effect on treatment response, with response rates of 39.5% for rTMS versus 8.8% for sham conditions (p < .0001). Moderator analysis revealed that longer rTMS session duration (in minutes) was associated with greater improvement in OCD severity, accounting for 24% of variance in treatment effects. Conversely, a higher number of rTMS sessions was negatively associated with symptom reduction, explaining 28% of modeled variance. No significant relationship was found between total pulse count and OCD severity reduction. Limitations included diagnostic heterogeneity, exclusion of four RCTs due to missing pre-post data, and lack of long-term follow-up (ranging from 1 to 12 weeks). The authors concluded that rTMS offers a threefold greater likelihood of treatment response compared to sham, and its efficacy, favorable safety profile, accessibility, and potential for treatment-refractory cases suggest rTMS as a promising therapeutic option for OCD, particularly for patients unresponsive to first-line interventions.

Functional Magnetic Resonance Imaging (fMRI) for OCD

Fitzsimmons et al (2024) conducted a blinded, randomized, proof-of-concept trial to evaluate and compare treatment-induced changes in task-based functional magnetic resonance imaging (tb-fMRI) activation following three different repetitive transcranial magnetic stimulation (rTMS) protocols. The study enrolled 61 participants diagnosed with obsessive-compulsive disorder (OCD) resistant to first-line treatments. Participants were randomized into three parallel arms: high-frequency rTMS to the left dorsolateral prefrontal cortex (DLPFC) (n=19), high-frequency rTMS to the left supplementary motor area (preSMA) (n=23), or low-intensity rTMS to the vertex as a control condition (n=19). Each participant received 16 rTMS sessions immediately prior to exposure and response prevention (ERP) psychotherapy over an 8-week period. Task-based fMRI scans and clinical assessments were conducted at baseline (T0), after eight combined rTMS/ERP sessions (4 weeks, T1), after 16 sessions (8 weeks, T2), and at 12 weeks post-treatment (T3). OCD symptom severity was measured using the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS), and depression symptoms were assessed concurrently. Results showed a significant reduction in mean OCD symptom severity across all groups at each time point compared to baseline (p < .001), with no significant differences between treatment arms. Depression symptoms also decreased significantly across the entire sample (p = .0006) and within each group. ERP adherence, measured by the Patient Exposure and Response Prevention Adherence Scale, did not differ between groups for homework or in-session exposure exercises. Side effect frequency was similar across groups, and no serious adverse events occurred. The authors concluded that combined rTMS and ERP produced substantial symptom reduction, with 57.4% of participants classified as responders; however, no differences in clinical outcomes were observed between stimulation sites. Limitations included the relatively small sample size, limited number of treatment sessions, short follow-up duration, and insufficient statistical power to detect between-group differences, which restricts the ability to draw firm clinical conclusions.

TMS for Adults with Migraine Headaches:

Saltychev et al (2022) conducted a systematic review and meta-analysis of eight RCTs (n=339 participants) that compared rTMS to sham stimulation in patients with migraine. All RCTs applied high-frequency rTMS to the left dorsolateral prefrontal cortex, and all studies except one included patients with chronic migraine. All studies except one had a low risk of bias and the risk of publication

bias was nonsignificant. Results for the frequency of migraine days per month and the intensity of migraine pain both favored rTMS; however, the authors stated that the difference in migraine pain intensity was clinically insignificant.

TMS for Smoking Cessation

TMS to aid in smoking cessation is being investigated as a non-pharmacological treatment option. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome (Li 2020; Shevorykin 2022).

Bellini et al (2024) conducted a double-blind, randomized, sham-controlled trial to test the effect of dTMS on adult smokers. A total of 100 participants were randomized to active (n=50) or sham (n=50) treatment of up to 21 sessions administer over 6 weeks. Participants completed abstinence, mood, and cognition scales at determined timepoints during follow-up. No serious adverse events occurred during this study. Three participants in the active treatment group were withdrawn from the study in the first week for forearm movements during the application of the pulse series. Based on study results the authors concluded that that use of rTMS, with the parameters used and the H4 coil, was not effective in treatment smoking cessation.

Addicott et al (2024) conducted a randomized sham-controlled trial to evaluate the clinical efficacy and safety of administering iTBS for tobacco use disorder, 38 patients received 28 sessions of active (n=25) or sham (n=13) iTBS over 14 visits. Both active and sham groups reported reduced cigarette consumption, cigarette craving, and tobacco withdrawal symptoms. The authors concluded that there were no differences in cigarette consumption between the active and sham iTBS groups, both groups decreased cigarette consumption similarly, and further research is needed to compare iTBS to standard high-frequency rTMS.

TMS for Other Indications

An updated Cochrane Review (Walton 2021) assessed the evidence for use of TMS in individuals with drug-resistant epilepsy compared with other available treatments in reducing seizure frequency, epileptiform discharges, anti-epileptic medication use and side effects, as well as improving quality of life. Eight RCTs (n=241 participants), seven of which were blinded, were included. Two of the studies showed a statistically significant reduction in seizure rate from baseline (72% and 78.9% reduction of seizures per week from the baseline rate). The remaining six studies did not show a significant reduction in seizure frequency with rTMS compared to controls. Three studies did show a statistically significant reduction in epileptic discharges after active rTMS treatment and adverse events were rare, but an increase in seizure frequency did occur in a small number of individuals. No significant change in medication use was reported. The authors concluded that even though there is reasonable evidence that rTMS is effective at reducing epileptiform discharges, the evidence for the efficacy of rTMS for seizure reduction is low, and further research is needed.

Evidence related to the efficacy of rTMS is limited for other indications. Studies have methodological limitations (e.g., small samples sizes and limited follow-up). The role that TMS has in the treatment of these indications has not yet been established. Alzheimer's disease (Ahmed 2012), amyotrophic lateral sclerosis (ALS) (Fang 2013; Di Lazzaro 2024), anxiety (Trevizol 2021), chronic pain (O'Connell 2018), gambling (Concerto 2023), insomnia (Krone 2023), fibromyalgia (Short 2011; Knijnik 2016;

Salychev and Laimi 2017), migraine (Lan 2017), Parkinson's disease (Benninger 2012; Xie 2020; Chen 2021, Zhang 2022), schizophrenia (Matheson 2010; He 2017; Guan 2020; Hua 2022; Johnstone 2022), stroke (Yang 2013; Shen 2022), tinnitus (Peng 2012), Tourette syndrome (Kwon 2011).

