ECHO IDAHO

Behavioral Health in Primary Care

TMS: Evidence Review & Efficacy

June 3, 2026

Mark Jepson PMHNP-BC

Idaho TMS & Behavioral Health

Mark Jepson, presenter for this educational event, has received travel expenses from LivaNova. All of the relevant financial relationships listed for this individual have been mitigated.

University of Idaho
School of Health and Medical Professions

Project ECHO

Disclosures

- LivaNova- travel expenses related to vagal nerve stimulation training.

Learning Objectives

- Participants will understand what TMS is and how we think it works.
- Participants will review the evidence for efficacy of TMS.
- Participants will be able to identify appropriate patients to receive TMS.

University of Idaho
School of Health and Medical Professions

Project ECHO

Burden of Depression in Primary Care

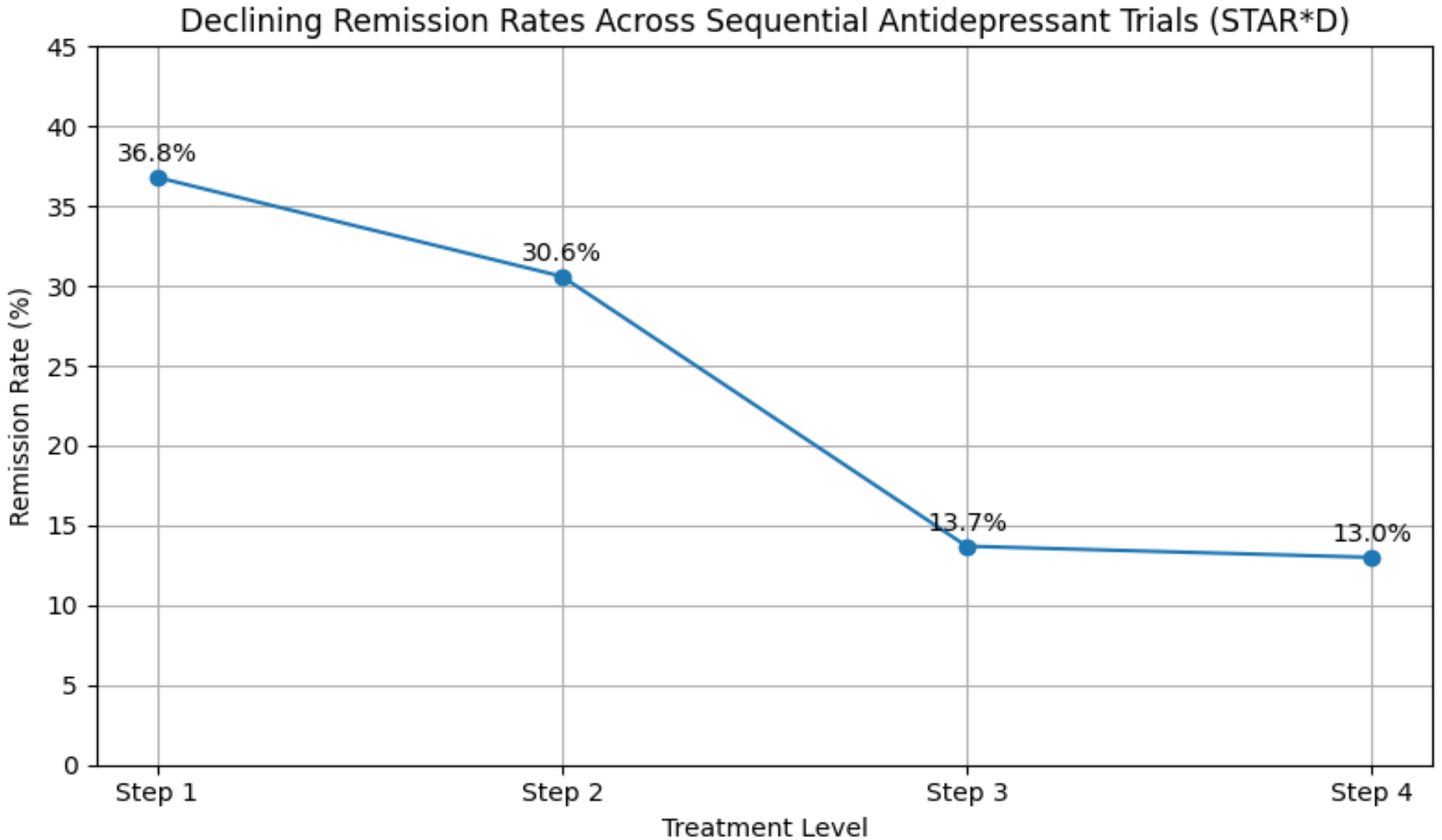
- 16-20% of people will experience a major depressive episode (MDD) at some point in their lives.
- About 40% of MDD patients are receiving treatment in a primary care setting.
- Approximately 30% of MDD patients develop treatment-resistant depression (TRD.)

