

CURRICULUM VITAE

WALTER J. ATWOOD

TITLE

Vice Chair, Department of Molecular Biology, Cell Biology & Biochemistry
Professor of Medical Science, Department of Molecular Biology, Cell Biology & Biochemistry
Professor of Neurology, The Warren Alpert Medical School at Brown University

ACADEMIC DEGREES

B.S. University of Massachusetts, Amherst, MA, 1986. Microbiology
Ph.D. University of Massachusetts, Amherst, MA, 1991. Neurovirology
Dissertation: Major Histocompatibility Complex Class I Proteins are Receptors for SV40
Master of Arts *Ad Eundem* Brown University, Providence RI. Honorary. (2001)

PROFESSIONAL APPOINTMENTS

March 1991 - March 1994	Staff Fellow, Section on Molecular Virology and Genetics, Laboratory of Viral and Molecular Pathogenesis, NINDS, NIH, Bethesda, Maryland
January 1992 - September 1995	Adjunct Assistant Professor of Microbiology and Immunology, The George Washington University School of Medicine and Health Sciences, Washington, D.C.
March 1994 - September 1995	Senior Staff Fellow, Section on Molecular Medicine and Virology, Laboratory of Molecular Medicine and Neuroscience, NINDS, NIH, Bethesda, Maryland
September 1995 – June 2001	Assistant Professor of Medical Science, Department of Molecular Microbiology and Immunology, Brown University, Providence, Rhode Island
July 2001-June 2005	Associate Professor of Medical Science with Tenure Department of Molecular Microbiology and Immunology, Brown University, Providence, Rhode Island
July 2005-June 2006	Associate Professor of Medical Science with Tenure Department of Molecular Biology, Cell Biology & Biochemistry, Brown University, Providence, Rhode Island
July 2006-present	Professor of Medical Science Department of Molecular Biology, Cell Biology &

Biochemistry, Brown University, Providence, Rhode Island

July 2009-present

Vice Chair, Department of Molecular Biology, Cell Biology & Biochemistry, Brown University, Providence, Rhode Island

RESEARCH INTERESTS

Virology, virus receptors, human polyomavirus host cell interactions, mechanisms of persistent infection

PROFESSIONAL HONORS AND AWARDS

Fellow of the American Academy of Microbiology (Elected February 2015)

Gerson-Lehrman Group Scholar (2007-present)

Dean's Teaching Excellence Award, Brown Medical School (2005-2006)

Master of Arts *Ad Eundem* Brown University (2001)

PROFESSIONAL SOCIETY MEMBERSHIPS

American Association for the Advancement of Science

American Society of Microbiology

American Society for Virology

International Society for NeuroVirology (Founding Member)

SERVICE TO THE PROFESSION

Study Sections and Grant Reviews

National Institutes of Health, CNBT Study Section, Ad hoc reviewer (2018)

National Institutes of Health, NAED Study Section, Ad hoc reviewer (2017)

National Institutes of Health, CNBT Study Section, Ad hoc reviewer (2017)

National Institutes of Health, Virology A Study Section, Ad hoc reviewer (2016)

National Institutes of Health, Special Emphasis Study Section, Chair (2014)

National Institutes of Health, Virology A Study Section, Ad hoc reviewer (2011)

National Cancer Institute, Site Visit Team, University of Pittsburgh Cancer Institute (2010)

National Cancer Institute, Molecular Oncology Special Emphasis Panel, Program Projects (2010)

National Institutes of Health, Virology B Study Section, Ad hoc reviewer (2009)

National Institutes of Health, Virology B Study Section, Ad hoc reviewer (2009)

National Institutes of Health, F32 Fellowship Panel (2008)

National Institutes of Health, Virology Study Section, Member (2003-2007)

National Institute of Neurological Disorders and Stroke, NSD-C Review Panel, 2003

National Institutes of Health Special Emphasis Panel to review the "Multi Center Neurologic AIDS Research Consortium" 2002

National Institutes of Health Special Emphasis Study Section, 2002

National Institutes of Health, Virology Study Section Ad-Hoc Member (2001-2003)
Department of Veterans Affairs, (2000-present)
Brown University Center for AIDS Research Developmental Grants Program (1998-present)
Lifespan Developmental Grants Program (1996-present)

Meetings Organized or Chaired

Polyomaviruses and Human Diseases: Basic and Clinical Aspects, Sept.11-14, 2005, Providence RI