Cranial Electrotherapy Stimulation (CES)

Additional evidence is needed to permit conclusions about whether CES improves outcomes for individuals with anxiety or depression. The evidence for depression and anxiety does not support the use of CES. The most direct evidence related to CES for anxiety and depression comes from 5 sham-controlled randomized trials (Barclay 2014; Mishoulon 2015; Lyon 2015; Kim 2021; Morriss 2023) and systematic reviews.

A 2022 meta-analysis by Ching et al. reviewed 11 RCTs (N=794) evaluating CES in patients with anxiety. Anxiety and depressive symptoms were significantly reduced with CES versus control (Hedges' g, -0.625 and -0.648, respectively); however, the analysis is limited by high variability in the number of sessions (14 to 126), session duration (10 to 60 minutes), outcomes scale, and the small number of patients in each trial.

Liu et al (2025) conducted the first meta-analysis of 16 RCT (n=1148) to explore efficacy of CES for primary and secondary depression in adults. Eight trials assessed CES as adjunctive therapy with antidepressants, while others examined CES as monotherapy. Treatment parameters varied widely: stimulation frequency ranged from 0.5 to 15,000 Hz; session duration from 20 to 60 minutes; session frequency from 3 to 7 times per week; and study duration from 2 to 24 weeks. Overall, CES significantly reduced depressive symptoms compared with non-CES treatment, though the effect size was small (Hedges' g = –0.33). CES showed no significant impact on quality of life (g = 0.13). Subgroup analyses suggested greater benefit among females, patients with secondary depression (g = –0.42), and protocols using frequency >100 Hz (g = –0.50), session length ≤30 minutes (g = –0.39), ≤5 sessions per week (g = –0.34), and study duration ≤5 weeks (g = –0.45). The authors concluded CES is an effective, safe, and well-tolerated intervention for reducing depressive symptoms in adults; however, larger, long-term RCTs are needed to confirm efficacy, optimize treatment parameters, and clarify mechanisms within broader mental health contexts.

PROFESSIONAL GUIDELINE(S)

Major Depressive Disorder

The American Psychiatric Association (APA) published a legacy clinical practice guideline, in 2010, for treatment of patient with major depressive disorder supports the use of TMS as a safe and well tolerated treatment in the acute phase.

In 2022, the Department of Veterans Affairs Department of Defense (VA/DoD) issued clinical practice guidelines for the management of MDD.

- A weak recommendation was made for rTMS for treatment for patients who have demonstrated partial or no response to two or more adequate pharmacologic treatment trials.
- The VA/DoD found that there is insufficient evidence to recommend for or against theta-burst stimulation.

- A weak recommendation against choosing Ketamine as an initial pharmacotherapy and for augmentation use of Ketamine for patients with MDD who have not responded to several adequate pharmacologic trials.

In 2025, the Clinical TMS Society (CTMSS) issued a supportive statement for rTMS for the treatment of MDD. Summarizing published evidence, CTMSS concluded that the evidence supports that using rTMS early in the treatment algorithm leads to better treatment outcomes and should be offered to patients after one antidepressant trial that does not result in remission of the depressive episode.

In 2025, an updated consensus review and considerations on TMS to treat depression was endorsed by the National Network of Depression Centers, the CTMSS, and the International Federation of Clinical Neurophysiology (Trapp 2025). Recommendations include:

- A general recommendation that patients receive the full treatment course of 30–36 sessions. There is conflicting evidence about prediction of response after a portion of sessions.
- Although maintenance TMS is promising, the frequency of maintenance treatments needed to sustain benefit is unclear, and larger scale RCT examining efficacy as a function of treatment interval are needed to establish the utility of maintenance protocols.
- Combining psychotherapy with rTMS may have additional benefits, though further research is needed before this is broadly recommended.
- No medication augmentation strategies have enough evidence to be broadly applied, although use of stimulants and glutamate receptor modulators is promising
- Various accelerated protocols are being investigated, and there is some evidence that increased dose (either by number of pulses or number of sessions) is associated with greater antidepressant effect. A novel and FDA-cleared highly accelerated protocol that also incorporates individualized targeting based on functional connectivity has shown high remission rates in an outpatient setting. Larger trials in other settings are underway, and this on-brand protocol only recently became commercially available in April 2024
- Intermittent theta burst stimulation is an FDA-cleared protocol of short duration and is non-inferior to standard high-frequency protocols. Standard high-frequency rTMS and iTBS are equally recommended as an initial antidepressant protocol.

<u>Obsessive-Compulsive Disorder</u>

The APA's legacy practice guideline (2013) for the treatment of patient with OCD states that the overall strength of evidence for somatic therapies (e.g., rTMS) is low and the therapies should be considered only after first- and second-line treatments, and well-supported augmentation strategies have been exhausted.

In 2020, the National Institute for Health and Care Excellence (NICE) published interventional procedures guidance for TMS for OCD, stating that the evidence on the safety of TMS raises no major safety concerns; however, the evidence on efficacy is inadequate in quantity and quality. NICE recommends that TMS should only be used in the context of research.

In 2021, the Clinical TMS Society (CTMSS) issued coverage guidance for TMS for OCD including:

- TMS is reasonable and necessary for a minimum of 29 visits over a 6-week period. Extensions in 2 to 4-week increments are based on clinical need with evidence of response from the first 29 sessions.
- If patients cannot come in five days a week, treatments may be administered three days a week over a longer period of time.
- Retreatment may be considered for patients who met the guidelines for initial treatment and experienced at least a 30% reduction in the YBOCS score, as long as the improvement persisted for at least one month after the prior treatments ended.
- TMS for adolescents with OCD may be appropriate if there is a higher level of treatment resistance. These cases should be reviewed individually for medical necessity and considered a compassionate use.

