

# CURRICULUM VITAE

University of Pittsburgh, Pittsburgh, PA

## BIOGRAPHICAL

**Name:** Rajesh Narendran, M.D. **Birth Date:** (b) (6)

**Home Address:** (b) (6) **Birth Place:** (b) (6)

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**Business Address:** Department of Radiology  
PET Facility, B-938  
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## EDUCATION AND TRAINING

### MEDICAL EDUCATION:

1995	Stanley Medical College Madras, India	MB., B.S. (MD Equivalent)	Medicine
2002	New York State Education Department	MD (Conferred)	Medicine

### INTERNSHIP

1994-1995	Intern in Medicine Government Stanley Hospital Madras, India		
1997-1998	Intern in Psychiatry State University of New York at Buffalo (SUNYAB) Consortium Hospitals Buffalo, New York		

### RESIDENCY

1998-2001	Resident in Psychiatry SUNYAB Consortium Hospital Buffalo, New York		
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### FELLOWSHIPS

1996 - 1997	Research Fellow in Psychiatry Bipolar and Psychotic Disorder Program McLean Hospital Belmont, Massachusetts		
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2001- 2004  
Research Fellow in Psychiatry  
Division of Functional Brain Mapping  
New York State Psychiatric Institute  
New York, New York

### **BOARD CERTIFICATION**

2003  
American Board of Psychiatry and Neurology  
(General Psychiatry)  
Board Certified

### **APPOINTMENTS AND POSITIONS**

#### **ACADEMIC:**

1996 - 1997  
Research Fellow in Psychiatry  
Consolidated Department of Psychiatry  
Harvard Medical School  
Boston, MA

1997 - 2001  
Assistant Clinical Instructor in Psychiatry  
University at Buffalo School of Medicine and Biomedical Sciences,  
SUNYAB  
Buffalo, NY

2001 - 2004  
Instructor in Psychiatry  
Columbia University College of Physicians and Surgeons  
New York, NY

2004 - 2006  
Assistant Professor of Clinical Psychiatry  
Columbia University College of Physicians and Surgeons  
New York, NY

2006 - 2011  
Assistant Professor of Radiology and Psychiatry  
University of Pittsburgh  
Pittsburgh, PA

2011- Present  
Associate Professor of Radiology and Psychiatry  
University of Pittsburgh  
Pittsburgh, PA

#### **HOSPITAL:**

2000 - 2001  
Junior Attending Psychiatrist  
Comprehensive Psychiatric Emergency Program  
Erie County Medical Center  
Buffalo, NY

2001 - 2004  
Assistant Attending Psychiatrist  
New York- Presbyterian Hospital  
New York, NY

2002 - 2006  
Attending Psychiatrist  
Our Lady of Mercy Medical Center

Bronx, NY

2004 - 2006

Attending Psychiatrist  
New York- Presbyterian Hospital  
New York, NY

2006 - 2009

Attending Psychiatrist  
Psychiatric Emergency and Intervention Service  
Western Psychiatric Institute and Clinics  
UPMC  
Pittsburgh, PA

2009 – Present

Attending Psychiatrist  
Re:solve Crisis Network  
Western Psychiatric Institute and Clinics  
UPMC  
Pittsburgh, PA

### **RESEARCH LAB:**

2001- 2006

Lead Primate PET Imaging Program  
Co-lead Biological Imaging Core  
Division of Functional Brain Mapping (DFBM)  
New York State Psychiatric Institute (NYSPI)  
New York, NY

2006 - Present

University of Pittsburgh PET Facility  
Psychiatric Molecular Imaging Program (PMIP)  
University of Pittsburgh  
Pittsburgh, PA

### **MEMBERSHIPS IN PROFESSIONAL AND SCIENTIFIC SOCIETIES**

1997- Present

American Psychiatric Association

### **PUBLICATIONS AND PROFESSIONAL ACTIVITIES**

#### **1. Refereed Articles**

1. Zarate CA Jr, Narendran R, Tohen M, Greaney J, Berman A, Pike S, Madrid A. Clinical predictors of acute response with olanzapine in psychotic mood disorders. *J Clin Psychiatry* 1998; 59:24-28
2. Zarate CA Jr, Tohen M, Narendran R, Tomassini EC, McDonald J, Sederer M, Madrid A. The adverse effect profile and efficacy of divalproex sodium compared with valproic acid: a pharmacoepidemiology study. *J Clin Psychiatry* 1999; 60:232-236
3. Kim KY, Hwang W, Narendran R. Acute liver damage possibly related to sertraline and venlafaxine ingestion. [letter] *Ann Pharmacother* 1999; 33:381-382
4. Leo RJ, Narendran R, DeGuiseppe B. Methadone detoxification of tramadol dependence. [brief report] *Journal of Substance Abuse Treatment* 2000; 19: 297-299
5. **Narendran R**, Young CM, Pato M. Possible risperidone-induced tardive dystonia. [letter] *Ann*

