

CURRICULUM VITAE

LOUIS M. LUTTRELL, M.D., Ph.D.

Work Address: Division of Endocrinology, Metabolism and
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Medical University of South Carolina
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P.O. Box 250624
Charleston, SC 29425

EDUCATIONAL BACKGROUND

University of Virginia School of Medicine Charlottesville, VA	1981-1988
Pomona College Claremont, CA	1975-1979
Monte Vista High School Danville, CA	1971-1975

DEGREES RECEIVED

Doctor of Medicine	1988, University of Virginia, Charlottesville, VA
Doctor of Philosophy	1988, Pharmacology, University of Virginia, Charlottesville, VA Dissertation Title: "The Mechanism of Insulin Action in Murine BC3H-1 Myocytes."
Batchelor of Arts	1979, Pomona College, Claremont, CA

POST-GRADUATE TRAINING

Fellowship	Division of Endocrinology and Metabolism Department of Medicine DUMC Durham, NC	1992-1995
Internship and Residency	Department of Medicine DUMC Durham, NC	1989-1992
Research Associate	Department of Pharmacology University of Virginia Charlottesville, VA	1988-1989

ACADEMIC APPOINTMENTS

James A. Keating, Jr. Endowed Chair in Diabetes Medical University of South Carolina Charleston, SC 29425	2009-present
Eminent Scholar in Molecular and Cellular Endocrinology Medical University of South Carolina Charleston, SC 29425	2007-present
Faculty, College of Graduate Studies Medical University of South Carolina Charleston, SC 29425	2004-present
Professor of Medicine Medical University of South Carolina Charleston, SC 29425	2003-present

Professor of Biochemistry & Molecular Biology Medical University of South Carolina Charleston, SC 29425	2003-present
Associate Professor of Medicine with tenure Duke University Medical Center Durham, NC 27710	2003
Associate Professor of Medicine Duke University Medical Center Durham, NC 27710	2001-2003
Assistant Professor of Medicine Duke University Medical Center Durham, NC 27710	1998-2001
Associate in Medicine Duke University Medical Center Durham, NC 27710	1995-1998

LICENSURE AND CERTIFICATION

South Carolina; License No. 26394	2003
North Carolina; License No. 95-00989	1995
ABIM Certified; Endocrinology and Metabolism	2001
ABIM Certified; Internal Medicine	1993

AWARDS/HONORS

James A. Keating, Jr. Endowed Chair in Diabetes	2009
Eminent Scholar in Molecular and Cellular Endocrinology, MUSC	2007
Henry L. Turner Lectureship, University of Oklahoma HSC	2002
Thomas J. Watson Foundation Fellowship	1979-1980
Vaile Prize in Zoology, Pomona College	1979
Magna Cum Laude, Pomona College	1979
National Merit Scholarship, Pomona College	1975-1979

SCHOLARLY SOCIETIES

The American Society for Clinical Investigation	2003
Alpha Omega Alpha, University of Virginia	1988
Phi Beta Kappa, Pomona College	1979
Sigma Xi, Pomona College	1979

PROFESSIONAL SOCIETIES AND ACTIVITIES

Associate Editor, The Journal of Pharmacology and Experimental Therapeutics	2004-present
Editorial Board Member, The Journal of Biological Chemistry	2003-2008
Member, MIST study section, NIH	2007-2008
Chairperson, CSD study section, NIH	2006-2007
Member, CSD study section, NIH	2005-2007
<i>Ad hoc</i> Chairperson, ZRG1 CB-N 03: Member SEP: Cell Biology, NIH	February 2009
<i>Ad hoc</i> Member, MIST study section, NIH	January 2009
<i>Ad hoc</i> Member, ZGM1 PPBC: Large-Scale Collaborative Project Awards, NIH	December 2008
<i>Ad hoc</i> Chairperson, ZRG1 CB-K 92C: NFκB and Gene Expression, NIH	April 2007
<i>Ad hoc</i> Member, ZRG1 MOSS-L Member SEP: Bone Cell Biology, NIH	March 2007
<i>Ad Hoc</i> Member, SBSR Skeletal Biology Structure and Regeneration, NIH	June 2005

<i>Ad Hoc</i> Member, CSD study section, NIH	June 2005
<i>Ad Hoc</i> Member, CSD Cellular Signaling and Dynamics study section, NIH	February 2005
<i>Ad Hoc</i> Member, CADO Cellular Aspects of Diabetes and Obesity, NIH	October 2004
<i>Ad Hoc</i> Member, PC study section, NIH	June 2004
<i>Ad Hoc</i> Member, NIAMS Special Emphasis Panel, NIH	November 2003
<i>Ad Hoc</i> Member, CDF3 Cellular Development and Function study section, NIH	October 2003
<i>Ad Hoc</i> Member, PC Physiological Chemistry study section, NIH	June 2003
Member, Association of Subspecialty Professors	2004
Member, American Society for Biochemistry and Molecular Biology	2002
Member, The Endocrine Society	2000
Member, The American Society for Cell Biology	2000

PATENTS AND INVENTIONS

U.S. Provisional Patent No. 60/053,659 (July 24, 1997) “Intracellular inhibitors of Gq Protein Signaling”
 U.S. Patent No. 6610532 (August 26, 2003) “Intracellular inhibitors of Gq Protein Signaling”
 U.S. Provisional Patent No. 60/907,439 (April 2, 2007) “Method of Promoting Bone Formation”
 U.S. Patent Pending No. 12/060,600 (April 1, 2008) “Biased Ligands for Receptors such as the PTH Receptor”

ADMINISTRATIVE, CLINICAL AND TEACHING RESPONSIBILITIES

Director, John A. Colwell Diabetes Research Center Medical University of South Carolina Charleston, SC 29425	2009-present
Director, Endocrinology Fellowship Training Program Medical University of South Carolina Charleston, SC 29425	2005-present
Attending Physician, Endocrinology Outpatient Clinic Medical University of South Carolina Charleston, SC 29425	2004-present
Director, Division of Endocrinology, Diabetes and Medical Genetics Medical University of South Carolina Charleston, SC 29425	2003-present
Staff Physician Ralph H. Johnson Veterans Affairs Medical Center Charleston, SC 29401	2003-present
Unit Leader CGS-702 First Year Core Curriculum College of Graduate Studies Medical University of South Carolina Charleston, SC 29425	2005-2006
Chief, Endocrine Section Durham Veterans Affairs Medical Center Durham, NC 27705	2000-2003
Staff Physician Durham Veterans Affairs Medical Center Durham, NC 27705	1995-2003
Attending Physician, Duke Outpatient Clinic Duke University Medical Center Durham, NC 27710	1995-2001

UNIVERSITY SERVICE AND COMMITTEES

Associate Program Director, Medical Scientist Training (MD-PhD) Program College of Graduate Studies Medical University of South Carolina	2007-present
Member, University Tenure Committee Medical University of South Carolina	2006-present
Member, First Year Curriculum Steering Committee College of Graduate Studies Medical University of South Carolina	2004-2006
Chairman, Space Advisory Committee Department of Medicine Medical University of South Carolina	2004-2005
Member, Department of Medicine Strategy Steering Team Department of Medicine Medical University of South Carolina	2004-2005
Developing Scholars Awards Committee Medical University of South Carolina	2004-2005
Distinguished University Professor Committee Medical University of South Carolina	2004

DEPARTMENT OF VETERANS AFFAIRS SERVICE AND COMMITTEES

Chair, Research and Development Committee Ralph H. Johnson Veterans Affairs Medical Center	2008-present
Chair, Diabetes Task Group Ralph H. Johnson Veterans Affairs Medical Center	2007-present
Vice-Chair, Research and Development Committee Ralph H. Johnson Veterans Affairs Medical Center	2006-2008
Member, Research and Development Committee Ralph H. Johnson Veterans Affairs Medical Center	2004-2006
Member, Research and Development Committee Durham Veterans Affairs Medical Center	2001-2003

GRANTS AND CONTRACTS

Active Research Support

R56 DK55524-10A1 (Luttrell) 08/01/2008-07/31/2009
NIH/NIDDK

Role of Tyrosine Kinases in G protein-mediated signaling.

The major goals of this project are to determine the mechanisms whereby G protein-coupled receptors regulate the activity of receptor tyrosine kinases, focal adhesion kinases, and Src kinases, and the roles of these kinases in G protein-coupled receptor-stimulated mitogenesis.

Role: Principal Investigator

R01 HL077192-03 (Jaffa) 02/01/2006 – 01/30/2011
NIH/NHLBI

Lipoproteins, CTGF and diabetic vascular & renal disease

The major goals of this project are to determine the relationship between lipoproteins, CTGF and the development and progression of vascular and renal disease in patients with type 1 diabetes mellitus and to determine *in vitro*, the mechanisms of lipoprotein-dependent regulation of CTGF expression.

Role: Co-Investigator

R01 HL087986-01 (Jaffa) 07/01/2008 – 06/30/2012
NIH/NHLBI

Kallikrein and vascular disease risk in diabetes

The major goals of this project are to determine the relationships between longitudinal changes in plasma kallikrein activity and vascular and renal disease progression in type 1 diabetes, and to characterize a novel mechanism of kinin-independent effects of kallikrein on vascular smooth muscle cells.

Role: Co-Investigator

Grant in Aid (Luttrell) 07/01/2007-06/30/2009
American Heart Association Mid-Atlantic Affiliate

Vitamin D Insufficiency and Cardiovascular Risk in Type 2 Diabetes.

This project tests the hypothesis that vitamin D exerts a cardioprotective effect through direct actions on the immune system and vasculature that are independent of its systemic calcitropic effects.