Theta Burst Stimulation

In 2022, the Clinical TMS Society (CTMSS) acknowledged FDA clearance of the SAINT Neuromodulation System, using the Magnus Medical Saint Neuromodulation System, for treatment-resistant MDD. SAINT differs from conventional iTBS protocols by requiring structural and functional MRI, neuronavigation, and a proprietary algorithm to individualize targeting based on functional connectivity. Whether similar outcomes can be achieved with other devices or standard targeting methods remains unknown and off-label SAINT-like protocols without neuronavigation or targeting methodology consistent with FDA-clearance is unknown

In 2023, the CTMSS issued a statement that iTBS was FDA-cleared for severe MDD based on a non-inferiority study comparing it to a standard 10 Hz TMS, with subsequent studies confirming its efficacy and safety. CTMSS states that there is a clear preponderance of evidence supporting once per day iTBS delivered to left dorsolateral prefrontal cortex (DLPFC) provides comparable acute outcomes to 10 Hz stimulation and should be considered a valid alternative for depression treatment.

Maintenance/Preservation TMS

The 2018 National Network of Depression Centers (NNDC) and APA Council on Research (CoR) consensus recommendations for the application of rTMS found limited evidence regarding maintenance strategies following response or remission with acute rTMS (McClintock 2018). One RCT compared a once-monthly scheduled approach with a re-introduction approach and found that both approaches were approximately equivalent in prolonging clinical benefits. The study also found that “rescue therapy” (re-introduction of daily rTMS triggered by symptom relapse) was effective in 69% of instances.

The Clinical TMS Society (2021) indicates that for patients who demonstrate a late response to TMS, subsequent treatment extensions in ten (10) treatment increments are allowed based on clinical need.

Other Indications

The APA published several clinical practice guidelines to provide evidence-based recommendation for the assessment and treatment of psychiatric disorders. TMS requires further study for use in treating

bipolar disorder (2002) and TMS is not addressed in the practice guidelines for borderline personality disorder (2024), eating disorders (2023), schizophrenia (2020), post-traumatic stress disorder (2000), Alzheimer's disease (2000).

The 2018 NNDC and APA CoR consensus recommendation for the application of rTMS reported that there is some evidence of the safe and therapeutic use and clinical benefit of TMS for other neuropsychiatric disorders, but the current evidence is insufficient to support routine clinical rTMS in these populations (McClintock 2018).

In 2023, the Department of Veterans Affairs Department of Defense (VA/DoD) issued clinical practice guidelines for the management of bipolar disorder. A weak recommendation was made to offer rTMS as an adjunctive treatment for individuals with bipolar disorder who have demonstrated partial or no response to pharmacologic treatment for depressive symptoms.

In 2023, the Clinical TMS Society issued coverage guidance (indication, limitations, and medical necessity) for TMS as a treatment for smoking.

REGULATORY STATUS

Devices for TMS have been cleared for marketing by the U.S. Food and Drug Administration (FDA) for the treatment of major depressive disorder in adults who have failed to achieve satisfactory improvement from prior antidepressant medication in the current episode.

The United States Food and Drug Administration (FDA) regulates TMS and CES devices and protocols as medical devices. All TMS and CES devices and protocols require FDA approval before marketing and use in the United States to ensure they are safe and effective for human use. Refer to the FDA Medical Device website. Available from: https://www.fda.gov/medical-devices [accessed 2025 Nov 3]

The FDA lists the most serious type of medical device recalls as well as early alert communications about corrective actions being taken by companies that the FDA believes are likely to be the most serious type of recalls. on our website by the date that the FDA posts the information on our website. Available from: https://www.fda.gov/medical-devices/medical-device-safety/medical-device-recalls [accessed 2025 Nov 3]

The U.S. Food and Drug Administration (FDA) has not determined the safety or efficacy of ketamine hydrochloride injection for the treatment of a psychiatric disorder(s) and is considered off-label use for these indications (FDA 2023).

TMS devices have been FDA cleared for the treatment of major depressive disorder (Product Code: OBP), migraine headache pain (Product Code: OKP), obsessive-compulsive disorder (Product Code: QCI), and short-term smoking cessation for adults (Product Code: QMD).

TMS Devices FDA-cleared for Major Depressive Disorder:

Device	Manufacturer	FDA Clearance	Clearance Date
BrainsWay Deep TMS System with accelerated iTBS protocol	BrainsWay	K251449	09/13/2025

BrainsWay Deep TMS System	BrainsWay	K222196	05/31/2025
NeuroStar Advanced Therapy System *ages 15-21	Neuronetics	K231926	03/22/2024
Horizon 3.0 TMS Therapy System	Magstim	K222171	01/13/2023
Magnus Nueromodulation System with SAINT Technology	Magnus Medical	K220177	09/01/2022
ALTMS Magnetic Stimulation Therapy System	REMED Co., Ltd	K220625	04/06/2022
MagVenture TMS Therapy	Tonica Elektronik	K193006	08/09/2020
Horizon TMS Therapy System with iTBS protocol	Magstim	K182853	03/15/2019
Mag Vita TMS Therapy System with Theta Burst Stimulation	Tonica Elektronik	K173620	8/14/2018
Apollo TMS Therapy System *age 15 and older	Magstim	K180313 K243700	05/04/2018 09/04/2025
Nexstim	Magstim	K171902	11/10/2017
Horizon	Magstim	K171051	09/13/2017
Neurosoft	TeleEMG	K160309	12/22/2016
Magvita	Tonica Elektronik	K150641	07/31/2015
Rapid Therapy System	Magstim	K143531	05/08/2015
Brainsway H-Coil Deep TMS System	BrainsWay	K122288	01/07/2013
NeoPulse, now known as Neurostar	Neuronetics	K083538	12/16/2008

TMS Devices FDA-cleared for Adults with Obsessive-Compulsive Disorder (OCD):

