

## Patrick R. Secor, Ph.D.

Assistant Professor  
Division of Biological Sciences  
University of Montana  
32 Campus Dr., Health Sciences Building 104, Missoula, MT 59812

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### Education

Ph.D., Biological Sciences Department of Cell Biology & Neuroscience Center for Biofilm Engineering Montana State University	2011
B.S., Biochemistry Montana State University, cum laude	2006

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### Research Experience

Assistant Professor University of Montana Division of Biological Sciences Center for Biomolecular Structure and Design Center for Translational Medicine	2017 - present
Postdoctoral Fellow University of Washington Department of Microbiology Mentor: Pradeep K. Singh, MD	2013 - 2017
Postdoctoral Fellow University of Washington Department of Medicine Division of Pulmonary and Critical Care Medicine Mentor: William C. Parks, PhD	2011 - 2013
Technician Montana State University Department of Chemistry and Biochemistry Mass Spectrometry Facility Principal Investigator: Brian Bothner, PhD	2010 - 2011
Doctoral Research Montana State University Center for Biofilm Engineering Mentor: Garth A. James, PhD	2006 - 2010
Undergraduate Research Assistant Montana State University Center for Biofilm Engineering Principal Investigator: Garth A. James, PhD	2004 - 2006

Undergraduate Research Assistant Montana State University Department of Microbiology Principal Investigator: Barry H. Pyle, PhD	2003 - 2004
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### Awards and Honors

Searle Scholar Nominee University of Montana	2018
Young Investigator Award Center for Biofilm Engineering, Montana State University	2018
Young Investigator Award Center for Biomolecular Structure and Design, University of Montana	2017
NIH/NIAID Career Transition Award (K22)	2016
The Charlie Moore Endowed Fellowship for Cystic Fibrosis Research	2016
Cystic Fibrosis Foundation (National) Postdoctoral Fellowship	2015 - 2017
Cystic Fibrosis Foundation Fellowship, Seattle Chapter	2013 - 2014
W.G. Characklis Scholarship for Outstanding Ph.D. Student	2009
Best Poster Award Montana Biofilm Meeting, Montana State University	2009
INBRE Undergraduate Research Fellowship Montana State University	2006 - 2008
Undergraduate Scholar Program Scholarship Montana State University	2005 - 2006
Dean's Honor Roll, Montana State University	2003 - 2006

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### Funding

#### Active

NIH/NIAID R01AI138981 (PI) Immunization against filamentous bacteriophages to prevent bacterial infection Initial submission funded. \$5,357,374 in total funds.	2018 - 2023
University of Montana Genomics Core-Illumina Mini-Grant (PI) Genome reduction in filamentous bacteriophage \$7,000 direct	2018
Dr. Ralph and Marian Falk Medical Research Trust – Catalyst Award (Co-I) \$1,000,000 total funds over two years.	2017 - 2019
NIH/NIGMS CBSD COBRE P20GM103546 (PI on subaward) Young Investigator Award \$335,760 direct over three years.	2017 - 2020
NIH/NIAID Career Transition Award K22AI125282 (PI) Understanding polymer-induced bacterial aggregation and antimicrobial tolerance Received a perfect priority score of 10, \$250,000 direct over two years.	2017 - 2019

**Completed**

The Charlie Moore Endowed Fellowship for Cystic Fibrosis Research \$10,000 to support my CF related research.	2016
Cystic Fibrosis Foundation (National) Postdoctoral Fellowship	2015 - 2017
Cystic Fibrosis Foundation Fellowship, Seattle Chapter	2013 - 2014
Stanford University Immunology Training Grant 5T32AI007290-29 (NIH/NIAID)	2013, awarded, but declined
University of Washington Pulmonary Training Grant 5T32HL007287-33 (NIH/NHLBI)	2011 - 2013

**Peer Reviewed Publications**

\*Indicates corresponding author

**Secor P.R.\***, Michaels, L.A., Ratjen, A., Jennings, L.K., Singh, P.K. Entropically-driven aggregation of bacteria by host polymers promotes antibiotic tolerance in *Pseudomonas aeruginosa*. **Proc Natl Acad Sci USA**, Oct 2018, 201806005; DOI:10.1073/pnas.1806005115

Jorth, P.A., McLean, K., Ratjen, A., **Secor, P.R.**, Bautista, G.E., Ravishankar, S., Rezayat, A., Garudathri, J., Harrison, J.J., Harwood, R.A., Penewit, K., Waalkes, A., Singh, P.K., Salipante, S.J. (2017) Evolved aztreonam resistance is multifactorial and can produce hypervirulence in *Pseudomonas aeruginosa*. **mBio**, 8:e00517-17.

