

PATRICK R. SECOR

University of Montana
Division of Biological Sciences – CMMB Graduate Program – Center for Translational Medicine
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ACADEMIC APPOINTMENTS

- 2017- present University of Montana
Assistant Professor
Division of Biological Sciences
CMMB Graduate Program
Center for Translational Medicine
- 2013-2017 University of Washington
Cystic Fibrosis Foundation Postdoctoral Fellow
Advisor: Pradeep K. Singh
- 2011-2013 University of Washington
NIH T32 Postdoctoral Fellow
Advisor: William C. Parks

EDUCATION

- 2006-2011 Montana State University
Center for Biofilm Engineering
Ph.D. in Biological Sciences/Microbiology
Advisor: Garth A. James
- 2002-2006 Montana State University
B.S. in Biochemistry, *cum laude*

PEER REVIEWED PUBLICATIONS

Link: [Google Scholar](#)

Cited >4,000 times, h-index 17

*Graduate student co-author, **Undergraduate co-author, ***Postdoc co-author
#P. R. Secor listed as corresponding author

- 2022 (27) M. S. Bach, C. R. de Vries, A. Khosravi, J. M. Sweere, M. C. Popescu, Q. Chen, S. Demirdjian, A. Hargil, J. D. Van Belleghem, G. Kaber, M. Hajfathalian, E. B. Burgener, D. Liu, Q. Tran, T. Dharmaraj, M. Birukova, V. Sunkari, S. Balaji, N. Ghosh, S. S. Steiner, M. S. El Masry, S. G. Keswani, N. Banaei, L. Nedelec, C. K. Sen, V. Chandra, **P. R. Secor**, G. A. Suh, P. L. Bollyky. Filamentous bacteriophage delays healing of *Pseudomonas*-infected wounds. *Cell Reports Medicine*, Vol 3, Issue 6, June 2022, <https://doi.org/10.1016/j.xcrm.2022.100656>
- (26) **Secor, P. R.**[#], Michaels, L. A., Bublitz, D.C., Jennings, L.K., Singh, P.K. (2022). The Depletion Mechanism Actuates Bacterial Aggregation by Exopolysaccharides and Determines Species Distribution & Composition in Bacterial Aggregates. *Front. Cell. Infect. Microbiol.* <https://doi.org/10.3389/fcimb.2022.869736>
- (25) Faith, D*., Kinnersley, M., Schwartzkopf, C.M*., de Mattos, C.D*., Schmidt, A.K*., and **Secor, P.R.**[#]. (2022). Complete Genome Sequence of the N4-like *Pseudomonas*

aeruginosa Bacteriophage vB_PaeP_CMS1. **Microbiol Resour Announc**, e0023922. 10.1128/mra.00239-22.

(24) van Rossem, M., Wilks, S., Kaczmarek, M., **Secor, P.R.**, and D'Alessandro, G. (2022). Modelling of filamentous phage-induced antibiotic tolerance of *P. aeruginosa*. **PLoS One** 17, e0261482. 10.1371/journal.pone.0261482.

(23) A.K. Schmidt*, A.D. Fitzpatrick, C. S. Schwartzkopf*, D.R. Faith*, L.K. Jennings, A. Coluccio, D.J. Hunt**, L.A. Michaels, D.W. Dorward, J. Wachter, P.A. Rosa, K.L. Maxwell, **P.R. Secor**[#]. A Filamentous Bacteriophage Protein Inhibits Type IV Pili to Prevent Superinfection of *Pseudomonas aeruginosa*. **mBio**, 2022; <https://doi.org/10.1128/mbio.02441-21>

2021

(22) Kirsch JM, Brzozowski RS***, Faith D.R.*, Round JL, **Secor PR**, Duerkop BA. Bacteriophage-Bacteria Interactions in the Gut: From Invertebrates to Mammals. **Annu Rev Virol.** 2021;8(1):95-113. doi:10.1146/annurev-virology-091919-101238.

(21) Jennings LK, Dreifus JE, Reichhardt C, Storek KM, **Secor PR**, Wozniak DJ, Hisert KB, Parsek MR. *Pseudomonas aeruginosa* aggregates in cystic fibrosis sputum produce exopolysaccharides that likely impede current therapies. **Cell Rep.** 2021;34(8):108782. doi: 10.1016/j.celrep.2021.108782.