Device	**Manufacturer**	**FDA Clearance**	**Clearance Date**
CloudTMS for OCD	TeleEMG	K221129	03/10/2023
Horizon 3.0 TMS Therapy System	Magstim	K222171	01/13/2023
Neurostar	Neuronetics	K212289	05/06/2022
MagVenture TMS Therapy	Tonica Elektronik	K193006	08/09/2020
Brainsway H-Coil Deep TMS System	Brainsway	K183303	03/08/2019

TMS Devices FDA-cleared for Migraine Headache with an Aura:

Device	Manufacturer	FDA Clearance	Clearance Date
Savi Dual Migraine Therapy	ENeura	K230358	05/16/2023
Brainsway H-Coil Deep TMS System	Brainsway	K183303	03/08/2019
Springtms Total Migraine System	Eneura	K140094	05/21/2014
Cerena	eNeura Therapeutics	K130556	03/05/2013

TMS Devices FDA-cleared to Aid in Smoking Cessation for Adults

Device	Manufacturer	FDA Clearance	Clearance Date
Brainsway Deep TMS System	Brainsway	K200957	08/21/2020

CES Devices FDA-cleared (select indications)

Device	Manufacturer	FDA Clearance	Clearance Date
Alpha-Stim CS, for anxiety and insomnia	Electromedical Products International, Inc.	K903014	05/12/1992
Flow FL-100, for moderate to severe Major Depressive Disorder in adults	Flow Neuroscience	PMA P230024	12/08/2025

CODE(S)

- Codes may not be covered under all circumstances.
- Code list may not be all inclusive (AMA and CMS code updates may occur more frequently than policy updates).
- (E/I)=Experimental/Investigational
- (NMN)=Not medically necessary/appropriate

CPT Codes

Code	Description
0889T (E/I)	Personalized target development for accelerated, repetitive high-dose functional connectivity MRI–guided theta-burst stimulation derived from a structural and resting-state functional MRI, including data preparation and transmission, generation of the target, motor threshold–starting location, neuronavigation files and target report, review, and interpretation
0890T (E/I)	Accelerated, repetitive high-dose functional connectivity MRI–guided theta-burst stimulation, including target assessment, initial motor threshold determination, neuronavigation, delivery and management, initial treatment day
0891T (E/I)	subsequent treatment day
0892T (E/I)	subsequent motor threshold redetermination with delivery and management, per treatment day
0997T (E/I)	Precuneus magnetic stimulation; treatment planning using magnetic resonance imaging-guided neuronavigation to determine optimal location, dose, and intensity for magnetic stimulation therapy, derived from evoked potentials from single pulses of electromagnetic energy recorded by 64-channel electroencephalogram, including automated data processing, transmission, analysis, generation of treatment parameters with review, interpretation, and report (effective 01/01/26)
0998T (E/I)	Precuneus magnetic stimulation; personalized treatment delivery of magnetic stimulation therapy to a prespecified target area derived from analysis of evoked potentials within the precuneus, utilizing magnetic resonance imaging-based neuronavigation, with management, per day (effective 01/01/26)
90867	Therapeutic repetitive transcranial magnetic stimulation (TMS) treatment; initial, including cortical mapping, motor threshold determination, delivery, and management
90868	subsequent delivery and management, per session
90869	subsequent motor threshold re-determination with delivery and management

HCPCS Codes

Code	Description
E0732	Cranial electrotherapy stimulation (CES) system, any type

ICD10 Codes

Code	Description
F17.20 - F17.29 (E/I)	Nicotine dependence (code range)
F32.0 - F32.9	Major depressive disorder, single episode (code range)
F33.0 - F33.9	Major depressive disorder, recurrent (code range)
F41.0 - 41.9 (E/I)	Anxiety disorders (code range)
F42.0 - F42.9	Obsessive-compulsive disorder (code range)
F51.0 - F51.09 (E/I)	Insomnia (code range)
G30.0 -G30.9 (E/I)	Alzheimer's disease (code range)
G43.0 – G43.9 (E/I)	Migraine, with and without aura (code range)

REFERENCES

Addicott MA, et al. A randomized controlled trial of intermittent theta burst stimulation to the medial prefrontal cortex for tobacco use disorder: Clinical efficacy and safety. Drug Alcohol Depend. 2024 May 1;258:111278. Epub 2024 Mar 30.

Ahmed MA, et al. Effects of low versus high frequencies of repetitive transcranial magnetic stimulation on cognitive function and cortical excitability in Alzheimer's dementia. J Neurol. 2012 Jan;259(1):83-92.

American Psychiatric Association [Internet]. Legacy practice guidelines. Major Depressive Disorder. 2010 May [accessed 2025 Dec 15]. Available from: https://www.psychiatry.org/psychiatrists/practice/clinical-practice-guidelines

American Psychiatric Association [Internet]. Legacy practice guidelines. Treatment of patients with obsessive-compulsive disorder. 2007 [accessed 2025 Dec 15]. Available from: https://www.psychiatry.org/psychiatrists/practice/clinical-practice-guidelines

American Psychiatric Association [Internet]. Policy Finder. Position Statement on Transcranial Magnetic Stimulation (TMS). 2024 Jul [accessed 2025 Dec 15]. Available from: https://www.psychiatry.org/about-apa/policy-finder

American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition,

Text Revision (DSM-5-TR). Washington, DC, American Psychiatric Association, 2022.

Avery DH, et al. A controlled study of repetitive transcranial magnetic stimulation in medication-resistant major depression. Biol Psychiatry. 2006 Jan 15;59(2):187-94.

Avery DH, et al. Transcranial magnetic stimulation reduces pain in patients with major depression: a sham-controlled study. J Nerv Ment Dis. 2007 May;195(5):378-81.

Avery DH, et al. Transcranial magnetic stimulation in the acute treatment of major depressive disorder: clinical response in an open-label extension trial. J Clin Psychiatry. 2008 Mar;69(3):441-51.

Bahun I, et al. A pilot study of accelerated deep transcranial magnetic stimulation effects on cognitive functioning in patients diagnosed with treatment resistant major depressive disorder. Psychiatry Res. 2022 Oct;316:114750.

