MASSACHUSETTS

Blue Cross Blue Shield of Massachusetts is an Independent Licensee of the Blue Cross and Blue Shield Association

Medical Policy

Transcranial Magnetic Stimulation as a Treatment of Depression and Other Psychiatric/Neurologic Disorders

Table of Contents

Policy Number: 297

BCBSA Reference Number: 2.01.50 (For Plans internal use only)
NCD/LCD: Local Coverage Determination (LCD): Transcranial Magnetic Stimulation (L33398)

Related Policies

- Outpatient Psychotherapy, #423
- Vagus Nerve Stimulation, #474
- Treatment of Tinnitus, #267
- Deep Brain Stimulation, #473

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity,

Repetitive transcranial magnetic stimulation (rTMS) or deep transcranial magnetic stimulation (dTMS) of the brain using an FDA-cleared device and modality may be considered **MEDICALLY NECESSARY** as a treatment of major depressive disorder when **all** of the following conditions (1-3) have been met:

1. Confirmed diagnosis of severe major depressive disorder (single or recurrent) documented by standardized rating scales that reliably measure depressive symptoms; and
2. Any one of the following (a, b, c, or d):
    a. Failure of 4 trials of psychopharmacologic agents including 2 different agent classes and 2 augmentation trials; or
    b. Inability to tolerate a therapeutic dose of medications as evidenced by 4 trials of psychopharmacologic agents with distinct side effects; or
    c. History of response to rTMS in a previous depressive episode (at least 3 months since the prior episode); or
    d. Is a candidate for electroconvulsive therapy; further, electroconvulsive therapy would not be clinically superior to rTMS (eg, in cases with psychosis, acute suicidal risk, catatonia or life-threatening inanition rTMS should NOT be used); and
3. Failure of a trial of a psychotherapy known to be effective in the treatment of major depressive disorder of an adequate frequency and duration, without significant improvement in depressive symptoms, as documented by standardized rating scales that reliably measure depressive symptoms.

Repetitive transcranial magnetic stimulation (rTMS) or deep transcranial magnetic stimulation (dTMS) for major depressive disorder that does not meet the criteria listed above is considered **INVESTIGATIONAL**.

Continued treatment with repetitive transcranial magnetic stimulation (rTMS) or deep transcranial magnetic stimulation (dTMS) or of the brain as maintenance therapy is considered **INVESTIGATIONAL**.

Repetitive transcranial magnetic stimulation (rTMS) or deep transcranial magnetic stimulation (dTMS) of the brain is considered **INVESTIGATIONAL** as a treatment of all other psychiatric/neurologic disorders, including but not limited to bipolar disorder, schizophrenia, obsessive-compulsive disorder, or migraine headaches.

Repetitive transcranial magnetic stimulation (rTMS) or deep transcranial magnetic stimulation (dTMS) should be performed using a U.S. Food and Drug Administration cleared device in appropriately selected patients, by physicians who are adequately trained and experienced in the specific techniques used. A treatment course should not exceed 5 days a week for 6 weeks (total of 30 sessions), followed by a 3-week taper of 3 TMS treatments in week 1, 2 TMS treatments the next week, and 1 TMS treatment in the last week.

Contraindications to repetitive TMS include:

a. Seizure Disorder or any history of seizure with increased risk of future seizure; or
b. Presence of acute or chronic psychotic symptoms or disorders (eg, schizophrenia, schizophreniform or schizoaffective disorder) in the current depressive episode; or)
c. Neurologic conditions that include epilepsy, cerebrovascular disease, dementia, increased intracranial pressure, having a history of repetitive or severe head trauma, or with primary or secondary tumors in the central nervous system; or
d. Presence of an implanted magnetic-sensitive medical device located within 30 centimeters from the TMS magnetic coil or other implanted items including but not limited to a cochlear implant, implanted cardioverter defibrillator, pacemakers, vagus nerve stimulator or metal aneurysm clips or coils, staples, or stents.