Editorial Boards

PLOS Pathogens (2009-present)
Journal of Neurovirology (2003-2008)
Journal of Virology (2004-present)
Virology (2010-present)
Virus Research (2012-present)
International Society for Neurovirology, Board of Directors (2003-2008)
International Society for Neurovirology, Secretary (2003-2004)

Manuscript Reviews

Science Translational Medicine (2014)
Cell Host and Microbe (2011)
PLOS Pathogens (2009)
PLOS Genetics (2009)
Science (1998)
Proceeding of the National Academy of Sciences (1998)
Journal of Immunology (1998)
Virology (1996-present)
Journal of Neurovirology (1996-present)
Journal of Virology (1996-present)
Cancer Research (2002-present)

Consulting Agreements

Biogen-IDEC (2005)
Millenium Pharmaceuticals (2005)
Glaxo-Smith Kline (2006)
Preseid Pharmaceuticals (2010)
Inhibikase Therapeutics (2010)
Vertex Pharmacueuticals (2011)

PUBLICATIONS

Book Chapters

9. Haley, S.A., and **W.J. Atwood**. 2017. Progressive Multifocal Leukoencephalopathy: Endemic viruses and lethal brain disease. *Ann. Rev. Virol.* 4:349-367.
8. Assetta, B., and **W.J. Atwood**. 2017. The Biology of JC Polyomavirus. *Biol. Chem.* 398(8): 839-855.
7. Ashok, A., and **W.J. Atwood**, 2006. Virus receptors and tropism. In: *Polyomaviruses and Human Diseases. Adv. Exp. Med. Biol.* 577:60-72.
6. **W.J. Atwood**. 2001. Cellular Receptors for the Polyomaviruses. in: *The Human Polyomaviruses, JC, BK, and SV40: Molecular and Clinical Perspectives.* ed. Kamel Khalili and Gerald Stoner, J. Wiley and Sons, Inc., pages 179-196.
5. Schweighardt, B., and **W.J. Atwood**. 2001. Glial cells as targets of viral infection in the human central nervous system. In: *Progress in Brain Research*, vol. 132:731-745. ed. B. Castellano Lopez and M. Nieto-Sampedro. Elsevier Science B.V., Amsterdam. This book chapter was the result of my presentation at the IVth European Meeting on Glial Cell Function in Health and Disease, Barcelona, Spain, May 24-27, 2000.
4. Liu, C.K., and **W.J. Atwood**. 2001. Propagation and Assay of JC Virus. In: *Methods in Molecular Biology: SV40 Protocols*, vol 165:9-18. ed. L. Raptis. Humana Press, Totowa, NJ.
3. **Atwood , W.J.**, and K.V. Shah.1999. Polyomaviruses. In: *Nature Encyclopedia of Life Sciences*, Nature Publishing Group., London.
2. **Atwood, W.J.**, Sumner, C., and E.O. Major. 1996. Molecular mechanisms in the pathogenesis of progressive multifocal leukoencephalopathy: A JC virus induced disease of the human brain. In: *Latent Infection of Pathogens* ed. Takeshi Kurata, Chapter 12, pp 134-146, Saikon Shuppan Press, Tokyo, Japan.
1. Major E.O., **Atwood, W.J.**, Conant, K., Amemiya, K., and R.G. Traub. 1995. Cell cultures from human fetal brain provide a model for HIV-1 persistence and reactivation in the central nervous system, In: *Technical advances in AIDS research in the human nervous system*, edited by Major, E.O. New York, NY: Plenum Publishing Corporation, p. 89-103.

Refereed Journal Articles

90. Assetta B., Morris-Love J., Gee GV., Atkinson AL., O'Hara BA., Maginnis MS., Haley SA., Atwood WJ. *Cell Reports* (2019), <https://doi.org/10.1016/j.celrep.2019.04.067>.
89. Morris-Love J., Gee GV., O'Hara BA., Assetta, B, Atkinson AL., Dugan AS., Haley SA., Atwood WJ., JC polyomavirus uses extracellular vesicles to infect target cells. *mBio* (2019) 10:e00379-19. <https://doi.org/10.1128/mBio.00379-19>.
88. O'Hara, B.A., Gee, G.V., Atwood, W.J., Haley, S.A., Susceptibility of primary human choroid plexus epithelial cells and meningeal cells to infection by JC virus. *J Virol.* 2018 Feb 7. pii:

JVI.00105-18. doi: 10.1128/JVI.00105-18. [Epub ahead of print].