Role: Principal Investigator

CTSA Pilot Project (She/Luttrell/Mayer-Davis) 05/01/2007-04/30/2009
Health Sciences South Carolina - Duke Endowment

Investigation of Risk Factors for Type 1 Diabetes and Associated Complications

The goal of this project is to establish a collaborative research program involving MUSC, the University of South Carolina, and the Medical College of Georgia for population-based research examining the genetic and biochemical determinants of risk in type 1 diabetes mellitus.

Role: Principal Investigator – MUSC component

Pending Research Support

R01 DK55524-11A2 (Luttrell) 07/01/2009-06/30/2014
NIH/NIDDK (Score 137; Percentile 3.1)

Role of Tyrosine Kinases in G protein-mediated signaling.

The major goals of this project are to determine the mechanism of signaling by G protein-coupled receptor-arrestin 'signalsomes', determine how G protein-independent signaling affects protein phosphorylation, and study the integration of G protein-dependent and -independent signals.

Role: Principal Investigator

ARRA Administrative Supplement (Luttrell) 07/01/2009-06/30/2011
NIH/NIDDK

Role of Tyrosine Kinases in G protein-mediated signaling.

The goals of this supplement to R01 DK055524-11 are to accelerate the proteomic discovery aims of the project by adding one postdoctoral researcher and to purchase new/ replacement equipment to support the overall aims of the project.

Role: Principal Investigator

S10 RR027777-01 (Luttrell)

04/01/2010 – 03/31/2011

NIH/NCCR

Fluorometric imaging plate reader (FLIPR^{TETRA})

This shared instrumentation grant proposes to fund the acquisition of a FLIPR^{TETRA} system as a replacement for aging and obsolescent equipment, provide a research resource to the MUSC research community and facilitate discovery research in cell signaling.

Role: Principal Investigator

R01 DK081575-01A1 (Jaffa)

11/01/2009 – 10/31/2014

NIH/NIDDK

Kinin and AT2 receptors in hypertension and renal injury.

The major goals of this project are to determine the role of receptor B1, B2 and angiotensin receptor heterodimerization in the regulation of bradykinin receptor signaling in the kidney and to characterize the role of kinin receptors in diabetic nephropathy using murine knockout models.

Role: Co-Investigator

R01 AR044883-11 (Trojanowska)

11/01/2009 – 10/31/2014

NIH/NIAMS

TGF-beta receptor signaling in scleroderma.

The major goal of this project is to understand the mechanism of pathologic fibrosis in scleroderma (SSc) focusing on identification and characterization of the key signaling pathways involved in the disease process, including the role of S1P receptors and arrestins in modifying the response of SSc fibroblasts to TGF-beta.

Role: Co-Investigator

Completed Research Support

K08 DK02352-05 (Luttrell)

07/01/1995-06/30/2000

NIH/NIDDK

The role of heterotrimeric G Proteins in mitogenesis.

The major goals of this project were to determine the contributions of the G α and G $\beta\gamma$ subunits of heterotrimeric G proteins to the transmission of mitogenic signals via G protein-coupled receptors.

Role: Principal Investigator

R01 DK58283-05 (Luttrell)

06/01/2001-05/31/2006

NIH/NIDDK

Receptor “transactivation” in insulin signaling.

The major goals of this project were to determine the mechanisms and functional significance of cross talk between insulin receptors, heterotrimeric G proteins, and classical receptor tyrosine kinases.

Role: Principal Investigator

R01 DK64353-06 (Luttrell)

09/01/2002-08/31/2007

NIH/NIDDK

Parathyroid hormone and osteoblast mitogenesis.

The major goals of this project were to determine the contribution of novel G protein-coupled receptor signaling mechanisms to the growth, maturation and function of osteoblasts using *in vitro* and *in vivo* model systems.

Role: Principal Investigator

Medicaid Transformation Grant (Luttrell)

07/01/2007-01/31/2009

South Carolina Department of Health and Human Services

SC TeleSupport: Diabetes Management Program for Rural Medicaid Patients with Type 2 Diabetes in Primary Care Practices

This pilot implementation project tested the efficacy and cost effectiveness of technology-assisted case management in improving diabetes control in underserved rural patients with limited access to outpatient services.

Role: Principal Investigator

RESEARCH ARTICLES

1. **Luttrell, L.M.** and A.D. Rogol. Partial insulin resistance in the mouse BC3H-1 Cell Line: Absent hexose-independent action of insulin. *Endocrinology* **119**: 331-342, 1986.
2. **Luttrell, L.M.** and A.D. Rogol. Hexose-independent activation of glycogen synthase and pyruvate dehydrogenase by insulin are dissociated in the mouse BC3H-1 cell line. *Mol. Pharm.* **30**: 624-630, 1986.
3. Luttrell, D.K., **Luttrell, L.M.** and S.J. Parsons. Augmented mitogenic responsiveness to epidermal growth factor in murine fibroblasts which overexpress pp60^{c-src}. *Mol. Cell. Biol.* **8**: 497-501, 1988.
4. Romero, G., **Luttrell, L.M.**, Rogol, A.D., Zeller, K., Hewlett, E. and J. Larner. The phosphatidylinositol-glycan anchors of membrane proteins: Potential precursors of insulin mediators. *Science*. **240**: 509-511, 1988.
5. **Luttrell, L.M.**, Hewlett, E.L., Romero, G., and A.D. Rogol. Pertussis toxin attenuates some effects of insulin in BC3H-1 murine myocytes. *J. Biol. Chem.* **263**: 6134-6141, 1988.
6. **Luttrell, L.M.**, Luttrell, D.K., Parsons, S.J., and A.D. Rogol. Insulin and phorbol ester induce distinct phosphorylation of pp60^{c-src} in the BC3H-1 murine myocyte cell line. *Oncogene*. **4**: 317-324, 1989.
7. Romero, G., Gomez, G., Huang, L.C., Lilley, K., and **L.M. Luttrell**. Anti-inositol glycan antibodies block selectively some of the actions of insulin in intact BC3H-1 cells. *Proc. Natl. Acad. Sci., U.S.A.* **87**: 1476-1480, 1990.
8. **Luttrell, L.M.**, Kilgour, E., Larner, J., and G. Romero. A pertussis toxin sensitive G-protein mediates some aspects of insulin action in BC3H-1 murine myocytes. *J. Biol. Chem.* **265**: 16873-16879, 1990.
9. **Luttrell, L.M.**, Ostrowski, J., Cotecchia, S.C., Kendall, H. and R.J. Lefkowitz. Antagonism of catecholamine receptor signaling by expression of cytoplasmic domains of the receptors. *Science*. **259**: 1453-1457, 1993.
10. Koch, W.J., Hawes, B.E., Inglese, J., **Luttrell, L.M.** and R.J. Lefkowitz. Cellular expression of the carboxyl terminus of a G Protein-coupled receptor kinase attenuates G $\beta\gamma$ -mediated signaling. *J. Biol. Chem.* **269**: 6193-6197, 1994.
11. Inglese, J., **Luttrell, L.M.**, Iniguez-Lluhi, J., Touhara, K., and R.J. Lefkowitz. A functionally active targeting domain of the β -adrenergic receptor kinase: An inhibitor of G $\beta\gamma$ -mediated stimulation of type II adenylyl cyclase. *Proc. Natl. Acad. Sci., U.S.A.* **91**: 3637-3641, 1994.
12. Hawes, B.E., **Luttrell, L.M.**, Exum, S.T. and R.J. Lefkowitz. Inhibition of G protein-coupled receptor signaling by expression of cytoplasmic domains of the receptor. *J. Biol. Chem.* **269**: 15776-15785, 1994.
13. **Luttrell, L.M.**, Kanj, S., Corey, G.R., Lins, R.E., Spinner, R.J., Mallon, W.J. and D.J. Sexton. Mycoplasma hominis Septic Arthritis: Case Reports and Review of the Literature. *Clinical Infectious Diseases* **19**: 1067-1070, 1994.
14. **Luttrell, L.M.**, Hawes, B.E., Touhara, K., van Biesen, T., Koch, W.J. and R.J. Lefkowitz. Effect of cellular expression of pleckstrin homology domains on Gi-coupled receptor signaling. *J. Biol. Chem.* **270**: 12984-12989, 1995.
15. **Luttrell, L.M.**, van Biesen, T., Hawes, B.E., Koch, W.J., Touhara, K. and R.J. Lefkowitz. G $\beta\gamma$ -subunits mediate MAP kinase activation by the tyrosine kinase IGF1 receptor. *J. Biol. Chem.* **270**: 16495-16498, 1995.

