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## BIOGRAPHICAL SKETCH

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NAME Maureen M. Barr	POSITION TITLE Professor of Genetics		
eRA COMMONS USER NAME mmbarr			
EDUCATION/TRAINING ( <i>Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training.</i> )			
INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY
Rutgers University, NJ	B.A.	1990	Biology
Columbia University, NY	Ph.D.	1995	Genetics & Development
California Institute of Technology	postdoc	1995-2000	Neurogenetics

### A. Personal Statement

The PI has a long-standing commitment to develop and use simple animal models to study processes relevant to human health and disease. My lab established *C. elegans* as a model of autosomal dominant polycystic kidney disease (ADPKD) and nephronophthisis. We have taken full advantage of *C. elegans* genetics and cell biology to address fundamental questions regarding cilia formation, morphogenesis, receptor trafficking, and function. Since our initial discovery over one decade ago that the *C. elegans* ADPKD gene products, the polycystins, localize to and function in cilia, the mammalian polycystins were found on renal primary cilia and shown to act as a flow sensor *in vitro*, and many human cystic kidney disease genes were cloned that affect cilia. My laboratory pioneered the use of *C. elegans* as a system to dissect the molecular mechanisms underlying ciliary receptor trafficking. We have continued to drive the field forward by identifying genes required for polycystin ciliary localization and function, as well as modifiers of the *C. elegans* kidney disease mutant phenotypes. Most of these worm genes have mammalian counterparts. Most recently, we discovered that *C. elegans* ciliated sensory neurons release polycystin-containing extracellular vesicles (ECVs) and that these ECVs function in animal communication. In humans and *C. elegans*, polycystin-1 and polycystin-2 act in the same genetic pathway, localize to cilia, are secreted in ECVs, and act in a sensory capacity, which makes the nematode an exceptional model to study the fundamental biology of polycystins, cilia, and ECVs. To our lab's expertise in molecular genetics, behavioral analysis, *in vivo* time-lapse imaging, and microscopy, we have added *in vivo* electrophysiological recording of neurons, single cell RNA-seq, and ECV biochemistry. The goal of this multidisciplinary approach is to provide deeper mechanistic insight to ciliary and ECV signaling, which has important implications for human development, sensory biology, and disease.

### B. Positions and Honors.

#### Positions and Employment

2000-2006	<b>Assistant Professor</b> , Pharmaceutical Sciences University of Wisconsin Madison
2006-2007	<b>Associate Professor with tenure</b> , Pharmaceutical Sciences University of Wisconsin
2007-2012	<b>Associate Professor with tenure</b> , Genetics Department, Rutgers University
2012-2013	<b>Visiting Scientist (sabbatical)</b> , Princeton University
2012-present	<b>Professor with tenure</b> , Genetics Department, Rutgers University

#### Honors and Awards

1986-1990	Douglass College Scholar, Rutgers University
1990	Summa cum laude
1990-1993	NIH Genetics and Development Training Grant
1996-1999	Howard Hughes Medical Institute Research Fellow
2005-2006	Teacher of the Year, 3 <sup>rd</sup> year Doctor of Pharmacy Program

#### Professional Activities and Organizations

-External Referee: NIH: Special Emphasis Panels and ad hoc reviewer 2001-present, CMBK study section, February 2004, October 2006; Ad hoc reviewer Biological Rhythms and Sleep (BRS) and Neuroendocrinology, Neuroimmunology and Behavior (NNB) study section, October 2008, February 2009; Shared Instrumentation S10 panel ZRG1 IMST-A(30); Ad hoc reviewer Nuclear and Cytoplasmic Structure/Function and Dynamics Study Section (NCSD) October 2012; Ad hoc reviewer KMBD Study Section February 2014; Alzheimers

Association: Ad hoc reviewer, 2003; The Wellcome Trust: Ad hoc reviewer, 2005; Polycystic Kidney Disease Foundation 2006 – 2008, 2014; European Commission FP7 evaluations, 2009

-Reviewer for American Journal of Physiology, BBA-Molecular Cell Research, Biochemistry, BMC Biology, Cell Research, Current Biology, Current Topics in Developmental Biology, Developmental Biology, Developmental Cell, Disease Models and Mechanisms, EMBO, Genetics, Human Molecular Genetics, Journal of the American Society of Nephrology, Journal of Cell Biology, Journal of Cell Science, Journal of Neurophysiology, Journal of Neuroscience, Molecular Biology of the Cell, Molecular and Cellular Neuroscience, Nature, Nature Genetics, Nature Protocols, PLoS Biology, PLoS Genetics, PLoS One, PNAS, Science, Traffic, Trends in Cell Biology, Trends in Neuroscience, Trends In Molecular Medicine

-Meeting Organizer, International *C. elegans* Neuroscience Meeting, Madison, WI (2006, 2008)

-Core Faculty, Summer Neurobiology Course Woods Hole Marine Biological Laboratory 2009; 2010