87. Dimitriadi M, Derdowski A, Kalloo G, Maginnis MS, O'Hern P, Bliska B, Sorkaç A, Nguyen KC, Cook SJ, Pouligiannis G, Atwood WJ, Hall DH, Hart AC., Decreased function of survival motor neuron protein impairs endocytic pathways. *Proc Natl Acad Sci U S A*. 2016 Jul 26;113(30):E4377-86. doi: 10.1073/pnas.1600015113. Epub 2016 Jul 11.
86. Assetta B, De Cecco M, O'Hara BA, Atwood WJ., JC Polyomavirus Infection of Primary Human Renal Epithelial Cells is Controlled by a Type I IFN-Induced Response. *mBio*. 2016. July 5: 7(4) e00903-16.
85. Luo Y, Motamedi N, Magaldi TG, Gee GV, Atwood WJ, DiMaio D., Interaction between Simian Virus 40 Major Capsid Protein VP1 and Cell Surface Ganglioside GM1 Triggers Vacuole Formation. *MBio*. 2016 Mar 22;7(2). pii: e00297-16. doi: 10.1128/mBio.00297-16. PMID: 27006465, PMCID: PMC4807364.
84. Ströh LJ, Gee GV, Blaum BS, Dugan AS, Feltkamp MC, Atwood WJ, Stehle T., Trichodysplasia spinulosa-Associated Polyomavirus Uses a Displaced Binding Site on VP1 to Engage Sialylated Glycolipids. *PLoS Pathog*. 2015 Aug 24;11(8):e1005112. doi: 10.1371/journal.ppat.1005112. eCollection 2015 Aug. PMID: 26302170; PubMed Central PMCID: PMC4547793
83. Haley SA, O'Hara BA, Nelson CD, Brittingham FL, Henriksen KJ, Stopa EG, Atwood WJ. Human Polyomavirus Receptor Distribution in Brain Parenchyma Contrasts with Receptor Distribution in Kidney and Choroid Plexus. *Am J Pathol*. 2015 Jun 6. pii: S0002-9440(15)00261-8. doi: 10.1016/j.ajpath.2015.04.003. [Epub ahead of print] PMID: 26056932; PubMed Central PMCID:PMC4530127
82. Ströh LJ, Maginnis MS, Blaum BS, Nelson CD, Neu U, Gee GV, O'Hara BA, Motamedi N, DiMaio D, Atwood WJ, Stehle T. The Greater Affinity of JC Polyomavirus Capsid for α 2,6-Linked Lactoseries Tetrasaccharide c than for Other Sialylated Glycans Is a Major Determinant of Infectivity. *J Virol*. 2015 Jun 15;89(12):6364-75. doi: 10.1128/JVI.00489-15. Epub 2015 Apr 8. PMID: 25855729; PubMed Central PMCID: PMC4474300
81. Nelson CD, Ströh LJ, Gee GV, O'Hara BA, Stehle T, **Atwood WJ**. Modulation of a pore in the capsid of JC polyomavirus reduces infectivity and prevents exposure of the minor capsid proteins. *J Virol*. 2015 Jan 21. pii: JVI.00089-15. [Epub ahead of print] PubMed PMID: 25609820.
80. Maginnis, MS., Nelson, CDS., **Atwood, W.J.** JC polyomavirus attachment, entry, and trafficking: unlocking the keys to a fatal infection. *J. Neurovirol* 2014 Jul 31. [Epub ahead of print] PubMed PMID: 25078361; PubMed Central PMCID: PMC4312552.
79. Haley SA, **Atwood WJ**. An animal model for progressive multifocal leukoencephalopathy. *J Clin Invest*. 2014 Dec;124(12):5103-6. doi: 10.1172/JCI79186. Epub 2014 Nov 17. PMID: 25401466 PubMed Central PMCID: PMC4348958.
78. Yatawara A, Gaidos G, Rupasinghe CN, O'Hara BA, Pellegrini M, Atwood WJ, Mierke DF. Small-