6. **Narendran R**, Young CM, Valenti AM, Pristach CA, Pato MT, Grace JG. Olanzapine therapy in treatment resistant psychotic mood disorders- a long term follow-up study. *J Clin Psychiatry* 2001; 62: 509-16
7. **Narendran R**, Young CM, Valenti AM, Nickolova MK, Pristach CA. Psychosis exacerbated by modafinil? [letter] *Arch Gen Psychiatry* 2002; 59(3): 292-3
8. Huang Y, Hwang D-R, Narendran R, Sudo Y, Chatterjee R, Bae S-A, Mawlawi O, Kegeles L, Wilson AA, Kung HF, Laruelle M. Comparative Evaluation of five positron emission tomography radiotracers for imaging serotonin transporters in vivo: [<sup>11</sup>C] McN 5652, [<sup>11</sup>C] ADAM, [<sup>11</sup>C] DASB, [<sup>11</sup>C] DAPA, and [<sup>11</sup>C] AFM. *J Cereb Blood Flow* 2002; 22:1377-1398
9. **Narendran R**, Young CM, Pristach CA, Pato MT, Valenti AM, Fass AR. Efficacy of clozapine in the treatment of atypical antipsychotic refractory schizophrenia- a pilot study. *J Clin Psychopharmacol.* 2003; 23(1): 103-4
10. Valenti AM, Narendran R, Young CM, Pristach CA. Who are patients on conventional antipsychotics? *Schizophrenia Bulletin* 2003; 29 (2): 195-9
11. Hwang D-R, Narendran R, Huang Y, Slifstein M, Talbot PS, Sudo Y, Van Berckel BN, Kegeles LS, Martinez D, Laruelle M. Quantitative analysis of (-)-N-[<sup>11</sup>C]-propyl-norapomorphine in vivo binding in nonhuman primates. *J Nucl Med* 2004 45: 338-346
12. **Narendran R**, Hwang D-R, Slifstein M, Talbot PS, Erritzoe D, Huang Y, Cooper T, Martinez D, Kegeles LS, Abi-Dargham A, Laruelle M. In vivo vulnerability to competition by endogenous dopamine: comparison of the D<sub>2</sub> receptor agonist radiotracer (-)-N-[<sup>11</sup>C]propyl-norapomorphine ([<sup>11</sup>C]NPA) with the D<sub>2</sub> receptor antagonist radiotracer [<sup>11</sup>C]-raclopride. *Synapse* 2004 52 (3): 188-208.
13. Slifstein M, Hwang D-R, Huang Y, Guo N, Sudo Y, Narendran R, Talbot PS, Laruelle M. In vivo affinity of [<sup>18</sup>F]fallypride for striatal and extrastriatal dopamine D<sub>2</sub> receptors in nonhuman primates. *Psychopharmacology (Berl)* 2004 175 (3):274-86.
14. Huang Y, Hwang D-R, Bae SA, Sudo Y, Guo N, Zhu Z, Narendran R, Laruelle M. A new positron emission tomography imaging agent for the serotonin transporter: synthesis, pharmacological characterization and pharmacokinetic analysis of [<sup>11</sup>C]-[2-(Dimethylaminomethyl)phenylthio]-5-fluoromethylphenylamine ([<sup>11</sup>C]AFM). *Nuclear Medicine and Biology* 2004 :31 (5):543-56.
15. Huang Y, Narendran R, SA Bae, Erritzoe D, Guo N, Zhu Z, Hwang D-R, Laruelle M. A PET Imaging Agent with Fast Kinetics: Synthesis and In Vivo Evaluation of the Serotonin Transporter Ligand [<sup>11</sup>C]-[2-(Dimethylaminomethyl)phenylthio]-5-fluorophenylamine ([<sup>11</sup>C]AFA). *Nuclear Medicine and Biology* 2004; 31 (6):727-38
16. Slifstein M, Narendran R, Hwang D-R, Sudo Y, Talbot PS, Huang Y, Laruelle M. Effect of amphetamine of [<sup>18</sup>F]fallypride in vivo binding to D<sub>2</sub> receptors in striatal and extrastriatal regions of primate brain: Single bolus and bolus plus constant infusion studies. *Synapse.* 2004 54 (1):46-63
17. Zhu Z, Guo N, Narendran R, Erritzoe D, Ekelund J, Hwang DR, Bae SA, Laruelle M, Huang Y. The new PET imaging agent [<sup>11</sup>C]AFE is a selective serotonin transporter ligand with fast brain uptake kinetics. *Nucl Med Biol.* 2004 31(8):983-94.
18. Talbot PS, Narendran R, Butelman ER, Huang Y, Ngo K, Slifstein M, Martinez D, Laruelle M, Hwang DR. [<sup>11</sup>C]-GR103545, a Radiotracer for Imaging {kappa}-Opioid Receptors In Vivo with PET: Synthesis and

Evaluation in Baboons. J Nucl Med. 2005 46 (3):484-94.

19. Frankle WG, Narendran R, Huang Y, Hwang D-R, Lombardo I, Cangiano C, Gil R, Laruelle M, Abi-Dargham A. Serotonin Transporter Availability in Patients with Schizophrenia: A Positron Emission Tomography Imaging Study with [(11)C]DASB. Biol Psychiatry. 2005 57(12):1510-6.

20. **Narendran R**, Frankle G, Keefe R, Gill R, Martinez D, Kegeles LS, Talbot PS, Huang Y, Hwang D-R, Khenissi L, Cooper T, Laruelle M, Abi-Dargham A. Dopaminergic alterations in a group of chronic recreational ketamine users. Am J Psych 2005; 162 (12):2352-9

21. Huang Y, Narendran R, Bischoff F, Guo N, Bae S-A, Lesage AS, Laruelle M. A Positron Emission Tomography Radioligand for the *in vivo* Labeling of Metabotropic Glutamate 1 Receptor: (3-Ethyl-2-[11C]methyl-6-quinolinyl)(*cis*-4-methoxycyclohexyl)methanone. J Med Chemistry 2005 11; 48 (16):5096-9

22. **Narendran R**, Hwang D-R, Slifstein M, Hwang Y, Huang Y, Ekelund J, Guillin O, Scher E, Martinez D, Laruelle M. Measurement of the proportion of D2 receptors configured in state of high affinity for agonists in vivo: a Positron Emission Tomography study using [<sup>11</sup>C]N-propyl-norapomorphine and [<sup>11</sup>C]raclopride in baboons. J PET. 2005 315(1): 80-90.

23. van Berckel BN, Kegeles LS, Waterhouse R, Guo N, Hwang D-R, Huang Y, Narendran R, Van Heertum R, Laruelle M. Modulation of amphetamine induced dopamine release by group II metabotropic glutamate receptor agonist LY354740 in non human primates studied with positron emission tomography. Neuropharmacology 2006; 31 (5): 967-77

24. **Narendran R**, Slifstein M, Guillin O, Hwang Y, Hwang DR, Scher E, Reeder S, Rabiner E, Laruelle M. Dopamine (D2/3) receptor agonist positron emission tomography radiotracer [<sup>11</sup>C]-(+)-PHNO is a D3 receptor preferring agonist in vivo. Synapse. 2006; 60(7):485-95.

25. Frankle WG, Slifstein M, Gunn RN, Huang Y, Hwang DR, Darr EA, Narendran R, Abi-Dargham A, Laruelle M. Estimation of serotonin transporter parameters with [<sup>11</sup>C]-DASB in healthy humans: reproducibility and comparison of methods. J Nucl Med. 2006; 47(5):815-26.

