

CURRICULUM VITAE
Allison D. Fryer, Ph.D. FBPhS

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Education

BS Biology	1980	Syracuse University, Syracuse, New York.
MSc Pharmacology	1983	Chelsea College, University of London, London, England
Ph.D. Pharmacology	1986	University of London, London, England

Professional Experience

(2008-) **Associate Dean of Graduate Studies**, Oregon Health & Science University
 (2006-2008) **Director of the Graduate Program Molecular Cellular Biology**. Oregon Health & Science University
 (2003-) **Professor** Pulmonary & Critical Care Medicine, and of Physiology & Pharmacology, Oregon Health & Science University, Portland Oregon.
 (1986-2003) Johns Hopkins University School of Public Health, Baltimore MD.
 (2002-2003) **Professor** Physiology and Environmental Health Sciences
 (1996-2002) **Associate Professor** Physiology and Environmental Health Sciences
 (1989-1996) **Assistant Professor** Physiology and Environmental Health Sciences
 (1987-1989) **Post-doctoral Fellow**, University of Maryland, Baltimore, Maryland
 (1986-1987) **Post-doctoral Fellow**, University of California, San Francisco, California
 (1980-1982) **Research Pharmacologist**, Roche Products Limited, Welwyn Garden City, England

Editorial/Grant Review Activities

Associate Editor: American Journal Respiratory and Critical Care Medicine (1999-2004)

Editorial Board: British Journal of Pharmacology (1993-1998)

Editorial Board: American Journal of Respiratory Cell and Molecular Biology (2010-2015)

Peer Reviewer: American Journal of Respiratory & Critical Care Medicine, American Journal of Respiratory Cell & Molecular Biology, American Journal Physiology, British Journal of Pharmacology, European Journal of Pharmacology, FASEB, Journal Allergy & Clinical Immunology, Journal Applied Physiology, Journal Clinical Investigations, Journal Pharmacology & Experimental Therapeutics.

Ad Hoc reviewer: NIH assorted study sections 2002-2016; participate on average once every 2 years

Regular Member: NIH SBIR study section member (1998-2000) participate 3 times/year

Regular Member: NIH LCMI Study Section (2008-2012) participate 3 times/year

Publications: 82 Peer-review original papers, 22 Review articles, 1 Book edited, 17 Book chapters, 207 Abstracts (abstracts not listed).

Honors/Awards

1983-1986	Ph.D. Scholarship from Roche Products Limited, England
1993	Sandoz Prize from British Pharmacological Society
1993-1998	Editor British Journal of Pharmacology
1999-2004	Associate Editor for Am. J. Respir and Critical Care Medicine.
2004	Elected Fellow of the British Pharmacological Society (FBPhS)
2005	Visiting Scholar Duke University and University N Carolina.
2005	Teaching award OHSU (also won in 2006, 2008, 2012, and 2016)
2010	John A Resko Faculty Research Achievement and Mentoring Award, OHSU
2011	Brian J Sproule Lecture, University of Edmonton, Canada

Publications

Peer Review Journal Articles

1. Machin PJ, Hurst DN, Bradshaw RM, Blaber LC, Burden DT, **Fryer AD**, Melarange RA, Shivdasani C. (1983) β 1-selective adrenoceptor antagonists .2.4-ether-linked phenoxy-propanolamines. *J Med Chem* 26:1570-1576.
2. **Fryer AD**, Maclagan J (1984) Muscarinic inhibitory receptors in pulmonary parasympathetic nerves in the guinea pig. *Br J Pharmacol* 83:973-978.
3. Blaber LC, **Fryer AD** * (1985) The response of the cat airways to histamine in vivo and in vitro. *Br J Pharmacol* 84:309-316. * I would have been the first author but journal policy was to list authors alphabetically at this time.
4. Blaber LC, **Fryer AD** *, Maclagan J (1985) Neuronal muscarinic receptors attenuate vagally induced contraction of feline bronchial smooth muscle. *Br J Pharmacol* 86:723-728. * I would have been the first author but journal policy was to list authors alphabetically at this time.
5. Faulkner D, **Fryer AD***, Maclagan J (1986) Post-ganglionic muscarinic inhibitory receptors in pulmonary parasympathetic nerves in the guinea pig. *Br J Pharmacol* 88:181-188. * I would have been the first author but journal policy was to list authors alphabetically at this time.
6. **Fryer AD**, Maclagan J (1987) Pancuronium and gallamine are antagonists for pre- and post-junctional muscarinic receptors in the guinea-pig lung. *Naunyn-Schmiedeberg's Archives of Pharmacology* 335:367-371.
7. **Fryer AD**, Maclagan J (1987) Ipratropium bromide potentiates bronchoconstriction induced by vagal nerve stimulation in the guinea pig. *Eur J Pharmacol* 139:187-191.
8. Maclagan J, **Fryer AD**, Faulkner D (1989) Identification of M1 muscarinic receptors in pulmonary sympathetic nerves using pirenzepine. *Br J Pharmacology* 97:499-505.
9. Lee NH, **Fryer AD**, Forray C, El-Fakahany EE (1989) Different mechanisms of antagonism by methocitramine of two neuronal muscarinic receptor mediated second messenger responses. *J Pharmacol and Expt Therapeutics* 251:992-999.
10. **Fryer AD**, El-Fakahany EE (1989) An endogenous factor induces heterogeneity of binding sites of selective muscarinic receptor antagonists in rat heart. *Membrane Biochem* 8:127-132.
11. **Fryer AD**, El-Fakahany EE, Jacoby DB. (1990) Parainfluenza virus type 1 reduces the affinity of agonists for muscarinic receptors in guinea-pig lung and heart. *Eur J Pharmacol* 181:51-58.
12. **Fryer AD**, El-Fakahany EE (1990) Identification of three muscarinic receptor subtypes in rat lung using binding studies with selective antagonists. *Life Sciences* 47:611-618.
13. **Fryer AD** & Jacoby DB. (1991) Parainfluenza virus infection damages inhibitory M₂ muscarinic receptors on pulmonary parasympathetic nerves in the guinea pig. *Br J Pharmacol* 102: 267-271.
14. **Fryer AD** & Wills-Karp M (1991) Dysfunction of M₂ muscarinic receptors in pulmonary parasympathetic nerves after antigen challenge. *J. Appl Physiol* 71: 2255-2261.
15. Fernandes L, **Fryer AD**, Hirshman CA (1992) M₂ muscarinic receptors inhibit isoproterenol-induced relaxation of canine airway smooth muscle. *J. Pharmacol. Exper. Therapeutics*, 262:119-126.
16. **Fryer AD** & Jacoby DB (1992) Function of pulmonary M₂ muscarinic receptors in antigen challenged guinea pigs is restored by heparin and poly-l-glutamate. *J Clin Invest*, 90: 2292-2298 **Peer**
17. **Fryer AD** & Okanlami OA (1993) Neuronal M₂ muscarinic receptor function in guinea-pig lungs is inhibited by indomethacin. *Am. Rev Respir Dis*, 147: 560-565.