Medicare HMO Blue℠ and Medicare PPO Blue℠ Members

Medical necessity criteria and coding guidance for **Medicare Advantage members living in Massachusetts** can be found through the link(s) below.

Local Coverage Determinations (LCDs) for National Government Services, Inc.

Local Coverage Determination (LCD): Transcranial Magnetic Stimulation (L33398)

Note: To review the specific LCD, please remember to click “accept” on the CMS licensing agreement at the bottom of the CMS webpage.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is **required**. Providers must submit the following form: Repetitive Transcranial Magnetic Stimulation (rTMS) Request Form
Commercial PPO and Indemnity	Prior authorization is **not required**.

Medicare HMO Blue℠	Prior authorization is **required**.
Medicare PPO Blue℠	Prior authorization is **required**.

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:

CPT Codes

CPT codes:	Code Description
90867	Therapeutic repetitive transcranial magnetic stimulation (TMS) treatment; initial, including cortical mapping, motor threshold determination, delivery and management
90868	Therapeutic repetitive transcranial magnetic stimulation (TMS) treatment; subsequent delivery and management, per session
90869	Therapeutic repetitive transcranial magnetic stimulation (TMS) treatment; subsequent motor threshold re-determination with delivery and management

The following ICD Diagnosis Codes are considered medically necessary when submitted with the CPT codes above if medical necessity criteria are met:

ICD-10 Diagnosis Codes

ICD-10-CM Diagnosis codes:	Code Description
F32.2	Major depressive disorder, single episode, severe without psychotic features
F33.2	Major depressive disorder, recurrent severe without psychotic features

Description

Transcranial Magnetic Stimulation

Transcranial magnetic stimulation (TMS), introduced in 1985 as a new method of noninvasive stimulation of the brain, involves placement of a small coil over the scalp, passing a rapidly alternating current through the coil wire, which produces a magnetic field that passes unimpeded through the scalp and bone, resulting in electrical stimulation of the cortex. TMS was initially used to investigate nerve conduction, eg, TMS over the motor cortex will produce a contralateral muscular-evoked potential. The motor threshold, which is the minimum intensity of stimulation required to induce a motor response, is empirically determined for each person by localizing the site on the scalp for optimal stimulation of a hand muscle, then gradually increasing the intensity of stimulation. The stimulation site for the treatment of depression is usually 5 cm anterior to the motor stimulation site.

In contrast to electroconvulsive therapy, TMS does not require general anesthesia and does not generally induce a convulsion. Interest in the use of TMS as a treatment for depression was augmented by the development of a device that could deliver rapid, repetitive stimulation. Imaging studies had shown a decrease in the activity of the left dorsolateral prefrontal cortex in depressed patients, and early studies suggested that high-frequency (eg, 5-10 Hz) TMS of the left dorsolateral prefrontal cortex had antidepressant effects. Low-frequency (1-2 Hz) stimulation of the right dorsolateral prefrontal cortex has

also been investigated. The rationale for low-frequency TMS is inhibition of right frontal cortical activity to correct the interhemispheric imbalance. A combination approach (bilateral stimulation), or deep stimulation with an H1 coil, is also being explored, as is theta burst stimulation.

Repetitive TMS is also being tested as a treatment for a variety of other disorders. In addition to the potential for altering interhemispheric imbalance, it has been proposed that high-frequency repetitive TMS may facilitate neuroplasticity.

Summary

Transcranial magnetic stimulation (TMS) is a noninvasive method of delivering electrical stimulation to the brain. TMS involves the placement of a small coil over the scalp and passing a rapidly alternating current through the coil wire. The electrical current produces a magnetic field that passes unimpeded through the scalp and bone that stimulate neuronal function. Repetitive TMS (rTMS) is being evaluated for the treatment of treatment-resistant depression (TRD) and other psychiatric and neurologic disorders.

