

## Interventional Psychiatry: Why Now?

*We must recollect that all of our provisional ideas in psychology will presumably one day be based on an organic substructure.*

Sigmund Freud, "On Narcissism"

**To the Editor:** Despite decades of research, current pharmacotherapies and psychotherapies remain ineffective or intolerable for many patients with psychiatric disorders.<sup>1</sup> These treatment-resistant and treatment-intolerant patients, particularly those with depression, are often referred for neuromodulatory interventions such as transcranial magnetic stimulation (TMS), electroconvulsive therapy (ECT), and deep brain stimulation (DBS).<sup>2-6</sup> However, unlike cardiology, radiology, and neurology, the field of psychiatry does not formally recognize or train "interventionalists" who perform specialized procedures on the spectrum between standard care and surgery.<sup>5</sup> The purpose of this letter is to explain why the field of interventional psychiatry should be recognized as a formal subspecialty of psychiatry and further developed.

### Definition

Interventional psychiatry is an emerging subspecialty that utilizes neurotechnologies to identify dysfunctional brain circuitry underlying psychiatric disorders<sup>7,8</sup> and apply brain stimulation techniques to modulate that circuitry.<sup>9-11</sup> This nascent clinical subspecialty is based on centuries of neuroscience research.<sup>12,13</sup> Within the last 50 years, and particularly the last decade, these classical techniques have been refined,<sup>14,15</sup> new treatments have been developed,<sup>16,17</sup> and novel therapeutic targets have been explored.<sup>6,18</sup> Nearly a dozen forms of brain stimulation are in development or currently US Food and Drug Administration–approved for a variety of neuropsychiatric indications (Table 1). These techniques are detailed throughout various journals, including at least 2 dedicated exclusively to brain stimulation.<sup>19,20</sup>

### Current State

It is clear that psychiatric disorders are a product of brain circuit dysregulation,<sup>21,22</sup> a concept that has been slow to be accepted by the psychiatric community.<sup>23-27</sup> Simultaneously, there has been an explosion in noninvasive (TMS and transcranial direct current stimulation)<sup>2,28</sup> and invasive (vagus nerve stimulation, epidural cortical stimulation [EpCS], and DBS)<sup>17,18,29</sup> neuromodulation techniques for neuropsychiatric disorders. Fortunately, leaders in psychiatric research, clinical practice, and education have recognized the discrepancy between our field's direction and our current training schema and are making plans and laying groundwork to ensure that psychiatrists remain relevant in this age of brain discovery.<sup>10,30-33</sup>

Formalized training in interventional psychiatry will enable practitioners to adapt to an ever-evolving understanding of brain circuitry<sup>22</sup> and to better modulate its function.<sup>16</sup> Traditional training curricula offer informal, inconsistent, and limited training opportunities in neurotechnologies such as neuromodulation and diagnostic modalities, but the number of proponents for increased exposure to these advances is growing.<sup>10,11,30,34</sup> Clinical neuroscientists, psychiatric interventionalists, and various certifying bodies of accreditation have already begun to collaborate on improvements to the existing education model.<sup>9,11,29,32,33</sup> Many realize that only formal expansion of interventional psychiatric training through dedicated residency tracks and fellowships will ensure the safe and timely growth of this ever-promising area of psychiatry.<sup>10,11</sup>

Specialty tracks are not a new idea within psychiatric graduate medical education<sup>35</sup> and can be achieved with current residency resources.<sup>10</sup> Interventional psychiatry fellowships, training not just researchers but also clinicians, have formed across the country and include exposure to both noninvasive and invasive neuromodulation.<sup>10,11</sup> Both residency and fellowship options would include neuroscience didactics<sup>34</sup> and hands-on experience with various forms of ECT<sup>36</sup>/TMS<sup>10</sup> and infusion therapies,<sup>34,37,38</sup> along with specialized experiences in neurophysiology,<sup>8,39,40</sup> device programming,<sup>6,10,41-43</sup> neuroradiology,<sup>7,44,45</sup> and intraoperative experiences for DBS/EpCS.<sup>29,42,46-48</sup>