Peer Reviewed Journal Articles Continued

18. Jacoby DB, Gleich GJ, & **Fryer AD**. (1993) Human eosinophil major basic protein is an endogenous allosteric antagonist at the inhibitory muscarinic M₂ receptor. *J Clin Invest*, 91:1314-1318.
19. **Fryer AD** & Jacoby DB. (1993) Effects of inflammatory cell mediators on M₂ muscarinic receptors in the lungs. *Life Sciences* 52:529-536
20. Schultheis AH, Bassett DJP & **Fryer AD**. (1994) Ozone-induced airway hyperresponsiveness and loss of neuronal M₂ muscarinic receptor function. *J Appl Physiol*, 76:1088-1097
21. **Fryer AD**, Yarkony KA & Jacoby DB (1994) The effect of leukocyte depletion on pulmonary M₂ muscarinic receptor function in parainfluenza virus infected guinea pigs. *Br. J. Pharmacol*, 112:588-594.
22. Gambone LM, Elbon CL. & **Fryer AD**. (1994) Ozone-induced loss of neuronal M₂ muscarinic receptor function is prevented by cyclophosphamide. *J. Appl Physiol* 77:1492-1499.
23. Elbon CL, Jacoby DB, & **Fryer AD**. (1995) The function of pulmonary M₂ muscarinic receptors in antigen challenged guinea pigs is protected by pretreatment with antibody to IL-5. *Am J Respir Cell and Mol Bio*. 12: 320-328.
24. Olubunmi AO, **Fryer AD**, & Hirshman C, (1996) Interaction of non-depolarizing muscle relaxants with M₂ and M₃ muscarinic receptors in guinea-pig lung and heart. *Anesthesiology*. 84:155-161.
25. Kahn RM, Olubunmi OA, Jacoby DB, **Fryer AD**. (1996) Viral infection induces dependence of neuronal M₂ muscarinic receptors on cyclooxygenase in guinea pig lung. *J. Clin Invest*. 98: 299-307.
26. **Fryer AD**, Elbon CL, Kim AL, Xiao HQ, Levey AI, Jacoby DB. (1996) Primary cultures of post-ganglionic parasympathetic nerves in the lungs express functional M₂ muscarinic receptors. *Am J Respir Cell and Mol Bio* 15:716-725.
27. **Fryer AD**, Costello RW, Lobb RR, Tedder TF, Bochner BS. (1997) Antibody to VLA4 protects neuronal M₂ receptors in antigen challenged guinea pigs. *J Clin Invest* 99:2036-2044.
28. **Fryer AD**, Huang YC, Rao G, Jacoby DB, Mancilla E, Whorton R, Piantadosi C, Kennedy T, Hoidal, J. (1997) Selective O-desulfation produces non anticoagulant heparin that retains pharmacologic activity in the lung. *J Pharm Expt Thera*. 282:208-219.
29. Costello RW, Schofield BH, Gleich GJ, Kephardt G, Jacoby DB, **Fryer AD**. (1997) Localization of eosinophils to airway nerves and the effect on neuronal M₂ muscarinic receptor function. *Am J Physiol*. 273:L93-L103.
30. Belmonte KE, Jacoby DB, **Fryer AD**. (1997) Increased function of inhibitory neuronal M₂ muscarinic receptors in diabetic rat lungs. *Br. J. Pharmacol* 121:1287-1294.
31. Schulman SR, Canada AT, **Fryer AD**, Winsett DW, Costa DL. (1997) Airway hyperreactivity produced by short-term exposure to hyperoxia in neonatal guinea pigs. *Am J Physiology* 270: L1211-1216.
32. Evans CE, **Fryer AD**, Jacoby DB, Gleich GJ, Costello RW. (1997) Pretreatment with an antibody to eosinophil major basic protein prevents hyperresponsiveness by protecting neuronal M₂ muscarinic receptors in antigen challenged guinea pigs. *J Clin Invest* 100:2254-2262.
33. Costello, RW, **Fryer AD**, Belmonte KE, Jacoby DB (1998) Effects of tachykinin NK1 receptor antagonists on vagal hyperreactivity and neuronal M₂ muscarinic receptor function in antigen challenged guinea pigs. *Br. J. Pharmacology* 124:267-276.
34. Jacoby DB, Xiao HQ, Lee NH, Chan-Li Y, **Fryer AD**. (1998) Virus and interferon induced loss of inhibitory M₂ muscarinic receptor function and gene expression in guinea-pig airway parasympathetic neurons. *J Clin Invest*. 102:242-248.

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35. Belmonte KE, **Fryer AD**, Costello RW. (1998) Role of insulin in antigen induced airway eosinophilia and neuronal M2 muscarinic receptor dysfunction. *J Appl Physiol* 85:1708-1718
36. **Fryer AD**, Adamko DJ, Yost BE, & Jacoby DB. (1999) Effects of inflammatory cells on neuronal M2 muscarinic receptor expression and function in the lungs. *Life Sciences* 64:449-455.
37. Costello RW, Evans CM, Yost BL, Belmonte KE, Gleich GJ, Jacoby DB, **Fryer AD**. (1999) Antigen induced hyperreactivity to histamine: the role of the vagus nerves and eosinophils. *Am J Physiol* 276: L709-714.
38. Yost BL, Gleich GJ & **Fryer AD**. (1999) Ozone induced hyperresponsiveness and blockade of M2 muscarinic receptors by eosinophil major basic protein. *J Appl Physiol*. 87:1272-1278.
39. Adamko, DA, Yost BL, Gleich GJ, **Fryer AD**, and DB Jacoby. (1999) Eosinophils Mediate Virus Induced Airway Hyperresponsiveness and M2 Muscarinic Receptor Dysfunction in Sensitized Guinea Pigs. *J Expt Med* 190:1465-1477.
40. Jacoby DB, Yost BL, Elwood T, **Fryer AD**. (2000) Effects of neurokinin receptor antagonists in virus infected airway. *Am J Physiol Lung Cell Mol Physiol* 279: L59-L65.
41. Evans CE, Belmonte KE, Gleich GJ, Costello RW, Jacoby DB, **Fryer AD**. (2000) Substance P induced M2 receptor dysfunction and airway hyperreactivity via neurokinin-1 receptor mediated eosinophil degranulation. *Am J Physiol* 279: L477-L486.
42. Golkar L, Yarkony KA, **Fryer AD**. (2000) Inhibition of neuronal M2 muscarinic receptor function in the lungs by extracellular nitric oxide. *Br J Pharmacol* 131:312-318.
43. Jacoby DB, Yost BL, Kumaravel B, Chan-Li Y, Xiao HQ, Kawashima K, **Fryer AD**. (2001) Glucocorticoid treatment increases inhibitory M2 muscarinic receptor expression and function in the airways. *Am J Respir Cell Mol Biol*. 2001 Apr 1;24(4):485-491.
44. Evans CE, Jacoby DB, **Fryer AD**. (2001) Effects of dexamethasone on antigen-induced airway eosinophilia and M2 receptor dysfunction. *Am J Respir Crit Care Med*. 163: 1484-1492.
45. Zhou C, **Fryer AD**, Jacoby DB. (2001) Structure of the M2 muscarinic acetylcholine receptor gene and its promoter. *Gene*. 271;87-92.
46. Coulson FR, Jacoby DB, **Fryer AD**. (2002) Increased function of inhibitory neuronal M2 muscarinic receptors in trachea and ileum of diabetic rats. *Br J Pharmacol* 135:1355-1362.
47. Bowerfind WML, **Fryer AD**, Jacoby DB. (2002) Double-stranded RNA causes airway hyperreactivity and neuronal M2 muscarinic receptor dysfunction. *J Applied Physiology* 92:1417-1422.
48. Sawatzky DA, Kingham PJ, Court E, Kumaravel B, **Fryer AD**, Jacoby DB, McLean WG, Costello RC. (2002) Eosinophil adhesion to cholinergic nerves via ICAM-1 and VCAM-1 and associated eosinophil degranulation. *Am J Physiology* 282: L1279-L1288.
49. Adamko DJ, **Fryer AD**, Bochner BS, Jacoby DB. (2003) CD8+ T lymphocytes in viral hyperreactivity and M2 muscarinic receptor dysfunction. *Am J Respir Critical Care Medicine* 167:550-556.
50. Moreno L, Jacoby DB, **Fryer AD**. (2003) Dexamethasone prevents virus-induced hyperresponsiveness by multiple mechanisms. *Am J Physiol, Lung Cell Mol*. 285:L451-L455.
51. Kingham PJ, McLean WG, Walsh MT, **Fryer AD**, Gleich GJ and Costello RW. (2003) Eosinophil-mediated nerve remodeling: The role of reactive oxygen species and p38 MAP kinase *Am J Physiol, Lung Cell Mol* 282: L1279-L1288.