- molecule inhibitors of JC polyomavirus infection. *J Pept Sci.* 2014 Dec 19. doi: 10.1002/psc.2731. [Epub ahead of print] PMID: 25522925 [PubMed - as supplied by publisher]
77. Carney, D.W., Nelson, CDS., Ferris, BD., Stevens, JP., Lipovsky, A., Kazakov, T., DiMaio, D., Atwood, WJ., Sello, JK. Structural optimization of a retrograde trafficking inhibitor that protects cells from infections by human polyoma- and papillomaviruses. *Bioorg Med Chem.* 2014 Sep 1;22(17):4836-47. doi: 10.1016/j.bmc.2014.06.053. Epub 2014 Jul 10. PMID: 25087050 [PubMed - in process]
76. Bouley SJ, Maginnis MS, Derdowski A, Gee GV, O'Hara BA, Nelson CD, Bara AM, Atwood WJ, Dugan AS. Host cell autophagy promotes BK virus infection. *Virology.* 2014 May;456-457C:87-95. doi: 10.1016/j.virol.2014.03.009. Epub 2014 Apr 2. PMID: 24889228 [PubMed - as supplied by publisher]
75. O'Hara BA, Rupasinghe C, Yatawara A, Gaidos G, Mierke DF, Atwood WJ., Gallic acid-based small-molecule inhibitors of JC and BK polyomaviral infection. *Virus Res.* 2014 Jun 21. pii: S0168-1702(14)00251-2. doi: 10.1016/j.virusres.2014.06.008. [Epub ahead of print] PMID: 24960120 PubMed Central PMCID: PMC4144447.
74. Zins, SR., Nelson, CDS., Maginnis, MS., Banerjee, R., O'Hara, BA., Atwood, WJ. The human alpha defensin HD5 neutralizes JC polyomavirus infection by reducing ER traffic and stabilizing the viral capsid. *J. Virol.* 2014. Nov 6. [Epub ahead of print]. PMID: 24198413; PMC – Journal in Process.
73. Nelson CDS., Carney DW., Derdowski A., Lipovsky A., Gee GV., O'Hara B., Williard P., DiMaio D., Sello JK., Atwood WJ.. 2013. A retrograde trafficking inhibitor of ricin and Shiga-like toxins inhibits infection of cells by human and monkey polyomaviruses. *MBio* 4(6):e00729-13. doi:10.1128/mBio.00729-13. PMID: 24222489; PMC – Journal in Process.
72. Neu, U., Allen, SA., Blaum, BS., Liu, Y., Frank, M., Palma, AS., Ströh, LJ., Feizi, T., Peters, T., Atwood, WJ., Stehle, T. A structure-guided mutation in the major capsid protein retargets BK Polyomavirus. *PLoS Pathog.* 2013, Oct;9(10):e1003688. Epub 2013 Oct 10. PMID: 24130487; PMCID: PMC3795024
71. Gee, GV., O'Hara, BA., Derdowski, A., Atwood, WJ. 2013. Pseudovirus mimics cell entry and trafficking of the human polyomavirus JCPyV. *Virus Res.* 2013 Oct 4. doi:pii: S0168-1702(13)00322-5. 10.1016/j.virusres.2013.09.030. [Epub ahead of print] PMID: 24100235; PMCID: PMC3849699
70. Assetta, B., Maginnis, MS., Gracia Ahufinger, I., Haley, SA., Gee, GV., Nelson, CDS., O'Hara, BA., Allen-Ramdial, SA., Atwood, WJ. 2013. 5-HT2 receptors facilitate JC polyomavirus entry. *J. Virol.* Oct 2. [Epub ahead of print] PMID: 24089568; PMC – Journal in Process.
69. Maginnis MS, Ströh LJ, Gee GV, O'Hara BA, Derdowski A, Stehle T, Atwood WJ. Progressive Multifocal Leukoencephalopathy-Associated Mutations in the JC Polyomavirus Capsid Disrupt

Lactoseries Tetrasaccharide c Binding. MBio. 2013 Jun 11;4(3). doi:pii: e00247-13. 10.1128/mBio.00247-13. PMID: 23760462; PMCID: PMC3685208