16. Hawes, B.E., van Biesen, T., Koch, W.J., **Luttrell, L.M.** and R.J. Lefkowitz. Distinct pathways of Gi- and Gq-mediated mitogen activated protein kinase activation. *J. Biol. Chem.* **270**: 17148-17153, 1995.
17. van Biesen, T., Hawes, B.E., Luttrell, D.K., Krueger, K.M., Touhara, K., Porfiri, E., Sakaue, M., **Luttrell, L.M.** and R.J. Lefkowitz. Receptor-tyrosine-kinase- and G $\beta\gamma$ -mediated MAP kinase activation by a common signalling pathway. *Nature.* **376**: 781-784, 1995.
18. van Biesen, T., Hawes, B.E., Raymond, J.R., **Luttrell, L.M.**, Koch, W.J., Touhara, K. and R.J. Lefkowitz. Go-protein α -subunits activate mitogen-activated protein kinase via a novel protein kinase C-dependent mechanism. *J. Biol. Chem.* **271**: 1266-1269, 1996.
19. Hawes, B.E., **Luttrell, L.M.**, van Biesen, T. and R.J. Lefkowitz. Phosphatidylinositol 3-kinase is an early intermediate in the G $\beta\gamma$ -mediated mitogen activated protein kinase signaling pathway. *J. Biol. Chem.* **271**: 12133-12136, 1996.
20. **Luttrell, L.M.**, Hawes, B.E., van Biesen, T., Luttrell, D.K., Lansing, T.J. and R.J. Lefkowitz. Role of c-Src in G protein-coupled receptor- and G $\beta\gamma$ subunit-mediated activation of mitogen activated protein kinases. *J. Biol. Chem.* **271**: 19443-19450, 1996.
21. **Luttrell, L.M.**, Della Rocca, G.J., van Biesen, T., Luttrell, D.K. and R.J. Lefkowitz. G $\beta\gamma$ subunits mediate Src-dependent phosphorylation of the epidermal growth factor receptor: A scaffold for G protein-coupled receptor-mediated Ras activation. *J. Biol. Chem.* **272**: 4637-4644, 1997.
22. Della Rocca, G.J., van Biesen, T., Daaka, Y., Luttrell, D.K., **Luttrell, L.M.** and R.J. Lefkowitz. Ras-dependent MAP kinase activation by G protein-coupled receptors: Convergence of Gi- and Gq-mediated pathways on calcium/calmodulin, Pyk2 and Src kinase. *J. Biol. Chem.* **272**: 19125-19132, 1997.
23. Daaka, Y., **Luttrell, L.M.** and R.J. Lefkowitz. Switching of the coupling of the β 2-adrenergic receptor to different G proteins by protein kinase A. *Nature.* **390**: 88-91, 1997.
24. **Luttrell, L.M.**, Daaka, Y., Della Rocca, G.J. and R.J. Lefkowitz. G protein-coupled receptors mediate two functionally distinct pathways of tyrosine phosphorylation in Rat 1a fibroblasts: Shc phosphorylation and receptor endocytosis correlate with activation of Erk kinases. *J. Biol. Chem.* **272**: 31648-31656, 1997.
25. Daaka, Y., **Luttrell, L.M.**, Ahn, S., Della Rocca, G.J., Ferguson, S.S.G., Caron, M.G. and R.J. Lefkowitz. Essential role for G protein-coupled receptor endocytosis in the activation of MAP kinase. *J. Biol. Chem.* **273**: 685-688, 1998.
26. Akhter, S.A., **Luttrell, L.M.**, Rockman, H.A., Lefkowitz, R.J. and W.J. Koch. Transgenic mice with deficient myocardial signaling through the guanine nucleotide binding protein Gq are resistant to pressure overload myocardial hypertrophy. *Science.* **280**: 574-577, 1998.
27. Ahn, S., Maudsley, S., **Luttrell, L.M.**, Lefkowitz, R.J., and Y. Daaka. Src-mediated tyrosine phosphorylation of dynamin is required for β -adrenergic receptor internalization and MAPK signaling. *J. Biol. Chem.* **274**: 1185-1188, 1999.
28. **Luttrell, L.M.**, Ferguson, S.S.G., Daaka, Y., Miller, W.E., Maudsley, S., Della Rocca, G.J., Lin, F-T., Kawakatsu, H., Owada, K., Luttrell, D.K., Caron, M.G. and R.J. Lefkowitz. β -Arrestin-dependent formation of β 2 adrenergic receptor/Src protein kinase complexes. *Science.* **283**: 655-661, 1999.
29. Della Rocca, G.J., Mukhin, Y.V., Garnovskaya, M.N., Daaka, Y., Clark, G., **Luttrell, L.M.**, Lefkowitz, R.J., and J.R. Raymond. Serotonin 5HT1A receptor-mediated MAP kinase activation requires calcium/calmodulin-dependent receptor endocytosis. *J. Biol. Chem.* **274**: 4749-4753, 1999.

30. Soeder, K.J., Snedden, S.K., Della Rocca, G.J., **Luttrell, L.M.**, and S. Collins. The β -adrenergic receptor activates MAP kinase in adipocytes through a Gi-dependent mechanism. *J. Biol. Chem.* **274**: 12017-12022, 1999.
31. Della Rocca, G.J., Maudsley, S.R., Daaka, Y., Lefkowitz, R.J., and **L.M. Luttrell**. Pleiotropic coupling of G protein-coupled receptors to the MAP kinase cascade: Role of focal adhesions and receptor tyrosine kinases. *J. Biol. Chem.* **274**: 13978-13984, 1999.
32. Lin, F-T, Miller, W.E., **Luttrell, L.M.**, and R.J. Lefkowitz. Feedback regulation of β -arrestin 1 function by extracellular signal-regulated kinases. *J. Biol. Chem.* **274**: 15971-15974, 1999.
33. Price, D.T., Della Rocca, G.J., Daaka, Y., Schwinn, D.A., and **L.M. Luttrell**. Activation of extracellular signal-regulated kinase in human prostate cancer. *J. Urology.* **162**: 1537-1542, 1999.
34. Seo, B., Choy, E.W., Maudsley, S., Miller, W.E., Wilson, B.E., and **L.M. Luttrell**. *Pasteurella multocida* toxin stimulates MAP kinase via Gq/11-dependent transactivation of Epidermal Growth Factor receptors. *J. Biol. Chem.* **275**: 2239-2245, 2000.
35. Guo, C., **L.M. Luttrell**, and D.T. Price. Mitogenic signaling in androgen-sensitive and -insensitive prostate cancer cell lines. *J. Urology.* **163**: 1027-1032, 2000.
36. Pierce, K.L., Maudsley, S., Miller, W.E., **Luttrell, L.M.**, and R.J. Lefkowitz. Role of endocytosis in the activation of the Erk cascade by sequestering and nonsequestering G protein-coupled receptors. *Proc. Natl. Acad. Sci., U.S.A.* **97**: 1489-1494, 2000.
37. Maudsley, S., Pierce, K.L., Zamah, A.M., Miller, W.E., Ahn, S.E., Daaka, Y., Lefkowitz, R.J., and **L.M. Luttrell**. The β 2-adrenergic receptor mediates MAP kinase activation via assembly of a multireceptor complex including the EGF receptor. *J. Biol. Chem.* **275**: 9572-9580, 2000.
38. Miller, W.E., Maudsley, S., Ahn, S., Kahn, K.D., **Luttrell, L.M.**, and R.J. Lefkowitz. β -Arrestin1 interacts with the catalytic domain of the tyrosine kinase c-SRC. *J. Biol. Chem.* **275**: 11312-11319, 2000.
39. Roudabush, F.L., Pierce, K.L., Maudsley, S., Khan, K.D., Lin, F-T, and **L.M. Luttrell**. Transactivation of the EGF receptor mediates IGF-1 stimulated Shc phosphorylation and ERK1/2 activation in COS-7 cells. *J. Biol. Chem.* **275**: 22583-22589, 2000.
40. Maudsley, S., Zamah, A.M., Rahman, N., Blitzer, J.T., **Luttrell, L.M.**, Lefkowitz, R.J., and R.A. Hall. PDGF receptor association with the Na⁺/H⁺ exchanger regulatory factor (NHERF) potentiates receptor activity. *Mol. Cell. Biol.* **20**: 8352-8363, 2000.
41. Cao, W., **Luttrell, L.M.**, Medvedev, A.V., Pierce, K.L., Lefkowitz, R.J., and S. Collins. Direct binding of activated c-Src to the β 3 adrenergic receptor is required for MAP kinase activation. *J. Biol. Chem.* **275**: 38131-38134, 2000.
42. **Luttrell, L.M.**, Roudabush, F.L., Choy, E.W., Miller, W.E., Field, M.E., Pierce, K.L., and R.J. Lefkowitz. Activation and targeting of Extracellular Signal-Regulated Kinases by β arrestin scaffolds. *Proc. Natl. Acad. Sci., U.S.A.* **98**: 2449-2454, 2001.
43. Pierce, K.L., Tohgo, A., Ahn, S., Field, M.E., **Luttrell, L.M.**, and R.J. Lefkowitz. Epidermal growth factor receptor dependent ERK activation by G protein-coupled receptors: A co-culture system for identifying intermediates upstream and downstream of HB-EGF shedding. *J. Biol. Chem.* **276**: 23155-23165, 2001.
44. Grewal, J.S., **Luttrell, L.M.**, and J.R. Raymond. G protein-coupled receptors desensitize and downregulate EGF receptors in renal mesangial cells. *J. Biol. Chem.* **276**: 27335-27344, 2001.