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52. Coulson FR, Jacoby DB, **Fryer AD**. (2004) Insulin regulates neuronal M2 receptor function in ileum of diabetic rats. *J Pharmacol Expt Thera*. 308:1-7.
53. **Fryer AD**, Lein PL, Howard AS, Yost BL, Jett DA. (2004) Mechanisms of organophosphate insecticide-induced airway hyperreactivity. *Am J Physiol* 286:L963-9.
54. Lee AM, **Fryer AD**, van Rooijen N, Jacoby DB. (2004) Virus induced airway hyperresponsiveness and neuronal M2 muscarinic receptor dysfunction are mediated by macrophages. *Am J Physiol Lung Cell Mol Physiol*. 286:L1255-9
55. Lein PL, **Fryer AD** (2005) Organophosphorus Insecticides Induce Airway Hyperreactivity by Decreasing Neuronal M2 Muscarinic Receptor Function Independent of Acetylcholinesterase Inhibition. *Toxicological Sciences* 83:166-176.
56. Rangasamy T, Guo J, Mitzner WA, Roman J, Singh A, **Fryer AD**, Yamamoto M, Kensler TW, Tuder RM, Georas SN, Biswal S. (2005) Disruption of Nrf2 enhances susceptibility to severe airway inflammation and asthma in mice. *J Expt Medicine*. 202:47-49.
57. Yost BL, Gleich GJ, Jacoby DB, **Fryer AD** (2005) Multiple roles of eosinophils in long term hyperreactivity following ozone. *Am J Physiol* 289:L627-535.
58. **Fryer AD**, Stein LH, Nie Z, Curtis DE, Evans CM, Hodgson ST, Jose PJ, Belmonte KE, Fitch E, Jacoby DB. (2006) Neuronal expression of eotaxin in airway hyperreactivity and M2 muscarinic receptor dysfunction. *J Clin Invest*. 116:228-236.
59. Verbout NG, Lorton JK, Jacoby DB, **Fryer AD**. (2007) Atropine pretreatment enhances airway hyperreactivity in antigen challenged guinea pigs through an eosinophil dependent mechanism. *Am J Physiol*. 292:L1126-35
58. Nie Z, Nelson CS, Jacoby DB, **Fryer AD** (2007) Expression and regulation of ICAM on airway parasympathetic nerves. *J Allergy Clinical Immunology*. 119:1415-22.
59. Proskocil BJ, Bruun DA, Lorton JK, Blensly KC, Jacoby DB, Lein PJ, **Fryer AD**. (2008) Antigen sensitization influences organophosphorus pesticide-induced airway hyperreactivity. *Environ Health Perspect*. 116 (3):381-8.
60. Verhein KC, Jacoby DB, **Fryer AD**. (2008) IL-1 Receptors Mediate Persistent, but Not Acute, Airway Hyperreactivity to Ozone in Guinea pigs. *Am J Respir Cell Mol Biol*. 39:730-8.
61. Nie Z, Jacoby DB, **Fryer AD** (2009) Etanercept prevents airway hyperresponsiveness by protecting neuronal M2 muscarinic receptors in antigen challenged guinea pigs. *Br J Pharmacology*;156:201-10.
62. Verbout NG, Jacoby DB, Gleich GJ, **Fryer AD**. (2009) Atropine-enhanced, antigen challenge-induced airway hyperreactivity in guinea pigs is mediated by eosinophils and nerve growth factor. *Am J Physiol*. 297:L228-37.
63. Moreno-Vinasco L, Verbout NG, **Fryer AD**, Jacoby DB. (2009) Retinoic acid prevents virus-induced airway hyperreactivity and M2 receptor dysfunction via anti-inflammatory and antiviral effects. *Am J Physiol* 297:L340-6. PMID: PMC2742790
64. Proskocil BJ, Bruun DA, Thompson CM, **Fryer AD** and Lein PJ (2010) Organophosphorus Pesticides Decrease M2 Muscarinic Receptor Function in Guinea Pig Airway Nerves via Indirect Mechanisms. *PLOS One* May 10;5(5):e10562. doi: 10.1371/journal.pone.0010562. PMID: PMC2866713
65. Verhein KC, Hazari MS, Moulton BC, Jacoby IW, Jacoby DB, **Fryer AD** (2011) Three days after a single exposure to ozone, the mechanism of airway hyperreactivity is dependent on substance P and nerve growth factor. *Am J Physiol Lung Cell Molecular Physiology* 300:L176-L184 PMID: PMC3043818