### Why Now?

Perhaps the simplest way to illustrate the emergence of interventional psychiatry is to cite the timely series of recent federal and nonprofit initiatives focused on brain stimulation. In 2011, the National Institute of Mental Health proposed a new classification system, Research Domain Criteria (RDoC), that aims to develop a circuit- and biomarker-based classification system for neuropsychiatric disorders.<sup>49</sup> Shortly thereafter, the Accreditation Council for Graduate Medical Education launched their Psychiatry Milestone Project to increase emphasis on the importance of teaching psychiatric trainees about circuit-based neuroscience and brain stimulation.<sup>32,34</sup> The most recent, but likely not last, addition to this list includes the Defense Advanced Research Projects Agency's \$70 million project Systems-Based Neurotechnology and Understanding for the Treatment of Neuropsychological Illnesses (SUBNETS), which is part of the BRAIN Initiative. SUBNETS seeks to develop invasive and intelligent closed-loop neuromodulation technologies that modulate dysfunctional circuits in neuropsychiatric disorders,<sup>50</sup> meaning that the devices developed will sense brain activity before, during, and after an event (neuropsychophysiologic) and then modify device stimulation on the basis of this "sensed" brain activity.<sup>51-53</sup>

**Table 1. Interventional Psychiatry Tools**

Interventional Method	Development	FDA-Approved Uses	Currently Being Investigated
Electroconvulsive therapy	In use for over 70 years, but with significant recent advances in delivery	Grandfathered in. APA guidelines indicate MDD, bipolar disorder, schizophrenia, schizoaffective disorder, and catatonia	Newer pulse types to further limit cognitive side effects. Use in Parkinson's disease
Transcranial magnetic stimulation	Modern version developed in 1985. Multiple newer delivery mechanisms being evaluated	Acute, treatment-resistant unipolar MDD	Pain management, psychosis, mania, poststroke recovery
Vagus nerve stimulation	In use for epilepsy since 1997, for treatment-resistant depression since 2005	Partial-onset epilepsy, chronic course of treatment-resistant depression	Less invasive means currently being evaluated
Deep brain stimulation	In use for Parkinson's disease, essential tremor, and dystonia since 2002	Essential tremor, Parkinson's disease, dystonia, humanitarian device exemption for OCD	Research into use in MDD and Tourette's disorder

Abbreviations: APA = American Psychiatric Association, FDA = US Food and Drug Administration, MDD = major depressive disorder, OCD = obsessive-compulsive disorder.

The initiatives above further emphasize how the confluence of translational and clinical research<sup>33</sup> has launched an interventional psychiatry subspecialty despite a lack of existing formal training programs.<sup>10,11</sup> The field of psychiatry must be prepared to take advantage of these developments, including embracing the neuroscience behind them and adapting to the advances that arise.<sup>33</sup> Without more formal training programs in interventional psychiatry, the field of psychiatry will be unprepared to effectively participate in the continued expansion of neuromodulation technologies for refractory neuropsychiatric disease.<sup>11,26</sup> This growth can be achieved while still embracing and even enhancing our knowledge of the current treatment modalities.<sup>7,54–56</sup>

## Summary

Interventional psychiatry offers substantial therapeutic benefits in some neuropsychiatric disorders<sup>16</sup> and enormous potential in treating others.<sup>6</sup> However, as interventional diagnostics and therapeutics require specialized knowledge and skill foreign to many psychiatrists,<sup>30</sup> the emerging subspecialty of interventional psychiatry must be more formally integrated into the continuum of psychiatric training to ensure both safe application and continued growth. By establishing training paradigms for interventional psychiatry, academic medical centers can help fill this knowledge gap.<sup>10,11</sup> The cultivation of a properly trained cohort of interventional psychiatrists will better meet the challenges of treatment-resistant psychiatric illness through safe and ethical practice, while facilitating a more informed development and integration of novel neuromodulation techniques.<sup>11,57,58</sup>