For individuals who have TRD who receive rTMS, the evidence includes a large number of sham-controlled randomized trials and meta-analyses of these trials. Relevant outcomes are symptoms, functional outcomes, and quality of life. The meta-analyses found a clinical benefit associated with rTMS for TRD with improved response rates and rates of remission compared with sham. The most recent meta-analyses have concluded that the effect of rTMS, on average depression scores, is smaller than the effect of electroconvulsive therapy (ECT) on TRD and that the mean improvement in depression scores with rTMS did not reach the minimal clinically important difference; however, clinically meaningful improvements were noted in a subgroup of studies using higher frequency pulses. One potential area of benefit for rTMS is in accelerating or enhancing the response to antidepressant medications, and there is some evidence that rTMS, when given in conjunction with the initiation of pharmacologic therapy, improves the response rate compared with pharmacologic therapy alone. The effect of rTMS appears to be less robust when it is given in combination with a stable dose of antidepressant medication. Meta-analyses have also found that the efficacy of rTMS decreases with longer follow-up, though some studies have reported persistent response up to 6 months in some patients. There is limited evidence to compare the effects of these treatments on cognition, although the adverse events of rTMS appear to be minimal. While the most recent meta-analyses have reported that the effect of rTMS is smaller than the effect of ECT on TRD, because rTMS does not require general anesthesia or induce seizures, some individuals may decline ECT so the balance of incremental benefits and harms associated with rTMS may be reasonable compared with ECT. Based on the short-term benefit observed in randomized controlled trials (RCTs) and the lack of alternative treatments, aside from ECT in patients with TRD, rTMS may be considered a treatment option in patients with TRD who meet specific criteria. The evidence for thetaburst stimulation includes a large, randomized trial showing noninferiority with another method of rTMS; no significant differences were noted in the number of adverse events. The evidence is sufficient to determine that the technology results in a meaningful improvement in the net health outcome.

For individuals who have migraine headaches who receive rTMS, the evidence includes a sham-controlled RCT of 201 patients conducted for submission to the U.S. Food and Drug Administration for clearance in 2013. The trial results were limited by the 46% dropout rate and the use of a post hoc analysis. No recent studies have been identified with these devices. The evidence is insufficient to determine the effects of the technology on health outcomes.

For individuals who have obsessive-compulsive disorder who receive rTMS, the evidence includes a number of small-to-moderate sized sham-controlled RCTs and a meta-analysis of these studies. The meta-analysis of 15 RCTs (total n=483 patients, range 18-65 patients) found a benefit of rTMS on patient-reported obsessive-compulsive disorder symptom severity at time points ranging from 2 to 6 weeks, but there was substantial variability in the stimulation parameters, including the cortical region that was stimulated and the frequency of stimulation. A more recent RCT compared deep rTMS to sham in 99 patients for 6 weeks, with an additional 4 weeks of follow-up as a secondary outcome. Using a modified ITT analysis (n=94), there was a larger mean change from baseline on the primary efficacy outcome; Yale-Brown Obsessive Compulsive Scale score in the active treatment group (-6.0 points) than the sham

group (-2.8 points), translating to a moderate effect size of 0.69. At 6 weeks, the response rate was 38.1% in the active treatment group compared to 11.1% in the sham group (P=0.003), as measured by a 30% or greater decrease in the Yale-Brown Obsessive Compulsive Scale. The difference in the primary outcome measure between active and sham groups was not statistically significant in the ITT analysis. There was a benefit for rTMS on clinician-reported measures of improvement, but no significant difference between groups on patient-reported disability and impairment. Additional trials with sufficient sample size and follow-up duration are needed to confirm these results. The evidence is insufficient to determine the effect of the technology on health outcomes.