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66. Kauffman E, **Fryer AD**, Jacoby DB (2011) Toll-like receptor 7 agonists are potent and rapid bronchodilators in guinea pigs. *J Allergy Clinical Immunology* 127:462-469 PMID: PMC3066064
67. Grodzki AC, Ghoga A, Mangini L, **Fryer AD**, Lein PJ (2011) IFN γ increases M2 muscarinic receptor expression in cultured sympathetic neurons. *Current Neurobiology* 2:23-29. PMID: PMC3515643
68. Nie Z, Scott GD, Weis PD, Itakura A, **Fryer AD**, Jacoby DB (2011) Role of TNF- α in virus-induced airway hyperresponsiveness and neuronal M2 muscarinic receptor dysfunction *Br J Pharmacol* 164:444-452 PMID: PMC3188913
69. Foster EL, Simpson EL, Fredrikson LJ, Lee JJ, Lee NA, **Fryer AD**, Jacoby DB. (2011) Eosinophils increase neuron branching in human and murine skin and in vitro. *PLoS One*. 2011;6(7):e22029. PMID: PMC3140999
70. Buels KS, Jacoby DB, **Fryer AD** (2012) Non-bronchodilating mechanisms of tiotropium prevent airway hyperreactivity in a guinea pig model of allergic asthma. *Br J Pharmacol*. 165:1501-1514. PMID: PMC3372733
71. Nie Z, **Fryer AD**, Jacoby DB. β (2)-Agonists Inhibit TNF- α -Induced ICAM-1 Expression in Human Airway Parasympathetic Neurons. *PLoS One*. 2012;7(9):e44780. doi: 10.1371/journal.pone.0044780. Epub 2012 Sep 25. PMID: PMC3458032
72. Scott GD, **Fryer AD**, Jacoby DB. (2013) Quantifying Nerve Architecture in the Mouse and Human Airway Using Three-Dimensional Computational Mapping. *Am J Respir Cell Mol Biol*. 2013 Jan;48(1):10-6 PMID: PMC3547082
73. Proskocil BJ, Bruun DA, Jacoby DB, van Rooijen N, Lein PJ, **Fryer AD**. (2013) Macrophage TNF α mediates parathion-induced airway hyperreactivity in guinea pigs. *Am J Physiol Lung Cell Mol Physiol*. 2013 Apr 15;304(8):L519-29. doi: 10.1152/ajplung.00381.2012. Epub 2013 Feb 1 PMID: PMC3625991
74. Drake MG, Evans SE, Dickey BF, **Fryer AD**, Jacoby DB (2013) TLR2/6 and TLR9 Agonists Suppress Viral Replication but not Airway Hyperreactivity in Guinea Pigs. *Am J Respir Cell Mol Biol*. 2013 Jun;48(6):790-6. doi: 10.1165/rcmb.2012-0498OC75. PMID: PMC3727870
75. Drake MG, Scott GD, Proskocil BJ, **Fryer AD**, Jacoby DB, Kaufman EH (2013) Toll-like receptor 7 rapidly relaxes human airways *Am J Respir Crit Care Med*. 2013 Sep 15;188(6):664-72. doi: 10.1164/rccm.201303-0442OC. PMID: PMC3826186
76. Verhein KC, Salituro FG, Ledebor MW, **Fryer AD**, Jacoby DB. (2013) Dual p38/JNK mitogen activated protein kinase inhibitors prevent ozone-induced airway hyperreactivity in guinea pigs. *PLoS One*. 2013 Sep 18;8(9):e75351. doi: 10.1371/journal.pone.0075351. eCollection 2013. PMID: PMC3776780
77. Scott GD, Blum ED, **Fryer AD**, Jacoby DB (2014). Tissue optical clearing, three-dimensional imaging, and computer morphometry in whole mouse lungs and human airways. *Am J Respir Cell Mol Biol*. 2014 Jul;51(1):43-55. doi: 10.1165/rcmb.2013-0284OC PMID: PMC4091855
78. Nie Z, Jacoby DB, **Fryer AD**. (2014) Hyperinsulinemia potentiates airway responsiveness to parasympathetic nerve stimulation in obese rats. *Am J Respir Cell Mol Biol*. 2014 Aug;51(2):251-61. doi: 10.1165/rcmb.2013-0452OC. PMID: PMC4148040
79. Rynko AE, **Fryer AD**, Jacoby DB (2014) Interleukin-1 β mediates virus-induced m2 muscarinic receptor dysfunction and airway hyperreactivity. *Am J Respir Cell Mol Biol*. 2014 Oct;51(4):494-501. doi: 10.1165/rcmb.2014-0009OC. PMID: PMC4189486

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80. Lee JJ, Protheroe CA, Luo H, Ochkur SI, Scott GD, Zellner KR, Raish RJ, Dahl MV, Vega ML, Conley O, Condjella RM, Kloeber JA, Neely JL, Patel YS, Maizer P, Mazzolini A, **Fryer AD**, Jacoby NW, Jacoby DB, Lee NA. (2015) Eosinophil-dependent skin innervation and itching following contact toxicant exposure in mice *J Allergy Clin Immunol*. 2015 Feb;135(2):477-487
81. Proskocil BJ, Bruun DA, Garg JA, Villagomez CC, Jacoby DB, Lein PJ, **Fryer AD**. (2015) The Influence of Sensitization on Mechanisms of Organophosphorus Pesticide-Induced Airway Hyperreactivity. *Am J Respir Cell Mol Biol*. 2015 Nov;53(5):738-47
82. Drake MG, Bivins-Smith ER, Proskocil BJ, Nie Z, Scott GD, Lee JJ, Lee NA, **Fryer AD**, Jacoby DB. (2016). Human and Mouse Eosinophils Have Antiviral Activity Against Parainfluenza Virus. *Am J Respir Cell Mol Biol*. 2016 Apr 6. [Epub ahead of print]

Review Articles and Editorials

1. Jacoby DB & **Fryer AD** (1990) Abnormalities in the neural control of smooth muscle in virus infected airways. *Trends in Pharmacological Sciences* 11:393-395.
2. Jacoby, DB & **Fryer AD** (1991) Virus induced airway hyperresponsiveness- possible involvement of neural mechanisms. *Am Rev Respir Dis* 144:1422-1423.
3. Gleich GJ, Jacoby DB, **Fryer AD**. (1995) Eosinophil-associated inflammation in bronchial asthma: a connection to the nervous system. *Int. Arch. Allergy Immunology* 107: 205-207.
4. Costello RW, Jacoby DB, **Fryer AD** (1998) Pulmonary neuronal M2 muscarinic receptor function in asthma and animal models of hyperreactivity. *Thorax* 53: 613-616.
5. **Fryer AD**, Jacoby DB, (1998) Muscarinic receptors and control of airway smooth muscle. *Am J Respir and Critical Care Medicine* 158: S154-S160.
6. Jacoby DB & **Fryer AD** (1999). Interactions of viral infections with muscarinic receptors. *Clinical and Experimental Allergy*. 29: 00-00.
7. **Fryer AD** (1999). Immunobiology of asthma and rhinitis: Pathogenic factors and therapeutic options. *American Thoracic Society Workshop Summary*. pg 15-16.
8. Costello RW, Jacoby BD, **Fryer AD**. (1999) Muscarinic receptor function in asthma. *Current opinion in cardiovascular. pulmonary and renal investigational drugs*. 4:468-477.
9. Costello RW, Jacoby BD, Gleich GJ, **Fryer AD**. (2000) Eosinophils and airway nerves in asthma. *Histology and Histopathology* 15:861-8.
10. **Fryer AD**, Costello RW, Jacoby DB (2000) Muscarinic receptor dysfunction in asthma. *J. Allergy and Clinical Immunology International*. 12: 63-67.
11. Jacoby DB, Costello RM, **Fryer AD**. (2001) Eosinophil Recruitment to the Airway Nerves. *J Allergy Clin Immunol*. Feb;107(2):211-8.
12. Jacoby DB, **Fryer AD**. (2001) Anticholinergic therapy in airway disease. *Life Sciences*, 68: 2565-2572.
13. Lee AM, Jacoby DB, **Fryer AD**. (2001) Selective muscarinic receptor antagonists for airway disease. *Current Opinion in Pharmacology*. 1: 223-229.
14. **Fryer AD** and Jacoby DB. (2002) Plasticity of cholinergic and tachykinergic nerves; the convergence of the twain. *Am J Physiol Lung Cell Mol* 27: L1-L2.
15. Coulson FR and **Fryer AD**. (2003) Muscarinic receptors and airway disease. *Pharmacol Ther*. 2003 98:59-69.