Barclay TH and Barclay RD. A clinical trial of cranial electrotherapy stimulation for anxiety and comorbid depression. J Affect Disord. 2014 Aug;164:171-177.

Bellini BB, et al. Does deep TMS really works for smoking cessation? A prospective, double blind, randomized, sham controlled study. Prog Neuropsychopharmacol Biol Psychiatry. 2024 Jun 8;132:110997. Epub 2024 Mar 24. PMID: 38531486.

Berlim MT, et al. Efficacy of theta burst stimulation (TBS) for major depression: An exploratory meta-analysis of randomized and sham-controlled trials. J Psychiatr Res. 2017 Jul;90:102-109.

Benninger DH, et al. Controlled study of 50-Hz repetitive transcranial magnetic stimulation for the treatment of Parkinson disease. Neurorehabil Neural Repair. 2012 Nov-Dec;26(9):1096-1105.

Berlim MT, et al. High frequency repetitive transcranial magnetic stimulation as an augmenting strategy in severe treatment-resistant major depression: a prospective 4-week naturalistic trial. J Affect Disord. 2011 Apr;130(1-2):312-7.

Blumberger DM, et al. Effectiveness of theta burst versus high-frequency repetitive transcranial magnetic stimulation in patients with depression (THREE-D): a randomised non-inferiority trial. Lancet. 2018 Apr 28;391(10131):1683-1692.

Blumberger DM, et al. Effectiveness of standard sequential bilateral repetitive transcranial magnetic stimulation vs bilateral theta burst stimulation in older adults with depression the FOUR-D randomized noninferiority clinical trial. JAMA Psychiatry. 2022;79(11):1065-1073.

Bulteau S, et al. Intermittent theta burst stimulation (iTBS) versus 10 Hz high-frequency repetitive transcranial magnetic stimulation (rTMS) to alleviate treatment-resistant unipolar depression: A randomized controlled trial (THETA-DEP). Brain Stimul. 2022;15(3):870-880

Buyuktaskin D, et al. Repetitive transcranial magnetic stimulation frequency effects on suicidal ideation in adolescents with major depressive disorder. J Affect Disord. 2025 Aug 15;383:101-107.

Cao P, et al. Efficacy and safety of repetitive transcranial magnetic stimulation combined with antidepressants in children and adolescents with depression: A systematic review and meta-analysis. J Affect Disord. 2023 Sep 1;336:25-34.

Carmi L, et al. Clinical and electrophysiological outcomes of deep TMS over the medial prefrontal and

anterior cingulate cortices in OCD patients. Brain Stimul. 2018 Jan - Feb;11(1):158-165.

Carmi L, et al. Efficacy and safety of deep transcranial magnetic stimulation for obsessive-compulsive disorder: A prospective multicenter randomized double-blind placebo-controlled trial. Am J Psychiatry. 2019;176(11):931-938.

Chen J, et al. Non-pharmacological treatment for Parkinson disease patients with depression: a meta-analysis of repetitive transcranial magnetic stimulation and cognitive-behavioral treatment. Int J Neurosci. 2021 Apr;131(4):411-424.

Ching PY, et al. Efficacy and tolerability of cranial electrotherapy stimulation in the treatment of anxiety: a systemic review and meta-analysis. Front Psychiatry. 2022 Jun 9;13:899040.

Clinical TMS Society [Internet]. Clinical standards. Revised statement regarding SAINT protocol. 2022 Dec 08 [accessed 2025 Dec 10]. Available from: https://clinicaltmssociety.org/committees-clinical-standard/

Clinical TMS Society [Internet]. Clinical standards. rTMS clarifying statement. 2023 Feb 10 [accessed 2025 Dec 10]. Available from: https://clinicaltmssociety.org/committees-clinical-standard/

Clinical TMS Society [Internet]. Clinical standards. Theta burst statement from the Clinical TMS Society. 2023 Mar 09 [accessed 2025 Dec 10]. Available from: https://clinicaltmssociety.org/committees-clinical-standard/

Clinical TMS Society [Internet]. Clinical standards. Preservation of TMS statement. 2023 Dec 8 [accessed 2025 Dec 10]. Available from: https://clinicaltmssociety.org/committees-clinical-standard/

Clinical TMS Society [Internet]. Clinical standards. Supportive statement for rTMS for MDD. Optimizing depression treatment: clinical and economic benefits of early repetitive transcranial magnetic stimulation. 2025 Apr 7 [accessed 2025 Dec 10]. Available from: https://clinicaltmssociety.org/committees-clinical-standard/

Clinical TMS Society [Internet]. Coverage guidance for TMS for OCD. 2021 Feb 2 [accessed 2025 Dec 10]. Available from: https://clinicaltmssociety.org/wp-content/uploads/2024/08/CTMSS-Recommended-OCD-Coverage-Policy_Approved-02-02-2021.pdf

Clinical TMS Society [Internet]. Coverage guidance for TMS for smoking cessation. 2023 Oct 9 [accessed 2025 Dec 10]. Available from: https://clinicaltmssociety.org/wp-content/uploads/2024/08/Ideal-Smoking-Cessation-Policy_Final_0.pdf

Cole EJ, et al. Stanford Accelerated Intelligent Neuromodulation Therapy for treatment-resistant depression. Am J Psychiatry. 2020 Aug 1;177(8):716-726.

Cole EJ, et al. Stanford Neuromodulation therapy (SNT): a double-blind randomized controlled trial. Am J Psychiatry. 2022 Feb;179(2):132-141. Epub 2021 Oct 29

Concerto C, et al. Transcranial magnetic stimulation for the treatment of gambling disorder: A systematic review. J Integr Neurosci. 2023;22(6):164.

Croarkin PE, et al. Left prefrontal transcranial magnetic stimulation for treatment-resistant depression in adolescents: a double-blind, randomized, sham-controlled trial. Neuropsychopharmacology. 2021

Jan;46(2):462-469.

d'Andrea G, et al. Investigating the role of maintenance TMS protocols for major depression: systematic review and future perspectives for personalized interventions. J Pers Med. 2023 Apr 21;13(4):697. PMID: 37109083.