68. Lipovsky A, Popa A, Pimienta G, Wyler M, Bhan A, Kuruvilla L, Guie MA, Poffenberger AC, Nelson CD, Atwood WJ, Dimaio D. Genome-wide siRNA screen identifies the retromer as a cellular entry factor for human papillomavirus. *Proc Natl Acad Sci U S A*. 2013 Apr 30;110(18):7452-7. doi: 10.1073/pnas.1302164110. Epub 2013 Apr 8. PMID: 23569269; PMCID: PMC3645514
67. Ferenczy MW, Marshall LJ, Nelson CD, Atwood WJ, Nath A, Khalili K, Major EO. Molecular Biology, Epidemiology, and Pathogenesis of Progressive Multifocal Leukoencephalopathy, the JC Virus-Induced Demyelinating Disease of the Human Brain. *Clin Microbiol Rev*. 2012 Jul;25(3):471-506. PMID: 22763635 [PubMed - in process]
66. Nelson CD, Derdowski A, Maginnis MS, O'Hara BA, **Atwood WJ**. The VP1 subunit of JC polyomavirus recapitulates early events in viral trafficking and is a novel tool to study polyomavirus entry. *Virology*. 2012 Apr 17. [Epub ahead of print] PMID: 22516137 PMCID: PMC3569719
65. Johne R, Buck CB, Allander T, **Atwood WJ**, Garcea RL, Imperiale MJ, Major EO, Ramqvist T, Norkin LC. Taxonomical developments in the family Polyomaviridae. *Arch Virol*. 2011 Sep;156(9):1627-34. Epub 2011 May 12. PMID: 21562881
64. Goodwin EC, Lipovsky A, Inoue T, Magaldi TG, Edwards AP, Van Goor KE, Paton AW, Paton JC, **Atwood WJ**, Tsai B, Dimaio D. BiP and Multiple DNAJ Molecular Chaperones in the Endoplasmic Reticulum Are Required for Efficient Simian Virus 40 Infection. *MBio*. 2011; 2 (3) PubMed PMID:21673190; PubMed Central PMCID: PMC3111607.
63. Johne R, Buck CB, Allander T, **Atwood WJ**, Garcea RL, Imperiale MJ, Major EO, Ramqvist T, Norkin LC. Taxonomical developments in the family Polyomaviridae. *Arch Virol*. 2011 May 12; PubMed PMID:21562881.
62. Shen, P.S., Enderlein, D., Nelson, C.D.S., Carter, W.S., Kawano, M., Xing, L., Swenson, R.D., Olson, N.H., Baker, T.S., Holland Cheng, R., **Atwood, W.J.**, Johne, R., and D.M. Belnap. 2011. The structure of avian polyomavirus reveals variably sized capsids, non-conserved inter-capsomere interactions, and a possible location of the minor capsid protein VP4. *Virology* 411:142-152.
61. Gee GV, Stanifer ML, Christensen BC, **Atwood WJ**, Ugolini D, Bonassi S, Resnick MB, Nelson HH, Marsit CJ, Kelsey KT. SV40 associated miRNAs are not detectable in mesotheliomas. 2010. *Br J Cancer*. 103:885-888.
60. Neu, U., Maginnis, M.S., Palma, A.S., Stroeh, L.J., Nelson, C.D., Feizi, T., **Atwood, W.J.**, and T. Stehle. 2010. Structure-function analysis of the human JC polyomavirus establishes the LSTc pentasaccharide as a functional receptor motif. *Cell Host & Microbe* 8:309-319.
59. Maginnis, M.S., Haley, S.A., Gee, G.V., and **W.J. Atwood**. 2010. The role of N-linked glycosylation of the 5-HT2A receptor in JCV infection. *J. Virol*. 84:9677-9684.

58. Haley, S.A., O'Hara, B.A., Banerjee, R., and **W.J. Atwood**. 2010. Unique susceptibility of a human lung carcinoid tumor cell line to infection with BK virus. *Virus Research* 149:128-132.
57. Jordan, J.A., Manley, K., Dugan, A.S., O'Hara, B.A., and **W.J. Atwood**. 2010. Transcriptional regulation of BK virus by nuclear factor of activated T-cells. *J. Virol.* 84:1722-1730.
56. Gasparovic, M.L., Maginnis, M.S., O'Hara, B.A., Dugan, A.S., and **W.J. Atwood**. 2009. Modulation of PML protein expression regulates JCV infection. *Virology* 390:279-288.
55. Maginnis, M.S., and **W.J. Atwood**. 2009. JC Virus: An oncogenic virus in humans? *Seminars in Cancer Biology*
54. Goodwin, E.C., **Atwood, W.J.**, and D. Dimaio. 2009. High-throughput cell-based screen for chemicals that Inhibit Infection by SV40 and human polyomaviruses. *J. Virol.* Epub
53. Neu, U., Stehle, T., and **W.J. Atwood**. 2009. The polyomaviridae: Contributions of virus structure to our understanding of virus receptors and infectious entry. *Virology* 384:389-399.
52. Seo, G.J., Fink, L.H., O'Hara, B., **Atwood, W.J.**, and C.S. Sullivan. 2008. Evolutionarily conserved function of a viral microRNA. *J. Virol.* 82:9823-9828.
51. Dugan A.S., Maginnis, M.S., Jordan, J.A., Gasparovic, M.L., Manley, K., Page, R., Williams, G., Porter, E., O'Hara, B.A., and **W.J. Atwood**. 2008. Human alpha-defensins inhibit BK virus infection by aggregating virions and blocking binding to host cells. *J. Biol. Chem.* 283: 31125-31132.
50. Schaumburg, C., O'Hara, B.A., Lane, T., and **W.J. Atwood**. 2008. Human embryonic stem cell-derived oligodendrocyte progenitor cells express the serotonin receptor and are susceptible to JC Virus infection. *J. Virol.* 82:8896-8899.
49. Dugan, A.S., Gasparovic, M.L., and **W.J. Atwood**. 2008. Direct correlation between sialic acid binding and infection of cells by human polyomaviruses. *J. Virol* 82:2560-2564.
48. O'Hara, B.A., and **W.J. Atwood**. 2008. Interferon β 1a and selective anti-5HT2a receptor antagonists inhibit infection of human glial cells by JC virus. *Virus Research* 132:97-103
47. Manley, K., O'Hara, B.A., and **W.J. Atwood**. 2008. Nuclear factor of activated T-cells (NFAT) plays a role in SV40 infection. *Virology* 372:48-55.
46. Dugan, A.S., Gasparovic, M.L., Tsomaia, N., Mierke, D.F., O'Hara, B.A., Manley, K., and **W.J. Atwood**. 2007. Identification of amino acid residues in BK virus VP1 critical for viability and growth. *J. Virol.* 81:11798-11808.
45. Manley, K., Gee, G.V., Simkevich, C.P., Sedivy, J.M., and **W.J. Atwood**. 2007. Microarray analysis of glial cells resistant to JCV infection suggests a correlation between viral infection and inflammatory cytokine gene expression. *Virology* 366:394-404.