45. Imamura, T., Huang, J., Dalle, S., Usui, I., Ugi, S., Miller, W.E., **Luttrell, L.M.**, Lefkowitz, R.J., and J.M. Olefsky. β -arrestin-mediated recruitment of the Src family kinase Yes mediates endothelin-1-stimulated glucose transport. *J. Biol. Chem.* **276**: 43663-43667, 2001.
46. Tohgo, A., Pierce, K.L., Choy, E.W., Lefkowitz, R.J. and **L. M. Luttrell**. β arrestin scaffolding of the ERK cascade enhances cytosolic ERK activity but inhibits ERK mediated transcription following angiotensin AT1a receptor stimulation. *J. Biol. Chem.* **277**: 9429-9436, 2002.
47. Ahn, S., Kim, J., Lucaveche, C. L., Reedy, M. C., **Luttrell, L. M.**, Lefkowitz, R. J., and Y. Daaka. c-Src dependent tyrosine phosphorylation regulates dynamin self-assembly and receptor-mediated endocytosis. *J. Biol. Chem.* **277**: 26642-26651, 2002.
48. Feldman, D.S., Zamah, A.M., Pierce, K.L., Miller, W.E., Kelly, F.L., Rapacciuolo, A., Rockman, H.A., Koch, W.J., and **L.M. Luttrell**. Selective inhibition of heterotrimeric G α s signaling: Targeting the receptor-G Protein interface using a peptide minigene encoding the G α s-carboxyl terminus. *J. Biol. Chem.* **277**: 28631-28540, 2002.
49. Zamah, A. M., Delahunty, M., **Luttrell, L. M.**, and R. J. Lefkowitz. PKA-mediated phosphorylation of the β 2-adrenergic receptor regulates its coupling to Gs and Gi: Demonstration in a reconstituted system. *J. Biol. Chem.* **277**: 31249-31256, 2002.
50. Tohgo, A., Choy, E. W., Gesty-Palmer, D., Pierce, K. L., Laporte, S., Oakley, R., Caron, M. G., Lefkowitz, R. J., and **L. M. Luttrell**. The Stability of the G protein-Coupled Receptor- β arrestin Interaction Determines the Mechanism and Functional Consequences of ERK Activation. *J. Biol. Chem.* **278**: 6258-6267, 2003.
51. Ahmed, I., Gesty-Palmer, D., Drezner, M. K., and **L. M. Luttrell**. Transactivation of the Epidermal Growth Factor receptor mediates G protein-coupled receptor-dependent MAP kinase activation in cultured Murine TMOB Osteoblasts. *Mol. Endocrinology*. **17**: 1607-1621, 2003.
52. Rapacciuolo, A., Suvarna, S., Barki-Harrington, L., **Luttrell, L.M.**, Cong, M., Lefkowitz, R.J., and H.A. Rockman. Phosphorylation sites of the β -1 adrenergic receptor determine the internalization pathway. *J. Biol. Chem.* **278**: 35403-35411, 2003.
53. Wei, H., Ahn, S., Shenoy, S.K., Karnik, S., Hunyady, L., **Luttrell, L.M.**, and R.J. Lefkowitz. Independent G protein and β -Arrestin2 mediated activation of ERK by angiotensin. *Proc. Natl. Acad. Sci., U.S.A.* **100**: 10782-10787, 2003.
54. Barki-Harrington, L., **Luttrell, L.M.**, and H.A. Rockman. Dual inhibition of β adrenergic and angiotensin II receptors a single antagonist: A functional role for receptor dimerization *in vivo*. *Circulation*. **108**: 1611-1618, 2003.
55. El Shewy, H., Kelly, F.L., Barki-Harrington, L., and **L.M. Luttrell**. Ectodomain shedding-dependent transactivation of Epidermal Growth Factor receptors in response to Insulin-like Growth factor type I. *Mol. Endocrinology*. **18**: 2727-2739, 2004.
56. Pi, M., Oakley, R., Cruickshank, R.D., Spurney, R.F., Gesty-Palmer, D., **Luttrell, L.M.**, and Quarles, L.D. GRK2 and 4 Mediates Desensitization of CASR By Different Mechanisms. *Mol. Endocrinology*. **19**: 1078-1087, 2005.
57. Gesty-Palmer, D., El Shewy, H., Kohout, T.A., and **Luttrell, L.M.** β -Arrestin 2 expression determines the transcriptional response to lysophosphatidic acid stimulation in β -arrestin1/2 null murine embryo fibroblasts. *J. Biol. Chem.* **280**: 32157-32167, 2005.
58. Caunt, C.J., Finch, A.R., Sedgley, K.R., Oakley, L., **Luttrell, L.M.** and C.A., McArdle. Arrestin-mediated ERK activation by gonadotropin-releasing hormone receptors (GnRHRs): Receptor-specific activation mechanisms and compartmentalization. *J. Biol. Chem.* **281**: 2701-2710, 2006.

59. Gesty-Palmer, D., Chen, M., Reiter, E., Ahn, S., Nelson, C.D., Wang, S., Eckhardt, A.E., Cowan, C.L., Spurney, R.F., **Luttrell, L.M.**, and Lefkowitz, R.J. Distinct Conformations of the Parathyroid Hormone Receptor Mediate G Protein and β -Arrestin Dependent Activation of ERK1/2. *J. Biol. Chem.* **281**: 10856-10864, 2006.
60. Jafri, F., El-Shewy, H.M., Lee, M-H., Kelly, M., Luttrell, D.K., and **Luttrell, L.M.** Expression of a Chimeric Neurokinin NK-1 Receptor- β -Arrestin 1 Fusion Protein Produces Constitutive ERK1/2 Activation in HEK-293 Cells: Probing the Composition and Function of the G Protein-Coupled Receptor 'Signalsome'. *J. Biol. Chem.* **281**: 19346-19357, 2006.
61. Gööz, M., Gööz, P., **Luttrell, L.M.**, and John R. Raymond. 5-HT_{2A} Receptor Induces ERK Phosphorylation and Proliferation through ADAM-17 (TACE) Activation and HB-EGF Shedding in Mesangial Cells. *J. Biol. Chem.* **281**: 21004-21012, 2006.
62. El Shewy, H.M., Johnson, K.R., Lee, M-H., Jaffa, A.A., Obeid, L.M., and **L.M. Luttrell**. Insulin-like growth factors mediate heterotrimeric G protein-dependent ERK1/2 activation by transactivating Sphingosine-1-Phosphate receptors. *J. Biol. Chem.* **281**: 31399-31407, 2006.
63. Morinelli, T.A., Raymond, J.R., Yang, Q., Lee, M-H., **Luttrell, L.M.**, and M.E. Ullian. Identification of a putative nuclear localization sequence within the angiotensin II AT_{1A} receptor associated with nuclear activation. *AJP Cell. Phys.* **292**: C1398-1408, 2007.
64. Fan, H., **Luttrell, L.M.**, Tempel, G.E., Senn, J.J., Halushka, P.V., and J.A. Cook. β -Arrestins 1 and 2 differentially regulate LPS-induced signaling and pro-inflammatory gene expression. *Mol. Immunol.* **44**: 3092-3099, 2007.
65. El Shewy, H.M., Lee, M-H., Obeid, L.M., Jaffa, A.A., and **L.M. Luttrell**. The insulin-like growth factor type 1 and insulin-like growth factor type 2/mannose-6-phosphate receptors independently regulate ERK1/2 activity in HEK293 cells. *J. Biol. Chem.* **282**: 26150-26157, 2007.
66. Shenoy, S.K., Barak, L.S., Xiao, K., Ahn, S., **Luttrell, L.M.**, and R.J. Lefkowitz. Ubiquitination of β -arrestin links 7 Membrane-Spanning Receptor endocytosis and ERK activation. *J. Biol. Chem.* **282**: 29549-29562, 2007.
67. Lee, M-H., El Shewy, H.M., Luttrell, D.K. and **L.M. Luttrell**. Role of β -arrestin-mediated desensitization and signaling in the control of angiotensin AT_{1a} receptor-stimulated transcription. *J. Biol. Chem.* **283**: 2088-2097, 2008.
68. Jaffa, A.A., Usinger, W.R., McHenry, B., Lipsitz, S.R., Tan, Y., Wang, B., Lackland, D.T., Lopes-Virella, M., **Luttrell, L.M.**, and P.W. Wilson. Connective Tissue Growth Factor and susceptibility to vascular disease risk in type 1 diabetes. *J. Clin. Endocrinol. Metab.* **93**: 1893-1900, 2008.
69. Lee, M-H., Klein, R.L., El-Shewy, H.M., Luttrell, D.K., and **L.M. Luttrell**. The adiponectin receptors AdipoR1 and AdipoR2 activate ERK1/2 through a Src/Ras-dependent pathway and stimulate cell growth. *Biochemistry.* **47**:11682-92, 2008.
70. Basher, F., Fan, H., Zingarelli, B., Borg, K.T., **Luttrell, L.M.**, Tempel, G.E., Halushka, P.V., and J.A. Cook. β -Arrestin 2: a Negative Regulator of Inflammatory Responses in Polymorphonuclear Leukocytes. *Int. J. Clin. Exp. Med.* **1**: 32-41, 2008.
71. Zimmerman, B., Simaan, M., Lee, M-H., **Luttrell, L.M.**, and S.A. Laporte. c-Src-mediated phosphorylation of AP-2 reveals a general mechanism for receptors internalizing through the clathrin pathway. *Cell Signal.* **21**: 103-110, 2009.
72. Baldys, A., Gööz, M., Morinelli, T.A., Lee, M-H., Raymond, J.R. Jr., **Luttrell, L.M.**, and J.R. Raymond. Essential role of c-Cbl in amphiregulin-induced recycling and signaling of the endogenous epidermal growth factor receptor. *Biochemistry.* **48**:1462-1473, 2009.

73. Morinelli, T.A., Kendall, R.T., **Luttrell, L.M.**, Walker, L.P. and, M.E. Ullian. Angiotensin II-induced cyclooxygenase 2 (COX-2) expression in rat aorta vascular smooth muscle cells does not require heterotrimeric G protein activation. *J. Pharm. Exp. Therapeutics*. In press.
74. Gesty-Palmer, D., Flannery, P., Yuan, L., Spurney, R., Lefkowitz, R.J., and **L. M. Luttrell**. A β -Arrestin Biased Agonist of a Parathyroid Hormone Receptor (PTH1R) Promotes Bone Formation Independent of G Protein Activation. *Science – Translational Medicine*. Submitted.
75. Wang, B., Carter, R.E., Jaffa, M.A., Nakerakanti, S., Lackland, D., Lopes-Virella, M., **Luttrell, L.M.**, Trojanowska, M., Jaffa, A.A., and the DCCT/EDIC Study Group. Genetic Variation in the Promoter of the Connective Tissue Growth Factor Gene Confers Susceptibility to Nephropathy in Type 1 Diabetes. *New Engl. J. Med.* Submitted.
76. Kusumam, J., Kandasamy, K., Baldys, A., Raymond, J.R., **Luttrell, L.M.**, Fernandes, D.J., and B.G. Tholanikunnel. Novel mechanism of G protein-coupled receptor membrane trafficking by mRNA localization. *Proc. Natl. Acad. Sci., U.S.A.* Submitted.
77. Fan, H., Zingarelli, B., **Luttrell, L.M.**, Borg, K., Halushka, P.V., and J.A. Cook. Beta-Arrestin 2 negatively regulates sepsis-induced inflammation. *Shock*. Submitted.