For individuals who have psychiatric or neurological disorders other than depression, migraine, or obsessive-compulsive disorder (eg, amyotrophic lateral sclerosis, chronic pain, epilepsy, fibromyalgia, panic disorder, Parkinson disease, posttraumatic stress disorder, schizophrenia, stroke, substance use disorder and craving) who receive rTMS, the evidence includes numerous small RCTs and meta-analyses of these randomized trials. Relevant outcomes are symptoms, functional outcomes, and quality of life. The trials included in the meta-analyses are typically small and of low methodologic quality. In addition, stimulation parameters have not been established, and trial results are heterogeneous. There are no large, high-quality trials for any of these conditions demonstrating efficacy or the durability of any treatment effects. The evidence is insufficient to determine the effects of the technology on health outcomes.

Policy History

Date	Action
12/2021	Annual policy review. Policy clarified to specify using an FDA-cleared device and modality. Policy statements otherwise unchanged.
1/2021	Medicare information removed. See MP #132 Medicare Advantage Management for local coverage determination and national coverage determination reference.
12/2020	Annual policy review. Description, summary and references updated. Policy statements unchanged.
8/2020	Local Coverage Determination (LCD): Transcranial Magnetic Stimulation (L33398) added.
1/2020	Prior authorization requirement for Medicare HMO and PPO Blue clarified. Effective 1/1/2020.
11/2019	Annual policy review. Description, summary and references updated. Policy statements unchanged.
3/22/2019	Prior authorization requirement for Medicare HMO Blue clarified. Effective 1/1/2019.
11/2018	Annual policy review. Description, summary and references updated. Policy statements unchanged.
8/2018	Annual policy review. Intent of policy statements unchanged. Prior authorization information clarified. Title changed. Effective 8/1/2018.
5/2015	New medical necessary indications described (coverage for deep rTMS added). Effective 5/1/2015.
12/2014	New investigational indications described (non-coverage for deep rTMS added). Effective 12/1/2014.
9/2014	Updated Medicare LCD. Effective 8/15/2014.
5/2014	Updated Coding section with ICD10 procedure and diagnosis codes. Effective 10/2015.
7/2013	New medically necessary indications described for Commercial. Effective 7/1/2013.
3/2013	New medical policy, reflecting ongoing non-coverage of rTMS for commercial products, and new coverage criteria for Medicare Advantage products. Effective 3/17/2013.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:
Medical Policy Terms of Use
Managed Care Guidelines
Indemnity/PPO Guidelines