26. **Narendran R**, Slifstein M, Hwang D-R, Hwang Y, Scher E, Reeder S, Martinez D, Laruelle M. Amphetamine-induced dopamine release: duration of action as assessed with the D2/3 agonist radiotracer (-)-N [<sup>11</sup>C]propyl-norapomorphine in an anesthetized nonhuman primate. Synapse 2007 61(2): 106-109

27. Martinez D, Narendran R, Foltin RW, Slifstein M, Hwang D-R, Broft A, Huang Y, Cooper TB, Fischman MW, Kleber HD, and Laruelle M. Amphetamine-induced dopamine release is markedly blunted in cocaine dependence and predictive of the choice to self administer cocaine. Am J Psychiatry 2007; 164 (4): 622-9

28. Ekelund J, Slifstein M, Narendran R, Guillin O, Belani H, Guo NN, Hwang Y, Hwang DR, Abi-Dargham A, Laruelle M. In vivo DA D<sub>1</sub> receptor selectivity of NNC 112 and SCH 23390. Mol Imaging Biol. 2007; 9(3):117-25

29. Narendran R, Martinez D. Cocaine abuse and striatal dopamine transmission: a critical review of the preclinical and clinical imaging literature. Synapse 2008 62(11): 851-69

30. Frankle WG, Cho RY, Narendran R, Mason NS, Vora S, Litschge M, Price JC, Lewis DA, Mathis CA. Tiagabine Increases [<sup>11</sup>C]flumazenil Binding in Cortical Brain Regions in Healthy Control Subjects. Neuropsychopharmacology. 2009; 34(3):624-33

31. **Narendran R**, Frankle WG, Mason NS, Laymon CM, Lopresti B, Price CJ, Kendro S, Vora S, Litschge M, Mountz JM, Mathis C.. PET Imaging of D<sub>2/3</sub> agonist binding in healthy human subjects with the radiotracer [<sup>11</sup>C]-N-propyl-nor-apomorphine (NPA): preliminary evaluation and reproducibility studies. *Synapse* 2009 63(7):574-84
32. **Narendran R**, Frankle WG, Mason NS, Rabiner EA, Gunn R, Searle GE, Vora S, Litschge M, Kendro S, Cooper TB, Mathis C, Laruelle M. Positron Emission Tomography Imaging of Amphetamine-Induced Dopamine Release in the Human Cortex: A comparative evaluation of the high affinity dopamine D<sub>2/3</sub> radiotracers [<sup>11</sup>C]FLB 457 and [<sup>11</sup>C]fallypride. *Synapse* 2009 63(6):447-61.
33. Laymon CM, Mason NS, Frankle WG, Carney JP, Lopresti BJ, Litschge MY, Mathis CA, Mountz JM, **Narendran R**. Human Biodistribution and Dosimetry of the D<sub>2/3</sub> Agonist 11C-N-Propylnorapomorphine (11C-NPA) Determined from PET. *J Nucl Med.* 2009; 50(5):814-7.
34. Martinez D, Slifstein M, Narendran R, Foltin RW, Broft A, Hwang DR, Perez A, Abi-Dargham A, Fischman MW, Kleber HD, Laruelle M. Dopamine D<sub>1</sub> receptors in cocaine dependence measured with PET and the choice to self-administer cocaine. *Neuropsychopharmacology.* 2009; 34(7):1774-82
35. Martinez D, Greene K, Broft A, Kumar D, Liu F, Narendran R, Slifstein M, Van Huertum R, Kleber HD. Lower level of endogenous dopamine in patients with cocaine dependence: findings from PET imaging of D<sub>2/3</sub> receptors following acute dopamine depletion. *Am J Psych* 2009; 166(10):1170-7
36. Martinez D, Orlowska D, Narendran R, Slifstein M, Liu F, Kumar D, Broft A, Van Huertum R, Kleber HD, Dopamine type 2/3 receptor availability in the striatum and social status in healthy volunteers. *Biol Psychiatry.* 2010; 67 (3): 275-8
37. Guo N, Guo W, Kralikova M, Jiang M, Schieren I, Narendran R, Slifstein M, Abi-Dargham A, Laruelle M, Javitch JA, Rayport S. Impact of D<sub>2</sub> receptor internalization on binding affinity of neuroimaging radiotracers. *Neuropsychopharmacology* 2010; 35 (3): 806-17
38. **Narendran R**, Mason NS, Laymon CM, Lopresti BJ, Velasquez ND, May MA, Kendro S, Martinez D, Mathis CA, Frankle WG. A comparative evaluation of the dopamine D<sub>2/3</sub> agonist radiotracer [<sup>11</sup>C]NPA and antagonist [<sup>11</sup>C]raclopride to measure amphetamine-induced dopamine release in the human striatum. *JPET* 2010 333: 533-39
39. Frankle WG, Mason NS, May MA, Asmonga D, Chen C-M, Kendro S, Cooper TB, Mathis CA, **Narendran R**. No effect of dopamine depletion on the binding of the high affinity D<sub>2/3</sub> radiotracer [<sup>11</sup>C]FLB 457 in the human cortex. *Synapse* 2010; 64 (12)879-85
40. **Narendran R**, Mason NS, May MA, Chen C-M, Kendro S, Ridler K, Rabiner EA, Laruelle M, Mathis CA and Frankle WG. PET imaging of D<sub>2/3</sub> receptors in the human cortex with [<sup>11</sup>C]FLB 457: reproducibility studies. *Synapse* 2011; 65 (1): 35-40
41. **Narendran R**, Mason NS, Chen CM, Himes M, Keating P, May MA, Rabiner EA, Laruelle M, Mathis CA, Frankle WG. Evaluation of dopamine D<sub>2/3</sub> specific binding in the cerebellum for the PET radiotracer [<sup>11</sup>C]FLB 457: Implications for measuring cortical dopamine release. *Synapse* 2011; 65 (10): 991-7
42. **Narendran R**, Martinez D, Mason NS, Lopresti BJ, Himes M, Chen-Min C, May MA, Price JC, Mathis CA, Frankle WG. Imaging of D<sub>2/3</sub> agonist binding in cocaine dependence: A [<sup>11</sup>C]NPA PET study. *Synapse* 2011; 65(12): 1344-9