REVIEW ARTICLES

78. Larner, J., Huang, L.C., Suzuki, S., Tang, G., Zhang, C., Schwartz, C.F.W., Romero, G., **Luttrell, L.M.** and A.S. Kennington. Insulin mediators and the control of the pyruvate dehydrogenase complex. *Ann. New York Acad. Sci.* **573**: 297-305, 1989.
79. van Biesen, T., **Luttrell, L.M.**, Hawes, B.E. and R.J. Lefkowitz. Mitogenic signaling via G protein-coupled receptors. *Endo. Rev.* **17**: 698-714, 1996.
80. **Luttrell, L.M.**, van Biesen, T., Hawes, B.E., Della Rocca, G.J., Luttrell, D.K. and R.J. Lefkowitz. Regulation of mitogen-activated protein kinase pathways by catecholamine receptors. *Adv. Pharmacology.* **42**: 466-470, 1998.
81. **Luttrell, L.M.**, Daaka, Y., and R.J. Lefkowitz. Regulation of tyrosine kinase cascades by G-protein coupled receptors. *Curr. Opin. Cell Biol.* **11**: 177-183, 1999.
82. Pierce, K.L., **Luttrell, L.M.**, and R.J. Lefkowitz. New mechanisms in heptahelical receptor signaling to mitogen activated protein kinase cascades. *Oncogene.* **20**: 1532-1539, 2001.
83. **Luttrell, L.M.**, and R.J. Lefkowitz. The role of β -arrestins in the termination and transduction of G protein-coupled receptor signals. *J. Cell Sci.* **115**: 455-465, 2002.
84. **L.M. Luttrell**. Activation and targeting of MAP kinases by G protein-coupled receptors. *Can. J. Physiol. Pharm.* **80**: 375-382, 2002.
85. **L.M. Luttrell**. Big G, little G: G proteins and actin cytoskeletal reorganization. *Mol. Cell.* **9**:1152-4, 2002.
86. Lefkowitz, R.J., Pierce, K.L. and **Luttrell, L.M.** Dancing with different partners: PKA phosphorylation of seven membrane-spanning receptors regulates their G protein coupling specificity. *Mol. Pharm.* **62**: 971-974, 2002.
87. **Luttrell, L.M.** Location, Location, Location. Spatial and temporal regulation of MAP kinases by G protein-coupled receptors. *J. Mol. Endo.* **30**: 117-126, 2003.
88. Luttrell, D.K. and **Luttrell, L.M.** Signaling in time and space. G protein-coupled receptors and mitogen-activated protein kinases. *Assay and Drug Development Technologies.* **1**: 327-338, 2003.

89. Luttrell, D.K. and **Luttrell, L.M.** Not so strange bedfellows: G protein coupled receptors and Src family kinases. *Oncogene Rev.* **23**: 7969-7978, 2004.
90. **Luttrell, L.M.** Composition and function of G protein-coupled receptor “signalsomes” controlling mitogen-activated protein kinase activity. *J. Mol. Neurosci.* **26**: 253-264, 2005.
91. Maudsley, S., Martin, B. and **Luttrell, L.M.** Perspectives in Pharmacology: The origins of diversity and specificity in G protein-coupled receptor signaling. *J. Pharm. Exp. Therapeutics.* **314**:485-494, 2005.
92. Smith, N.J. and **L.M. Luttrell.** Signal switching, crosstalk and arrestin scaffolds: Novel G protein-coupled receptor signaling in cardiovascular disease. *Hypertension.* **48**:173-179, 2006.
93. Maudsley, S., Martin, B., and **L.M. Luttrell.** G protein-coupled receptor signaling complexity in neuronal tissue: Implications for novel therapeutics. *Current Alzheimer's Research.* **4**: 3-19, 2007.
94. Gesty-Palmer, D., and **L.M. Luttrell.** Heptahelical terpsichory. Who calls the tune? *J. Receptors & Signal Transduction.* **28**: 39-58, 2008.
95. **L.M. Luttrell.** Reviews in Molecular Biology and Biotechnology: Transmembrane signaling by G protein-coupled receptors. *Mol. Biotechnol.* **39**: 239-264, 2008.
96. El-Shewy, H.M., and **L.M. Luttrell.** Insulin-like growth factor-2 / Mannose-6-Phosphate Receptors. *Vitamins & Hormones.* **80**: 667-697, 2009.
97. Kendall, R.T., and **L.M. Luttrell.** Diversity in β -Arrestin Function. *Cell. Mol. Life Sci.* Submitted.
98. Wang, L., Martin, B., Brennehan, R., **Luttrell, L.M.**, and S. Maudsley. Allosteric receptor modulation and future therapeutics for complex physiological disorders. *J. Pharm. Exp. Therapeutics.* Submitted.

BOOK CHAPTERS

99. Larner, J., Huang, L.C., Tang, G., Suzuki, S., Schwartz, C.F.W., Romero, G., Roulidis, Z., Zeller, K., Shen, T.Y., Oswald, A.S. and **L.M. Luttrell.** Insulin mediators: Structure and formation. *Cold Spring Harbor Symposia on Quantitative Biology.* **Volume LIII**: 965-971, 1988.
100. **Luttrell, L.M.**, van Biesen, T., Hawes, B.E., Koch, W.J., Krueger, K.M., Touhara, K. and R.J. Lefkowitz. G protein-coupled receptors and their regulation: Activation of the MAP kinase signaling pathway by G protein-coupled receptors. In: *Signal transduction in health and disease: Advances in 2nd Messenger and Phosphoprotein Research.* J. Corbin and S. Francis, eds. Lippincott-Raven Publishers, Philadelphia, PA. 263-277, 1997.
101. **Luttrell, L.M.**, and D.K. Luttrell. Phosphorylation of heterotrimeric G proteins. In: *Handbook of Cell Signaling, Volume 2.* R. Bradshaw and E. Dennis, eds. Elsevier Science (USA). 609-612, 2003.
102. Gesty-Palmer, D., and **L.M. Luttrell.** G protein-coupled receptors. In: *Encyclopedia of Endocrinology and Endocrine Diseases, Volume 2.* L. Martini, editor-in-chief. Academic Press, San Diego, CA. 336-348, 2004.
103. **L.M. Luttrell.** Regulators of GPCR activity: The Arrestins. In: *Contemporary Clinical Neuroscience: The G Protein-Coupled Receptors Handbook.* L. Devi, editor. Humana Press, Inc., Totowa, NJ. 159-198, 2005.

104. **L.M. Luttrell**. Transmembrane signaling by G protein-coupled receptors. In: *Methods in Molecular Biology, Vol. 332: Transmembrane signaling protocols, Second Edition*. H. Ali and B. Haribabu, editors. Humana Press, Inc., Totowa, NJ. 3-49, 2006.

TEXT BOOKS

105. Signal Transduction Protocols, Third Edition. *Methods in Molecular Biology, Vol. XXX*: **L.M. Luttrell** and S.S. Ferguson, editors. Humana Press, Inc. Totowa, NJ. In preparation, 2010.