Dalhuisen I, et al. rTMS as a next step in antidepressant nonresponders: a randomized comparison with current antidepressant treatment approaches. Am J Psychiatry. 2024 Sep 1;181(9):806-814.

Di Lazzaro V, et al. Transcranial static magnetic stimulation for amyotrophic lateral sclerosis: a bicentric, randomised, double-blind placebo-controlled phase 2 trial. Lancet Reg Health Eur. 2024 Jul 30;45:101019. PMID: 39185360

Dragon K, et al. Four weeks standard vs. one week accelerated intermittent Theta Burst Stimulation for the treatment of depression - A retrospective analysis. Behav Brain Res. 2025 Feb 28;479:115361.

Fang J, et al. Repetitive transcranial magnetic stimulation for the treatment of amyotrophic lateral sclerosis or motor neuron disease. Cochrane Database Syst Rev. 2013 May 31;5(5):CD008554.

Fitzgerald PB, et al. A pilot investigation of an intensive theta burst stimulation protocol for patients with treatment resistant depression. Brain Stimul. Jan-Feb 2020;13(1):137-144.

Fitzgerald PB, et al. Accelerated repetitive transcranial magnetic stimulation in the treatment of depression. Neuropsychopharmacology. 2018 Jun;43(7):1565-1572.

Fitzgerald PB, et al. An open label trial of clustered maintenance rTMS for patients with refractory depression. Brain Stim. 2013 May;6(3):292-7.

Fitzsimmons SMDD, et al. Repetitive transcranial magnetic stimulation for obsessive-compulsive disorder: A systematic review and pairwise/network meta-analysis. J Affect Disord. 2022 Apr 1;302:302-312.

Fitzsimmons SMDD, et al. Transcranial magnetic stimulation-induced plasticity improving cognitive control in obsessive-compulsive disorder, part I: clinical and neuroimaging outcomes from a randomized trial. Biol Psychiatry. 2025 Apr 1;97(7):678-687. Epub 2024 Jul 30.

Garzon JF, et al. A multisite, 6-month, open-label study of maintenance transcranial magnetic stimulation for adolescents with treatment-resistant depression. J Child Adolesc Psychopharmacol. 2025 Mar;35(2):99-108. doi: 10.1089/cap.2024.0067. Epub 2024 Dec 26.

Gao F, et al. Repetitive transcranial magnetic stimulation for pain after spinal cord injury: a systematic review and meta-analysis. J Neurosurg Sci. 2017 Oct;61(5):514-522.

Geoly AD, et al. Durability of clinical benefit with Stanford Neuromodulation Therapy (SNT) in treatment-resistant depression. Brain Stimul. 2025 May-Jun;18(3):875-881.

George MS, et al. Daily left prefrontal transcranial magnetic stimulation therapy for major depressive disorder: a sham- controlled randomized trial. Arch Gen Psychiatry. 2010 May;67(5):507-16.

Guan HY, et al. High-frequency neuronavigated rTMS effect on clinical symptoms and cognitive dysfunction: a pilot double-blind, randomized controlled study in veterans with schizophrenia. Transl

Psychiatry. 2020 Feb 25;10(1):79.

He H, et al. Repetitive transcranial magnetic stimulation for treating the symptoms of schizophrenia: A PRISMA compliant meta-analysis. Clin Neurophysiol. 2017 May;128(5):716-724.

Hua JPY, et al. Cerebellar stimulation in schizophrenia: A systematic review of the evidence and an overview of the methods. Front Psychiatry. 2022;13:1069488.

Janicak PG, et al. Durability of clinical benefit with transcranial magnetic stimulation (TMS) in the treatment of pharmacoresistant major depression: assessment of relapse during a 6-month, multisite, open-label study. Brain Stimul. 2010 Oct;3(4):187-99.

Johnstone S, et al. Neuromodulation to treat substance use disorders in people with schizophrenia and other psychoses: A systematic review. Front Psychiatry. 2022;13:793938.

Kim J, et al. Effects of cranial electrotherapy stimulation with novel in-ear electrodes on anxiety and resting-state brain activity: A randomized double-blind placebo-controlled trial. J Affect Disord. 2021 Dec 1;295:856-864.

Knijnik LM, et al. Repetitive transcranial magnetic stimulation for fibromyalgia: systematic review and meta-analysis. Pain Pract. 2016 March;16(3):294-304.

Krone LB, et al. Brain stimulation techniques as novel treatment options for insomnia: A systematic review. J Sleep Res. 2023 Dec;32(6):e13927.

Kumar N, et al. A randomized, double blind, sham-controlled trial of repetitive transcranial magnetic stimulation (rTMS) in the treatment of negative symptoms in schizophrenia. Brain Stimul 2020 May-Jun;13(3):840-849.

Lam RW, et al. Repetitive transcranial magnetic stimulation for treatment-resistant depression: A systematic review and meta-analysis. Can J Psychiatry. 2008;53(9):621-631.

Lan L, et al. The efficacy of transcranial magnetic stimulation on migraine: a meta-analysis of randomized controlled trails. J Headache Pain. 2017 Aug 22;18(1):86.

Levkovitz Y, et al. Efficacy and safety of deep transcranial magnetic stimulation for major depression: a prospective multicenter randomized controlled trial. World Psychiatry. 2015;14:64–73.

Li CT, et al. Effects of prefrontal theta-burst stimulation on brain function in treatment-resistant depression: A randomized sham-controlled neuroimaging study. Brain Stimul. 2018 Sep-Oct;11(5):1054-1062.

Li X, et al. Two weeks of image-guided left dorsolateral prefrontal cortex repetitive transcranial magnetic stimulation improves smoking cessation: A double-blind, sham-controlled, randomized clinical trial. Brain Stimul. 2020 Sep-Oct;13(5):1271-1279.