43. **Narendran R**, Lopresti BJ, Martinez D, Mason NS, Himes M, May MA, Daley DC, Price JC, Mathis CA, Frankle WG. In vivo evidence for reduced striatal vesicular monoamine transporter (VMAT2) availability in cocaine abusers. *Am J Psych* 2012; 169 (1): 55-63
44. Laymon CM, Narendran R, Mason NS, Carney JP, Lopresti BJ, Mathis CA, Mountz JM, Sashin D, Frankle WG. Human biodistribution and dosimetry of the PET radioligand [<sup>11</sup>C]flumazenil. *Mol Imaging Biol* 2012; 14 (1): 115-22
45. Abi-Dargham A, Xu X, Thompson JL, Gil R, Kegeles LS, Urban NB, Narendran R, Hwang DR, Laruelle M, Slifstein M. Increased prefrontal cortical D1 receptors in drug naïve patients with schizophrenia: a PET study with [<sup>11</sup>C]NNC112. *J Psychopharmacol*: 26 (6): 794-805
46. Bailer UF, Narendran R, Frankle WG, Himes ML, Duvvuri V, Mathis CA, Kaye WH. Amphetamine-induced dopamine release increases anxiety in individuals recovered from anorexia nervosa. *Int. J. Eat Disord* 2012; 45 (2): 263-71
47. Frankle WG, Cho RY, Mason SN, Chen C-M, Himes M, Walker C, Lewis DA, Mathis CA, **Narendran R**. [<sup>11</sup>C]flumazenil binding is increased in a dose-dependent manner with tiagabine induced elevations in GABA levels. *PLoS One* 2012; 7 (2):e32443
48. Huang Y, Narendran R, Bischoff F, Guo N, Bae S-A, Hwang D-R, Lesage A, Laruelle M. Synthesis and characterization of two PET radioligands for the metabotropic glutamate 1 (mGLU1) receptor. *Synapse* 2012; 66 (12): 1002-14
49. **Narendran R**, Frankle WG, Mason NS, Muldoon MF, Moghaddam B. Improved working memory but no effect on striatal vesicular monoamine transporter type 2 after omega-3 polyunsaturated fatty acid supplementation. *PLoS One* 2012;7(10):e46832
50. **Narendran R**, Himes M, Mason NS. Reproducibility of post-amphetamine [<sup>11</sup>C]FLB 457 binding potential to cortical D<sub>2/3</sub> receptors. *PLoS One* 2013; 8(9):e76905
51. **Narendran R**, Jedema HP, Lopresti B, Mason NS, Gurnsey K, Ruskiewicz J, Chen C-M, Deutch L, Frankle WG, Bradberry CW. Imaging dopamine transmission in the frontal cortex: a simultaneous microdialysis and [<sup>11</sup>C]FLB 457 PET study. *Molecular Psychiatry* 2014; 19 (3): 302-10
52. Forbes EE, Rodriguez EE, Musselman S, **Narendran R**. Prefrontal response and frontostriatal functional connectivity to monetary reward in abstinent alcohol-dependent young adults *PLoS One* 2014; 9(5):e94640
53. **Narendran R**, Mason NS, Paris J, Himes ML, Douaihy AB, Frankle WG. Prefrontal cortical dopamine transmission is decreased in alcoholism. *Am J Psych* 2014; 171:881-888
54. Jedema H, Narendran R and Bradberry CW. Amphetamine-induced release of dopamine in primate prefrontal cortex and striatum: striking differences in magnitude and time course. *J Neurochem* 2014; 130 (4): 490-7
55. **Narendran R**, Jedema H, Lopresti BJ, Mason NS, Himes M, Bradberry CW. Decreased vesicular monoamine transporter, type 2 availability in the striatum following chronic cocaine self-administration in non human primates. *Biol Psychiatry* 2015; 77 (5): 488-92
56. **Narendran R**, Lopresti BJ, Mason NS, Deutch L, Paris J, Himes M, Chowdari KV, Nimgaonkar VL. Cocaine abuse in humans is not associated with increased microglial activation: an 18-kDa translocator protein positron emission tomography imaging study with [<sup>11</sup>C]PBR28. *J Neurosci* 2014; 34 (30):9945-50

57. Slifstein M, van de Giessen E, Snellenberg JV, Thompson JL, Narendran R, Gil R, Hackett E, Girgis R, Ojeil N, Moore H, D' Souza D, Malison RT, Huang Y, Lim K-P, Nabulsi N, Carson RE, Lieberman JA, Abi-Dargham A. Deficits in prefrontal cortical and extra-striatal dopamine release in schizophrenia: a PET fMRI study. *JAMA Psychiatry* 2015; 72 (4) 316-24

58. Frankle WG, Cho RY, Prasad KM, Mason NS, Paris J, Himes ML, Walker C, Lewis DA, **Narendran R**. In vivo measurement of GABA transmission in healthy comparison subjects and subjects with schizophrenia. *Am J Psych* 2015; 172 (11): 1148-59

59. Weidner LD, Paris A, Frankle WG, **Narendran R**. Safety of oral amphetamine administered during positron emission tomography scans in medically screened humans. *PLoS ONE* 2015; 10(12): e0140647. (doi:10.1371/journal.pone.0140647)

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(b) (4)

In press)

## 2. Reviews, invited published papers, proceedings of conference and symposia, monographs, books and book chapters

1. Leo RJ, **Narendran R**. Anticonvulsant use in the treatment of bipolar disorder: a primer for primary care physicians. *Primary Care Companion- J Clin Psychiatry* 1999; 1: 74-84

2. Hwang D-R, Narendran R, Laruelle M. Positron-labeled dopamine agonists for probing the high affinity states of dopamine subtype 2 receptors. *Bioconj Chem*. 2005; 16(1):27-31.