PUBLISHED ABSTRACTS

1. **Luttrell, L.M.** and A.D. Rogol. Partial insulin resistance in the mouse BC3H-1 cell line: Absent mechanism I actions of insulin. **67th Annual Meeting of the Endocrine Society**. Baltimore, MD. 1985. Abstract 270.
2. **Luttrell, L.M.** and A.D. Rogol. Bordetella pertussis toxin treatment attenuates the effects of insulin in BC3H-1 murine myocytes. **69th Annual Meeting of the Endocrine Society**. Indianapolis, IN. 1987. Abstract 240.
3. **Luttrell, L.M.**, Luttrell, D.K., Parsons, S.J. and A.D. Rogol. Insulin and phorbol esters induce distinct phosphorylations of pp60^{c-src} in the BC3H-1 cell line. **Third Annual Meeting on Oncogenes**. Frederick, MD. 1987. Abstract 183.
4. Luttrell, D.K., **Luttrell, L.M.**, and S.J. Parsons. Augmented mitogenic responsiveness to EGF in murine fibroblasts which overexpress pp60^{c-src}. **Third Annual Meeting on Oncogenes**. Frederick MD. 1987. Abstract 190.
5. Romero, G., **Luttrell, L.M.**, Rogol, A.D., Zeller, K., Hewlett, E., and J. Larner. Insulin mediator may originate from the glycopospholipid anchor of membrane proteins. **Federation of American Societies for Experimental Biology, 72nd Annual Meeting**. Las Vegas, NV. 1988. Abstract 1623.
6. Luttrell, D.K., **Luttrell, L.M.**, and S.J. Parsons. Mechanism of enhanced β -adrenergic stimulation of cAMP production in fibroblasts overexpressing *c-src*. **Fifth Annual Meeting on Oncogenes**. Frederick, MD. 1989. Abstract 10.
7. Kilgour, E., **Luttrell, L.M.**, and G. Romero.: Insulin interacts with the guanine nucleotide-binding protein system in BC3H-1 myocytes. **UCLA Symposia on Molecular and Cellular Biology: Signal Transduction by G Proteins**. Tamarron, CO. 1990. Abstract G 220.
8. Koch, W.J., Hawes, B.E., Inglese, J.I., **Luttrell, L.M.**, Freedman, N.J. and R.J. Lefkowitz. The carboxyl terminus of a G protein-coupled receptor kinase acts as a cellular G $\beta\gamma$ -antagonist. **Keystone Symposia on Molecular and Cellular Biology: Transmembrane Signal Transduction: Structure, Mechanisms, Regulation and Evolution**. Keystone, CO. 1994. Abstract I233. *J. Cell. Biochem. Supp 18B*: 239.
9. Inglese, J.I., **Luttrell, L.M.**, Boekhoff, I., Schleicher, S., Koch, W.J., Breer, H. and R.J. Lefkowitz. Inhibition of divergent $\beta\gamma$ -dependent pathways employing the $\beta\gamma$ -binding domain derived from the β -adrenergic receptor kinase. **Keystone Symposia on Molecular and Cellular Biology. Transmembrane Signal Transduction: Structure, Mechanisms, Regulation and Evolution**. Keystone, CO. 1994. Abstract I225. *J. Cell. Biochem. Supp 18B*: 237.
10. Hawes, B.E., **Luttrell, L.M.**, Exum, S.T. and R.J. Lefkowitz. Expression of receptor cytoplasmic domains inhibits G protein-coupled receptor signaling. **76th Annual Meeting of the Endocrine Society**. Anaheim, CA. 1994. Abstract 1459.
11. **Luttrell, L.M.**, Exum, S.T. and R.J. Lefkowitz. Specific antagonism of G protein-coupled receptor-mediated signaling by cellular expression of the carboxy-terminal domain of a G protein alpha-subunit. **76th Annual Meeting of the Endocrine Society**. Anaheim, CA. 1994. Abstract 1460.
12. **Luttrell, L.M.**, Touhara, K., Hawes, B.E., van Biesen, T., Exum, S.T. and R.J. Lefkowitz. Effect of cellular expression of pleckstrin homology domains on Gi-coupled receptor signaling. **Keystone Symposia on Molecular and Cellular Biology. Oncogenes: 20 Years Later**. Keystone, CO. 1995. Abstract A1-151. *J. Cell. Biochem. Supp 19A*: 21.
13. van Biesen, T., Hawes, B.E., Koch, W.J., **Luttrell, L.M.** and R.J. Lefkowitz. Mitogenic signaling via G protein-coupled receptors: Roles for G $\beta\gamma$ and G α subunits of pertussis toxin

- sensitive G proteins. **American Society for Biochemistry and Molecular Biology / Division of Biological Chemistry - American Chemical Society**. San Francisco, CA. 1995. Abstract 894. *FASEB J.* **9**: A1411.
14. Hawes, B.E., van Biesen, T., Koch, W.J., **Luttrell, L.M.** and R.J. Lefkowitz. Activation of the Ras/mitogen activated protein kinase signaling pathway by the $\beta\gamma$ Subunit of G proteins utilizes a tyrosine kinase and is independent of phosphoinositide hydrolysis. **American Society for Biochemistry and Molecular Biology / Division of Biological Chemistry - American Chemical Society**. San Francisco, CA. 1995. Abstract 895. *FASEB J.* **9**: A1411.
 15. Luttrell, D.K., van Biesen, T., Hawes, B.E., Krueger, K., Touhara, K., Koch, W.J., **Luttrell, L.M.** and R.J. Lefkowitz. Activation of MAP kinase by heterotrimeric G protein $\beta\gamma$ subunits involves Shc, GRB2 and SOS. **Eleventh Annual Meeting on Oncogenes**, Frederick, MD. 1995. Abstract 273.
 16. van Biesen, T., Hawes, B.E., Luttrell, D.K., **Luttrell, L.M.** and R.J. Lefkowitz. Characterization of the mitogenic signaling pathways mediated by G protein α and $\beta\gamma$ subunits. **Keystone Symposia on Molecular and Cellular Biology. Small GTP-Binding Proteins and Growth Factor Signaling Pathways**. Tamarron, CO. 1996. Abstract A1-307.
 17. **Luttrell, L.M.**, Hawes, B.E., van Biesen, T., Luttrell, D.K., and R.J. Lefkowitz. An essential role for Src tyrosine kinase/Shc adapter protein complexes in G $\beta\gamma$ subunit-mediated mitogen activated protein kinase activation. **Biomedicine '96: Medical Research from Bench to Bedside**. Washington, D.C. 1996. *J. Invest. Med.* **44**: 271A.
 18. Della Rocca, G.J., van Biesen, T., Hawes, B.E., **Luttrell, L.M.**, Lefkowitz, R.J. Distinct mechanisms of Ras-dependent activation of mitogen activated protein kinase by $\alpha 1B$ and $\alpha 2A$ adrenergic receptors in HEK-293 cells. **The Eighth International Catecholamine Symposium**. Pacific Grove, CA. 1996.
 19. **Luttrell, L.M.**, van Biesen, T., Hawes, B.E., Della Rocca, G.J., Luttrell, D.K., Lefkowitz, R.J. Regulation of mitogen activated protein kinase pathways by catecholamine receptors. **The Eighth International Catecholamine Symposium**. Pacific Grove, CA. 1996.
 20. Akhter, S.A., **Luttrell, L.M.**, Rockman, H.A., Lefkowitz, R.J. and W.J. Koch. Attenuation of pressure overload myocardial hypertrophy in transgenic mice expressing an inhibitor of Gq-coupled signaling. *Circulation*, **96**: (8) 1635 Suppl. S, 1997.
 21. Price, D., Della Rocca, G.J., Ballo, M.S., Eckhart, A.D., **Luttrell, L.M.** and Y. Daaka. Increased activation of extracellular regulated kinase in human prostate cancer. **10th International Conference on Second Messengers and Phosphoproteins**. Jerusalem, Israel 1998.
 22. Daaka, Y., **Luttrell, L.M.**, Ferguson, S.S.G., Della Rocca, G.J., Miller, W., Caron, M.G., and R.J. Lefkowitz. Beta-arrestin-dependent formation of beta-2-adrenergic receptor / Src kinase complexes: A mechanism for G protein-coupled receptor-mediated mitogenic signaling. **10th International Conference on Second Messengers and Phosphoproteins**. Jerusalem, Israel. 1998.
 23. Price, D., Della Rocca, G., Eckhart, A.D., Guo, C., Ballo, M.S., Daaka, Y., Schwinn, D.A., and **L.M. Luttrell**. Increased activation of extracellular signal-regulated kinase in human prostate cancer. *J. Urology*, **161** Suppl. (4S): 131, 1999.
 24. Ahmed, I., Drezner, M.K., and **L.M. Luttrell**. Transactivation of the epidermal growth factor receptor mediates G protein-coupled receptor-dependent MAP kinase activation in cultured transgenic mouse osteoblasts. **82nd Annual Meeting of the Endocrine Society**. Toronto, Ontario, Canada. 2000. Abstract 1266.
 25. Cao, W., **Luttrell, L.M.**, Pierce, K.L., Medvedev, A.V., Lefkowitz, R.J., and S. Collins. Activation of extracellular signal-regulated kinase [ERK] pathway by the $\beta 3$ -adrenergic

- receptor: Direct recruitment of c-Src kinase IGF-1 Receptors Activate the ERK1/2 Mitogen-Activated Protein Kinase Pathway Via Distinct Tyrosine Kinase-Dependent and Heterotrimeric G Protein-Dependent Pathways in HEK-293 Fibroblasts. **82nd Annual Meeting of the Endocrine Society**. 2000. Abstract 1224.
26. Rapacciuolo, A., Cong, M., **Luttrell, L.M.**, Kohout, T.A., Lefkowitz, R.J., and H.A. Rockman. Both β -adrenergic receptor kinase 1 and cAMP-dependent protein kinase mediate agonist-induced β 1-adrenergic receptor sequestration. **American Heart Association 73rd Scientific Sessions**. New Orleans, LA. Abstract 105541. *Circulation*, **102** Suppl. (S): 120, 2000.
 27. **L.M. Luttrell**. Activation of MAP kinase pathways by G protein-coupled receptors. **Experimental Biology 2002. The American Society for Biochemistry and Molecular Biology Annual Meeting**. New Orleans, LA. Abstract 667.1. *FASEB J.* **16**: A893, 2002.
 28. **L.M. Luttrell**. Receptor cross talk in growth regulation by G protein-coupled receptors. **ENDO 2002. The 84th Annual Meeting of the Endocrine Society**. San Francisco, CA. 2002. Abstract S65-3.
 29. Kelly, F.L., and **L.M. Luttrell**. IGF-1 Receptors Activate the ERK1/2 Mitogen-Activated Protein Kinase Pathway Via Distinct Tyrosine Kinase-Dependent and Heterotrimeric G Protein-Dependent Pathways in HEK-293 Fibroblasts. **ENDO 2002. The 84th Annual Meeting of the Endocrine Society**. San Francisco, CA. 2002. Abstract P2-156.
 30. **L.M. Luttrell**. MAPK pathway activation by G protein-coupled receptors. **XXIII Meeting of the Congress of the Collegium Internationale NeuroPsychopharmacologicum**. Montreal, Quebec, Canada. 2002. *Int. J. Neurophyschpharm.* **5** (suppl. 1): S.83.4
 31. **L.M. Luttrell**. Spatial and temporal regulation of MAP kinases by G protein-coupled receptors. **The 5th International Congress of Neuroendocrinology 2002**. Bristol, UK. 2002. Abstract S12
 32. Barki-Harrington, L., **Luttrell, L.M.**, and H.A. Rockman. β -Adrenergic Receptor Antagonists Block Angiotensin II Receptor Signaling and G-Protein Coupling. **American Heart Association – Scientific Sessions 2002**. Chicago, IL. 2002. Abstract 108423.
 33. Gesty-Palmer, D., El-Shewy, H., Dar, M., Kohout, T.A., and **L. M. Luttrell**. β -Arrestin Expression Determines the Mechanism of ERK1/2 Activation and the Transcriptional Response to Lysophosphatidic Acid in Murine Embryo Fibroblasts. **2003 American Society for Clinical Investigation/American Association of Physicians Joint Meeting**. Chicago, IL. 2003.
 34. Suvarna, S., Barki-Harrington, L., **Luttrell, L.M.** and H. A. Rockman. PKA and GRK phosphorylation mediate β -1 adrenergic receptor endocytosis through dual pathways: Internalization via clathrin-coated vesicles or caveolae. **American Heart Association – Scientific Sessions 2003**. Orlando, FL. 2003. Abstract 15098.
 35. Barki-Harrington, L., **Luttrell, L.M.**, Mao, L., Hesser Porter, K. and H. A. Rockman. Dual inhibition of β adrenergic and angiotensin II receptor signaling in the heart by a single receptor antagonist: a functional role for receptor dimerization *in vivo*. **American Heart Association – Scientific Sessions 2003**. Orlando, FL. 2003. Abstract 9529.
 36. El-Shewy, H., and **L.M. Luttrell**. Ectodomain shedding-dependent transactivation of EGF receptors in response to IGF-1. **The American Society for Biochemistry and Molecular Biology Annual Meeting**. Boston, MA. 2004.
 37. **L.M. Luttrell**. Novel mechanisms of G protein-coupled receptor-stimulated ERK activation controlling gene expression and cell growth. **XII International Congress of Endocrinology. International Society of Endocrinology**. Lisbon, Portugal. August 30-September 4, 2004. Abstract PY92.