Clinical Exception Process
Medical Technology Assessment Guidelines

References

1. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Transcranial magnetic stimulation for depression. TEC Assessments. 2009;Volume 24:Tab 5.
2. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Transcranial magnetic stimulation for depression. TEC Assessments. 2011;Volume 26:Tab 3.
3. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Transcranial magnetic stimulation for depression. TEC Assessments. 2013;Volume 28:Tab 9.
4. Gross M, Nakamura L, Pascual-Leone A, et al. Has repetitive transcranial magnetic stimulation (rTMS) treatment for depression improved? A systematic review and meta-analysis comparing the recent vs. the earlier rTMS studies. Acta Psychiatr Scand. Sep 2007;116(3):165-173. PMID 17655557.
5. Schutter DJ. Antidepressant efficacy of high-frequency transcranial magnetic stimulation over the left dorsolateral prefrontal cortex in double-blind sham-controlled designs: a meta-analysis. Psychol Med. Jan 2009;39(1):65-75. PMID 18447962.
6. Sehatzadeh Sh, Tu HA, Palimaka S, et al. Repetitive Transcranial Magnetic Stimulation for Treatment-Resistant Depression: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Ont Health Technol Assess Ser. 2016; 16(5): 1-66. PMID 27099642
7. Berlim MT, Van den Eynde F, Daskalakis ZJ. High-frequency repetitive transcranial magnetic stimulation accelerates and enhances the clinical response to antidepressants in major depression: a meta-analysis of Disorders randomized, double-blind, and sham-controlled trials. J Clin Psychiatry. Feb 2013;74(2):e122-129. PMID 23473357.
8. Berlim MT, Van den Eynde F, Daskalakis ZJ. Efficacy and acceptability of high frequency repetitive transcranial magnetic stimulation (rTMS) versus electroconvulsive therapy (ECT) for major depression: a systematic review and meta-analysis of randomized trials. Depress Anxiety. Jul 2013;30(7):614-623. PMID 23349112.
9. Gaynes B, Lux L, Lloyd S, et al. Nonpharmacologic Interventions for Treatment-Resistant Depression in Adults. Comparative Effectiveness Review No. 33 (AHRQ Publication No. 11-EHC056-EF). Rockville, MD: Agency for Healthcare Research and Quality; 2011.
10. Blumberger DM, Vila-Rodriguez F, Thorpe KE, 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. Apr 28 2018;391(10131):1683-1692. PMID 29726344.
11. Food and Drug Administration. 510(k) Summary: Brainsway deep TMS System (K122288). 2013; https://www.accessdata.fda.gov/cdrh_docs/pdf12/k122288.pdf. Accessed September 24, 2019.
12. O'Reardon JP, Solvason HB, Janicak PG, et al. Efficacy and safety of transcranial magnetic stimulation in the acute treatment of major depression: a multisite randomized controlled trial. Biol Psychiatry. Dec 1 2007;62(11):1208-1216. PMID 17573044.
13. Kedzior KK, Reitz SK, Azorina V, et al. Durability OF the antidepressant effect of the high-frequency repetitive transcranial magnetic stimulation (rTMS) In the absence of maintenance treatment in major depression: a systematic review and meta-analysis of 16 double-blind, randomized, sham-controlled trials. Depress Anxiety. Mar 2015;32(3):193-203. PMID 25683231.
14. Dunner DL, Aaronson ST, Sackeim HA, et al. A multisite, naturalistic, observational study of transcranial magnetic stimulation for patients with pharmacoresistant major depressive disorder: durability of benefit over a 1- year follow-up period. J Clin Psychiatry. Dec 2014;75(12):1394-1401. PMID 25271871.
15. Richieri R, Guedj E, Michel P, et al. Maintenance transcranial magnetic stimulation reduces depression relapse: a propensity-adjusted analysis. J Affect Disord. Oct 2013;151(1):129-135. PMID 23790811.
16. Connolly KR, Helmer A, Cristancho MA, et al. Effectiveness of transcranial magnetic stimulation in clinical practice post-FDA approval in the United States: results observed with the first 100 consecutive cases of depression at an academic medical center. J Clin Psychiatry. Apr 2012;73(4):e567-573. PMID 22579164.