44. Manley, K., O'Hara, B. A., Gee, G.V., Simkevich, C.P., Sedivy, J.M., and **W.J. Atwood**. 2006. NFAT4 is required for JCV infection of glial cells. *J. Virol.* 80:10858-10861.
43. Gasparovic, K.L., Gee, G.V., and **W.J. Atwood**. 2006. The JC Virus (JCV) minor capsid proteins VP2 and VP3 are essential for virus propagation. *J. Virol.* 80:10858-10861.
42. Querbes, W., O'Hara, B.A., Williams, G., and **W.J. Atwood**. 2006. Invasion of host cells by JC virus identifies a novel role for caveolae in endosomal sorting of non-caveolar ligands. *J. Virol.* 80:9402-9413.
41. Dugan, A.S., Eash, S., and **W.J. Atwood**. 2006. Update on BK virus entry and intracellular trafficking. *Transpl Infect Dis.* 8:62-67.
40. Gee, G.V., Dugan, A.S., Tsomaia, N., Mierke, D.F., and **W.J. Atwood**. 2006. Sialic acid and human polyomaviruses. *Glycoconjugate Journal* 23:19-26.
39. Eash, S., Manley, K., Gasparovic, M., Querbes, W., and W.J. Atwood. 2006. The Human Polyomaviruses. *Cell Mol. Life Sci.* 63:865-876.
38. Josephson, M.A., Gillen, D., Javaid, B., Kadambi, P., Meehan, S., Foster, P., Harland, R., Thistlethwaite, R.J., Garfinkel, M., **Atwood, W.**, Jordan, J., Sadhu, A., Millis, M.J., and J, Williams. 2006. Treatment of renal allograft polyoma BK virus infection with leflunomide. *Transplantation* 81:704-710.
37. Dugan, A.S., Eash, S., and **W.J. Atwood**. 2005. A N-linked Glycoprotein with $\alpha(2,3)$ -Linked Sialic Acid is a Receptor for BK Virus. *J. Virol.* 79:14442-14445.
36. Eash, S., and **W.J. Atwood**. 2005. Involvement of cytoskeletal components in BKV infectious entry. *J. Virol.* 79:11734-11741.
35. Williams J., Javaid, B., Kadambi, P., Meehan, S., Foster, P., Harland, R., Thistlethwaite, R., Garfinkel, M., **Atwood, W.**, Sadhu, A., Gillen, D., Millis, M., and M. Josephson. 2005. Leflunomide for Polyomavirus Type BK Nephropathy. *NEJM* 352:1157-1158.
34. Elphick, G.F., Querbes, W., Jordan, J.A., Gee, G.V., Eash, S., Manley, K., Dugan, A., Stanifer, M., Roth, B.L., and **W.J. Atwood**. 2004. The human polyomavirus, JCV, uses serotonin receptors to infect cells. *Science* 306:1380-1384.
32. Gee, G.V., Tsomaia, N., Mierke, D., and **W.J. Atwood**. 2004. Modeling a sialic acid binding pocket in the external loops of JCV VP1. *J. Biol. Chem.* 279(47):49172-6.
32. Eash, S., Querbes, W., and **W.J. Atwood**. 2004. Infection of Vero cells by BK Virus (BKV) is caveolae dependent. *J. Virol.* 78:11583-11590.