Review Articles and Editorials continued

16. Proskocil BJ, **Fryer AD**. (2005) Beta2-agonist and anticholinergic drugs in the treatment of lung disease. *Proc Am Thorac Soc*. 2005;2(4):305-10; discussion 311-2
17. Abrams P, Andersson KE, Buccafusco JJ, Chapple C, de Groat WC, **Fryer AD**, Kay G, Laties A, Nathanson NM, Pasricha PJ, Wein AJ. (2006) Muscarinic receptors: their distribution and function in body systems, and the implications for treating overactive bladder. *Br J Pharmacol*. 148:565-78.
18. Verhein KC, **Fryer AD**, Jacoby DB (2009) Neural control of airway inflammation. *Curr Allergy Asthma Rep*. 2009 Nov;9(6):484-90.
19. Moulton B and **Fryer AD** (2011). Muscarinic Receptor Antagonists, From Folklore to Pharmacology; Finding Drugs that Actually Work. *Br J Pharmacology*. 163:44-52. PMID: PMC3085867
20. Scott GD, **Fryer AD**. (2012) Role of parasympathetic nerves and muscarinic receptors in allergy and asthma. *Chem Immunol Allergy*. 98:48-69. Epub 2012 Jun 26 PMID: PMC4039300
21. Drake MG, Kaufman EH, **Fryer AD**, Jacoby DB. The therapeutic potential of toll-like receptor 7 stimulation in asthma. *Inflamm Allergy Drug Targets*. 2012 Dec 1;11(6):484-91 PMID: PMC4049154
22. Buels KS, **Fryer AD**. Muscarinic receptor antagonists: effects on pulmonary function. *Handb Exp Pharmacol*. 2012;(208):317-41. doi: 10.1007/978-3-642-23274-9_14. Review PMID: MC4104281

Books

Fryer AD, A Christopoulos and N Nathanson. Editors of *Muscarinic Receptors for the Handbook of Experimental Pharmacology* published by Springer Verlag. Series Editors: Ganten, D., Page, C.P., Rosenthal, W., Michel, M.C., Beavo, J.A., Busch, A., Karlsson, J. This book is in progress and is due to be published in 2011.

Book Chapters

1. Gleich GJ, **Fryer AD**, Jacoby DB. (1993) Eosinophil granule proteins and bronchial hyperreactivity. *Asthma: Physiology, Immunopharmacology and Treatment*. 4th International Symposium. Academic Press Ltd. pp119-129.
2. **Fryer AD** Muscarinic Receptors. (1994) *Asthma and Rhinitis*, eds: W. Busse and S. Holgate. Blackwell Scientific Publications, Boston. pp691-703.
3. **Fryer AD** & Jacoby DB. (1996) Parasympathetic Innervation of the Lungs. *Pulmonary Pharmacology and Therapeutics*. ed: A. Leff. McGraw-Hill. pp 81-98.
4. **Fryer AD** (1997) Cholinergic control of the airways. *Autonomic control of the respiratory system*. editor Peter Barnes. Series editor Prof. G. Burnstock. Harwood Academic Publishers, Reading England. pp59-86.
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6. **Fryer AD** Costello RW, & Jacoby DB. (1998) Anticholinergic agents. *Allergy Principles and Practice*. Chapter 48, pgs 668-677 ed F. Adkinson Jr. Mosby-Year Book.
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Major Contributions to Science:

1. **Identified that acetylcholine release is controlled by muscarinic receptors on parasympathetic nerves and that neuronal M₂ muscarinic receptor dysfunction is a major mechanism of airway hyperreactivity.** Pre-junctional receptors had been described on sympathetic nerves, but none had been described on parasympathetic nerves before I demonstrated in 1984 that muscarinic receptors on parasympathetic nerves supplying the lungs had powerful inhibitory control over acetylcholine release. I demonstrated that these receptors were pharmacologically identical to cardiac muscarinic receptors, and when receptors in the heart were classified as M₂, 'my' neuronal receptors were similarly classified as M₂. I subsequently demonstrated that M₂ receptors were not functional in all animal models of airway hyperreactivity, and Peter Barnes in the UK, demonstrated they were not functional in human asthma. *This discovery is so well accepted that it now appears in textbooks without acknowledgement.* The clinical impact of this work is that all new muscarinic antagonists for treatment of lung disease are selective for M₃ muscarinic receptors and thus are designed to protect neuronal M₂ receptors.
2. **Developed a method for isolating and growing parasympathetic nerves in cell culture:** Culturing sympathetic nerves required removing the large ganglia from chains along the spine and growing the cells in medium with nerve growth factor. However, I was the first to develop a method for culturing parasympathetic nerves. I devised a method to disaggregate and selectively plate cells from the whole trachea to isolate parasympathetic nerves, and grow them on matrigel. We have subsequently refined the method to pick parasympathetic ganglia out of the trachea to measure mRNA in nerves cells from treated animal and human trachea. Autonomic neurobiologists now commonly use my method and the method appears in textbooks describing nerve methods.
3. **Described that airway nerves actively recruit eosinophils and that eosinophils change nerve function and phenotype partly via release of endogenous antagonist (eosinophil major basic protein):** It was known that mast cells were found within parasympathetic ganglia, but while examining histologic sections of lungs from antigen challenged guinea pigs I noticed that eosinophils were present along airway nerves. In collaboration with Dr. Jacoby and Dr. Costello, we devised a staining method to better label nerves and eosinophils and demonstrated that there were more eosinophils around nerves than anywhere else in the lungs. We showed that depleting eosinophils with an Ab to IL-5 protected neuronal M₂ receptors, and prevented antigen-challenge induced airway hyperreactivity.

We subsequently demonstrated that parasympathetic nerves make eotaxin and that blocking eotaxin receptors was sufficient to displace eosinophils away from nerves, protect neuronal M₂ muscarinic receptors and prevent airway hyperreactivity. We also demonstrated that eosinophils block M₂ receptors by releasing a preformed protein, eosinophil major basic protein, which we showed was an endogenous antagonist for M₂ muscarinic receptors (the first endogenous antagonist described). Neutralizing major basic protein with heparin or with desulphated heparin, acutely restored M₂ receptor function in vivo and reversed airway hyperreactivity within 15 minutes.

These observations contributed to development of a monoclonal antibody to IL-5 that has been shown to effectively prevent asthma exacerbations in eosinophilic asthmatics; this antibody is likely to receive FDA approval for use in asthma. Desulfated heparin (to target eosinophil major basic protein) and eotaxin receptor antagonists have also been developed but await focused trials in specific patients (similar to trials for the Ab to IL-5) to determine clinical effectiveness in allergy and asthma.

4. **Demonstrated multiple, non-eosinophil mediated, mechanisms that lead to loss of M₂ receptor function:** Dr. Jacoby and I demonstrated that depletion of eosinophils does not protect neuronal M₂ receptors or prevent airway hyperreactivity in animals exposed to viral infection or organophosphate pesticide (unless the animals are previously sensitized). We have subsequently demonstrated that viruses cause loss of inhibitory M₂ receptor expression on airway parasympathetic neurons via recruitment of macrophages and production of both TNF- α and IL-1

hyperreactivity.