3. Abi-Dargham A, Guo N, Narendran R, Hwang D-R, Ekelund J, Guillin O, Martinez D, Frankle G, Laruelle M. S40 prefrontal dopamine transmission in schizophrenia: is d1 receptor a relevant biomarker? *Behavioral Pharmacology* 2005 Suppl 1: S13

4. Laruelle M, Frankle WG, Narendran R, Kegeles LS, Abi-Dargham A. Mechanism of action of antipsychotic drugs: from dopamine D(2) receptor antagonism to glutamate NMDA facilitation. *Clin Ther*. 2005;27 Suppl A:S16-24.

5. Price JC, Laymon CL, Narendran R, Lopresti BJ. Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET). In: *Handbook of Neuroimaging Research in Geriatric Mental Health* (Aizenstein HJ, Reynolds, CF, III, Ferandes M, eds). New York: Springer Publishing, 2010; 17-70.

6. Martinez D and **Narendran R**. Imaging neurotransmitter release by drugs of abuse. *Curr Top Behav Neurosci*. 2010; 3: 219-45

7. Deutch L and **Narendran R**. Imaging of neurochemical transmission in the Central Nervous System. *Imaging of the Human Brain in Health and Disease* (Seeman P, Madras B, Johnson JE). E-book: neuroscience-net at neuroscience.com

## 3. Published abstracts (select list)

1. Zarate CA Jr, Narendran R, Tohen M, Greaney J, Berman A. Clinical predictors of acute response with olanzapine in psychotic mood disorders, Proc 150<sup>th</sup> Annual Meeting, American Psychiatric Association, San Francisco, CA 1997.

2. Zarate CA Jr, Tohen M, Narendran R, Tomassini E, McDonald J. The adverse effect profile and efficacy of divalproex sodium compared with valproic acid. Proc 151<sup>st</sup> Annual Meeting, American Psychiatric Association,



Toronto, Canada 1998.

3. Narendran R, Young CM, Pato MT, Grace J. Olanzapine therapy in treatment-resistant psychotic mood disorders-a long term follow-up study. Proc 153<sup>rd</sup> Annual Meeting, American Psychiatric Association Research Colloquium for Junior Investigators, Chicago, IL 2000.
4. Narendran R, Young CM, Valenti AM, Yap D, Pristach CA. Treatment of atypical antipsychotic resistant schizophrenia. Proc 154<sup>th</sup> Annual Meeting, American Psychiatric Association, New Orleans, LA
5. Young CM, Narendran R, Pristach CA, Valenti AM, Abbate M. Emotional stress among resident physicians. Proc 154<sup>th</sup> Annual Meeting, American Psychiatric Association, New Orleans, LA 2001
6. Valenti AM, Fass AR, Young CM, Narendran R, Pristach CA. Sexual dysfunction in schizophrenics on atypical antipsychotics. Proc 154<sup>th</sup> Annual Meeting, American Psychiatric Association, New Orleans, LA
7. Abbate M, Young CM, Narendran R, Pato MT, Weapons screening and safety measures in New York State psychiatric emergency rooms. Proc 154<sup>th</sup> Annual Meeting, American Psychiatric Association, New Orleans, LA
8. Narendran, Talbot PS, Slifstein M, Sudo Y, Guo N, Hackett E, Ali M, Huang Y, Hwang D-R, Laruelle M. Effects of d-amphetamine on the binding of <sup>18</sup>F-fallypride in striatal and extrastriatal regions in baboons: single bolus and bolus plus constant infusion studies. [Abstract #] 49<sup>th</sup> Annual Meeting, Society of Nuclear Medicine, Los Angeles CA 2002
9. Hwang D-R, Kegeles LS, Narendran R, Huang Y, Sudo Y, Chatterjee R, Talbot PS, Ngo K, Laruelle M. Characterization of dopamine agonist PET tracer <sup>11</sup>C-NPA [Abstract #956] 49<sup>th</sup> Annual Meeting, Society of Nuclear Medicine, Los Angeles CA 2002
10. Huang Y, Hwang DR, Narendran R, Sudo Y, Chatterjee R, Bae SA, Kegeles LS, Wilson AA, Kung HF, Laruelle M. Comparative evaluation of [<sup>11</sup>C]MCN 5652 with [<sup>11</sup>C]ADAM, [<sup>11</sup>C]DASB, [<sup>11</sup>C]DAPA, and [<sup>11</sup>C]AFM as PET imaging agents for the serotonin transporters. Program No. 519.1. 2002 Abstract Viewer/Itinerary Planner. Orlando, FL: Society for Neuroscience, 2002.
11. R. Narendran, P.S. Talbot, M. Slifstein, Y. Sudo, N. Guo, E. Hackett, M. Ali, Y. Huang, D.-R. Hwang, A. Abi-Dargham, M. Laruelle. Effects of d-amphetamine on [<sup>18</sup>F]fallypride binding in striatal and extrastriatal regions. Program No. 404.17. 2002 Abstract Viewer/Itinerary Planner. Orlando, FL: Society for Neuroscience, 2002. Online.
12. R. Narendran, P.S. Talbot, L.S. Kegeles, K. Ngo, E. Hackett, D. Martinez, Y. Huang, A. Abi-Dargham, M. Laruelle, D-R. Hwang. Comparison of the invivo vulnerability of a dopamine-2-agonist tracer [<sup>11</sup>C]-N-propylnorapomorphine (NPA), with a D2 antagonist tracer [<sup>11</sup>C]raclopride, on striatal binding following an amphetamine challenge. T-118 2002 Abstract Viewer/Itinerary Planner. Puerto Rico: ACNP, 2002.
13. P.S.Talbot, R. Narendran, Y. Huang, K. Ngo, E. Hackett, N. Quadri, J. Castrillon, D. Martinez, M. Laruelle, D-R. Hwang. [<sup>11</sup>C] GR103545 is a promising PET ligand for imaging kappa opioid receptors. M-107, 2002. Abstract Viewer/Itinerary Planner. Puerto Rico: ACNP, 2002.
14. R. Narendran, PS Talbot, M. Slifstein, Y. Sudo, L. Hackett, Y. Huang, A. Abi-Dargham, M. Laruelle. Vulnerability of [<sup>18</sup>F]fallypride in vivo binding in striatal and extrastriatal regions following a d-amphetamine challenge in baboons: Single bolus and bolus plus constant infusion studies. Schizophrenia Research 2003; 60 (1): 244.
15. Narendran R, Talbot PS, Kegeles LS, Martinez D, Huang Y, Ngo K, Hackett E, Castrillon J, Abi-