31. Qu, Q., Sawa, H., Suzuki, T., Semba, S., Henmi, C., Okada, Y., Tsuda, M., Tanaka, S., **Atwood, W.J.**, and K. Nagashima. 2004. Nuclear entry mechanism of the human polyomavirus JC virus like particle: role of importins and the nuclear pore complex. *J. Biol. Chem.* 279:27735-42.
30. Querbes, W., Benmerah, A., Tosoni, D., Di Fiore, P.P., and **Atwood, W.J.**, 2004. A JC virus induced signal is required for infection of glial cells by a clathrin and eps15 dependent pathway. *J. Virol.* 78: 250-256
29. Eash, S., Tavares, R., Stopa, E.G., and **Atwood, W.J.**, 2004. Differential distribution of the JC virus receptor-type sialic acid in normal human tissues. *Am. J. Pathol.* 164:419-428.
28. Trophe, J., Gordon, J., Roy-Chaudhury, P., Koralnik, I., **Atwood, W.J.**, Eash, S., Alloway, R.R., Khalili, K., Alexander, J.W., and E. S. Woodle. 2004. Basic and Clinical Research in Polyomavirus Nephropathy. *Experimental and Clinical Transplantation* 2:162-173.
27. Trophe, J., Gordon, J., Roy-Chaudhury, P., Koralnik, I., **Atwood, W.J.**, Alloway, R.R., Khalili, K., and E. S. Woodle. 2004. Polyomavirus nephropathy in kidney transplantation. *Progress in Transplantation* 14:130-142.
26. **Atwood, W.J.**, 2003. Genotypes, archetypes, and tandem repeats in the molecular epidemiology and pathogenesis of JC virus induced disease. *J. NeuroVirol.* 9:519-521.
25. Gee, G., Manley, K., and **Atwood, W.J.**, 2003. Derivation of a JC Virus resistant human glial cell line: Implications for the identification of host cell factors that determine viral tropism. *Virology* 314:101-109.
24. Baum, S., Ashok, A., Gee, G., Eash, S., Querbes, W., Jordan, J., and **Atwood, W.J.**, 2003. Early events in the life cycle of JC Virus (JCV) as potential therapeutic targets for the treatment of Progressive Multifocal Leukoencephalopathy (PML). *J. NeuroVirol.* 9: 32-37.
23. Ashok, A., and **Atwood, W.J.**, 2003. Contrasting roles of endosomal pH and the cytoskeleton in infection of human glial cells by JC Virus and SV40. *J. Virol.* 77:1347-1356.
22. Komagome, R., Sawa, H., Suzuki, T., Tanaka, S., **Atwood, W.J.**, and K. Nagashima. 2002. Oligosaccharides as receptors for JC Virus. *J. Virol.* 76:12992-13000.
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Active Funding

1. **National Institutes of Health Grant # R01-NS043097-15**; “Virus-Host Cell Interactions in AIDS-Associated PML”; 12/15/01-01/31/22; **Principal Investigator; W. J. Atwood.** Direct Costs-\$218,750/yr; 25% effort.
2. **National Institutes of Health Grant # P01-NS065719-06**; “Structure-function based development of JC virion specific antagonists for PML; 08/01/14-05/31/20; **Principal Investigator; W. J. Atwood.** Direct costs-\$1,333,900/yr; 30% effort.

Award and Funding History

1. **National Institutes of Health Grant # P30 RR031153-01**; “Center for Cancer Signaling Networks”; 04/15/2011-03/31/2016; **Principal Investigator; W.J. Atwood.** Direct Costs-\$721,601/yr; 30% effort
2. **National Institutes of Health Grant # P01-NS065719**; “Structure-function based development of JC virion specific antagonists for PML; 09/30/09-07/31/14; **Principal Investigator; W. J. Atwood.** Direct costs-\$951,744/yr; 20% effort.
3. **Translational Innovation Partnership Awards Program**; Small molecule inhibitors of human polyomavirus infection. **Principal Investigator**; 08/08/2012-06/26/2013 **W.J. Atwood.** Direct Costs-\$50,000.
4. **National Institutes of Health Grant # R01-CA71878**; “Cellular Receptors for the Human Polyomavirus, JCV”; 04/1/02-03/31/13; **Principal Investigator; W. J. Atwood.** Direct Costs - \$165,590/yr; 15% effort.