## REFERENCES

- Holtzheimer PE, Mayberg HS. Stuck in a rut: rethinking depression and its treatment. *Trends Neurosci*. 2011;34(1):1–9.
- 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*. 2007;62(11):1208–1216.
- UK ECT Review Group. Efficacy and safety of electroconvulsive therapy in depressive disorders: a systematic review and meta-analysis. *Lancet*. 2003;361(9360):799–808.
- Slotema CW, Blom JD, Hoek HW, et al. Should we expand the toolbox of psychiatric treatment methods to include Repetitive Transcranial Magnetic Stimulation (rTMS)? a meta-analysis of the efficacy of rTMS in psychiatric disorders. *J Clin Psychiatry*. 2010;71(7):873–884.
- Kammer T, Spitzer M. Brain stimulation in psychiatry: methods and magnets, patients and parameters. *Curr Opin Psychiatry*. 2012;25(6):535–541.
- Williams NR, Okun MS. Deep brain stimulation (DBS) at the interface of neurology and psychiatry. *J Clin Invest*. 2013;123(11):4546–4556.
- McGrath CL, Kelley ME, Holtzheimer PE, et al. Toward a neuroimaging treatment selection biomarker for major depressive disorder. *JAMA Psychiatry*. 2013;70(8):821–829.
- Broadway JM, Holtzheimer PE, Hilimire MR, et al. Frontal theta cordance predicts 6-month antidepressant response to subcallosal cingulate deep brain stimulation for treatment-resistant depression: a pilot study. *Neuropsychopharmacology*. 2012;37(7):1764–1772.
- Williams NTJ, Snipes J, Short B, et al. Interventional psychiatry: planning for core competency across the psychiatry milestone spectrum. Paper presented at: American Psychiatric Association Meeting; May 18–22, 2013; San Francisco, CA.
- Stetka BS, Kantor EM, Williams NR. A new psychiatry subspecialty? Medscape Web site. <http://www.medscape.com/viewarticle/804826>. Published May 30, 2013. Accessed February 12, 2014.
- Williams NR, Taylor JJ, Snipes JM, et al. Interventional psychiatry: how should psychiatric educators incorporate neuromodulation into training? [published online ahead of print February 20, 2014]. *Acad Psychiatry*.
- Parent A, Giovanni Aldini: from animal electricity to human brain stimulation. *Can J Neurol Sci*. 2004;31(4):576–584.
- Gildenberg PL. History of electrical neuromodulation for chronic pain. *Pain Med*. 2006;7(s1):S7–S13.
- Nahas Z, Short B, Burns C, et al. A feasibility study of a new method for electrically producing seizures in man: focal electrically administered seizure therapy [FEAST]. *Brain Stimul*. 2013;6(3):403–408.
- Sackeim HA, Prudic J, Nobler MS, et al. Effects of pulse width and electrode placement on the efficacy and cognitive effects of electroconvulsive therapy. *Brain Stimul*. 2008;1(2):71–83.
- George MS, Taylor JJ, Short EB. The expanding evidence base for rTMS treatment of depression. *Curr Opin Psychiatry*. 2013;26(1):13–18.
- Nahas Z, Marangell LB, Husain MM, et al. Two-year outcome of vagus nerve stimulation (VNS) for treatment of major depressive episodes. *J Clin Psychiatry*. 2005;66(9):1097–1104.
- Mayberg HS, Lozano AM, Voon V, et al. Deep brain stimulation for treatment-resistant depression. *Neuron*. 2005;45(5):651–660.
- Kellner CH. The journal's new name and a new award. *Convuls Ther*. 1997;13(4):207.
- Sackeim HA, George MS. Brain stimulation—basic, translational, and clinical research in neuromodulation: why a new journal? *Brain Stimul*. 2008;1(1):4–6.
- Ressler KJ, Mayberg HS. Targeting abnormal neural circuits in mood and anxiety disorders: from the laboratory to the clinic. *Nat Neurosci*. 2007;10(9):1116–1124.