Nazik, H., Joubert, L.M., **Secor, P.R.**, Sweere, J.M., Bollyky, P.L., Sass, G., Cegelski, L., Stevens, D.A. (2017) *Pseudomonas* Phage Inhibition of *Candida albicans*. **Microbiology**, 163 (11), 1568-1577.

**Secor P.R.\***, Sass G, Nazik H, Stevens DA. (2017) Effect of acute predation with bacteriophage on intermicrobial aggression by *Pseudomonas aeruginosa*. **PLoS One**. 16;12(6):e0179659. doi: 10.1371/journal.pone.0179659. PubMed PMID: 28622385

**Secor, P.R.\***, Michaels, L.A., Smigiel, K.S., Rohani, M.G., Jennings, L.K., Hisert, K.B., Arrigoni, A., Braun, K.R., Birkland, T.P., Hallstrand, T.S., Lai, Y., Bollyky, P.L., Singh, P.K., Parks, W.C. (2017) Filamentous bacteriophage produced by *Pseudomonas aeruginosa* alters the inflammatory response and promotes non-invasive infection *in vivo*. **Infection and Immunity**, vol. 85, issue 1  
Featured on journal cover

Penner, J.C., Ferreira, J.A.G., **Secor, P.R.**, Sweere, J.M., Birukova, M.K., Joubert, L.M., Haagensen, J.A.J., Garcia, O., Malkovskiy, A.V., Kaber, G., Nazik, H., Manasherob, R., Spormann, A.M., Clemons, K.V., Stevens, D.A., Bollyky, P.L. (2016) Pf4 Bacteriophage Produced by *Pseudomonas aeruginosa* Inhibits *Aspergillus fumigatus* Metabolism via Iron Sequestration. **Microbiology**, 162, 1583-1594

**Secor, P.R.\***, Jennings, L.K., Michaels, L.A., Sweere, J.M., Singh, P.K., Parks, W.C., Bollyky, P.L. (2016) Biofilm assembly becomes crystal clear – filamentous bacteriophage organize the *Pseudomonas aeruginosa* biofilm matrix into a liquid crystal. **Microbial Cell**, 3(1): 49-52  
Featured on journal cover

**Secor, P.R.\***, Sweere, J.M., Michaels, L.A., Malkovskiy, A.V., Lazzareschi, D., Katznelson, E., Rajadas, J., Birnbaum, M.E., Arrigoni, A., Braun, K.R., Evanko, S.P., Stevens, D.A., Kaminsky, W., Singh, P.K., Parks, W.C., Bollyky, P.L. (2015) Filamentous Bacteriophage Promote Biofilm Assembly and Function. **Cell Host & Microbe**, 18(5): 549-59