Lipton RB, et al. Single-pulse transcranial magnetic stimulation for acute treatment of migraine with aura: a randomised, double-blind, parallel-group, sham-controlled trial. Lancet Neurol. 2010 Apr;9(4):373-80.

Liu SY, et al. Efficacy of cranial electrotherapy stimulation for treating primary and secondary depression in adults: A meta-analysis of randomized controlled trials. J Affect Disord. 2025 Aug

1;382:488-497.

Lyon D, et al. Randomized sham-controlled trial of cranial microcurrent stimulation for symptoms of depression, anxiety, pain, fatigue and sleep disturbances in women receiving chemotherapy for early-stage breast cancer. Springerplus. 2015 Jul 23;4:369.

Majumder P, et al. The safety and efficacy of repetitive transcranial magnetic stimulation in the treatment of major depression among children and adolescents: a systematic review. Cureus. 2021 Apr 19;13(4):e14564.

Mallik G, et al. Safety and efficacy of continuous theta burst “intensive” stimulation in acute-phase bipolar depression. J of ECT. 2023 Mar;39(1):28-33.

Mantovani A, et al. Long-term efficacy of repeated daily prefrontal transcranial magnetic stimulation (TMS) in treatment-resistant depression. Depress Anxiety. 2012 Oct;29(10):883-90.

Matheson SL, et al. Quality assessment, and comparison of evidence for electroconvulsive therapy and repetitive transcranial magnetic stimulation for schizophrenia: a systematic meta-review. Schizophr Res. 2010 May;118(1-3):201-10.

McClintock SM, et al. Consensus recommendations for the clinical application of repetitive transcranial magnetic stimulation (rTMS) in the treatment of depression. J Clin Psychiatry. 2018 Jan/Feb;79(1).

McLoughlin DM, et al. The clinical effectiveness and cost of repetitive transcranial magnetic stimulation versus electroconvulsive therapy in severe depression: a multicentre pragmatic randomized controlled trial and economic analysis. Health Technol Assess. 2007 Jul;11(24):1-54.

Mischoulon D, et al. Efficacy and safety of a form of cranial electrical stimulation (CES) as an add-on intervention for treatment-resistant major depressive disorder: A three-week double blind pilot study. J Psychiatr Res. 2015 Nov;70:98-105.

Morriss R, et al. Clinical effectiveness of active Alpha-Stim AID versus sham Alpha-Stim AID in major depression in primary care in England (Alpha-Stim-D): a multicentre, parallel group, double-blind, randomised controlled trial. Lancet Psychiatry. 2023 Mar;10(3):172-183.

National Institute for Health and Clinical Excellence (NICE) [Internet]. Repetitive transcranial magnetic stimulation for depression. Interventional Procedure Guidance [IPG 542]. 2015 Dec [accessed 2025 Dec 15]. Available from: https://www.nice.org.uk/guidance/ipg542

National Institute for Health and Clinical Excellence (NICE) [Internet]. Transcranial magnetic stimulation for obsessive-compulsive disorder. Interventional Procedure Guidance [IPG676] 2020 Aug [accessed 2025 Dec 15]. Available from: https://www.nice.org.uk/guidance/ipg676

O’Connell NE, et al. Non-invasive brain stimulation techniques for chronic pain. Cochrane Database Syst Rev 2018 Apr 13;4:CD008208.

Ontario Health. Repetitive transcranial magnetic stimulation for people with treatment-resistant depression: a health technology assessment. Ont Health Technol Assess Ser. 2021 May; 21(4):1-232.

O’Reardon JP, et al. Efficacy and safety of transcranial magnetic stimulation in the acute treatment of major depression: a multisite randomized controlled trial. Biol Psychiatry. 2007 Dec 1;62(11):1208-

16.

Ozer U, et al. Efficacy of accelerated deep transcranial magnetic stimulation with double cone coil in obsessive-compulsive disorder: A double-blind, placebo-controlled study. J Psychiatr Res. 2024 Mar;171:325-331. Erratum in: J Psychiatr Res. 2025 Jan;181:647.

Papakostas GI, et al. Comparative effectiveness research trial for antidepressant incomplete and non-responders with treatment resistant depression (ASCERTAIN-TRD) a randomized clinical trial. Mol Psychiatry. 2024 Aug;29(8):2287-2295.

Peng Z, et al. Effectiveness of repetitive transcranial magnetic stimulation for chronic tinnitus: a systematic review. Otolaryngol Head Neck Surg. 2012 Nov;147(5):817-25.

Prato M, et al. Accelerated repetitive Transcranial Magnetic Stimulation (aTMS) vs. standard repetitive Transcranial Magnetic Stimulation (rTMS) in the treatment of Major Depressive Episodes: A randomized, single-blind, controlled trial. TMS Journal. 2025 Aug. Volume 4:100177

Price L, et al. A meta-analysis of cranial electrotherapy stimulation in the treatment of depression. J Psychiatr Res. 2021 Mar;135:119-134. Epub 2020 Dec 21.

Qiu H, et al. Efficacy and safety of repetitive transcranial magnetic stimulation in children and adolescents with depression: A systematic review and preliminary meta-analysis. J Affect Disord. 2023 Jan 1;320:305-312.

Ramakrishnan D, et al. An evaluation of treatment response and remission definitions in adult obsessive-compulsive disorder: A systematic review and individual-patient data meta-analysis. J Psychiatr Res. 2024 May;173:387-397.

Roth Y, et al. Real world efficacy and safety of various accelerated deep TMS protocols for major depression. Psychiatry Res. 2023 Oct;328:115482

Saltychev M and Juhola J. Effectiveness of high-frequency repetitive transcranial magnetic stimulation(rTMS) in migraine - a systematic review and meta-analysis. Am J Phys Med Rehabil. 2022 Nov 1;101(11)101-1006.

Saltychev M and Laimi K. Effectiveness of repetitive transcranial magnetic stimulation in patients with fibromyalgia: a meta-analysis. Int J Rehabil Res. 2017 March;40(1):11-18.