2020

(20) E. B. Burgener, **P. R. Secor**, M. C. Tracy, J. M. Sweere, E. M. Bik, C. E. Milla, and P. L. Bollyky. Methods for Extraction and Detection of Pf Bacteriophage DNA from the Sputum of Patients with Cystic Fibrosis, **Phage: Therapy, Applications, and Research**, June 2020, doi.org/10.1089/phage.2020.0003

(19) **P. R. Secor**[#] and A. A. Dandekar, More than Simple Parasites: The Sociobiology of Bacteriophages and Their Bacterial Hosts. **mBio**, March 10, 2020, <https://mbio.asm.org/content/11/2/e00041-20>

(18) **P. R. Secor**, E B Burgener, M Kinnersley, L K Jennings, V Roman-Cruz*, M Popescu, J D Van Belleghem, N Haddock, C Copeland**, L A Michaels, C R De Vries, Q Chen, J Pourtois, T J Wheeler, C E Milla, P L Bollyky, Pf Bacteriophage and Their Impact on *Pseudomonas* Virulence, Mammalian Immunity, and Chronic infections. **Front. Immunol.**, 21 February 2020 doi.org/10.3389/fimmu.2020.00244

2019

(17) J M. Sweere, H Ishak, V Sunkari, M S. Bach, R Manasherob, K Yadava, S. M. Ruppert, C. K. Sen, S Balaji, S. G. Keswani, **P. R. Secor**, and Paul L. Bollyky. (2019) The Immune Response to Chronic *Pseudomonas aeruginosa* Wound Infection in Immunocompetent Mice. **Advances in Wound Care**, Vol. 8.

(16) E. B. Burgener, J. M. Sweere, M. S. Bach, **P. R. Secor**, N Haddock, L. K. Jennings, R. L. Marvig, H. K. Johansen, E. Rossi, X. Cao, L. Tian, L. Nedelec, S. Molin, P. L. Bollyky, and C. E. Milla. (2019) Filamentous bacteriophages are associated with chronic *Pseudomonas* lung infections and antibiotic resistance in cystic fibrosis. **Science Translational Medicine**, Vol. 11, Issue 488, eaau9748

(15) J. M. Sweere, H. Ishak, M. S. Bach, V. Sunkari, G. Kaber, R. Manasherob, G. A. Suh, M. Popescu, P. L. Marshall, M. Birukova, E. Katznelson, D. V. Lazzareschi, S. Balaji, S. Keswani, T. R. Hawn, **P. R. Secor**, and P. L. Bollyky. (2019) Filamentous Bacteriophage Suppress Clearance of Bacterial Infection. **Science**, Vol. 363, Issue 6434, eaat9691.

2018

(14) **P. R. Secor**[#], M., L.A., Ratjen, A., Jennings, L.K., Singh, P.K. Entropically-driven aggregation of bacteria by host polymers promotes antibiotic tolerance in *Pseudomonas aeruginosa*. **PNAS**, Oct 2018, 201806005; DOI:10.1073/pnas.1806005115

2017

(13) 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

(12) 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

(11) **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

(10) **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.

2016

(9) 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

(8) **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

2015

(7) **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

(6) 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. **PNAS**, 112(36): 11353-8

2012

(5) **Secor, P. R.** #, Jennings, L. K., James, G. A., Kirker, K. R., Pulcini, E. D., McInnerney, 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

2011

(4) **Secor, P. R.** #, James, G. A., Fleckman, P., Olerud, J. E., McInnerney, 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

2009

(3) 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

2008

(2) 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

(1) 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 1,600 times.

PREPRINTS & INVITED COMMENTARIES

- 2022 C. D. de Mattos*, A. A. Nemudryi, D. Faith*, D. C. Bublitz, L. Hammond, M. A. Kinnerley, C. M. Schwartzkopf*, A. J. Robinson**, A. Joyce**, L. A. Michaels, R. S. Brzozowski***, A. Coluccio, D. D. Xing, J. Uchiyama, L. K. Jennings, P. Eswara, B. Wiedenheft, **P. R. Secor**. Bacterial threat assessment of bacteriophage infection is mediated by intracellular polyamine accumulation and Gac/Rsm signaling. *bioRxiv*. 2022, <https://doi.org/10.1101/2022.04.01.486733>
- 2021 **Secor, P. R.**, Michaels, LA, Bublitz, DC, Jennings, LK, Singh, PK. The depletion mechanism can actuate bacterial aggregation by self-produced exopolysaccharides and determine species distribution and composition in bacterial aggregates. *bioRxiv*. 2021, doi.org/10.1101/2021.05.11.443568
- 2020 Bach MS, Vries CRd, Sweere JM, Popescu M, Belleghem JDV, Kaber G, Burgener EB, Liu D, Tran Q-L, Dharmaraj T, Birukova M, Sunkari V, Balaji S, Keswani S, Banaei N, Khona DK, Nedelec L, Sen CK, Chandra V, **Secor P. R.**, Suh GA, Bollyky PL. Filamentous Bacteriophage Delay Healing of *Pseudomonas*-Infected Wounds. *bioRxiv*. 2020, doi.org/10.1101/2020.03.10.985663
- 2019 Bollyky, P.L. and **Secor, P.R.** (2019) The Innate Sense of Bacteriophages. *Cell Host & Microbe*, 25(2).