- Deisseroth K. Circuit dynamics of adaptive and maladaptive behaviour. *Nature*. 2014;505(7483):309–317.
- Rubin EH, Zorumski CF. Perspective: upcoming paradigm shifts for psychiatry in clinical care, research, and education. *Acad Med*. 2012;87(3):261–265.
- Reynolds CF 3rd, Lewis DA, Detre T, et al. The future of psychiatry as clinical neuroscience. *Acad Med*. 2009;84(4):446–450.
- Althoff RR, Waterman GS. Commentary: psychiatric training for physicians: a call to modernize. *Acad Med*. 2011;86(3):285–287.
- Bullmore E, Fletcher P, Jones PB. Why psychiatry can't afford to be neurophobic. *Br J Psychiatry*. 2009;194(4):293–295.
- Insel TR. Faulty circuits. *Sci Am*. 2010;302(4):44–51.
- Brunoni AR, Valiengo L, Baccaro A, et al. The sertraline vs electrical current therapy for treating depression clinical study: results from a factorial, randomized, controlled trial. *JAMA Psychiatry*. 2013;70(4):383–391.
- Nahas Z, Anderson BS, Borckardt J, et al. Bilateral epidural prefrontal cortical stimulation for treatment-resistant depression. *Biol Psychiatry*. 2010;67(2):101–109.
- Akil H, Brenner S, Kandel E, et al. Medicine. The future of psychiatric research: genomes and neural circuits. *Science*. 2010;327(5973):1580–1581.
- Roffman JL, Simon AB, Prasad KM, et al. Neuroscience in psychiatry training: how much do residents need to know? *Am J Psychiatry*. 2006;163(5):919–926.
- Thomas CR, Accreditation Council for Graduate Medical Education, American Board of Psychiatry and Neurology. The Psychiatry Milestone Project. <https://www.acgme.org/acgmeweb/Portals/0/PDFs/Milestones/PsychiatryMilestones.pdf>. Published November 2013. Accessed February 12, 2014.
- Insel TR, Quirion R. Psychiatry as a clinical neuroscience discipline. *JAMA*. 2005;294(17):2221–2224.
- Benjamin S. Educating psychiatry residents in neuropsychiatry and neuroscience. *Int Rev Psychiatry*. 2013;25(3):265–275.
- Shore JH. Psychiatry at a crossroad: our role in primary care. *Am J Psychiatry*. 1996;153(11):1398–1403.
- Rabheru K, Wiens A, Ramprasad B, et al. Comparison of traditional didactic seminar to high-fidelity simulation for teaching electroconvulsive therapy technique to psychiatry trainees. *J ECT*. 2013;29(4):291–296.
- Hallak JE, Maia-de-Oliveira JP, Abreu J, et al. Rapid improvement of acute schizophrenia symptoms after intravenous sodium nitroprusside: a randomized, double-blind, placebo-controlled trial. *JAMA Psychiatry*. 2013;70(7):668–676.
- Murrough JW, Iosifescu DV, Chang LC, et al. Antidepressant efficacy of ketamine in treatment-resistant major depression: a two-site randomized controlled trial. *Am J Psychiatry*. 2013;170(10):1134–1142.
- FDA permits marketing of first brain wave test to help assess children and teens for ADHD [news release]. Silver Spring, MD: US Food and Drug Administration; July 15, 2013. <http://www.fda.gov/newsevents/newsroom/pressannouncements/ucm360811.htm>. Accessed February 12, 2014.
- Schulman JJ, Cancro R, Lowe S, et al. Imaging of thalamocortical dysrhythmia in neuropsychiatry. *Front Hum Neurosci*. 2011;5:69.
- Tsai HC, Chang CH, Pan JI, et al. Acute stimulation effect of the ventral capsule/ventral striatum in patients with refractory obsessive-compulsive disorder: a double-blinded trial. *Neuropsychiatr Dis Treat*. 2014;10:63–69.
- Morishita T, Fayad SM, Goodman WK, et al. Surgical neuroanatomy and programming in deep brain stimulation for obsessive compulsive disorder [published online ahead of print December 17, 2013]. *Neuromodulation*.
- Hassan A, Okun MS. Emerging subspecialties in neurology: deep brain

