Kathleen Mary Curtius

Curriculum Vitae

University of California, San Diego
Division of Biomedical Informatics
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Areas of Expertise

General: Mathematical and Computational Biology, Stochastic Processes, Data Science, Biostatistics, Cancer Evolution and Epidemiology

Emphasis: Multiscale Cancer Modeling, Translational Bioinformatics, Cancer Screening, Early Detection, Epigenetic Aging

Qualifications

- Ph.D. in Applied Mathematics, University of Washington, Seattle *Aug 2015*
  Thesis: *Multiscale Modeling of Esophageal Adenocarcinoma*
  Advisor: E. Georg Luebeck
- M.S. in Applied Mathematics, University of Washington, Seattle *June 2011*
  Graduated Magna Cum Laude
  Master's Presentation: *Period Three Implies Chaos*
- B.S. in Mathematics with Highest Honors, University of California, Los Angeles *June 2010*
  Graduated Summa Cum Laude
  Thesis: *Geographic Profiling of Criminal Activity in Los Angeles using Lévy Flights*
  Advisor: George Mohler

Academic Position History

University of California, San Diego

- Assistant Professor, Department of Medicine, *Biomedical Informatics* *July 2020 - Present*
- Associate Member, Moores Cancer Center, *Cancer Control Program* *Aug 2020 - Present*

Centre for Genomics & Computational Biology, Barts Cancer Institute

- UK Research Initiative (UKRI) Rutherford Research Fellow *Feb 2018 – June 2020*
- Postdoctoral Research Fellow
  Evolution and Cancer Laboratory, Supervisor: Trevor A. Graham *May 2016 – Feb 2018*

Division of Gastroenterology, Department of Medicine, University of Washington

- Senior Research Fellow, Supervisor: John M. Inadomi *2015 – 2016*

Public Health Sciences Division, Fred Hutchinson Cancer Research Center

- Postdoctoral Research Fellow Affiliate, Supervisor: E. Georg Luebeck *2015 – 2016*

Department of Applied Mathematics, University of Washington

- National Science Foundation (NSF) Graduate Research Fellow *2011 – 2014*
- Teaching Assistant *Fall 2010*

Funding and Fellowship History

- CRUK Early Detection Primer Award (co-PI) *October 2020 - October 2021*
  Project title: *Understanding the molecular age of Barrett's oesophagus in a population-representative sample of patients spanning paediatric to older age groups*
  Co-PI: Prof. Helen Coleman, Queen's University Belfast, Northern Ireland, UK
- CRUK City of London Centre Development Fund Award (co-I) *March 2020*
  Project title: *Tracing and timing pre-cancerous clonal dynamics in normal tissues*
  PI: Dr. Marnix Jansen, University College London
- CRUK Early Detection Project Award (co-I) *March 2020 - March 2023*
  Project title: *Molecular biomarkers to predict progression of Barrett's Oesophagus (BO) to Oesophageal Adenocarcinoma (OAC)*
  PI: Dr. Richard Turkington, Queen's University Belfast, Northern Ireland, UK
- UKRI/Health Data Research UK Rutherford Research Fellowship *Feb 2018 - Feb 2021*
- National Institutes of Health (NIH) T32 Postdoctoral Training Fellowship *2016*
  $*$ awarded, declined to accept Barts Cancer Institute postdoctoral offer
- NSF Graduate Research Fellowship *2011 – 2014*
- NSF Research Experience for Undergraduates (REU) Fellowship *Summer 2009*

Awards

- QMUL Life Sciences Initiative - Centre for Computational Biology Showcasing Award *2017*
- Society for Experimental Biology (SEB) Cell Symposium Early Career Travel Award *2016*
- National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) R13 Travel Award *2016*
- Society of Industrial and Applied Mathematics (SIAM) Life Sciences Poster Award *2012*

Publications

Preprints

18. **Curtius K***, Kabir M*, Al Bakir I, Choi CHR, Hartono J et al. (2020) Multi-centre derivation and validation of a colitis-associated colorectal cancer risk prediction web-tool. medRxiv doi: 10.1101/2020.04.10.20057869 *joint first authors (in revision)