University of Idaho
School of Health and Medical Professions

Project ECHO

Treatment-Resistant Depression (TRD)

- Higher suicide risk
- Functional impairment
- Increased healthcare utilization
- Reduced likelihood of remission with each medication trial



Rush AJ et al. STAR*D Trial

University of Idaho
School of Health and Medical Professions
Project ECHO

What is TMS?

- **Transcranial Magnetic Stimulation (TMS)** is a noninvasive treatment that uses magnetic pulses to stimulate specific areas of the brain—most often involved in mood regulation. (DLPFC for MDD and smoking cessation, and ACC/dmPFC for OCD.
- Often used for depression, especially when other treatments have not worked.
- FDA-cleared for MDD, OCD, and smoking cessation.

Mechanism of Action

- **TMS stimulates the DLPFC**, altering local excitability.
- **Activity propagates through connected circuits**, especially fronto-limbic pathways.
- **Connectivity in depression-related networks normalizes**, particularly involving the sgACC.
- **Repeated sessions induce durable neuroplastic changes**, improving mood regulation.

What?

- In depression, the **DLPFC–sgACC circuit** is often stuck in a loop of:
  - Overactivity in the sgACC (sadness center)
  - Underactivity in the DLPFC (control center)
- TMS stimulates the DLPFC → which sends signals down to the sgACC → which helps calm the overactive sadness circuit.

TMS Devices

TMS is Valuable Because:

- Effective after multiple antidepressant failures.
- Minimal systemic side effects.
- No cognitive impairment typical of ECT.
- No anesthesia required.
- Patients remain awake and functional.
- More effective than additional medication trials
- Safer and cognitively gentler than ECT
- More durable than ketamine for many patients

Treatment Options for Major Depressive Disorder (MDD)

Efficacy & Key Considerations

	TMS (rTMS)	ANTIDEPRESSANTS (Medications)	KETAMINE (IV)	ECT (Electroconvulsive Therapy)
EFFICACY (Response / Remission)	**Response:** ~30–40% **Remission:** ~20–30% (TRD meta-analyses)[1,2]	**Response:** ~30–35% **Remission:** ~15–20% (STAR*D level 1)[3]	**Response:** ~50–70% **Remission:** ~30–40% (within 24 hrs – 7 days)[4]	**Response:** ~70–90% **Remission:** ~50–70% (acute course)[5]
TIME TO RESPONSE	**2–4 weeks** (gradual)	**4–8 weeks** (gradual)	**Hours to days** (rapid)	**Days to 1–2 weeks** (rapid)
DURATION OF EFFECT	**Weeks to months** Often requires maintenance for durability	**Weeks to months** Requires ongoing daily medication	**Days to weeks** Typically requires repeated infusions	**Months** Maintenance ECT may be required
TOLERABILITY / SIDE EFFECTS	**Mild and transient** Scalp discomfort, headache **No systemic effects**	GI upset, sexual dysfunction, weight gain, sleep changes, anticholinergic effects, activation	Dissociation, nausea, blood pressure ↑, dizziness, perceptual changes	Anesthesia risks, transient cognitive side effects (memory), headache, myalgias
PRACTICAL CONSIDERATIONS	Office-based Awake, no anesthesia 5 days/week for ~4–6 weeks	Daily oral medication Requires adherence Trial-and-error	IV infusion Monitored setting Cost, access, need for repeated dosing	Hospital or specialized center Anesthesia required 2–3x/week for 2–4 weeks
BEST SUITED FOR	**Patients with TRD** **Prefer non-pharmacologic** Well tolerated, comorbid anxiety, medical illness	First-line for mild–moderate MDD, or as part of stepwise treatment	**Severe depression, suicidal ideation, need for rapid response, when other treatments fail**	**Severe depression, psychotic depression, high suicide risk, treatment-refractory**

All four treatments are effective for MDD, but differ in onset, durability, tolerability, and practicality.
Treatment selection should be individualized based on severity, patient preference, past response, and clinical urgency.