\square ; similar

5. **Demonstrated that insulin controls acetylcholine release from parasympathetic nerves:** Old epidemiologic data suggested that diabetes is protective for development of asthma. In collaboration with a graduate student, we demonstrated that streptozocin-induced diabetes (ie loss of insulin) results in hyper-functional M₂ receptors and airway hypo-responsiveness at baseline and protects against antigen-induced hyperreactivity. Conversely obesity is associated with asthma; but is difficult to treat and is not responsive to steroids. In collaboration with Dr. Jacoby and Dr. Nie, we have recently demonstrated obesity causes airway hyperreactivity and M₂ receptor dysfunction only in the presence of increased circulating insulin. We subsequently demonstrated that insulin alone, independent of weight, glucose, or % body fat was sufficient to cause M₂ dysfunction and airway hyperreactivity. The implications are that controlling insulin may be a better clinical approach to obesity-induced asthma than steroids.

RESEARCH GRANT PARTICIPATION

R01 HL113023 (PI Jacoby) 4/2012 - 3/2017 33% effort
 NIH-NHLB \$2,177,000
 Acute airway effects of TLR7 and TLR8 stimulation in health and disease.

R01 AR061567 (PI Jacoby) 4/2102 - 3/2017 25% effort
 NIH-NIAMS \$3,379,453
 Eosinophil nerve interactions in mouse models of dermatitis.

R01 ES017592 (co-PI Fryer and Lein) 07/07/10-06/30/2015 2.0 calendar
 NIH/NIEHS 171,500 to OHSU
 (under extension- competing renewal submitted)
 Role of Macrophages in Organophosphorus Pesticide-Induced Airway Hyperreactivity
 The major goal of this project to determine the interaction between nerves and macrophages following exposure to organophosphates.

R56 AI092210 (PI Jacoby) 8/18/11 – 7/31/2012 1.2 calendar
 NIH/NHLBI 250,000
 Bronchodilator Effects of toll-like receptor-7 agonists
 Environmental influences on the vagal control of the airways
 The major goal of this project is to determine how TLR-7 agonists induce airway smooth muscle relaxation

Previous grants:

Asthma exacerbation by organophosphate pesticides 2006-2013 RO1: NIH-NIEHS
 Principal Investigator: AD Fryer

Air Pollution and Systemic Inflammation of Autonomic Nerves 2011-2015 Health Effects Institute
 Principal Investigator: AD Fryer

Ozone inhibition of neuronal M2 muscarinic receptors. 1996-2011 R01: NIH-Heart Lung & Blood Institute. Principal Investigator: AD Fryer

Environmental influences on the vagal control of airways. 1996-2009 R01: NIH-Heart Lung & Blood Institute. Principal Investigator: DB Jacoby, Co-investigator: AD Fryer.

Mechanisms of virus-induced hyperreactivity in atopics. 1998-2007 R01: NIH-Heart Lung & Blood Institute. Principal Investigator: DB Jacoby, Co-investigator: AD Fryer

Mechanistic studies investigating the role of organophosphate insecticide exposure in the development and exacerbation of asthma. 2002-2005 Dept of Defense. Principal investigator; AD Fryer and PL Lein.

Mechanisms of inflammation-induced airway hyperreactivity. 1999-2005, PPG. NIH Heart Lung Institute. Principal Investigator: Wayne Mitzner. Project 4. Mechanisms of hyperreactivity in atopic hosts. Principal Investigator AD Fryer.

Mechanisms of eosinophil recruitment to parasympathetic nerves. 1998-2001 American Heart Association, Established Investigator Award. Principal Investigator: AD Fryer

Determine whether S-Albuterol affects hyperreactivity in antigen challenged guinea pigs. 2000-2001. Sepracore Pharmaceuticals. Principal investigator AD Fryer

Virus induced changes in M2 muscarinic receptor function and expression. 1996-2000 Center for Indoor Air Research. Principal Investigator: DB Jacoby, Co investigator, AD Fryer.

Mechanisms of neuronal M2 muscarinic receptor dysfunction in the lung. 1994-1997 Council for Tobacco Research, Principal Investigator: AD Fryer.

Previous grants continued:

Development of a method to study neuronal muscarinic receptor function in cultured nerve cells. 1994-1995 Pilot Project: EHS, Johns Hopkins, Principal Investigator: AD Fryer.

Effect of heparin analogues on neuronal M₂ receptor function in antigen-challenged guinea pigs. 1994-1995. Scandipharm., Inc. Principal Investigator: AD Fryer.

Viral enzymes and neuronal muscarinic receptors in lung. 1991-1996. FIRST award, NIH-Heart Lung & Blood Institute. Principal Investigator: AD Fryer.

Airway disease and neuronal muscarinic receptors in lung. 1991-1994. Council for Tobacco Research, Principal Investigator: AD Fryer.

Allergen-induced dysfunction of airway muscarinic receptors in the lung. 1991-1993. American Lung Association. Principal Investigator: AD Fryer.

Neuronal muscarinic receptors and ozone-induced inflammation and hyperreactivity in the lungs. 1990-1991. Pilot Project EHS, Johns Hopkins University. Principal Investigator: AD Fryer.

Interaction of canine mastocytoma cells and airway smooth muscle. 1987-1988. California Lung Association. Principal Investigator: AD Fryer and W Gold.

Characterization of muscarinic receptors in the lung. 1987-1989. Individual National Research and Service Award from the NIH. Principal Investigator: AD Fryer.

Invited lectures

- 1984 British Thoracic Society, Royal Free Hospital School of Medicine, London, England
- 1985 Pharmacology Department, Strathclyde University, Glasgow, Scotland
- 1985 Glaxo Group Research Ltd, Ware, Hertfordshire, England
- 1985 Royal Postgraduate Medical School, Hammersmith Hospital, London, England
- 1985 Pharmacology/Medicinal Chemistry Dept, Organon Pharmaceuticals, Glasgow, Scotland
- 1986 Pharmacology Department, Pfizer Ltd, Sandwich, Kent, England
- 1986 Pharmacology Department, Stuart Pharmaceuticals, Wilmington, Delaware
- 1987 Cardiovascular Research Institute, University of California, San Francisco, California
- 1988 Pulmonary Division, Temple University School of Medicine, Philadelphia, Pennsylvania
- 1989 Pulmonary Division, University of Maryland School of Medicine, Baltimore, Maryland
- 1990 Cardiovascular Research Institute, University of California, San Francisco, California
- 1990 School Veterinary Medicine, Michigan State University, East Lansing, Michigan
- 1991 Anesthesiology Grand Rounds, Johns Hopkins University, Baltimore, Maryland
- 1992 *Chairman:* Poster session muscarinic receptors, American Thoracic Society, Miami, FL
- 1992 *Speaker* 5th International Symposium Subtypes of Muscarinic Receptors, Newport, CA
- 1992 Physiology Department, Wayne State University, Detroit, Michigan
- 1993 Pharmacology Department, Temple University School of Medicine, Philadelphia, PA
- 1993 *Speaker* American Thoracic Society, San Francisco, CA.
- 1993 *Chairman:* Poster session: Prejunctional control of pulmonary autonomic nerves. American Thoracic Society, San Francisco, CA.
- 1993 Pharmacology of muscarinic receptors in the lungs. Pulmonary Research Group, New York, NY.
- 1994 The effect of age on neuroregulation in asthma. NIH Workshop: Adult vs Childhood Asthma. Bethesda, MD.
- 1994 Research Division, Syntex Pharmaceuticals, Palo Alto, California
- 1995 Dept of Pharmacology and Toxicology, University of West Virginia, Morgantown WV
- 1995 *Speaker* American Thoracic Society & American Academy of Allergy, Asthma and Immunology, Symposium on Asthma: theory to treatment. Chicago, IL.
- 1995 *Chairman and speaker:* Neuronal Control of Airway Smooth Muscle. American Thoracic Society & American Academy of Allergy, Asthma and Immunology, Symposium on Asthma: theory to treatment. Chicago, IL
- 1996 Department of Pharmacology, Shering Plough Pharmaceuticals, New Jersey
- 1996 Neuropharmacology Seminar, Johns Hopkins University, Baltimore, Maryland
- 1996 *Speaker* Muscarinic receptor subtypes: Contribution to asthma pathogenesis and potential for therapeutic options. ATS Post graduate course on asthma pathogenesis and therapy, New Orleans, Louisiana.
- 1996 *Chairman:* Poster session: In vivo models of airway inflammation. American Thoracic Society, New Orleans.
- 1997 Pulmonary Division, Washington University, St Louis Missouri
- 1998 Pharmacology Department, Connecticut University, Hartford, Connecticut
- 1998 *Symposium Speaker* Parasympathetic control of airway smooth muscle. Transatlantic Conference, Lucern, Switzerland.
- 1998 *Symposium Speaker* Eosinophils mediate hyperreactivity by inhibiting neuronal M2 muscarinic receptor function. American Academy of Allergy Asthma and Immunology, Washington DC
- 1998 *Chairman and speaker:* Session on muscarinic receptors in heart and lung 8th International Symposium on Subtypes of Muscarinic Receptors, Boston, MA
- 1998 Pharmacology muscarinic receptors in the lungs. Pulmonary Research Group, Rutgers, NJ.
- 1999 Pharmacology Department, University of Groningen, The Netherlands