Dargham A, Laruelle M, Hwang D-R. In vivo vulnerability to endogenous dopamine: comparison of the D<sub>2</sub> agonist tracer [<sup>11</sup>C]NPA with the D<sub>2</sub> antagonist tracer [<sup>11</sup>C]raclopride. JNM supplement 2003; 44(5) 2003:5 [Abstract #226]

16. Narendran R, Huang Y, Talbot PS, Erritzoe D, Hwang D-R, Sokoloff P, Mann A, Thomas C, Laruelle M. Pharmacological evaluation of the benzamide [11C]nafadotride as a potential PET imaging agent for the dopamine D<sub>3</sub> receptors. JNM supplement 2003; 44(5) 2003; 5: [Abstract #231]

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18. Abi-Dargham A, Narendran R, Frankle G, Khenissi L, Gill R, Cooper T, Hwang D-R, Erritzoe D, Huang Y, Martinez D, Laruelle M. PET imaging of prefrontal dopamine D<sub>1</sub> receptors in chronic PCP/ketamine human abusers: a model for schizophrenia. Program No 234.5, 2004 Abstract Viewer/Itinerary Planner. New Orleans, LA: Society for Neuroscience, 2003. Online.

19. Narendran R, Frankle WG, Keefe R, Gil R, Martinez D, Kegeles LS, Huang Y, Hwang D-R, Khenissi L, Cooper TB, Laruelle M, Abi-Dargham A. Dopaminergic alterations in human ketamine abusers. Abstract #26. Abstract Viewer/Itinerary Planner. Philadelphia, PA: Society for Nuclear Medicine, 2004. Online

20. Narendran R, Hwang D-R, Slifstein M, Hwang YC, Huang Y, Guillin O, Ekelund J, Martinez D, Abi-Dargham A, Laruelle M. Measurement of the D<sub>2</sub> high affinity site receptor density (R<sub>high</sub>) in baboons using [<sup>11</sup>C]raclopride and [<sup>11</sup>C]NPA. Program 123.12, 2004 Abstract Viewer/Itinerary Planner. San Francisco, CA: Society for Neuroscience, 2004. Online.

21. Frankle W, Narendran R, Huang Y, Hwang D-R, Cangiano C, Scher E, Gelbard-Stokes I, Reich E, Gil R, Laruelle M, Abi-Dargham A. PET Imaging of the serotonin transporter (SERT) in patients with schizophrenia and healthy controls using [<sup>11</sup>C]DASB. Program 346.4, 2004 Abstract Viewer/Itinerary Planner. San Francisco, CA: Society for Neuroscience, 2004. Online.

22. Martinez D, Narendran R, Hwang D-R, Huang Y, Gil R, Hackett E, Frankle G, Evans S, Krystal J, Laruelle M, Abi-Dargham A. Alcohol Dependence is associated with blunted dopamine transmission in the ventral striatum. Program 489.2, 2004 Abstract Viewer/Itinerary Planner. San Francisco, CA: Society for Neuroscience

23. Narendran R, Slifstien M, Guillin O, Hwang Y, Hwang D-R, Scher E, Reeder S, Rabiner E, Laruelle M. Pharmacological evaluation of the novel D<sub>2/3</sub> agonist radiotracer [11C]PHNO in anesthetized non-human primates: A potential D<sub>3</sub> receptor preferring agonist? Neuroreceptor Mapping 2006, Copenhagen, Denmark. Neuroimage Vol 31, Suppl 2. Page T 116

24. Rabiner EA, Slifstein M, Gunn RN, Gentile G, Cunningham VJ, Narendran R, Huiban M, Plisson C, Laruelle M. Narendran R, Slifstien M, Guillin O, Hwang Y, D<sub>3</sub> receptor quantification with [11C]PHNO PET. 2007. Abstract Viewer/Itinerary Planner. Boca Raton, FL: ACNP 2007.

25. Frankle W, Narendran R, Mason N, Vora S, Litschge M, Price J, Mathis C, Lewis D. In vivo measurement of increased extracellular GABA with PET in healthy control subjects. 2007. Abstract Viewer/Itinerary Planner. Boca Raton, FL: ACNP 2007.

26. Narendran R, Frankle WG, Mason N, Lopresti BJ, Litschge M, Vora SN, Asmonga D, Mountz J, Mathis CA. Imaging D<sub>2</sub> agonist binding sites in healthy humans with [11C]NPA: Preliminary validation and reproducibility studies. Neuroreceptor mapping 2008, Pittsburgh, PA. Neuroimage Vol 41. Suppl 2. Page T41.

27. Narendran R, Mason N, Rabiner EA, Riddler K, May MA, Chen C-M, Kendro S, Mathis CA, Laruelle

M, Frankle WG. Further validation of [11C]FLB 457 as a tool to measure prefrontal cortical DA release. Neuroreceptor mapping 2010, Glasgow, UK. Neuroimage Vol 52. Suppl 1. Page S40.

28. Forbes EE, Rodriguez E, Hariri A, Keating P, Himes M, Narendran R. Alcohol dependence: altered neural response to monetary reward? Biol Psychiatry 2011; 69: 1S: Page 272S

29. Narendran R. Validation of [C-11]FLB 457 as a tool to measure cortical dopamine release. Neuropsychopharmacology 2011; 36(S1): 20

30. Frankle WG, Robinson B, Maier G, Paris J, Asmonga D, Chen C-M, Maureen M, Mason NS, Mathis CA, Narendran R. An open label PET study to evaluate serotonin transporter (SERT) occupancy following escalating dose of desvenlafaxine. JCBFM 2012; 32: S59: P023

31. Narendran R, Jedema H, Lopresti B, Mason NS, Gurnsey K, Ruskiewicz J, Chen C-M, Mathis C, Frankle WG. Imaging dopamine transmission in the prefrontal cortex: a combined microdialysis and [11C]FLB 457 PET study. JCBFM 2012; 32: S157: P131

32. Deutch L, Gurnsey K, Ruskiewicz J, Himes ML, Griswold K, Frankle WG, Jedema HP, Bradberry CW, Narendran R. Imaging of prefrontal cortical dopamine transmission with [11C]FLB 457 and amphetamine. Program No. 74.09.2012. Neuroscience Meeting Planner. New Orleans, LA, Society for Neuroscience, 2012, Online.