5. **National Institutes of Health Grant # P20 RR015578-07**; “Center for Cancer Signaling Networks”; 07/01/05-02/29/11; **Principal Investigator; W.J. Atwood**, Direct Costs-\$1,620,513/yr 30% effort.
6. **Raymond and Beverly Sackler Foundation, Inc.**; “Targeted Therapies for Carcinoid Syndrome”; 09/01/06-08/31/11; **Principal Investigator; W.J. Atwood**, Direct Costs-\$150,000/yr; 10% effort.
7. **National Institutes of Health Grant # 1F31 NS053340-01**; “Role of JCV coat proteins in neuropathogenesis of PML”; 09/01/05-08/31/08; PI-Megan Gasparovic; Direct Costs-\$45,833/yr.; **Mentor; W.J. Atwood.**
8. **National Multiple Sclerosis Society Pilot Award**; “Human Embryonic Stem Cell Model of JCV-Induced CNS Disease”; 08/01/07-07/31/08; **Principal Investigator: W.J. Atwood**, Direct costs-\$40,000/yr; 2% effort.
9. **National Institutes of Health Grant # R13-CA110760-01**; "2nd Symposium on Polyomaviruses and Human Disease"; 06/04/04-05/31/08; **Principal Investigator; W.J. Atwood.** Direct Costs-\$17,000/yr.
10. **Biogen-Idec, Inc.**; “Development and Screening of JC Virus Specific Therapeutics” 08/01/06-07/31/07; **Principal Investigator; W.J. Atwood**, Direct Costs-\$122,258/yr; 2.5% effort.
11. **Fujisawa Healthcare Inc.**, “Anti-viral Activity of FK778 against the Human Polyomaviruses, JCV and BKV”; 12/1/02-06/30/05; **Principal Investigator; W.J. Atwood.** Direct Costs-\$24,683/yr; 5% effort.
12. **National Institutes of Health Grant # R29-CA71878**; “Cellular Receptors for the Human Polyomavirus,JCV”; 09/1/97-08/31/01; **Principal Investigator; W. J. Atwood.** Direct Costs - \$69,500/yr; 50%effort.
13. **National Institutes of Health, Center of Biomedical Research Excellence Grant # NIH 1 P20 RR15578-01** (01-05); Center for Genetics and Genomics; 10/1/00-9/30/05; (PI- J. Sedivy) - Co-Investigator of Project A - Characterization of Events Regulating the Balance Between Resistance and Infection (Project PI- C.A. Biron); Direct Costs Requested for Project A - \$913,000/5yr. Project A, Specific Aim 1-Establishment of Approaches to Identify Early Events in Infection of B cells by JC Virus (**Investigator-W.J. Atwood**); 10% Effort in Year 1, 15% Effort in Years 2-5.
14. **National Institutes of Health Sponsored Lifespan/Tufts/Brown Center for AIDS Research.** Developmental Research Grant, “Virus Chemokine Receptor Interactions in HIV-Dementia”, **Principal Investigator; W. J. Atwood.** 01/01/00-12/31/01, Direct Costs \$30,000/1yr; 10% effort.
15. Brown University Salomon Faculty Research Award, “Virus-Chemokine Receptor Interactions in AIDS Dementia”, 1999, **Principal Investigator; W. J. Atwood.** Award of \$7,500/1yr.

16. Brown University Salomon Faculty Research Award, “The Role of Cellular Receptor in Restricting the Tropism of JCV to Glial Cells”, 1998, **Principal Investigator; W. J. Atwood** Award of \$10,000/1yr.
17. Brown University Funded Small Grant, “Cellular Receptor for the Human Polyomavirus, JCV”, 1997, **Principal Investigator; W. J. Atwood.** Award of \$1500/1yr.
18. Rhode Island Foundation Medical Research Grant, “Cellular Receptor for the Human Polyomavirus, JCV”, 1997, **Principal Investigator; W. J. Atwood.** Award of \$5000/1yr.
19. American Cancer Society Institutional Grant Allocation, 1996, **Principal Investigator; W. J. Atwood.** “Cellular Receptor for the Human Polyomavirus, JCV”, Award of \$11,000/1yr.
21. Rhode Island Foundation Medical Research Grant, “Cellular Receptor for the Human Polyomavirus, JCV”, 1996, **Principal Investigator; W. J. Atwood.** Award of \$4,840/1yr.
22. Sanofi-Genzyme Corp., “Antiviral activity of teriflunomide” 11/17/2017-4/16/2019; **Principal Investigator; W.J. Atwood.** Direct costs-\$82,965; 5% effort.

Patents

2017 US 9,695,156 Compounds for the Treatment and Prevention of Infections, Issued July 4, 2017