17. Janicak PG, Nahas Z, Lisanby SH, 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. Oct 2010;3(4):187-199. PMID 20965447.
18. Food and Drug Administration. De Novo classification request for cerena transcranial magnetic stimulator (TMS) device. 2013; https://www.accessdata.fda.gov/cdrh_docs/reviews/K130556.pdf. Accessed September 24, 2019.
19. Goodman WK, Price LH, Rasmussen SA et al. The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. Arch. Gen. Psychiatry, 1989 Nov 1;46(11). PMID 2684084.
20. Storch EA, De Nadai AS, Conceição do Rosário M et al. Defining clinical severity in adults with obsessive-compulsive disorder. Compr Psychiatry, 2015 Nov 12;63:30-5. PMID 26555489.
21. Farris SG, McLean CP, Van Meter PE et al. Treatment response, symptom remission, and wellness in obsessive-compulsive disorder. J Clin Psychiatry, 2013 Aug 16;74(7). PMID 23945445.
22. Trevizol AP, Shiozawa P, Cook IA, et al. Transcranial magnetic stimulation for obsessive-compulsive disorder: an updated systematic review and meta-analysis. J ECT. Dec 2016;32(4):262-266. PMID 27327557.
23. Carmi L, Tendler A, Bystritsky A 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 May 22;appiajp201918101180:appiajp201918101180. PMID 31109199.
24. U.S. Food and Drug Administration. De novo classification request for Brainsway Deep Transcranial Magnetic Stimulation System. 2018; https://www.accessdata.fda.gov/cdrh_docs/reviews/DEN170078.pdf. Accessed September 23, 2019.
25. Tee MMK, Au CH. A Systematic Review and Meta-Analysis of Randomized Sham-Controlled Trials of Repetitive Transcranial Magnetic Stimulation for Bipolar Disorder. Psychiatr Q. Aug 29 2020. PMID 32860557.
26. Cui H, Jiang L, Wei Y, et al. Efficacy and safety of repetitive transcranial magnetic stimulation for generalised anxiety disorder: A meta-analysis. Gen Psychiatr. 2019; 32(5): e100051. PMID 31673675
27. Li H, Wang J, Li C, et al. Repetitive transcranial magnetic stimulation (rTMS) for panic disorder in adults. Cochrane Database Syst Rev. Sep 17 2014;9(9):CD009083. PMID 25230088.
28. Mantovani A, Aly M, Dagan Y, et al. Randomized sham controlled trial of repetitive transcranial magnetic stimulation to the dorsolateral prefrontal cortex for the treatment of panic disorder with comorbid major depression. J Affect Disord. Jan 10 2013;144(1-2):153-159. PMID 22858212.
29. Trevizol AP, Barros MD, Silva PO, et al. Transcranial magnetic stimulation for posttraumatic stress disorder: an updated systematic review and meta-analysis. Trends Psychiatry Psychother. Jan-Mar 2016;38(1):50-55. PMID 27074341.
30. He H, Lu J, Yang L, et al. Repetitive transcranial magnetic stimulation for treating the symptoms of schizophrenia: A PRISMA compliant meta-analysis. Clin Neurophysiol. May 2017;128(5):716-724. PMID 28315614.
31. Dougall N, Maayan N, Soares-Weiser K, et al. Transcranial magnetic stimulation (TMS) for schizophrenia. Cochrane Database Syst Rev. Aug 20 2015;8(8):CD006081. PMID 26289586.
32. Blue Cross and Blue Shield Association Technology Evaluation Center (TEC). Transcranial magnetic stimulation for the treatment of schizophrenia. TEC Assessments. 2011;Volume 26:Tab 6.
33. Guan HY, Zhao JM, Wang KQ, 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. Feb 25 2020; 10(1): 79. PMID 32098946
34. Kumar N, Vishnubhatla S, Wadhawan AN, 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. May 2020; 13(3): 840-849. PMID 32289715
35. Zhuo K, Tang Y, Song Z, et al. Repetitive transcranial magnetic stimulation as an adjunctive treatment for negative symptoms and cognitive impairment in patients with schizophrenia: a randomized, double-blind, sham-controlled trial. Neuropsychiatr Dis Treat. 2019; 15: 1141-1150. PMID 31190822
36. Jansen JM, Daams JG, Koeter MW, et al. Effects of non-invasive neurostimulation on craving: a meta-analysis. Neurosci Biobehav Rev. Dec 2013;37(10 Pt 2):2472-2480. PMID 23916527.