Journal Articles

17. **Curtius K**, Dewanji A, Hazelton WD, Rubenstein JH, Luebeck EG. (2020) Optimal timing for cancer screening and adaptive surveillance using mathematical modeling. Cancer Res, Epub ahead of print doi: 10.1158/0008-5472.CAN-20-0335
16. **Curtius K**, Rubenstein JH, Chak A, Inadomi JM. (2020) Computational modeling suggests that Barrett's esophagus may be the precursor of all esophageal adenocarcinomas. Gut, Epub ahead of print doi:10.1136/gutjnl-2020-321598

15. Tamura N, Shaikh N, Muliaditan D, McGuinness J, Moralli D, Durin MA, Green CM, Bowtell D, Balkwill FR, **Curtius K**, McClelland SE. (2020) Mechanisms of Chromosomal Instability in High-grade Serous Ovarian Carcinoma. Cancer Res, doi:10.1158/0008-5472.CAN-19-0852

14. Saunderson EA, Baker AM, Williams M, **Curtius K**, Jones JL, et al. (2020) A novel method of single strand library preparation for whole genome sequencing of formalin-fixed paraffin-embedded tissue samples. NAR Genomics and Bioinformatics 2(1); doi: https://doi.org/10.1093/nargab/lqz017

13. Baker AM*, Cross WC*, **Curtius K***, Al-Bakir I*, Choi CHR*, et al. (2019) The evolutionary history of human colitis-associated colorectal cancer. Gut 68(6):985-995 *joint first authors

12. Rockne R, Hawkins-Daarud A, Swanson K, Sluka J, Glazier J, et al. (2019) The 2019 Mathematical Oncology Roadmap. Phys Biol 16:041005

11. Luebeck EG, Hazelton WD, **Curtius K**, Maden S, Yu M, et al. (2019) Implications of Epigenetic Drift in Colorectal Neoplasia. Cancer Res 79(3):495-504

10. Al Bakir I, **Curtius K**, Graham TA. (2018) From Colitis to Cancer: An Evolutionary Trajectory That Merges Maths and Biology. Front Immunol 9:2368

9. **Curtius K**, Wright NA, Graham TA. (2018) An evolutionary perspective on field cancerization. Nat Rev Cancer 18: 19-32

8. Luebeck EG, **Curtius K**, Hazelton WD, Maden SK, Yu M, et al. (2017) Identification of a key role of widespread epigenetic drift in Barrett's esophagus and esophageal adenocarcinoma. J Clin Epigenet 9(113):1-10

7. Kroep S*, Heberle C*, **Curtius K***, Lansdorp-Vogelaar I, Hazelton WD, et al. (2017) Radiofrequency Ablation of Barrett's Esophagus Reduces Esophageal Adenocarcinoma Incidence and Mortality in a Comparative Modeling Analysis. Clin Gastroenterol Hepatol 15(9):1471-1474 *joint first authors

6. **Curtius K**, Wong C, Hazelton WD, Kaz AM, Chak A, et al. (2016) A Molecular Clock Infers Heterogeneous Tissue Age Among Patients with Barrett's Esophagus. PLoS Comput Biol 12(5): e1004919

5. Hazelton WD, **Curtius K**, Inadomi JM, Vaughn TL, Meza R, et al. (2015) The role of gastroesophageal reflux and other factors during progression to esophageal adenocarcinoma. Cancer Epidemiol Biomarkers Prev 24(7): 1012-1023

4. **Curtius K**, Hazelton WD, Jeon J, Luebeck EG. (2015) A Multiscale Model Evaluates Screening for Neoplasia in Barrett's Esophagus. PLoS Comput Biol 11(5):e1004272

3. Kong CY, Kroep S, **Curtius K**, Hazelton WD, Jeon J, et al. (2014) Exploring the Recent Trend in Esophageal Adenocarcinoma Incidence and Mortality Using Comparative Simulation Modeling. Cancer Epidemiol Biomarkers Prev 23(6):997-1006

2. Luebeck EG, **Curtius K**, Jeon J, Hazelton WD. (2013) Impact of Tumor Progression on Cancer Incidence Curves. Cancer Res 73(3):1086-96

Book Chapters

1. **Curtius K**, Wright NA, Graham TA. (2017) Evolution of Premalignant Disease, in *Cancer Evolution*, Swanton C, Bardelli A, Polyak K, Shah S, Graham TA, editors, Cold Spring Harbor Press.