38. El-Shewy, H.M., Johnson, K.R., Obeid, L.M., and **Luttrell, L.M.** Activation and Translocation of Sphingosine Kinase 1 upon Stimulation with IGF-1, IGF-II and EGF. **ENDO 2005. The 87th Annual Meeting of the Endocrine Society.** San Diego, CA. 2005.
39. El-Shewy, H.M., Luttrell, D.K., Lee, M.H., and **Luttrell, L.M.** The IGF-1 and IGF-2/Mannose 6-Phosphate receptors mediate ERK1/2 activation via distinct mechanisms in HEK-293 cells. **ENDO 2005. The 87th Annual Meeting of the Endocrine Society.** San Diego, CA. 2005.
40. Jafri, F., and **Luttrell, L.M.** Expression of a Chimeric Neurokinin NK-1 Receptor- β -Arrestin 1 Fusion Protein Produces Constitutive ERK1/2 Activation in HEK-293 Cells: Probing the Composition and Function of the G Protein-Coupled Receptor 'Signalsome'. **The 87th Annual Meeting of the Endocrine Society.** San Diego, CA. 2005.
41. Gesty-Palmer, D., Reiter, E., Spurney, R.F., **Luttrell, L.M.**, and Lefkowitz R J. Distinct Conformations of the Parathyroid Hormone Receptor Mediate G Protein and β -Arrestin Dependent Activation of ERK1/2. **Gordon Research Conference: Second Messengers and Protein Phosphorylation.** Biddeford, ME. 2005
42. Lee, M.H., Kline, R.L., and **Luttrell, L.M.** Activation of the Extracellular Signal-Regulated Kinases 1 and 2 by Adiponectin binding in HEK-293 cells. **American Diabetes Association 65th Scientific Sessions.** San Diego, CA. 2005.
43. Gesty-Palmer, D., Reiter, E., Spurney, R.F., **Luttrell, L.M.**, and Lefkowitz, R.J. Distinct conformations of the parathyroid hormone receptor mediate G protein and β -arrestin dependent activation of ERK1/2. **American Society for Bone and Mineral Research. 27th Annual Meeting.** Nashville, TN. 2005.
44. Fan, H., **Luttrell, L.M.**, Zingarelli, B., Senn, J.J., Tempel, G.E., Halushka, P.V., and Cook, J.A. β -Arrestins Regulate Lipopolysaccharide (LPS)-Induced Signaling and Proinflammatory Gene Expression **Twenty-Ninth Annual Conference on Shock.** The Shock Society. Broomfield, CO. 2006. Abstract 24.
45. Hermayer, K.L., Baliga, P., **Luttrell, L.M.**, Arnold, P.C., Turrisi, K.L., Mensching, K.J., Cox, C.M., Janulyte, B., Cumbie, B.C., Sutton, A.V., and Carter, R. Outcomes of tight glycemic control utilizing a Diabetes Management Service team in the renal transplant patient. **American Diabetes Association 66th Scientific Sessions.** Washington, DC. 2006. Abstract 952994.
46. Gooz M., Gooz P., Raymond J.R., and **L.M. Luttrell.** AlphaV and beta1 integrins mediate 5-HT_{2A} receptor-EGFR cross-talk. **Biennial Meeting of the American Society for Matrix Biology,** Nashville, TN. November 1-4, 2006.
47. Gooz, M., Gooz, P., Twal, W.O., Luttrell, L.M., Rocha, C.L., and Raymond, J.R. Fibronectin activates ADAM17/TACE by competing with alpha5 beta1 integrin binding. **3rd GPCR Colloquium,** Washington, DC. April 27-28, 2007.
48. Gooz, M., Gooz, P., Twal, W.O., **Luttrell, L.M.**, J.R. Raymond. 5-HT induces disassembly of TACE/ β 1 integrin complex and promotes co-immunoprecipitation of EGFR/ β 3 integrin during 5-HT_{2A} receptor-EGFR cross-talk. **FASEB Experimental Biology 2007.** Washington, DC. April 28-May 2, 2007.
49. Gesty-Palmer, D. and **L.M. Luttrell.** G protein-independent signals. Are they physiologically relevant? **8th Annual Great Lakes GPCR Retreat & Club des Recepteur a Sept Domaines Transmembranaires du Quebec Joint Meeting,** London, Ontario, Canada. September 27-29, 2007.
50. Orr, K.A., Gault, C.R., Anelli, V.V., **Luttrell, L.M.**, and L.M. Obeid. Mechanism of TNF α -induced S1P₁ receptor internalization. **42nd Annual Southeastern Regional Lipid Conference (SERLC).** Cashiers, NC. November 7 - 9, 2007.

51. El-Shewy, H.M., Anelli, V., Abdel-Razek, S.A., Jaffa, A.A., Obeid, L.M., and **Luttrell, L.M.** Protein kinase C $\beta 2$ mediates IGF-2 activated ERK1/2 phosphorylation via sphingosine kinase activation. **Gordon Research Conference: Glycolipid & Sphingolipid Biology**. Il Ciocco, Italy. February 17 - 22, 2008.
52. Gooz, M. Rocha, C.L., Bell, L.H., Gooz, P., **Luttrell, L.M.**, and J.R. Raymond. 5-HT induces threonine (T375) phosphorylation of ADAM17/TACE cytoplasmic tail. **FASEB Experimental Biology 2008**. San Diego, CA. April 5 – 9, 2008.
53. El-Shewy, H.M., Johnson, K.R., Lee, M-H., Abdel-Razek, S.A., Obeid, L.M., and **Luttrell, L.M.** Sphingosine kinase activation mediates EGF induced intracellular Ca^{2+} release. **ENDO 08. The 90th Annual Meeting of the Endocrine Society**. San Francisco, CA. June 15 – 18, 2008.
54. El-Shewy, H.M., Anelli, V., Abdel-Razek, S.A., Jaffa, A.A., Obeid, L.M., and **Luttrell, L.M.** Protein kinase C $\beta 2$ mediates IGF-2 activated ERK1/2 phosphorylation via sphingosine kinase activation. **ENDO 08. The 90th Annual Meeting of the Endocrine Society**. San Francisco, CA. June 15 – 18, 2008.
55. Kendall, R.T., Lee, M-H., El-Shewy, H.M., Janech, M.G., Luttrell, D.K., and **Luttrell, L.M.** Activation of G protein-independent angiotensin AT1a receptor signaling pathways elicits a distinct protein phosphorylation profile. **ENDO 08. The 90th Annual Meeting of the Endocrine Society**. San Francisco, CA. June 15 – 18, 2008.
56. Gööz, M., Gööz, P. Twal, W.O., **Luttrell, L.M.**, and Raymond, J.R. 5-HT induces disassembly of TACE/ $\beta 1$ integrin complex and promotes co-immunoprecipitation of EGFR/ $\beta 3$ integrin during 5-HT_{2A} receptor-EGFR cross-talk. **NIH NIDDK 'Life after K'**, Washington, DC. June 18 - 20, 2008,
57. Jenkins, S., Lake, B., and **L.M. Luttrell**. Thyrotoxic hypokalemic periodic paralysis as the initial manifestation of Graves' disease. **SC Chapter of ACP Annual Meeting**. Hilton Head, SC. October 16-19, 2008.
58. Zimmerman, B., Simaan, M., Lee, M-H., **Luttrell, L.M.**, and S.A. Laporte. c-Src-mediated phosphorylation of AP-2 reveals a general mechanism for receptors internalizing through the clathrin pathway. **9th Annual Great Lakes GPCR Retreat & Club des Recepteur a Sept Domaines Transmembranaires du Quebec Joint Meeting**, Bromont, Quebec, Canada. October 16-18, 2008.
59. Kendall, R.T., Lee, M-H., El-Shewy, H.M., Janech, M.G., Luttrell, D.K., and **Luttrell, L.M.** Biased agonism reveals new G protein-independent AT1a receptor signals. **FASEB Experimental Biology 2009**. New Orleans, LA. April 18-22, 2008.
60. El-Shewy, H.M., Komlosi, P., Lee, M-H., Abdel-Razek, S.A., Bell, P.D., Obeid, L.M., and **L.M. Luttrell**. Role of sphingosine kinase 1 in Ang II-mediated regulation of vascular tone. **ENDO 09. The 91st Annual Meeting of the Endocrine Society**. Washington, DC CA. June 10 – 13, 2009.