FUNDING

- 2022 – 2024 NIH/NIAID Administrative Supplement to contract HHSN272201800048C (PI: Evans, JT, **Co-I Secor, PR**), Adjuvanted Lyme disease vaccine. \$1M direct
- 2022 – 2023 NIH/INBRE Faculty Research Grant (**PI Secor, PR**)
Defining the immunogenicity of tick saliva in mice and men. \$50k direct.
- 2022 – 2023 NIH/NIGMS COBRE **P30** GM140963 (PI: Bowler, B, Subaward PI: **Secor, PR**), Pilot Award, Structural variation of small phase proteins. \$35k direct
- 2020 – 2024 NIH/NIDDK **R01** DK124317 (PI: Round, J.L., **Co-I Secor, PR**), Bacteriophage pathobiology of inflammatory bowel disease. \$2,539,200 total
- 2020 – 2022 NIH/NIAID **R21** AI151597 (**PI: Secor, PR**), Targeting a ubiquitous spirochete bacteriophage to prevent Lyme disease. \$275k direct
- 2018 – 2023 NIH/NIAID **R01** AI138981 (**PI: Secor, PR**), Immunization against filamentous bacteriophages to prevent bacterial infection. \$5,618,222 total
- 2018 University of Montana Genomics Core–Illumina Mini-Grant (**PI, Secor, P.R.**). \$5k direct
- 2017 – 2021 NIH/NIGMS COBRE **P30** GM140963 (PI: Sprang, S, Subaward PI: **Secor, PR**) Young Investigator Award. \$300k direct
- 2017 – 2020 NIH/NIAID Career Transition Award **K22** AI125282 (**PI: Secor, PR**)
Understanding polymer-induced bacterial aggregation and antimicrobial tolerance. \$250k direct
- 2017 – 2019 Dr. Ralph and Marian Falk Medical Research Trust – Catalyst Award (PI Bollyky, P.L.). \$1M direct
- 2016 The Charlie Moore Endowed Fellowship for Cystic Fibrosis Research, \$10,000 direct.
- 2015 – 2017 Cystic Fibrosis Foundation (National) Postdoctoral Fellowship
- 2013 – 2014 Cystic Fibrosis Foundation Fellowship, Seattle Chapter, Postdoctoral Fellowship
- 2013 Stanford University Immunology Postdoctoral Training Grant, awarded, but declined **5T32** AI007290-29 (NIH/NIAID)

2011 University of Washington Pulmonary Postdoctoral Training Grant
5T32 HL007287-33 (NIH/NHLBI)

OTHER AWARDS

2021 Faculty Merit Award for outstanding research productivity, University of Montana
2020 Faculty Merit Award for outstanding research productivity, University of Montana
2020 Co-moderator, Life at the Cutting Edge, ASM Microbe, Chicago, IL (canceled, COVID-19)
2018 Searle Scholar Nominee, University of Montana
2018 Young Investigator Award, Center for Biofilm Engineering, Montana State University
2017 Young Investigator Award, Center for Biomolecular Structure and Design, University of Montana
2016 NIH/NIAID Career Transition Award (K22)
2016 The Charlie Moore Endowed Fellowship for Cystic Fibrosis Research
2015-2017 Cystic Fibrosis Foundation (National) Postdoctoral Fellowship
2013-2014 Cystic Fibrosis Foundation Postdoctoral Fellowship, Seattle Chapter
2009 W.G. Characklis Scholarship for Outstanding Ph.D. Student

INTELLECTUAL PROPERTY

2020 US Patent App. 63/078,777; Compositions and Methods Targeting Filamentous Bacteriophage.
2019 US Patent 10,835,607 - Monoclonal antibody and vaccine targeting filamentous bacteriophage.

TEACHING

Fall 2018-present Instructor, Microbial Physiology (plus lab) BIOM 450/451, University of Montana
Spring 2020 Co-instructor, The Diversity of Life BIOB 170, University of Montana
Summer 2018 HHMI Summer Institute on Scientific Teaching
Spring 2010 Co-instructor, Microbes in the Environment, Montana State University
2007-2008 Teaching Assistant, Molecules to Cells, Montana State University

MENTORING

Graduate students Camilla de Mattos, 5th year PhD candidate
Valery Roman-Cruz, 5th year PhD candidate (co-advised with Dr. Jay Evans)
Caleb Schwartzkopf, 4th year PhD candidate
Amelia Schmidt, 2nd year PhD student
Dominick Faith, 1st year PhD student
Postdocs Dr. Robert Brzozowski, 3rd year postdoc
Research Faculty Dr. Laura Jennings
Dr. Margie Kinnersley
Dr. DeAnna Bublitz