1. Berlim MT, et al. *Psychol Med.* 2014;44(2):225-239. 2. McGirr A, et al. *J Clin Psychiatry.* 2018;79(2):17r12018. 3. Rush AJ, et al. *Am J Psychiatry.* 2006;163(11):1905-1917.
4. Grunebaum MF, et al. *Am J Psychiatry.* 2018;175(4):327-335. 5. Wijkstra J, et al. *World Psychiatry.* 2015;14(2):163-177.

TRD = Treatment-Resistant Depression

Efficacy

- **<u>2023 Meta-Analysis –Vida et al.</u>**
- **Response rate:** (Greater than or equal to 50% symptom reduction) 39.7% active TMS vs 13.7% sham
- **Remission rate:** substantially higher with active TMS.
- Relative Risk (RR) for response: **2.25.**
- Relative Risk for remission: **2.78.**

Earlier Landmark Meta-Analysis

-Berlim et al. 2014.

- Response rate: **29.3%**
- Remission rate: **18.6%**
- Sham response: 10.4%
- Sham remission: 5%.

Large Network Meta-Analysis (JAMA Psychiatry)

Psychiatry Brunoni AR, et al.

- **81 studies**
- **4,233 patients**

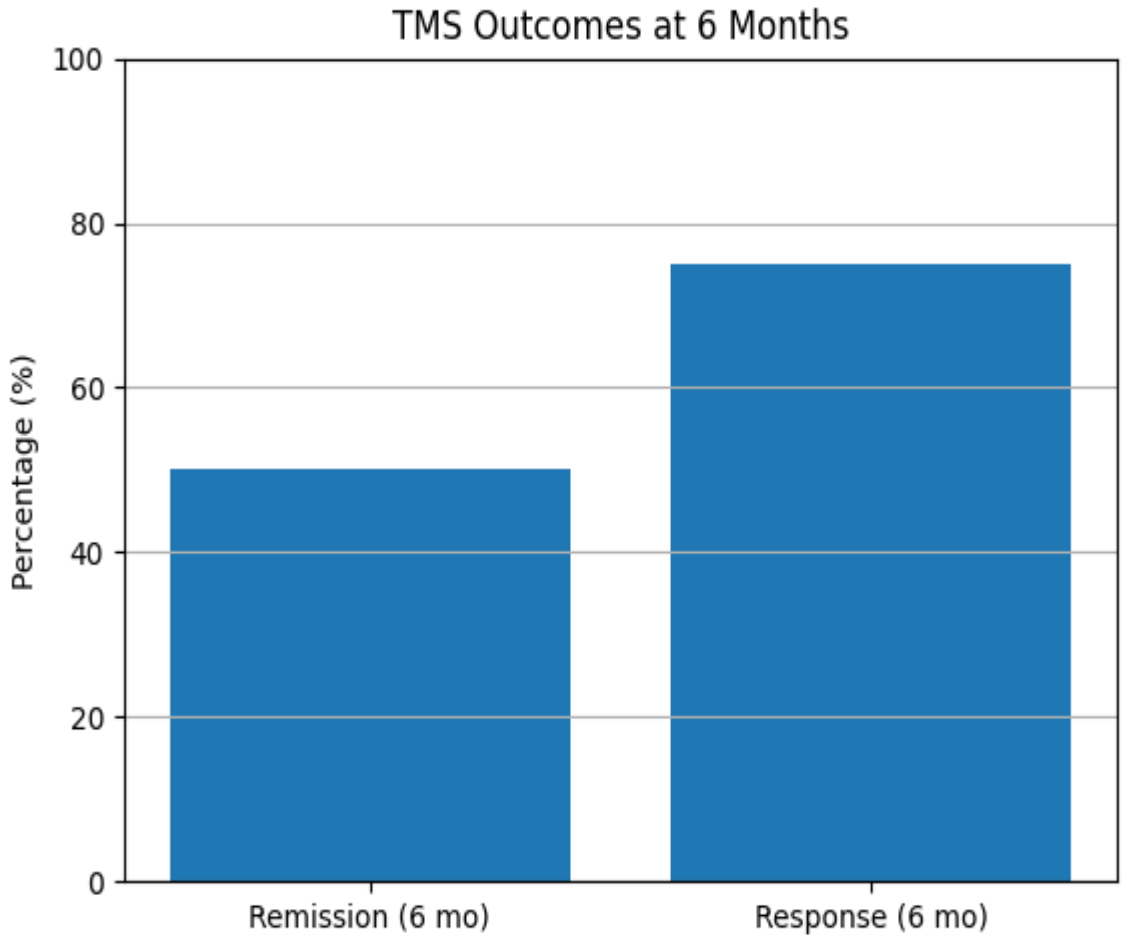
High-Frequency TMS vs Sham

- **Response OR: 3.07**
- 95% CI: 2.24–4.21
- Meta-analyses of randomized sham-controlled trials demonstrate that TMS approximately doubles-to-quadruples the likelihood of clinical response and remission in treatment-resistant depression compared with sham stimulation.

Safety & Tolerability

Side Effect	Frequency
Scalp discomfort	Common
Headache	Common
Fatigue	Mild
Seizure	Extremely Rare

*about 1 in 30,000