- 1999 *Speaker* Muscarinic receptor dysfunction in asthma. American Thoracic Society & American Academy of Allergy, Asthma and Immunology, Symposium on Asthma: theory to treatment. Honolulu, Hawaii
- 2000 *Speaker* Neuroregulation in asthma. NIH Workshop: Mechanisms of severe asthma. Bethesda, MD.
- 2000 Pharmacology Department, Sinai School of Medicine, New York, New York.
- 2001 Toxicology Division, Johns Hopkins University School of Public Health.
- 2001 Biochemistry Department, Johns Hopkins University School of Public Health
- 2001 Department of Medicine, University of Dublin, Ireland.
- 2001 *Chairman and speaker*: Symposium Pharmacology of the airways. American Thoracic Society, San Francisco, CA.
- 2001 *Speaker* Eosinophil 2001 International Symposium, Banff, Alberta, Canada.
- 2002 *Speaker* American Academy of Allergy Asthma and Immunology, New York, NY.
- 2002 *Speaker* Pharmacology of Airway Nerves. IUPHAR, San Francisco, CA
- 2003 *International Advisory Board and Symposium Speaker* 3rd Biennial International Eosinophil Symposium 2003, Snowmass, Aspen CO.
- 2004 *Member International Advisory Board* Novartis Pharmaceuticals Muscarinic Receptor Symposium, NY.
- 2004 *Chairman and Symposium Speaker*: Cholinergic nerves and asthma. American Thoracic Society, Orlando, Florida
- 2004 Combination of beta agonists and anticholinergics in treatment of Lung disease. 4th Congress on Respiratory Science. Miami, Florida
- 2005 *Visiting Scholar*. Duke University, University North Carolina and Environmental Protection Agency.
- 2005 *Speaker*. NIH Workshop: Integrating mechanisms Linking Mind, Brain and Periphery Washington DC.
- 2006 Anesthesiology Department, Oregon Health and Science University.
- 2006 Heart Research Center, Oregon Health and Science University
- 2008 *Organizer and Symposium Speaker*: 10th International Symposium Subtypes of Muscarinic Receptors, San Diego, California.
- 2009 Invited Speaker “Excellence Cluster Cardio-Pulmonary System” Series at the Max-Planck Institute, Germany.
- 2009 *Invited Speaker*, International Eosinophil Symposium, Bruges, Belgium.
- 2010 *Invited Speaker*, Cardiovascular Medicine, Albany Medical School.
- 2011 *Brian J Sproule Lecture*, University of Edmonton, Canada
- 2011 Marquam Lecturer, Science for the Public, Portland Oregon
- 2011 *Invited Speaker*, World Allergy Congress, Cancun Mexico
- 2014 Invited Speaker, Pharmacology Department University of Minnesota

TEACHING

Thesis students

- Amy Schultheis**, Thesis advisor (1990-1992) PhD thesis: *Effect of ozone on inflammatory cell infiltration and airway hyperresponsiveness in the guinea pig*. Research Associate Physics Department at Johns Hopkins University
- Kathryn Yarkony**, Thesis advisor (1992-1995) PhD thesis: *The role of nitric oxide synthase in pulmonary neuronal M2 muscarinic receptor function*. Research Coordinator Johns Hopkins University
- Kristen Belmonte**, Thesis advisor (1993-1997) PhD thesis: *The role of insulin in function of neuronal M2 muscarinic receptors*. Director - Corporate Development, Corporate Strategy and Development at GlaxoSmithKline.
- Richard Costello**, BMS, MD Thesis advisor (1994-1997) MD Thesis awarded by University of Dublin, Ireland: *'Eosinophil recruitment to airway nerves and effects on vagal neurotransmission'*. Consultant and Professor University Dublin, Ireland.
- Christopher Evans**, Thesis advisor (1996-2000) PhD thesis: *Eosinophils and Neuronal M2 Muscarinic Receptor Function in the Guinea Pig*. His thesis was awarded the Kruse award (top thesis in the School of Public Health that year). Associate Professor University of Colorado, Denver.
- Liliana Moreno**, Thesis advisor (2000-2003) PhD thesis: *Mechanisms Underlying the Ability of Glucocorticoids and Retinoic Acid to Reverse Virus-Induced Hyperreactivity*. Assistant Professor University of Chicago
- Louis Stein**, Thesis advisor (2001-2003) left program to attend Medical School, (Jefferson University)
- Mehdi Hazari**, Thesis advisor (2002-2005) PhD thesis: *Neural Plasticity Following Ozone Exposure Mediates Airway Hyperresponsiveness*. Assistant Professor at US Environmental Protection Agency
- Norah Verbout** Thesis advisor (2004-2008) PhD Thesis: *Role of eosinophils and muscarinic receptors in paradoxical airway hyperreactivity associated with antigen challenge*. Instructor in Biomedical Engineering, Portland Oregon, faculty at Anora Pharmaceuticals.
- Kirsten Blensley** Thesis advisor (2005-2010) PhD Thesis: *Mechanisms of ozone induced airway hyperreactivity change over time*. Instructor at NIEHS, Research Triangle Park, NC.
- Erin Fitch** Thesis Advisor (2006-2010) PhD Thesis: *Eosinophils Increase Sensory Neuron Branching*. Postdoctoral Fellow at Rockefeller Institute
- Kalmia Smith** Thesis advisor (2006- 2011) PhD Thesis: *Tiotropium Inhibits Increases in Nerve-Associated Eosinophils Following Antigen Challenge and Prevents Airway Hyperreactivity in a Guinea Pig Model of Asthma*. Postdoctoral fellow at Harvard
- Elad Kauffman** Thesis advisor (2006-2011) PhD thesis: *Acute Broncodilator Effects of Toll-Like Receptor 7-Agonists*. PhD Thesis Pharmacologist at Theravance Pharmaceuticals
- Greg Scott** Thesis advisor (2009-2012) recipient of NRSA grant from the NIH. PhD Thesis: *Sensory Neuroplasticity in Asthma*. Postdoctoral Fellow Stanford University
- Abby Rynko** Thesis advisor (2009-2013) PhD Thesis: *The role of TNF- [alpha] and IL-1[beta] in virus-induced M2 receptor dysfunction*. Associate Product Manager at DiscoveRx in CA.
- Sarah Wicher** Thesis advisor (2010-)
- Quinn Roth-Carter** Thesis advisor (2011-)