-Editorial Board, BMC Cell Biology 2009 – present

-FASEB Meeting on Cilia and Flagella: Vice organizer (2013), Organizer (2015)

### **C. Selected peer-reviewed publications (in chronological order).**

Barr, M.M. and Sternberg, P. (1999) A polycystic kidney-disease gene homologue required for male mating behaviour in *Caenorhabditis elegans*. Nature 401, 386-389. PMID:10517638

Qin, H., Rosenbaum, J.S., and Barr, M.M. (2001) An ARPKD gene homologue is involved in Intraflagellar transport in *C. elegans* ciliated sensory neurons. Current Biology, 11, 457-461. PMID:11301258

Barr, M.M., DeModena, J., Braun, D., Nguyen, C.Q., Hall, D.H. and Sternberg, P. (2001) The *Caenorhabditis elegans* autosomal dominant polycystic kidney disease gene homologs *lov-1* and *pkd-2* act in the same pathway, Current Biology 11, 1341-6. PMID:11553327

Hu, J. and Barr, M. M. (2005) The PLAT domain of LOV-1 interacts with ATP-2 to regulate polycystin signaling in *C. elegans*. Molecular Biology of the Cell 16, 458-469. PMCID: PMC545878

Peden, E. M. and Barr, M.M. (2005) KLP-6 is a Kinesin Required for Polycystin Ciliary Localization and Male Mating Behavior in *Caenorhabditis elegans*. Current Biology 5, 394-404. PMID:15753033

Jauregui, A.R. and Barr, M.M. (2005) Functional characterization of the *C. elegans* nephrocystins NPHP-1 and NPHP-4 and their role in cilia and male sensory behaviors. Exp Cell Res. 2005 May 1;305(2):333-42. PMID: 15817158

Qin, H., Burdette, D., Bae, Y.K., Forscher, P., Barr, M.M., and Rosenbaum, J.L. 2005. Intraflagellar transport is required for the vectorial movement of TRPV channels in the ciliary membrane. Current Biology 15, 1695-9. (co-corresponding author with J.L.Rosenbaum). PMID:16169494

Hu, J., Bae, Y.K., Knobel, K.M. and Barr, M.M. (2006) Regulation of ciliary sensory receptors by opposing activities of casein kinase II and calcineurin, Molecular Biology of the Cell, 17, 2200-11. PMCID: PMC1446073

Bae, Y.-K., Qin, H., Knobel, K.M., Hu, J., Rosenbaum, J.L. and Barr, M.M. (2006) General and cell type specific mechanisms target TRPP2/PKD-2 to cilia. Development 133, 3859-3870. PMID:16943275

Liu, T., Kim, K, Li, C., and Barr, M.M. (2007) Neuropeptide modulation of a sex-specific mechanosensory behavior in *C. elegans*. Journal of Neuroscience 27, 7174-82. PMID:17611271

Hu, J., Wittekind, S.G., and Barr, M.M. (2007) STAM and Hrs downregulate ciliary receptors and signaling in *C. elegans*. Molecular Biology of the Cell. 18(9):3277-89. PMCID: PMC1951776

Jauregui A.R., Nguyen, K.C., Hall, D.H., and Barr M.M. (2008) The *C. elegans* nephrocystins act as global modifiers of cilium structure. The Journal of Cell Biology. 180(5):973-88. PMCID: PMC2265406

Knobel, K.M. Peden, E.M. and Barr, M.M. (2009) Distinct protein domains regulate ciliary targeting and function of *C. elegans* PKD-2. Exp Cell Res. 2008 February 15; 314(4): 825–833. PMCID: PMC2275051

Bae, Y.-K., Lyman-Gingerich, J., Barr, M.M., and Knobel, K.M. Identification of genes involved in the ciliary trafficking of *C. elegans* PKD-2. Developmental Dynamics. Aug;237(8):2021-9. PMCID: PMC3118579

Bae, Y.-K., Kim, E., L'Hernault, S.W., and Barr, M.M. (2009) The CIL-1 phosphoinositide 5-phosphatase regulates ciliary localization of the TRP polycystins and sperm function in *C. elegans*. Current Biology, Oct 13;19(19):1599-607. Epub 2009 Sep 24. PMCID: PMC2762383

Wang, J., Schwartz, H.T., and Barr, M.M. (2010) Functional specialization of Sensory Cilia by an RFX transcription Factor Isoform. Genetics, 186(4):1295-307. PMCID: PMC2998312

Morsci, N. and Barr, M.M. (2011) Kinesin-3 KLP-6 regulates intraflagellar transport in male-specific cilia of *Caenorhabditis elegans*. Current Biology 21:1239-44. PMCID: PMC3143291

Morsci NS, Haas LA, Barr MM. (2011) Sperm status regulates sexual attraction in *C. elegans*. Genetics 189:1341-6. PMCID: PMC324141