33. Himes ML, Pazehoski D, Riley M, Paris J, Deutch L, Lopresti BJ, Muldoon MF, Moghaddam B, Narendran R. Omega-3 polyunsaturated fatty acid supplementation does not increase VMAT2 availability in humans. A [11C]DTBZ positron emission tomography study. Program No. 256.23.2012. Neuroscience Meeting Planner. New Orleans, LA, Society for Neuroscience, 2012, Online.

34. Narendran R. Imaging dopamine in prefrontal cortex. Page 436. Program/Abstracts. Dopamine 2013, Alghero, May 24-28, 2013, Online.

35. Narendran R. Imaging vesicular monoamine transporter, type2 in cocaine dependence. Neuropsychopharmacology 2014; 40, SI-III: Panel Abstract 7.1

#### **4. Other publications**

None

#### **5. Presentations:**

None

### **OTHER RESEARCH ACTIVITIES**

#### **Awards and Honors**

1998- The Excellence in Psychiatry Residency Award,  
151<sup>st</sup> Annual Meeting, American Psychiatric Association, Toronto, Canada.

1998 - Intern of the Year, Psychiatry Residency Training Program, SUNYAB, Buffalo, New York

2000 - American Psychiatric Institute for Research and Education/Janssen Scholar in Research on Severe Mental Illness Award, 153<sup>rd</sup> Annual Meeting, American Psychiatric Association, Chicago, Illinois.

2000 - APA Research Colloquium for Junior Investigators Travel Award, 153<sup>rd</sup> Annual Meeting, American Psychiatric Association, Chicago, Illinois.

2000 - Resident Service Award, Psychiatry Residency Training Program, SUNYAB, Buffalo, New York

2001 - Department of Psychiatry Grand Rounds 'The Treatment of Resistant Psychotic Disorders' at SUNYAB, Buffalo, New York.

2004 - Young Investigator Award, Neuroscience Track, 51<sup>st</sup> Annual Meeting, Society of Nuclear Medicine, Philadelphia, PA.

2006 - GSK Young Investigator Award, Neuroreceptor Mapping 2006, Copenhagen, Denmark

**Current Research Support:**

1R01DA026472 Narendran (PI) 1/2015-12/2019  
NIH/NIDA  
PET Imaging of Cortical Dopamine Transmission in Cocaine Addiction  
This study proposes to develop and validate a PET imaging technique to measure amphetamine-induced DA release in the cortex to study cocaine dependence.  
Role: PI

2015 NARSAD Independent Investigator Award Narendran (PI) 9/2015- 9/2017  
Imaging nociceptin receptors (NOP) in post-traumatic stress disorder (PTSD) and resilience  
This study proposes to evaluate nociceptin receptors in college women who have experienced sexual violence and difference in nociceptin receptors available between women who develop PTSD and those who did not.  
Role: PI

**Completed Research Support:**

1R01AA018330 Narendran (PI) 9/2009-8/2015  
NIH/NIAAA  
Imaging Cortical Dopamine Transmission in Alcohol Dependence  
This study evaluates amphetamine-induced DA release with [<sup>11</sup>C]FLB 457 in alcoholics  
Role: PI

RO1 MH086523 Frankle/Narendran (PI) 11/2009-11/2015 (No cost extension)  
NIH/NIMH  
In vivo measurement of dopamine transmission in schizophrenia  
To measure amphetamine-induced dopamine transmission in schizophrenia with [<sup>11</sup>C]NPA and [<sup>11</sup>C]FLB 457  
Role: PI



RC1 MH088913 Phillips (PI) 10/2009-9/2012  
NIH/NIMH/ARRA  
Validation of Functional MRI-based Reward Processing Task as a Non-invasive Tool To Measure Dopamine Release  
To validate a reward task with functional MRI and PET  
Role: Co-Investigator

1R21DA023450 Narendran (PI) 03/15/2009 - 03/15/2012

NIH/NIDA

Imaging Dopamine D2 Agonist Binding Sites in Cocaine Dependence with [<sup>11</sup>C]NPA

This study evaluates dopamine D2high receptor sites in cocaine dependence

Role: PI

1R03DA024704-01A1 Narendran (PI) 05/15/2009 - 05/15/2011

NIH/NIDA/ARRA

Vesicular Monoamine Transporter 2 Imaging in Cocaine Abuse

This study evaluates [<sup>11</sup>C]DTBZ binding sites in cocaine dependence

Role: PI

5K08MH068762-04 Narendran (PI) 06/01/2005 - 06/01/2010

NIH/NIMH

Imaging of dopamine-2 (D2) receptor sites in schizophrenia.

This study evaluates dopamine D2high receptor sites in schizophrenia

Role: PI

### **Seminars and invited lectureships:**

#### Research Society on Alcoholism, San Antonio, TX, June 23, 2015

'Neurochemical abnormalities in the prefrontal cortex in alcoholism' in the symposium titled, "Recent basic and clinical advances identifying mesocorticolimbic neurochemical, structural and synaptic neuroadaptations in ethanol dependence"

#### Yale PET Talks, New Haven, CT, Jun 16, 2014

"Imaging cortical dopamine transmission in alcoholism"

#### Colorado Translational Research Center Lecture, Denver, CO, Jul 19, 2013

"Dopamine transmission in cocaine addiction: linking the animal and human studies"

#### Dopamine 2013, Alghero, Italy, May 24-28

"Imaging dopamine in the prefrontal cortex' in the symposium titled, 'Imaging and the role of dopamine across addictions: differences and commonalities'

#### Lieber Center for Schizophrenia Research and Treatment, Columbia University, New York, NY, Apr 17, 2013

"Dopamine transmission in cocaine addiction: linking the animal and human studies"

10th International Symposium on Catecholamines, Pacific Grove, CA, Sept 11, 2012

"Dopamine transmission in cocaine addiction: linking the animal and human studies"