Senova A, et al. Durability of antidepressant response to repetitive transcranial magnetic stimulation: Systematic review and meta-analysis. Brain Simul. 2019;12(1):119-128.

Shen Y, et al. Repetitive transcranial magnetic stimulation, and transcranial direct current stimulation as treatment of poststroke depression: a systematic review and meta-analysis. Neurologist. 2022 Jul 1;27(4):177-182.

Shevorykin A, et al. Transcranial magnetic stimulation for long-term smoking cessation: preliminary examination of delay discounting as a therapeutic target and the effects of intensity and duration. Front Hum Neurosci. 2022 Jul 5;16:920383.

Short et al. Ten sessions of adjunctive left prefrontal rTMS significantly reduces fibromyalgia pain: a randomized, controlled pilot study. Pain. 2011 Nov;152(11)2477-2484.

Sigrist C, et al. Transcranial magnetic stimulation in the treatment of adolescent depression: a systematic review and meta-analysis of aggregated and individual-patient data from uncontrolled studies. Eur Child Adolesc Psychiatry. 2022 Oct;31(10):1501-1525.

Sonmez AI, et al. Accelerated TMS for depression: a systematic review and meta-analysis. Psychiatry Res. 2019 Mar;273:770-781. Epub 2018 Dec 7

Steuber ER and McGuire JF. A meta-analysis of transcranial magnetic stimulation in obsessive-compulsive disorder. Biol Psychiatry Cogn Neurosci Neuroimaging. 2023 Nov;8(11):1145-1155.

Sun CH, et al. Adjunctive repetitive transcranial magnetic stimulation for adolescents with first-episode major depressive disorder: a meta-analysis. Front Psychiatry. 2023 Aug 1;14:1200738.

Trapp NT, et al.; National Network of Depression Centers Neuromodulation Task Group. Consensus review and considerations on TMS to treat depression: A comprehensive update endorsed by the National Network of Depression Centers, the Clinical TMS Society, and the International Federation of Clinical Neurophysiology. Clin Neurophysiol. 2025 Feb;170:206-233. Epub 2024 Dec 19.

Trevizol AP, et al. Effect of repetitive transcranial magnetic stimulation on anxiety symptoms in patients with major depression: An analysis from the THREE-D trial. Depress Anxiety. 2021 Mar;38(3):262-271. Epub 2020 Dec 11.

VA/DoD Clinical Practice Guideline [Internet]. Management of bipolar disorder (BP). 2023 May [accessed 2025 Dec 15]. Available from: https://www.healthquality.va.gov/guidelines/mh/bd/index.asp

VA/DoD Clinical Practice Guideline [Internet]. Management of major depressive disorder. 2022 Feb [accessed 2025 Dec 15] Available from: https://www.healthquality.va.gov/guidelines/MH/mdd/index.asp

VA/DoD Clinical Practice Guideline [Internet]. Management of post-traumatic stress disorder and acute distress disorder. 2023 Jun [accessed 2025 Dec 15]. Available from https://www.healthquality.va.gov/guidelines/MH/ptsd/

Voigt JD, et al. Theta burst stimulation for the acute treatment of major depressive disorder: A systematic review and meta-analysis. Translational Psychiatry. 2021;11(330):1-12.

Walton D, et al. Transcranial magnetic stimulation for the treatment of epilepsy. Cochrane database Syst Rev 2021 Apr 22;(4):CD011025.

Wilson S, et al. Systematic review of preservation TMS that includes continuation, maintenance, relapse-prevention, and rescue TMS. J Affect Disord. 2022 Jan;296:79-88.

Xie YJ, et al. Effect of repetitive transcranial magnetic stimulation on gait and freezing of gait in Parkinson disease: a systematic review and meta-analysis. Arch Phys Med Rehabil. 2020 Jan;101(1):130-140.

Yamazaki R, et al. Maintenance repetitive transcranial magnetic stimulation (rTMS) therapy for treatment-resistant depression: a study protocol of a multisite, prospective, non-randomized longitudinal study. Psychiatry. 2023 Jun;23:437.

Zhang W, et al. Efficacy of repetitive transcranial magnetic stimulation in Parkinson's disease: A systematic review and meta-analysis of randomised controlled trials. EClinicalMedicine. 2022 Jul 29;52:101589.

SEARCH TERMS

Not Applicable

CENTERS FOR MEDICARE AND MEDICAID SERVICES (CMS)

Transcranial Magnetic Stimulation (LCD) L33398 [accessed 2025 Dec 9]

PRODUCT DISCLAIMER

- Services are contract dependent; if a product does not cover a service, medical policy criteria do not apply.
- If a commercial product (including an Essential Plan or Child Health Plus product) covers a specific service, medical policy criteria apply to the benefit.
- If a Medicaid product covers a specific service, and there are no New York State Medicaid guidelines (eMedNY) criteria, medical policy criteria apply to the benefit.
- If a Medicare product (including Medicare HMO-Dual Special Needs Program (DSNP) product) covers a specific service, and there is no national or local Medicare coverage decision for the service, medical policy criteria apply to the benefit.
- If a Medicare HMO-Dual Special Needs Program (DSNP) product DOES NOT cover a specific service, please refer to the Medicaid Product coverage line.

POLICY HISTORY/REVISION

Committee Approval Dates

08/20/09, 07/15/10, 08/18/11, 11/15/12, 12/19/13, 12/18/14, 10/15/15, 12/15/16, 12/21/17, 12/20/18, 01/16/20, 01/21/21, 01/20/22, 01/19/23, 01/18/24, 01/23/25, 01/22/26

Date	Summary of Changes
01/22/26	• Annual review; stance change to allow treatment of OCD and also lowered the minimum age for treatment of MDD to 15 years old. Policy intent unchanged with a title change, adding codes and associated investigational statement, from other corporate medical policies, for functional connectivity MRI–guidance, precuneus magnetic stimulation, and cranial electrotherapy stimulation.
01/23/25	• Annual review, revision to Policy Statement and Policy Guidelines, policy intent unchanged.

01/01/25	• Summary of changes tracking implemented.
08/20/09	• Original effective date