Post Doctoral Fellows

Olubunmi Okanlami, M.D. (1990-1992) Director of Pediatric Intensive Care Unit Univ. Indiana
Richard Kahn, M.D. (1993-1995) Private Practice, Maine
Richard Costello, M.D. (1994-1997) Consultant and Associate Professor U Dublin, Ireland
Thomas Elwood, M.D. (1996-1997) Associate Professor Medicine Univ. Calgary, Canada
Darryl Adamko, M.D. (1997-2001) Associate Professor Medicine U Alberta, Canada
Ann Lee, M.D. (1999-2003). Private Practice, Tacoma, WA
William Bowerfind, M.D. (1999-2003) Private Practice, Portland, OR
Fiona Coulson, PhD (2000-2003) Faculty Physiology and Pharmacology, Griffith University, Australia
Claire Smyth, MD (2002) Instructor, University of Dublin.
Becky Proskocil, PhD (2004-2010) recipient of NRSA grant from the NIH.
 Research Associate at OHSU.
Bart Moulton, MD (2010-2012) Assistant Professor, Pulmonary and Critical Care Medicine, OHSU
Matthew Drake, MD (2010- 2014) Assistant Professor, Pulmonary and Critical Care Medicine, OHSU
Brenda Marsh, MD (2015-

Advisor

Linda Gambone: pre-doctoral advisor (1990-1992) PhD from Johns Hopkins 1996
Laleh Golkar; undergraduate student (1996-1999) MD 2003 from Cornell University
Michael Kelso: summer intern (1999-2001) BS 2004 U. North Carolina
Ray Moore: intern from Dunbar High School (2001). BS 2005 U. Maryland
Kroshona Tabb: intern from University of Alabama (2001). Graduate student Emery
Janese Latimer: intern from University of Florida (2002). BS 2005 U. Florida
Justin Hoover; intern from Gettysburg University (2002). Medical School at Jefferson
Jasmine Gargag: summer intern from Berkley (2013, 2014, 2015)
Lydia McClaran: summer intern from Oregon State University (2013, 2014)
Chloe Villagomez: summer intern from Oregon State University (2013, 2014, 2015)

Classroom Instruction

1987-1989	Receptor Theory, Physiology, School of Pharmacy, University of Maryland
1990-2003	Autonomic Nervous System, Physiology, Johns Hopkins University
1990-1994	Lab Physiology, Medical School, Johns Hopkins University
1993-2003	Autonomic and Somatic Nervous Systems, Undergraduate Physiology, Johns Hopkins University
1995-1998	Autonomic and Somatic Nervous Systems, Physiology, Johns Hopkins University
1994-1996	Course Director: Communication in Science, Johns Hopkins University
1997-1998	Course Director: Pharmacology of the Airways. Johns Hopkins University
1999-2000	Neurotoxins affecting the autonomic nerves. Neurotoxicology, Johns Hopkins University
2004-2008	Receptors and G proteins. Neuroscience. Oregon Health & Science University
2005-2008	Create and direct: Organ Systems Biology Oregon Health & Science University.
2005-2015	Lectures on Autonomic and Motor nerves, Systems Biology at OHSU
2005-2015	Pulmonary Pharmacology, Systems Processes, Oregon Health & Science University

ACADEMIC SERVICE

Oregon Health & Science University

Representative for Physiology and Pharmacology Graduate Student Committee (2003-2006)
 PMCB Graduate Student Admission Committee (2004-2008)
 Search Committee, Chairman Emergency Medicine (2006)
 Faculty Council (2004-2006)
 Internal Review: Center for Research on Occupational and Environmental Toxicology (2009)
 Director Graduate Program in Cellular and Molecular Biosciences (2006-2008)
 Associate Dean Graduate Studies (2008-current)
 Mentor High School Students in OHSU Partnerships in Scientific Inquiry (2008-09)
 Chair Graduate Council (2008-current)
 Member Steering Committee to create OHSU's Research Roadmap (2010-current)
 Internal Review: Department of Science and Engineering (2010)
 Chair Review of PhD Graduate Programs (2011)
 Assessment Council (2008-2011)
 Convene committee to create integrated MD/PhD program (2011-2012)
 Chair review of NIH training grants at OHSU (2012)
 Committee to redesign MD curriculum (2012)
 Internal Review: Behavioral Neuroscience (2009)
 Internal Review: Department Biochemistry (2015)
 Internal Review: Department of Physiology and Pharmacology (2015)
 Faculty advisor for Graduate Student Organization (2009-current)
 Faculty advisor for Women in Science (2010-current)

Johns Hopkins University

Animal Care and Use Committee School of Public Health (1997-2000)
 Biochemistry and Molecular Biology strategic planning committee (2000-2001)
 Faculty Senate School of Public Health (2000-2002)
 Search Committee for Chairman Population Health and Family Planning (2002)
 Committee of Academic Standards (2001-2003)
 Search Committee for Assistant Professor in Department Environmental Health Sciences (1998)
 Search Committee for Assistant Professor in Department Environmental Health Sciences (1999)
 Self Study for Environmental Health Sciences (2001)
 Departmental Committee of Academic Standards (2001-2003)

Scientific Community

Editor British Journal of Pharmacology (1993-1998)
 Associate Editor American Review Respiratory and Critical Care Medicine (1999-2004)
 Regular Member NIH SBIR study section member (1998-2000)
 NIH ad Hoc Reviewer Lung Injury, Repair, and Remodeling Study Section (2002, 2004-6)
 NIH ad Hoc Reviewer Lung Cellular, Molecular Immunobiology Study Section (2000, 2002, 2004-6)
 Regular Member NIH LCMI study section member (2008-2011)
 External Advisory Board: Center of Excellence in Environmental Toxicology, Penn State (2007-2011)
 Review Grants for Wellcome Trust: 2010 and 2014
 NIH ad Hoc Reviewer Special Emphasis Panel (2011-2012)

Community

Volunteer in Public Elementary and Middle Schools-Baltimore, MD

(1994-2003) Art and Science classes and demonstrations

(1998-1999) Coach Odyssey of the Mind team (State Champions'98)

(1999-2001) Coach Destination Imagination team (District Champions each year)

Volunteer in Public Elementary and Middle Schools-Lake Oswego, OR

(2003-2006) classroom volunteer-Art and Science once a month.

(2004-2006) Coach Destination Imagination team

Volunteer Portland Oregon Food Bank, once a month (2008-2011).

Member OHSU School of Medicine Alliance (2009-current)

Member Board of Directors for the Art Council of Lake Oswego (2013-current)