“Approximately 50% of patients remain in remission at 6 months, while ~75% maintain clinical response; durability declines over time without maintenance strategies.”

Dunner DL et al. *J Clin Psychiatry*. 2014 – durability of TMS response
Carpenter LL et al. *Depression and Anxiety*. 2012 – 3-month outcomes (~58% remission)
Janicak PG et al. *Brain Stimulation*. 2010 – durability and relapse data
Senova S et al. *Brain Stimulation*. 2019 – meta-analysis of TMS durability

Maintenance TMS or Retreatment

- Retreatment response rates are often high. Approximately **84% regained clinical benefit** (Janicak et al. (2010.)
- **Maintenance TMS** refers to periodic booster treatments after an acute response to reduce relapse risk and sustain remission.
- **Typical maintenance schedule (highly individualized)**
  - 3–5 sessions over 1–2 weeks
  - Sometimes 1–2 sessions weekly temporarily

Patient Selection for TMS

Favorable Candidates

- Multiple failed antidepressant trials
- Patients preferring non-pharmacologic options
- Adolescents 15–21

Unfavorable Candidates

- Metal in or near the head
- Active psychosis or mania
- Seizure disorders
- Inability to tolerate stimulation

University of Idaho
School of Health and Medical Professions
Project ECHO

Key Points

- TMS is evidence-based for TRD
- Robust sham-controlled data support efficacy
- Remission rates significantly exceed placebo
- Excellent tolerability and safety profile
- Valuable option between medication treatment and ECT
- Covered by most insurances including Idaho Medicaid and Medicare