- Jennings L.K., Storek K.M., Ledvina H.E., Coulon C., Marmont L.S., Sadovskaya I., **Secor, P.R.**, Tseng B.S., Scian M., Filloux A., Wozniak D.J., Howell P.L., Parsek M.R. (2015) Pel is a cationic exopolysaccharide that cross-links extracellular DNA in the *Pseudomonas aeruginosa* biofilm matrix. **Proc Natl Acad Sci USA**, 112(36): 11353-8
- Secor, P. R.\***, Jennings, L. K., James, G. A., Kirker, K. R., Pulcini, E. D., McInerney, K., Gerlach, R., Livinghouse, T., Hilmer, J. K., Bothner, B., Fleckman, P., Olerud, J. E., Stewart, P. S. (2012) Phevalin (aureusimine B) production by *Staphylococcus aureus* biofilm and impacts on human keratinocyte gene expression, **PLoS One** 7(7) e40973
- Secor, P. R.\***, James, G. A., Fleckman, P., Olerud, J. E., McInerney, K., and Stewart, P.S. (2011) *Staphylococcus aureus* Biofilm and Planktonic cultures differentially impact gene expression, MAPK phosphorylation, and cytokine production in human keratinocytes. **BMC Microbiol**, 11:143
- Kirker, K.R., **Secor, P.R.**, James, G.A, Fleckman, P., Olerud, J.E., Stewart, P.S., (2009) Loss of viability and induction of apoptosis in human keratinocytes exposed to *Staphylococcus aureus* biofilms in vitro. **Wound Repair Regen**, 17(5): 690-9
- Dowd, S.E., Sun, Y., **Secor, P.R.**, Rhoads, D.D., Wolcott, B.M., James, G.A., Wolcott, R.D. (2008) Survey of bacterial diversity in chronic wounds using pyrosequencing, DGGE, and full ribosome shotgun sequencing. **BMC Microbiol**, 8: 43
- James, G.A., Swogger, E., Wolcott, R., Pulcini, E., **Secor, P.R.**, Sestrich, J., Costerton, J.W., Stewart, P.S. (2008) Biofilms in chronic wounds. **Wound Repair Regen**, 16(1): 37-44  
Cited over 1,000 times

### Manuscripts under review / in preparation

- Johanna M. Sweere, Heather Ishak, Michelle S. Bach, Vivekananda Sunkari, Gernot Kaber, Robert Manasherob, Gina A. Suh, Medeea Popescu, Payton L. Marshall, Maria Birukova, Ethan Katznelson, Daniel V. Lazzareschi, Swathi Balaji, Sundeep Keswani, Thomas R. Hawn, **Patrick R. Secor**, and Paul L. Bollyky. Filamentous Bacteriophage Suppress Clearance of Bacterial Infection. Under review. Revisions were requested by the Editor, June 2018.
- Elizabeth Burgener, Johanna M. Sweere, Michelle S. Bach, **Patrick R. Secor**, Lu Tian, Paul L. Bollyky, C. E. Milla. Pf bacteriophage are associated with poor lung function in patients with cystic fibrosis. Under review. Revisions were requested by the Editor, September 2018.
- Michelle S. Bach, Johanna M. Sweere, Elizabeth B. Burgener, **Patrick R. Secor**, Paul L. Bollyky, and Gina A. Suh. Pf Bacteriophage Promote Poor Clinical Outcomes in *Pseudomonas aeruginosa* Human Wound Infections. In preparation.

### Service and Outreach

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| Ad hoc reviewer, <i>eLife</i>                                                             | 2018 - present |
| Promoting Enrichment Activities for Kids (PEAK) Outreach Program<br>University of Montana | 2018           |
| Center for Translational Medicine Faculty Advisory Council<br>University of Montana       | Jan. 2018      |
| Harkins High School Science Fusion Lecturer<br>University of Montana                      | Oct. 2017      |

Graduate Admissions Committee University of Montana	Sept. 2017
Microbiology Curriculum Advisory Committee University of Montana	Aug. 2017
Ad hoc reviewer, <i>Cell Host &amp; Microbe</i>	2017 - present
Laser Scanning Confocal Microscopy Workshop Montana Biofilm Meeting, Montana State University	bi-annual, 2007 - 2010
American Indian Research Opportunities (AIRO) Program Montana State University	2007 - 2009
Promoting Enrichment Activities for Kids (PEAK) Outreach Program Helena, MT public schools	2007

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### Teaching Experience

BIOM 450/451, Microbial Physiology and Lab University of Montana	Fall 2018
HMI Summer Institute on Scientific Teaching	Summer 2018
Guest lecturer University of Montana BIOM 410 Microbial Genetics	Spring 2018
Co-Instructor Montana State University Microbes in the Environment	Spring, 2010
Teaching Assistant Montana State University Molecules to Cells	2007 - 2008

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### Patents

Monoclonal antibody and vaccine targeting filamentous bacteriophage  
U.S. Patent applications 62/027,698 and 62/027,713