- O'Hagan, R., Piasecki, B., Silva, M., Phirke, P., Nguyen, K., Hall, D.H., Swoboda, P., and Barr, M.M. (2011) The Tubulin Deglutamylase CAPP-1 Regulates the Function and Stability of Sensory Cilia in *C. elegans*. *Current Biology*, *Current Biology* 21:1685-94. PMID:2198259
- Warburton-Pitt S.R., Jauregui A.R., Li C., Wang J., Leroux M.R., and Barr M.M. (2012) Ciliogenesis in *Caenorhabditis elegans* requires genetic interactions between ciliary middle segment localized NPHP-2 (inversin) and transition-zone associated proteins. *J Cell Sci* 125(11): 2592-603. PMCID: PMC3403231
- Barrios, A., Ghosh, R., Fang, C. Emmons, S.W. and Barr, M.M. (2012) PDF-1 neuropeptide signaling modulates a neural circuit for mate searching behavior in *C. elegans*. *Nature Neuroscience* 15(12): 1675-82. PMCID: PMC3509246
- Schroeder, N.E., Androwski, R.J., Rashid, A., Lee, H., Lee, J., and Barr, M.M. (2013) Dauer specific dendrite arborization in *C. elegans* is regulated by KPC-1/Furin. *Current Biology* 23: 1-9. PMID:23932402
- Wang, J., Silva, M., Haas, L.A., Morsci, N.S., Nguyen, K.C., Hall, D.H., and Barr, M.M. (2014) *C. elegans* ciliated neurons release extracellular vesicles that function in animal communication. *Current Biology*, 24(5):519-25. PMID:24530063

#### Invited Reviews and Book Chapters

- Barr, M.M. (2003) Super Models. *Physiol. Genomics*,13(1):15-24. PMID:12644630
- Barr, M.M. and Wang, J. (2003) Book chapter and cover image: "RNAi in *Caenorhabditis elegans*" in "RNA interference Nuts and Bolts," ed. David R. Engelke, DNA Press.
- Barr, M.M. and Hu, J. (2004) Book chapter "Molecular Basis for Behavior" in "Nematode Behavior," ed. Randy Gaugler, CABI press
- Wang, J. and Barr, M.M. (2005) "RNA interference in *C. elegans*." *Methods in Enzymology*, 392, 36-55. PMID:15644174
- Barr, M.M. (2005) *C. elegans* as a Model of Renal Development and Disease: Sexy Cilia. *Journal of the American Society for Nephrology* 16, 305-312. PMID:15647338
- Barr, M.M. and Garcia, L.R. (2006) Book Chapter "Male mating behavior" in "WormBook," ed. Martin Chalfe, Electronic publication. [www.wormbook.org](http://www.wormbook.org). PMID:18050467
- Xu, X.Z. and Barr, M.M. (2007) Book Chapter "TRP channels functioning in *C. elegans* mating and fertilization" in "TRP ion channel function in sensory transduction and cellular signaling cascades." eds. Stefan Heller and Wolfgang Liedtke, CRC Press.
- Bae, Y.-K., and Barr, M.M. (2008) "Sensory roles of neuronal cilia: cilia development, morphogenesis, and function in *C. elegans*." *Front Biosci*. May 1;13:5959-74. Review. PMCID: PMC3124812
- O'Hagan, R. and Barr, M.M. (2012) "Regulation of tubulin glutamylation plays cell-specific roles in the function and stability of sensory cilia." *Worm* 1(3). July/August/September 2012. Invited commentary. <http://www.landesbioscience.com/journals/worm/article/19539/> PMCID: PMC3670407
- Sengupta, P. and Barr, M.M. (2014). New insights into an old organelle: Meeting report on Biology of Cilia and flagella. *Jun*;15(6):717-26. PMID:24612344
- Silva, M. and Barr, M.M. (2014). Tomography gives new dimension to an ancient organelle. *eLife*,3:e02589. DOI: 10.7554/eLife.02589. PMCID: PMC3965212
- Barr, M.M. (2014). Guest editor for special topics issue. Editorial: *C. elegans* male mating behavior. *Semin Cell Dev Biol*. Jun 12. pii: S1084-9521(14)00179-7. doi: 10.1016/j.semcdb.2014.06.006. [Epub ahead of print] PMID:24930770
- O'Hagan, R., Wang, J., and Barr, M.M. (2014). Mating Behavior, Male Sensory Cilia, and Polycystins in *C. elegans*. *Semin Cell Dev Biol*. Jun 27. pii: S1084-9521(14)00174-8. doi: 10.1016/j.semcdb.2014.06.001. [Epub ahead of print] PMID:24977333

#### **D. Active Research Support**

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| 1) | Title: Polycystins and Cilia in <i>C. elegans</i><br>Agency: NIH/NIDDK Type: R01 DK59418         | Principal Investigator: Maureen M. Barr, Ph.D.<br>Period: 05/01/01-03/31/15   |
| 2) | Title: A model for Nephronophthisis in <i>C. elegans</i><br>Agency: NIH/NIDDK Type: R01 DK074746 | Principal Investigator: Maureen M. Barr, Ph.D.<br>Period: 04/01/06 - 07/31/15 |