OUTREACH

2018-2020 My lab has hosted multiple high school students through the local Advanced Problems in Science Program. Students work on a research project for an entire semester and then share their findings with their peers and at a poster session at the University of Montana.
2018 & 2019 My lab hosted scientific outreach activities with the Ray Bjork Learning Center's PEAK Program for gifted and talented elementary-aged children.
2017 Harkins High School Science Fusion Lecture, University of Montana

2009-2011 Instructor, American Indian Research Opportunities (AIRO) educational outreach program for Native American students interested in STEM-based careers, Montana State University

INVITED SEMINARS, CONFERENCES, & SYMPOSIUMS

Upcoming Nov. 2022 Departmental Seminar, Department of Plant and Microbial Biology at UC Berkeley, host Kimberley Seed, PhD

2022 Thinking like a microbe: a tribute to Stanley Falkow symposium, NIH Division of Intramural Research, NIAID Rocky Mountain Laboratories, Hamilton, MT

2022 18th International Conference on *Pseudomonas*, Atlanta, Georgia

2021 Center for Biomolecular Structure and Dynamics Research Symposium, University of Montana

2020 University of Denver Anschutz Microbiology Seminar Series

2020* American Society for Microbiology 2020 Microbe Meeting, Co-moderator, in-depth symposium Life at the Cutting Edge *cancelled, covid

2020 *Pseudomonas* Seminar Series, online seminar series organized by Urvish Trivedi (University of Copenhagen) and Cassandra Nelson (University of Maryland).

2019 NIH Rocky Mountain Laboratories Summer Research Symposium, Hamilton, MT

2019 University of Utah Department of Pathology Seminar Series, University of Utah

2019 Division of Biological Sciences Seminar Series, University of California, San Diego

2019 Department of Microbiology and Immunology Seminar Series, Montana State University

2019 Integrative Microbiology Seminar Series, University of California, San Francisco

2019 Center for Biomolecular Structure and Dynamics Research Symposium, University of Montana

2019 Institute for Infection, Immunology, and Inflammation Seminar Series, Vanderbilt University

2018 Center for Biomolecular Structure and Dynamics Research Symposium, University of Montana

2018 Organismal Biology, Ecology, and Evolution Brewery Chalk Talk Series, University of Montana

2018 Montana Biofilm Meeting, Center for Biofilm Engineering, Montana State University

2017 Harkins High School Science Fusion Lecture, University of Montana

2016 Pacific Northwest Epithelial Biology Meeting, University of Washington

2016 Cystic Fibrosis Foundation Retreat, University of Washington

2015 North American Cystic Fibrosis Conference, Phoenix, AZ

2014 North American Cystic Fibrosis Conference, Atlanta, GA

2012 Cystic Fibrosis Foundation Retreat, University of Washington

2008 Invited Speaker, Molecular Probes, Invitrogen, Eugene, OR

2006-2010 Montana Biofilm Meeting, Center for Biofilm Engineering, Montana State University

PROFESSIONAL ACTIVITIES

Referee for Professional Publications –

Cell Host & Microbe, *Cell Reports*, *iScience*, *Science Advances*, *eLife*, *EMBO Journal*, *Virulence*, *Nature Biofilms and Microbiomes*, *Frontiers in Microbiology*, *Genome Evolution*, *Virus Evolution*, *mBio*, *Journal of Bacteriology*, *Applied and Environmental Microbiology*, *mSphere*, *Journal of Virology*, *Soft Matter*, *PLoS ONE*, *Spectrum*, *Viruses*.

Grant review –

2022 *ad hoc* member, NIAID P01 Study Section, 2021 *ad hoc* member, NIH DDR Study Section, 2020 *ad hoc* member, NIH Special Emphasis Study Section, 2021 *ad hoc* reviewer, Cystic Fibrosis Foundation

Postdoctoral Fellows Mentored –

Robert Brzozowski, PhD

Graduate Students Mentored –

Camilla de Mattos, Caleb Schwartzkopf, Amelia Schmidt, Dominick Faith, Valery Roman-Cruz

Graduate Student Committees –

Camilla de Mattos, Caleb Schwartzkopf, Amelia Schmidt, Dominick Faith, Shaun Wachter, Kelley Van Vaerenberghe, Christopher Pierpont, John Statz, Nanami Kubota (U Pitt)

Professional Society Affiliations –

American Society for Microbiology

Departmental Service –

Neuroscience Faculty Search Committee, Center for Translational Medicine Faculty Advisory Council, Graduate Admissions Committee, Microbiology Curriculum Advisory Committee

College Service –

Undergraduate Award and Scholarship Committee, DBS Curriculum Committee

University Service –

Institutional Biosafety Committee