



## COLLEGE of BIOLOGICAL SCIENCE

DEPARTMENT OF MOLECULAR  
AND CELLULAR BIOLOGY

### **Announcement:**

All interested members of the university community are invited to attend the Final Oral Examination for the degree of **Doctor of Philosophy** of

## **MADISON WRIGHT**

On Wednesday, May 31, 2023 at 1:30 p.m. (online)

**Thesis Title:** Impacts of changes in cell surface components and intraspecific competition on the interactions of *Pseudomonas aeruginosa* with cystic fibrosis bronchial epithelial cells

### **Examination Committee:**

Dr. Jaideep Mathur, Dept. of Molecular and Cellular Biology (Exam Chair)  
Dr. Cezar Khursigara, Dept. of Molecular and Cellular Biology  
Dr. Emma Allen-Vercoe, Dept. of Molecular and Cellular Biology  
Dr. Sarah Wooton, Dept. of Pathobiology  
Dr. Denice Bay, Dept. of Medical Microbiology and Infectious Diseases, University of Manitoba (External Examiner)

### **Advisory Committee:**

Dr. Cezar Khursigara (Advisor)  
Dr. Emma Allen-Vercoe  
Dr. Jennifer Geddes-McAlister  
Dr. Nina Jones

**Abstract:** *Pseudomonas aeruginosa* is the most predominant pathogen in adults with cystic fibrosis' lungs. It is a highly adaptable, biofilm-forming, multidrug-resistant opportunistic pathogen with an arsenal of virulence factors. Gaining a better understanding of *P. aeruginosa* pathogenicity is important to develop more effective treatments. My research explores the impacts of cellular surface component modifications and intraspecific competition on the interactions of *P. aeruginosa* with bronchial epithelial cells.

I assessed the impact of cell surface alterations using three genetic lipopolysaccharide (LPS) O-antigen knockout strains that express only the common polysaccharide antigen (PAO1  $\Delta wbpM$ ), only the O-specific antigen (PAO1  $\Delta rmd$ ), or no O-antigen (PAO1  $\Delta wbpL$ ) along with PAO1 wild type, expressing both types of O-antigens. The greatest bacterial burden on bronchial epithelial cells was observed when no O-antigen was present on the bacterial surface and CFTR was present on the epithelial cell surface. Additionally, I demonstrated that, compared to PAO1 wild type, PAO1  $\Delta wbpM$  has increased non-surface attached aggregation, PAO1  $\Delta rmd$  has stronger surface attachment, and PAO1  $\Delta wbpL$  has increased intracellular invasion. Therefore, changes in LPS O-antigen are likely adaptive strategies *P. aeruginosa* employs to survive in different environments.

I assessed *P. aeruginosa* intraspecific competition using a Prairie epidemic strain (PES) isolate (P291) in combination with unique clinical strains (P637 and P261). I demonstrated that a unique clinical strain, replaced by the PES in the clinic (P261), was not replaced by a different PES isolate (P291) when tested *in vitro*. P261 outcompetes P291 *in vitro* for more than 90% of the epithelial cell niche. Therefore, my work shows that PES isolates cannot universally displace all unique clinical strains. Additionally, I demonstrated that the intraspecific competition between these *P. aeruginosa* strains is an additive relationship that relies primarily on the intrinsic ability of each strain to interact with the epithelial cells.

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Overall, my thesis research provides a deeper understanding of the factors that influence bacterial colonization of the CF lung environment.

**Curriculum Vitae:** Madison completed her Bachelor of Science (Honours, co-op) in Microbiology with a minor in Biotechnology and a Food Science Certificate at the University of Guelph in Winter 2018. She started a direct-entry PhD in Molecular and Cellular Biology in Summer 2018 under the supervision of Dr. Cezar Khursigara.

**Awards:** NSERC Postgraduate Scholarship – Doctoral (2020-2023); ISSOTL Emerging Scholars Award (2022); Teaching and Career Development Fellowship (2021); Queen Elizabeth II GSST (2019-2020); NSERC Canada Graduate Scholarship – Masters (2018-2019)

**Publications:** Park, A.J.\*, **Wright, M.A.\***, Roach, E.J., & Khursigara, C.M. (2021). Imaging host-pathogen interactions using epithelial and bacterial cell infection models. *Journal of Cell Science*, 134(5), 1–14. <https://doi.org/10.1242/jcs.250647>

\* denotes authors contributed equally to this work

Stockley, D., & **Wright, M.A.** (2022). The course on research ethics (CORE): Implications for SoTL. In L. Fedoruk (Ed.), *Ethics and the Scholarship of Teaching and Learning*. Springer. [https://link.springer.com/chapter/10.1007/978-3-031-11810-4\\_1](https://link.springer.com/chapter/10.1007/978-3-031-11810-4_1)

Kolomitro, K., Inglese, J., Stockley, D., Scott, J., & **Wright, M.A.** (2022). Institutional change through departmental quality assurance self-studies. *Quality Assurance in Education*, Vol. ahead of print. <https://doi.org/10.1108/QAE-02-2022-0030>