Presentations

Invited Seminars

17. Talk: "Computational modeling of field cancerization to improve cancer control." UCSD Moores Cancer Center Structural and Functional Genomics Cross-lab Meeting, San Diego (virtual) *Dec 2020*

16. Talk: "Inference of field cancerization using stochastic models to improve cancer control." Computational Oncology Seminar Series, Memorial Sloan Kettering Cancer Center (virtual) *Dec 2020*

15. Talk: "Modeling field cancerization and tissue aging to improve screening and surveillance." Biomathematics Seminar Series, UCLA Department of Computational Medicine (virtual) *Nov 2020*

14. Talk: "Quantifying copy number evolution to predict colitis-associated cancer risk ." Moores Cancer Center Annual Retreat, UCSD Moores Cancer Center, San Diego (virtual) *Oct 2020*

13. Talk: "Making sense of the numbers: using math to improve early cancer prevention." UCSD Moores Cancer Center Cancer Control Program Meeting, San Diego (virtual) *Oct 2020*

12. Talk: "Computational modeling of cancer evolution to optimize screening and surveillance." Integrative Mathematical Oncology Seminar, Moffitt Cancer Center, FL (virtual) *Sept 2020*

11. Talk: "Quantifying and communicating colitis-associated cancer risk to patients and clinicians." IBD City Wide Meeting, San Diego, CA (virtual) *Aug 2020*

10. Talk: "Catching cancer in the act: biologically-based models to optimize screening and surveillance." UC Riverside Interdisciplinary Center for Quantitative Modeling in Biology (virtual) *May 2020*

9. Talk: "How did that get there? Modelling tissue age evolution of Barrett's esophagus." Mathematical Biology and Ecology Seminar Series, Oxford Mathematical Institute, Oxford, UK *Feb 2019*

8. Talk: "Spatial evolution of Barrett's esophagus: insights from molecular clocks and mechanistic modelling." Life Sciences Initiative Centre for Computational Biology Workshop, Queen Mary University of London, London UK *Nov 2018*

7. Talk: "Optimal adaptive design for cancer screening and surveillance using multiscale modelling." Oslo Centre for Biostatistics and Epidemiology Seminar, University of Oslo, Norway *Feb 2018*

6. Talk: "Methylomic drift: a molecular clock for hidden biological aging." Program for Evolutionary Dynamics Seminar, Harvard University, Cambridge, MA *May 2016*

5. Talk: "Beyond Chronological Age: using Bayesian Inference for hidden biological aging." Spring Speaker Series 2016, Nathan Schock Center of Excellence in the Basic Biology of Aging, UW Healthy Aging and Longevity (HALo) Research Institute, Seattle, WA *April 2016*

4. Talk: "Bayesian inference of Barrett's esophagus tissue age using a molecular clock." Stochastic Modeling Group meeting, UW Department of Statistics, Seattle, WA *April 2016*

3. Talk: "Beyond Chronological Age: using Bayesian Inference for hidden biological aging." Data Science Affinity Group Seminar, Fred Hutchinson Cancer Research Center, Seattle, WA *Mar 2016*

2. Talk: "Biological vs. Chronological Aging: a biomathematical study of Barrett's esophagus." Research Information Management Seminar, Department of Information Sciences, Beckman Research Institute, City of Hope, Duarte, CA *Feb 2016*

1. Keynote Talk: "How Long Has That Been There? Multiscale Modeling of Barrett's Esophagus." WECAN Esophageal Cancer Research Forum, OHSU Knight Cancer Center, Portland, OR *Jan 2015*

Recent Conference Presentations

16. Poster of Distinction: "Multi-centre validation of risk stratification for colitis patients with low grade dysplasia using UC-CaRE: a predictive clinical decision support tool." Digestive Disease Week, Chicago, IL (virtual) *May 2020*

15. Talk: "Shallow whole genome sequencing predicts future colorectal cancer risk in ulcerative colitis." New Horizons in Genomics conference, London, UK *July 2019*

14. Talk (invited): "Optimal adaptive design for cancer screening using mathematical modeling: a case study in Barrett's esophagus." Cancer Intervention and Surveillance Modeling Network (CISNET) Mid-year Meeting, Seattle, WA *May 2019*

13. Distinguished Abstract Plenary Talk: "Quantifying evolution of early dysplastic lesions in ulcerative colitis predicts future colorectal cancer risk." Digestive Disease Week, San Diego, CA *May 2019*

12. Future Leaders Proferred Talk: "Single Cell Clonal Diversity Predicts Progression to Esophageal Adenocarcinoma in Patients with High Risk Barrett's Esophagus." International Symposium on Oesophageal Cancer 2019, London, UK *May 2019*