37. Fang J, Zhou M, Yang M, et al. Repetitive transcranial magnetic stimulation for the treatment of amyotrophic lateral sclerosis or motor neuron disease. Cochrane Database Syst Rev. May 31 2013;5(5):CD008554. PMID 23728676.
38. O'Connell NE, Wand BM, Marston L, et al. Non-invasive brain stimulation techniques for chronic pain. Cochrane Database Syst Rev. Apr 11 2014;4(4):CD008208. PMID 24729198.
39. O'Connell NE, Marston L, Spencer S et al. Non-invasive brain stimulation techniques for chronic pain. Cochrane Database Syst Rev, 2018 Apr 14;4:CD008208. PMID 29652088.
40. Chen R, Spencer DC, Weston J, et al. Transcranial magnetic stimulation for the treatment of epilepsy. Cochrane Database Syst Rev. Aug 11 2016(8):CD011025. PMID 27513825.
41. Mishra A, Maiti R, Mishra BR, et al. Effect of Repetitive Transcranial Magnetic Stimulation on Seizure Frequency and Epileptiform Discharges in Drug-Resistant Epilepsy: A Meta-Analysis. J Clin Neurol. Jan 2020; 16(1): 9-18. PMID 31942753
42. Saltychev M, Laimi K. Effectiveness of repetitive transcranial magnetic stimulation in patients with fibromyalgia: a meta-analysis. Int J Rehabil Res. Mar 2017;40(1):11-18. PMID 27977465.
43. Chou YH, Hickey PT, Sundman M, et al. Effects of repetitive transcranial magnetic stimulation on motor symptoms in Parkinson disease: a systematic review and meta-analysis. JAMA Neurol. Apr 2015;72(4):432-440. PMID 25686212.
44. Shirota Y, Ohtsu H, Hamada M, et al. Supplementary motor area stimulation for Parkinson disease: a randomized controlled study. Neurology. Apr 9 2013;80(15):1400-1405. PMID 23516319 Disorders.
45. Hao Z, Wang D, Zeng Y, et al. Repetitive transcranial magnetic stimulation for improving function after stroke. Cochrane Database Syst Rev. May 31 2013;5(5):CD008862. PMID 23728683.
46. Le Q, Qu Y, Tao Y, et al. Effects of repetitive transcranial magnetic stimulation on hand function recovery and excitability of the motor cortex after stroke: a meta-analysis. Am J Phys Med Rehabil. May 2014;93(5):422-430. PMID 24429509.
47. Li Y, Qu Y, Yuan M, et al. Low-frequency repetitive transcranial magnetic stimulation for patients with aphasia after stoke: A meta-analysis. J Rehabil Med. Sep 3 2015;47(8):675-681. PMID 26181486.
48. Zhang L, Xing G, Fan Y, et al. Short- and long-term effects of repetitive transcranial magnetic stimulation on upper limb motor function after stroke: a systematic review and meta-analysis. Clin Rehabil. Sep 2017;31(9):1137-1153. PMID 28786336.
49. Graef P, Dadalt ML, Rodrigues DA, et al. Transcranial magnetic stimulation combined with upper-limb training for improving function after stroke: A systematic review and meta-analysis. J Neurol Sci. Oct 15 2016;369:149-158. PMID 27653882.
50. McClintock SM, Reti IM, Carpenter LL et al. Consensus Recommendations for the Clinical Application of Repetitive Transcranial Magnetic Stimulation (rTMS) in the Treatment of Depression. J Clin Psychiatry, 2017 May 26;79(1). PMID 28541649.
51. American Psychiatric Association. Practice Guidelines for the treatment of patients with major depressive disoder. Third Edition. 2010; http://psychiatryonline.org/pb/assets/raw/sitewide/practice_guidelines/guidelines/mdd.pdf. Accessed September 12, 2020
52. Murphy TK, Lewin AB, Storch EA, et al. Practice parameter for the assessment and treatment of children and adolescents with tic disorders. J Am Acad Child Adolesc Psychiatry. Dec 2013; 52(12): 1341-59. PMID 24290467
53. National Institute for Health and Care Excellence (NICE). Repetitive transcranial magnetic stimulation for depression [IPG542]. 2015; https://www.nice.org.uk/guidance/ipg542. Accessed September 12, 2020.
54. National Institute for Health and Care Excellence (NICE). Transcranial magnetic stimulation for treating and preventing migraine [IPG477]. 2014; https://www.nice.org.uk/guidance/ipg477. Accessed September 13, 2020.
55. Miyasaki JM, Shannon K, Voon V, et al. Practice Parameter: evaluation and treatment of depression, psychosis, and dementia in Parkinson disease (an evidence-based review): report of the Quality Standards Subcommittee of the American Academy of Neurology. Neurology. Apr 11 2006; 66(7): 996-1002. PMID 16606910