Departmental research conference, Department of Psychiatry, Johns Hopkins University School of Medicine, Baltimore, Mar 6, 2012

"Imaging dopamine transmission in addiction: moving beyond [11C]raclopride"

Grand Rounds, Department of Radiology, University of Pittsburgh, Pittsburgh, Oct 28, 2011

"Recent advances in imaging neurotransmitter release"

Guest Lecture, Sackler Institute, Weill Medical College of Cornell University, Center for Brain, Gene and Behavioral (CBGB) research across development and the Neuroscience Graduate Program, New York, NY, March 31, 2011

"Dopamine transmission in cocaine addiction"

Grand Rounds, Department of Psychiatry, University of Pittsburgh, Pittsburgh, Jan 28, 2011

"Recent advances in imaging neurochemical transmission"

Guest Lecture, Neuroscience Research Training Program (NRTP), Yale University, New Haven, CT, Sept 17, 2010

"Dopamine transmission in cocaine addiction-linking the animal and human studies"

Grand Rounds, State University of New York at Buffalo, Feb 12, 2010

"Recent advances in imaging neurochemical transmission in the brain with positron emission tomography"

IXth International Conf. on Quantification of Brain Function with PET (Brain PET), Chicago, IL, July 1, 2009, Symposium, Measuring endogenous neurotransmitter release,

"Overview of imaging dopamine release with emission tomography methods"

Lieber Center for Schizophrenia Research and Treatment, Columbia University, New York, NY, Jan 7, 2009

"Imaging neurotransmitter release: moving beyond [C-11]raclopride"

Society for Nuclear Medicine Annual Meeting 2009, Brain Imaging Council, June 13, 2009

Course: A critical evaluation of molecular imaging in neuropsychiatry

"New paradigms in imaging transmitter release"

WFSBP Regional Symposium Marseille: South European Biological Psychiatry Associations Joint Meeting, Marseille, France, Nov 4

Symposium: Sensitization in schizophrenia and substance abuse: would the dopamine D<sub>3</sub> receptor have a key role?

"The role of dopamine in schizophrenia: evidences from PET imaging"

#### **Other activities (research service/administrative):**

##### FDA Advisory Committee

12/2015 Temporary member (voting), Psychopharmacology Drug Advisory Committee (Gepirone ER)

1/2015 Temporary member (voting), Psychopharmacology Drug Advisory Committee (Probuphine)

2/2015 Temporary member (voting), Psychopharmacology Drug Advisory Committee (Vortioxetine)

##### NIH Study Sections

09/2015 Temporary member, ZRG1-IFCN-B (40), PAR13-259: P01 review Drug Addiction

06/2015 Temporary member, ZRG1-BDCN-A-02, Member Conflict applications review

03/2015 Temporary member, ZRG1-BDCN-C-02, Member Conflict applications review

03/2015 Temporary member, ZRG1-BDCN-A-02, Member Conflict applications review

02/2015 Temporary member, ZDA1-MXL-F-06 NIDA I/START Small grant review

10/2014 Temporary member, ZRG1-IFCN-B (50), PAR 13-259: P01 review Drug Addiction  
 2010-2014 **Permanent member, Neural Basis of Psychopathology, addictions and sleep disorders study section (NPAS)**  
 11/2013 Temporary member, ZAA1 DD (04) NIAAA Member Conflict applications review- Basic sciences  
 03/2013 Temporary member, ZAA1 DD (04) NIAAA Member Conflict applications review- Neuroscience  
 2012 Temporary member, ZRG1-BDCN-W (02) M Neuroimmunology, Multiple sclerosis, Alzheimer's Dementia, Sleep Apnea and Restless Legs Syndrome  
 2012 Temporary member, ZAA1 DD (01) NIAAA Member Conflict applications review- Biosciences  
 2010 Temporary member, ZRG1-BDCN-C (85) NIMH Special Emphasis Panel  
 2009-2010 Temporary member, Neural Basis of Psychopathology, addictions and sleep disorders study section (NPAS)

VAMC Grant Study Sections

2011 Temporary member, Special Emphasis Panel (SPLD), Research on Gulf War Veterans' Illness

Yale Diabetes Research Center, Pilot Project Application

2016 Reviewer

Rachel Upjohn Clinical Scholars Award, University of Michigan Comprehensive Depression Center

2015 Reviewer

WWTF Vienna Science and Technology Funds

2015 Reviewer, Cognitive Science Projects

NIH Work Groups

2011 NIMH Research Domain Criteria (RDoC) Positive Valence System Workshop

School of Medicine Committee

2011- 2014 Member, Standing committee for Non-Tenured Faculty Promotions and Appointments

Departmental Committee

2010- present Member, Committee for recruitment of faculty in mechanisms of addiction  
 Department of Psychiatry, University of Pittsburgh, Pittsburgh, PA

2011- present Member, MR Research Center User Advisory Committee,  
 Department of Radiology, University of Pittsburgh, Pittsburgh, PA

Peer Review for Journals

JAMA Psychiatry

American Journal of Psychiatry

Biological Psychiatry (Member, Editorial Board, 2013-Present)

Bipolar Disorders

Cognitive neuroscience and neuroimaging (Member, Editorial Board, 2015- Present)

Journal of Cerebral Blood Flow and Metabolism

Journal of Neuroscience

Journal of Nuclear Medicine

Neuropsychopharmacology

PLOS One (Academic Editor, Editorial Board, 2014-Present)

Proceedings of National Academy of Sciences

Psychopharmacology

Schizophrenia Bulletin

Synapse

Peer review for meetings

2008 -2012 Scientific Review Committee, Neuroreceptor Mapping  
2008- 2014 Society for nuclear medicine abstract reviewer

### Teaching

2013- present 'Neurobiology of addiction'  
Lecture for the 'Introduction to Psychiatry Course' for UPSOM MS1  
Course Director: [REDACTED] (b) (6)

2011- present 'An introduction to human brain imaging techniques'  
Guest lecture for undergraduate neuroscience students at the University of Pittsburgh for NROSCI  
1042, "Neurochemical Basis of Behavior", Course Director: [REDACTED] (b) (6)

2006 - present Clinical supervision of PGY I to IV psychiatry residents at WPIC  
Clinical preceptor for medical students at WPIC