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### Conference Activity

Center for Biomolecular Structure and Dynamics Research Symposium Seeley Lake, MT, speaker	2018
Montana Biofilm Meeting Center for Biofilm Engineering, Bozeman, MT, speaker	2018
Pacific Northwest Epithelial Biology Meeting Seattle, WA, speaker	2016
Cystic Fibrosis Foundation Retreat Seattle, WA, speaker	2016

Gordon Research Conference: Microbial Stress Responses South Hadley, MA, poster	2016
North American Cystic Fibrosis Conference Phoenix, AZ, speaker	2015
North American Cystic Fibrosis Conference Atlanta, GA, speaker	2014
Cystic Fibrosis Foundation Retreat Seattle, WA, speaker	2012
5 <sup>th</sup> American Society for Microbiology Conference on Biofilms Cancun, Mexico, poster	2009
4 <sup>th</sup> American Society for Microbiology Conference on Biofilms Quebec City, Quebec, Canada, poster	2007
Montana Biofilm Meeting Bozeman, MT, speaker	2006 - 2010

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### Invited Oral Presentations

Department of Microbiology and Immunology Seminar Series Bozeman, MT Montana State University “Bacteriophage as virulence determinants in <i>Pseudomonas aeruginosa</i> ”	Invited, Spring 2019
Center for Biomolecular Structure and Dynamics Research Symposium Seeley Lake, MT, speaker University of Montana “A bacteriophage regulates virulence factor production by <i>P. aeruginosa</i> ”	2018
Montana Biofilm Meeting Bozeman, MT Center for Biofilm Engineering, Montana State University “A bacteriophage integrase regulates virulence factor production by <i>P. aeruginosa</i> ”	2018
Organismal Biology, Ecology, and Evolution Brewery Chalk Talk Series Missoula, MT University of Montana “Genome reduction in bacteriophage”	2018
Harkins High School Science Fusion Lecture Missoula, MT University of Montana “When bacteria get sick—How virus–bacteria interactions affect infection”	2017
CBSD COBRE Symposium Missoula, MT University of Montana “Tolerating a crowd: Defining how macromolecular crowding promotes antibiotic tolerance”	2017

Pacific Northwest Epithelial Biology Meeting Seattle, WA University of Washington "Filamentous bacteriophage promote a non-invasive infection phenotype <i>in vivo</i> "	2016
Cystic Fibrosis Foundation Retreat Seattle, WA University of Washington "Entropically-driven bacterial aggregation promotes antibiotic tolerance in <i>Pseudomonas aeruginosa</i> "	2016
North American Cystic Fibrosis Conference Phoenix, AZ "Host and microbial polymers passively aggregate CF pathogens producing resistance to killing and promoting interspecies interactions"	2015
North American Cystic Fibrosis Conference Atlanta, GA "Host conditions can produce the non-invasive and resistant phenotype of CF infections"	2014
Cystic Fibrosis Foundation Retreat Seattle, WA University of Washington "Filamentous bacteriophage as structural components of <i>Pseudomonas aeruginosa</i> biofilms"	2012
Montana Biofilm Meeting Bozeman, MT Montana State University "Keratinocytes produce pro-inflammatory markers during <i>S. aureus</i> biofilm infection"	2010
Montana Biofilm Meeting Bozeman, MT Montana State University "Host-pathogen interactions in an <i>in vitro</i> chronic wound model"	2009
Montana Biofilm Meeting Bozeman, MT Montana State University "Molecular characterization of wound biofilm communities"	2008
Montana Biofilm Meeting Bozeman, MT Montana State University "The impacts of <i>S. aureus</i> biofilm on keratinocyte morphology"	2008
Molecular Probes, Invitrogen Eugene, OR "Host-pathogen interactions in an <i>in vitro</i> chronic wound model"	2008
Montana Biofilm Meeting Bozeman, MT Montana State University "Molecular biology of chronic wound biofilms"	2007

Montana Biofilm Meeting

Bozeman, MT

Montana State University

“Community analysis of chronic wounds using molecular techniques”

2006