- stimulation and electrical neuro-network modulation. *Neurology*. 2013;80(5):e47–e50.
44. Lujan JL, Chaturvedi A, Choi KS, et al. Tractography-activation models applied to subcallosal cingulate deep brain stimulation. *Brain Stimulat*. 2013;6(5):737–739.
  45. Gutman DA, Holtzheimer PE, Behrens TE, et al. A tractography analysis of two deep brain stimulation white matter targets for depression. *Biol Psychiatry*. 2009;65(4):276–282.
  46. Haq IU, Foote KD, Goodman WG, et al. Smile and laughter induction and intraoperative predictors of response to deep brain stimulation for obsessive-compulsive disorder. *Neuroimage*. 2011;54(suppl 1):S247–S255.
  47. Okun MS, Bowers D, Springer U, et al. What's in a "smile?" intra-operative observations of contralateral smiles induced by deep brain stimulation. *Neurocase*. 2004;10(4):271–279.
  48. Shapira NA, Okun MS, Wint D, et al. Panic and fear induced by deep brain stimulation. *J Neurol Neurosurg Psychiatry*. 2006;77(3):410–412.
  49. Insel T, Cuthbert B, Garvey M, et al. Research Domain Criteria (RDoC): toward a new classification framework for research on mental disorders. *Am J Psychiatry*. 2010;167(7):748–751.
  50. Gorman J. Agency initiative will focus on advancing deep brain stimulation. *New York Times*. October 24, 2013. [http://www.nytimes.com/2013/10/25/science/pentagon-agency-to-spend-70-million-on-brain-research.html?\\_r=0](http://www.nytimes.com/2013/10/25/science/pentagon-agency-to-spend-70-million-on-brain-research.html?_r=0). Updated October 2013. Accessed February 12, 2014.
  51. Sillay KA, Rutecki P, Cicora K, et al. Long-term measurement of impedance in chronically implanted depth and subdural electrodes during responsive neurostimulation in humans. *Brain Stimulat*. 2013;6(5):718–726.
  52. Morrell MJ; RNS System in Epilepsy Study Group. Responsive cortical stimulation for the treatment of medically intractable partial epilepsy. *Neurology*. 2011;77(13):1295–1304.
  53. Maling N, Hashemiyoan R, Foote KD, et al. Increased thalamic gamma band activity correlates with symptom relief following deep brain stimulation in humans with Tourette's syndrome. *PLoS ONE*. 2012;7(9):e44215.
  54. Carhart-Harris RL, Mayberg HS, Malizia AL, et al. Mourning and melancholia revisited: correspondences between principles of Freudian metapsychology and empirical findings in neuropsychiatry. *Ann Gen Psychiatry*. 2008;7(1):9.
  55. Kandel ER. Biology and the future of psychoanalysis: a new intellectual framework for psychiatry revisited. *Am J Psychiatry*. 1999;156(4):505–524.
  56. Schlaepfer TE, George MS, Mayberg H; WFSBP Task Force on Brain Stimulation. WFSBP Guidelines on Brain Stimulation Treatments in Psychiatry. *World J Biol Psychiatry*. 2010;11(1):2–18.
  57. Fins JJ, Rezai AR, Greenberg BD. Psychosurgery: avoiding an ethical redux while advancing a therapeutic future. *Neurosurgery*. 2006;59(4):713–716.
  58. Fins JJ, Mayberg HS, Nuttin B, et al. Misuse of the FDA's humanitarian device exemption in deep brain stimulation for obsessive-compulsive disorder. *Health Aff (Millwood)*. 2011;30(2):302–311.

**Nolan R. Williams, MD**  
willianr@musc.edu  
**Joseph J. Taylor, PhD**  
**Suzanne Kerns, MD**  
**E. Baron Short, MD, MSCR**  
**Edward M. Kantor, MD**  
**Mark S. George, MD**

**Author affiliations:** Departments of Psychiatry (all authors) and Neurosciences (Drs Williams, Taylor, and George), Medical University of South Carolina, Charleston, and Ralph H. Johnson VA Medical Center, Charleston, South Carolina (Dr George).

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