11. Talk: "Spatial evolution of Barrett's esophagus: insights from molecular clocks and mechanistic modelling." BIRS-CMO Workshop: Mathematical challenges in the analysis of continuum models of cancer growth, evolution and treatment, Casa Matematica Oaxaca, Oaxaca, MX *Nov 2018*

10. Poster: "Quantifying evolution of early dysplastic lesions in ulcerative colitis predicts future colorectal cancer risk." Early Detection of Cancer, Oregon Health Sciences University, Portland, OR *Oct 2018*

9. Minisymposium Talk (invited): "Optimal cancer screening regimes in gastrointestinal evolution using mathematical modelling" in Data-driven mechanistic cancer models minisymposium. Society for Mathematical Biology/ Japanese Society for Mathematical Biology Annual Meeting, University of Sydney, Australia *July 2018*

8. Talk: "Optimal adaptive design for Barrett's esophagus screening and surveillance using multiscale modelling." UK Conference on Multiscale Biology, University of Nottingham, UK *April 2018*

7. Talk (invited): "Mapping phenotype and genotype during colitis-associated neoplastic progression." Centre for Computational Biology Networking Day, Queen Mary University of London, UK *July 2017*

6. Future Leaders Proferred Talk: "Widespread Epigenetic Drift in Barrett's Esophagus: molecular clock and evolutionary force." Cancer Research UK International Symposium on Oesophageal Cancer, Cambridge, UK *April 2017*

5. Talk: "Tissue Ageing and Cancer Risk: lessons from the methylome." Society for Experimental Biology Cell Symposium, Oxford, UK *Sept 2016*

4. Poster: "Beyond Chronological Age: methylomic drift and biological aging in intestinal metaplasia." James W. Freston Conference 2016, Chicago, IL *Aug 2016*

3. Talk: "Bayesian inference of Barrett's esophagus tissue age using a molecular clock." European Society for Mathematical and Theoretical Biology (ESMTB)/ SMB Meeting 2016, Nottingham, UK *July 2016*

2. Talk: "Methylomic Drift in EAC Progression." Multiscale Modeling Mid-year Meeting, Massachusetts General Hospital, Boston, MA *May 2016*

1. Talk: "Barrett's Esophagus Dwell Time: a new candidate biomarker." CISNET Annual Meeting, National Cancer Institute, Rockville, MD *Nov 2015*

Professional Societies and Groups

- American Association for Cancer Research (AACR) Associate Member *2019 – Present*
- American Gastroenterology Association (AGA) Member *2018 – Present*
- Society for Mathematical Biology (SMB) Member *2010 – Present*
- QMUL Life Sciences Initiative Centre for Computational Biology (CCB) Member *2018 – 2020*
- NCI CISNET Esophagus Group Member *2011 – 2016*
- SIAM Student Chapter Member, University of Washington *2010 – 2015*
- Phi Beta Kappa National Honor Society Member *2010 – Present*

Professional Activities and Service

Conference Committees/Organizer

5. Program committee member: International Symposium on Mathematical and Computational Oncology 2020. (virtual) *Oct 2020*
4. Symposium co-organizer : "Models of Cancer Evolution and Ecology." Mathematical Models in Ecology and Evolution (MMEE), Lyon, France *July 2019*
3. Conference co-organizer: "New Horizons in Genomics." QMUL, London, UK *1 - 5 July, 2019*
2. Minisymposium co-organizer: "Forecasting cancer evolution I & II: combining mathematical modelling and experimental/clinical data." MMEE, London, UK *July 2017*
1. Minisymposium organizer: "Barrett's Esophagus: biology, etiology, and cancer risk." European Conference for Mathematical and Theoretical Biology (ECMTB), Nottingham, UK *July 2016*

Invited Journal Referee

- Gastroenterology, Cancer Research, Risk Analysis, PLoS Computational Biology, Evolutionary Applications, Cancer Epidemiology Biomarkers and Prevention, Annals of the New York Academy of Sciences, European Biophysics Journal

Invited Grant Referee

- Moores Cancer Center/Padres Pedal the Cause Team Science Award ($250K each) *Dec 2020*
- UCSD KL2 Training Awards (up to $360K each) *Fall 2020*
- CRUK City of London Center Development Fund Awards ($33,000 each) *March 2019*