References

- Berlim, M. T., van den Eynde, F., & Daskalakis, Z. J. (2013). High-frequency repetitive transcranial magnetic stimulation accelerates and enhances the clinical response to antidepressants in major depression: A meta-analysis of randomized, double-blind, and sham-controlled trials. *Journal of Clinical Psychiatry, 74*(2), e122–e129. https://doi.org/10.4088/JCP.12r07996
- Berlim, M. T., van den Eynde, F., Tovar-Perdomo, S., & Daskalakis, Z. J. (2014). Response, remission and drop-out rates following high-frequency repetitive transcranial magnetic stimulation (rTMS) for treating major depression: A systematic review and meta-analysis of randomized, double-blind and sham-controlled trials. *Psychological Medicine, 44*(2), 225–239. https://doi.org/10.1017/S0033291713000512
- Brunoni, A. R., Chaimani, A., Moffa, A. H., Razza, L. B., Gattaz, W. F., Daskalakis, Z. J., & Carvalho, A. F. (2017). Repetitive transcranial magnetic stimulation for the acute treatment of major depressive episodes: A systematic review with network meta-analysis. *JAMA Psychiatry, 74*(2), 143–152. https://doi.org/10.1001/jamapsychiatry.2016.3644
- Carpenter, L. L., Janicak, P. G., Aaronson, S. T., Boyadjis, T., Brock, D. G., Cook, I. A., Alvarado, J. L., Demitrack, M. A., & O'Reardon, J. P. (2012). Transcranial magnetic stimulation (TMS) for major depression: A multisite, naturalistic, observational study of acute treatment outcomes in clinical practice. *Depression and Anxiety, 29*(7), 587–596. https://doi.org/10.1002/da.21969
- Dunner, D. L., Aaronson, S. T., Sackeim, H. A., Janicak, P. G., Carpenter, L. L., Boyadjis, T., Brock, D. G., Bonneh-Barkay, D., & Demitrack, M. A. (2014). 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. *Journal of Clinical Psychiatry, 75*(12), 1394–1401. https://doi.org/10.4088/JCP.13m08977
- Fitzgerald, P. B., Grace, N., Hoy, K. E., Bailey, M., & Daskalakis, Z. J. (2013). An open label trial of clustered maintenance rTMS for patients with refractory depression. *Brain Stimulation, 6*(3), 292–297. https://doi.org/10.1016/j.brs.2012.05.003
- Gaynes, B. N., Rush, A. J., Trivedi, M. H., Wisniewski, S. R., Balasubramani, G. K., Spencer, D. C., & Fava, M. (2008). Primary care patients' attitudes regarding depression and antidepressants: Results from the STAR*D study. *Journal of General Internal Medicine, 23*(5), 543–550. https://doi.org/10.1007/s11606-008-0527-x
- Janicak, P. G., Dunner, D. L., Aaronson, S. T., Carpenter, L. L., Boyadjis, T., Brock, D. G., Cook, I. A., & Demitrack, M. A. (2010). Durability of clinical benefit with transcranial magnetic stimulation in the treatment of pharmacoresistant major depression: Assessment of relapse during a 6-month, multisite, open-label study. *Brain Stimulation, 3*(4), 187–199. https://doi.org/10.1016/j.brs.2010.07.003
- McIntyre, R. S., Alsuwaidan, M., Baune, B. T., Berk, M., Brietzke, E., et al. (2023). Major depressive disorder and treatment outcomes: A global perspective. *World Psychiatry, 22*(3), 394–412. https://doi.org/10.1002/wps.21104
- Rush, A. J., Trivedi, M. H., Wisniewski, S. R., Nierenberg, A. A., Stewart, J. W., Warden, D., et al. (2006). Acute and longer-term outcomes in depressed outpatients requiring one or several treatment steps: A STAR*D report. *American Journal of Psychiatry, 163*(11), 1905–1917. https://doi.org/10.1176/ajp.2006.163.11.1905
- Senova, S., Cotovio, G., Pascual-Leone, A., Oliveira-Maia, A. J., & Dumas, R. (2019). Durability of antidepressant response to repetitive transcranial magnetic stimulation: Systematic review and meta-analysis. *Brain Stimulation, 12*(1), 119–128. https://doi.org/10.1016/j.brs.2018.10.001
- Vida, R., Sághy, E., Bella, R., Karádi, K., Szőcs, A., Darnai, G., Perlaki, G., Orsi, G., Janszky, J., & Komoly, S. (2023). Efficacy of repetitive transcranial magnetic stimulation (rTMS) adjunctive therapy for major depressive disorder after two antidepressant treatment failures: Meta-analysis of randomized sham-controlled trials. *BMC Psychiatry, 23*, 545. https://doi.org/10.1186/s12888-023-05033-y

Contact Information

Mark Jepson PMHNP-BC

Idaho TMS & Behavioral Health

7310 W. Potomac Dr.

Boise, Idaho 83704

Call/text:(986) 300-5771

mark @idahoTMS.org

University of Idaho
School of Health and Medical Professions

Project ECHO