INVITED PRESENTATIONS – National / International Scientific Meetings

- Gordon Research Conference, “Second Messengers and Protein Phosphorylation.” Heidi Hamm, Chairperson. Kimball Union Academy, Meriden, NH. August 13-18, 1995.
- The Eighth Annual Catecholamine Symposium, Asilomar Conference Center, Pacific Grove, CA. October 13-18, 1996.
- Gordon Research Conference, “Angiotensin.” Pierre Corvol, Chairperson. Il Ciocco, Italy. April 20-25, 1997.
- Gordon Research Conference, “Catecholamines.” Nancy Zahniser, Chairperson. Proctor Academy, NH. July 20-25, 1997.
- G-Protein Signaling Workshop. Henrik Dohlman, Chairperson. Mt. Sinai School of Medicine, New York, NY. April 8, 1999.
- FASEB Summer Research Conferences, “Gastrointestinal Tract VIII: Signaling, Transport and Intergration.” Kim Barrett, Chairperson. Copper Mountain, CO. July 25-30, 1999.
- 1st Annual Great Lakes GPCR Retreat. Stephen S. G. Ferguson, Chairperson. Spencer Hall Conference Center, London, Ontario, Canada. November 19-21, 1999
- The American Society for Biochemistry and Molecular Biology & The American Society for Pharmacology and Experimental Therapeutics Joint Meeting. James C. Garrison, session Chairperson. Hynes Convention Center, Boston, MA. June 4-8, 2000.
- 2nd Annual Great Lakes GPCR Retreat & Club des Recepteur a Sept Domaines Transmembranaires du Quebec Joint Meeting. Stephen S. G. Ferguson, Chairperson. London, Ontario, Canada. October 20-22, 2000
- Advances in Mineral Metabolism/American Society for Bone and Mineral Research. John Haddad Young Investigators Meeting. Harald Jueppner, Chairperson. Snowmass, CO. March 27-31, 2001.
- Gordon Research Conference, “Second Messengers and Protein Phosphorylation.” Jack E. Dixon and Ron Taussig, Co-chairpersons. Kimball Union Academy, Meriden, NH. June 10-15, 2001.
- Peptide Receptors: From Gene to Therapy. Domenico Regoli and Remi Quirion, Co-chairpersons. Montreal, Quebec, Canada. July 29-August 2, 2001
- The American Society for Biochemistry and Molecular Biology & The American Society for Pharmacology and Experimental Therapeutics Joint Meeting. Sarah J. Parsons, Session Chairperson. Sheraton, New Orleans, LA. April 20-24, 2002.
- ENDO 2002. The 84th Annual Meeting of the Endocrine Society. Moscone Convention Center. San Francisco, June 19-22, 2002.
- XXIII Meeting of the Congress of the Collegium Internationale NeuroPsychopharmacologicum. Claude de Montagny, Local Organizing Committee Chair. Montreal Convention Centre. Montreal, Quebec, Canada. June 23-27, 2002.
- 5th International Congress of Neuroendocrinology. Society for Endocrinology. Susan Wray, Stafford Lightman, and Colin Ingram, Program Organizing Committee. Bristol, United Kingdom. August 31-September 4, 2002
- GPCR Meeting, Boehringer Ingelheim Pharmaceuticals Inc. Tarrytown, NY. November 11-12, 2002.
- Gordon Research Conference, “Molecular Pharmacology.” Diane Barber, Chairperson. Ventura, CA. February 9-14, 2003.

- IBC 8th International G-protein Coupled Receptors Conference. Mimi Quek, Organizer. Boston, MA. Oct 20-22, 2003.
- Gordon Research Conference, "Angiotensin". Kenneth M. Baker, Chairperson. Ventura, CA. February 28-March 5, 2004
- ENDO 2004. The 86th Annual Meeting of the Endocrine Society. Chair - Symposium on G protein Signaling in Metabolism and Disease. Ernest N. Morial Convention Center. New Orleans, LA. June 16-19, 2004.
- XII International Congress of Endocrinology. International Society of Endocrinology. Shlomo Melmed, Chairperson. Lisbon, Portugal. August 31-September 4, 2004.
- International Wenner-Gren Symposium. "Receptor-receptor interactions among heptaspanning membrane receptors: From structure to function." Kjell Fuxe, Organizer. Wenner-Gren Center. Stockholm, Sweden. September 8-11, 2004.
- American Heart Association. 58th Annual Fall Conference and Scientific Sessions of the Council for High Blood Pressure Research. State-of-the-Art Lecture. Robert M. Carey, Chairperson. Chicago, Illinois. October 9-12, 2004.
- IBC 9th International G-protein Coupled Receptors Conference. Mimi Quek, Organizer. Sheraton San Diego Hotel & Marina. San Diego, CA. October 18-20, 2004.
- Gordon Research Conference, "Second Messengers and Protein Phosphorylation." Jeffrey Benovic and Mark von Zastrow, Co-chairpersons. University of New England, Biddeford, ME. June 12-17, 2005.
- 39th Winter Conference on Brain Research. Kim Neve, Session Chairperson. Steamboat Springs, CO. January 21-27, 2006.
- Gordon Research Conference, "Phosphorylation & G-Protein Mediated Signaling Networks." Henrik Dohlman and JoAnn Trejo, Co-chairpersons. University of New England, Biddeford, ME. June 10-15, 2007.
- 9th Annual Great Lakes GPCR Retreat & Club des Recepteur a Sept Domaines Transmembranaires du Quebec Joint Meeting. Stephen S. G. Ferguson and Peter Chidiac, Co-chairpersons. London, Ontario, Canada. September 27-29, 2007.
- Society for Biomolecular Sciences. Keynote Speaker. Tom Kost, Organizer. King of Prussia, PA. October 23-24, 2008.
- ENDO 2009. The 91st Annual Meeting of the Endocrine Society. Chairperson – Symposium on Advances in GPCR Signaling. Washington, D.C. June 10-13, 2009.

INVITED SEMINARS AND LECTURESHIPS

Neural and Behavioral Science Seminar. SUNY Downstate Medical Center. Alan Gintzler, Host. Brooklyn, NY. December 6, 2000.

The London Cardiovascular Society. Diabetes Research Center and The Vascular Biology Unit. The John P. Robarts Research Institute. Ross Feldman, Host. London, Ontario, Canada. March 22, 2001

Microbiology Department Seminar. State University of New York at Stonybrook. William Parrish, Host. Stonybrook, NY. December 3, 2001.

Endocrinology Grand Rounds. Massachusetts General Hospital. Henry Kronenberg, Host. Boston, MA. March 5, 2002.

Henry L. Turner Lecture. The University of Oklahoma Health Sciences Center. David C. Kem, Host. Oklahoma City, OK. March 13, 2002.

Cardiology Grand Rounds. Medical University of South Carolina. David S. Feldman, Host. Charleston, SC. June 6, 2002.

Department of Cell and Molecular Physiology Seminar. University of North Carolina – Chapel Hill. James Faber, Host. Chapel Hill, NC. October 7, 2002.

Signal Transduction Colloquium, Department of Pharmacology and Cancer Biology. Duke University Medical Center. Shirish Shenolikar, host. Durham, NC. February 19, 2003.

Department of Pharmacology and Toxicology Seminar. Medical College of Virginia. Dana E. Selley, Host. Richmond, VA. March 4, 2003.

Tenth Annual Diabetes Fall Symposium for Primary Health Care Professionals. The Diabetes Initiative of South Carolina. John A. Colwell, Chairperson. Charleston, SC. September 23, 2004.

Department of Physiology Seminar. University of Texas Health Sciences Center at San Antonio. Michael Katz, host. San Antonio, TX. April 5, 2004.

Endocrinology Grand Rounds. National Institutes of Health. Kevin Catt, host. Bethesda, MD. January 7, 2005.

Department of Pharmacology Seminar. The University of Pittsburgh School of Medicine. Peter Friedman, host. Pittsburgh, PA. May 13, 2005.

Department of Neurosciences Seminar. Medical University of South Carolina. Jacqueline McGinty, host. Charleston, SC. September 16, 2005.

Robarts Research Institute Seminar Series. The Robarts Research Institute. The University of Western Ontario. Steven Ferguson, host. London, Ontario, Canada. October 20, 2005.

Department of Medicine Grand Rounds. Medical University of South Carolina. Charleston, SC. October 25, 2005.

Department of Pharmacology Seminar. Vanderbilt University School of Medicine, Nashville, TN. Vsevolod Gurevich, host. March 6, 2007.

Department of Microbiology Seminar, Oklahoma State University, Stillwater, OK. Edward Shaw, host. March 26, 2007.

Department of Pathology Seminar, Medical College of Georgia, Augusta, GA. Yehia Daaka, host. August 13, 2007.

Laboratory of Molecular Carcinogenesis / National Institute of Environmental Health Science Seminar, Research Triangle Park, NC. Robert Langenbach, host. November 13, 2007.

Division of Endocrinology Seminar, McGill University Royal Victoria Hospital, Montreal, Quebec, CA. Stephane LaPorte, host. March 6, 2008.

Department of Biomedical Sciences Seminar, University of California – Riverside, Riverside, CA. Kathryn DeFea, host. April 27, 2009.

GlaxoSmithKline Internal Conference - 7TMs and Ion Channels. Terry Kenakin, host. Ware, United Kingdom. June 3-4, 2009.