Departmental Leadership and Career Development

- Participant, UCSD National Center of Leadership in Academic Medicine (NCLAM) program *2021*
- Member, UCSD Bioinformatics and Systems Biology Admissions committee *July 2020 – Present*
- Member, UCSD Bioinformatics Diversity, Equity, and Inclusion committee *July 2020 – Present*
- Member, QMUL Institute of Applied Data Science Colloquia organising committee *2018 – May 2020*

- Lab meeting leader: Evolution and Cancer Laboratory, Barts Cancer Institute *Oct 2016 – Feb 2018*
- Journal club leader: UW Mathematical Biology Journal Club *Sept 2011 – Winter 2014*
- Treasurer: SIAM Student Chapter, University of Washington *Sept 2010 – 2014*

Teaching Experience

- Course lecture speaker: Cancer Genomics and Evolution, UCSD
  - MED 264: Principles of Biomedical Informatics *Fall 2020*
- Tutor (UK Instructor), Barts and The London School of Medicine and Dentistry, London:
  - Problem-Based Learning: Human Science and Public Health Module *Spring 2019, Spring 2020*
- MRes course lecture: Cancer Modelling, King's College London:
  - Molecular pathology of cancer, application in cancer diagnosis, screening and treatment *Jan 2019*
- Invited Tutor, Evolutionary Biology and Ecology of Cancer Advanced Course, Wellcome Genome Campus Conference Centre, Hinxton, Cambridge, UK:
  - Evolutionary prognostics: Introduction to Multistage Models *Summer 2018*
- Tutor, Barts and The London School of Medicine and Dentistry, London:
  - Problem-Based Learning: Human Science and Public Health Module *Spring 2017, Spring 2018*
- MRes course lecture: Math in cancer research, King's College London:
  - Molecular pathology of cancer, application in cancer diagnosis, screening and treatment *Nov 2017*
- Teaching Assistant, University of Washington, Seattle:
  - MATH 125: Calculus with Analytic Geometry II *Fall 2010*
- Academics in the Commons, Math/Science Tutor, University of California, Los Angeles:
  -MATH 31A: Differential & Integral Calculus *Fall 2008*
  -MATH 31B: Integration & Infinite Series *Winter 2009*

Students Supervised

- Mckenna Lewis: Computer Science major undergraduate, UCSD (current)
  CSE 199 (Independent Study): *"Building molecular clocks in gastrointestinal precancers"* *Fall 2020*
- Daniel Muliaditan: MSc Cancer & Molecular and Cellular Biology, Barts and The London
  Thesis: *"Exploring copy-number alterations in colitis-associated carcinogenesis"* *Summer 2018*
  - Barts and the London Principal's Prize for academic excellence
  - Drapers' Company Postgraduate Prize
  - Current position: PhD student in Biomedical Engineering at A*star Genome Institute of Singapore
- Kristiana Grigoriadis: Oxford undergraduate math summer student, Barts and The London
  Project: *"Mathematical modelling of the development of Barrett's esophagus"* *Summer 2017*
  - Wellcome Trust Biomedical Vacation Scholarship
  - E J Ball Research Scholarship
  - Current position: PhD student in Charles Swanton lab at the Francis Crick Institute, London, UK

Research Institutes and Projects

- HDR-UK Propensity Score Workshop participant, University College London *Sept 2018*
- National Biomarker Development Alliance participant, Biodesign Institute, Tempe AZ *Oct 2017*
  - Think Tank: Evolutionary Biomarkers: A Key Strategy for Precision Medicine
- UW Summer Institute in Statistics and Modeling in Infectious Diseases participant *July 2015*
  - Stochastic Epidemic Models with Inference
  - Markov Chain Monte Carlo I & II for Infectious Diseases

Professional Skills

- Proficient in Unix-based programming, High Performance Computing cluster use, bioinformatics script development, R, Shiny, MATLAB, Github, Maple, Mathematica, LaTeX, Microsoft Excel
- Proficient in Spanish reading and writing

Outreach and Engagement

- Bowel Cancer Awareness Month Article: "IBD and bowel cancer: Predicting patient risk," BCI News Article *April 2019*
- Career Women Article: "What it's like to be a mathematical oncologist in a male-dominated industry," Hello Giggles Interview article *April 2016*
- Kew Science Fair staff volunteer, London, UK *Aug 2017*
- Math Fair leader: UW student volunteer program for local elementary, Seattle, WA *Fall 2013*