Rory Costello Academic *Curriculum Vitae*

Personal details						
Full name	*Title* Mr	*First name* Rory	*Second name(s)* Morgan	*Family name* Costello		
Present position		PhD Candidate				
Organisation/Employer		University of Otago, New Zealand				
Contact Address	Microbiology Building, University of Otago					
	PO Box 56					
	Dunedin, New Zealand			**Post code**	9054	
Work telephone			**Mobile**	+64210413067		
Email	rory.costello@postgrad.otago.ac.nz					
Personal website	https://micro.otago.ac.nz/our-people/phd-students/rory-costello/					
LinkedIn	https://www.linkedin.com/in/rorymorgancostello/					
ORCID	https://orcid.org/0000-0002-2963-0685					

Research statement

Living in southern New Zealand, a region with a high prevalence of colorectal cancer, I have also seen the profound personal impact this disease has on individuals and communities. Having grown up with an oncologist as a father, I was immersed from an early age in discussions about oncology and patient care. This has driven my desire to work with doctors to directly improve patient well-being through translatable research.

Cancer is a disease that thrives on interactions between diverse cells and structures within its microenvironment. The T cell response is one of the most important tumour immune responses. My research investigates how T cells can modulate fibroblasts to shape the immune response and *vice versa*. I am using spatial proteomics techniques, including Imaging Mass Cytometry, to identify how and why these cells come together to shape the immune response.

My passion for imaging extends beyond the laboratory. As a photographer and conservationist, I am inspired by both natural and cellular landscapes. This parallel fuels my drive to visualise the tumour microenvironment with precision, and creativity. Ultimately, my goal is to bridge the gap between fundamental research and clinical application, providing tools and insights that empower oncologists to tailor treatments and improve patient outcomes.

Total years research experience	5 years

Research publications and dissemination

1. Costello, R. M., Fenton, S., McGuire, H., Lim, L., Howell, D., Raza, Q., Chwee, J. Y., & Kemp, R. (2024). Abstract 67: Predicting colorectal patient prognoses by functional characterisation of heterogeneous cell types and their spatial interaction using a new technique: Whole slide imaging mass cytometry. Cancer Research, 84(6_Supplement), 67-67. https://doi.org/10.1158/1538-7445.Am2024-67

Unpublished manuscripts in preparation

- Rhodes, J.L., Costello, R. McCall, J.L., Grambin, N.E., Ward-Hartstonge, K.A., Marion, V., Fenton, S., Russel-Camp, T., Pattison, S., Munro, F.M., Fan, S., Kemp, R.A., Highton, A.H. (**in-preparation**). 'Development and validation of a deep-learning model to incorporate Immunoscore data in colorectal cancer patient cohorts'

  Synopsis: Incorporating an open-source 'Immunoscore', a quantification of CD3 and CD8 T cells in the centre of the tumour (CT) and invasive margin into a deep-learning algorithm with clinical features to investigate the importance of immune features in determining patient prognosis with standard-of-care treatment, in a cohort of 359 colorectal cancer (CRC) patients from the Dunedin CRC Cohort (DNCRC). **Hypothesis**: Immune features portray how the body is responding to the tumour and should show higher importance than clinical features of the tumour itself. **Aim:** To determine the importance of a validated immune feature to determine patient prognosis relative to current clinical features. **Methodology:** CD3 and CD8 T cells in the CT and IM quantified in CRC patient tumour samples (n=749) via QuPath (Bankhead, P. et al 2017); duplicate patient pathology numbers, colitis, patients with neoadjuvant radiation therapy or chemotherapy excluded; CD3 or CD8 T cells in the CT or IM counts per mm^2 added with patient clinical features obtained from the DNCRC to a deep learning model using the survex package (Spytek, M. et al. 2023). **Preliminary results:** CD8 T cells in the CT show higher importance than American Joint Committee on Cancer (AJCC) Staging in CRC patients to determine patient outcome.

- Costello, R. M., Fenton, S., McGuire, H., Lim, L., Howell, D., Raza, Q., Chwee, J. Y., & Kemp, R. (**in-preparation**). 'Whole-slide imaging mass cytometry for high-dimensional analysis of cell types and distribution in colorectal cancer'

  Synopsis: Utilising novel whole-slide imaging (WSI) method using Imaging Mass Cytometry™ (IMC™) in a cohort of 10 colorectal cancer (CRC) patients from the Dunedin CRC Cohort (DNCRC) to determine a rapid Immunoscore (IS) profile and investigate heterogenous cell types in the CT and IM, and whole tumour section. **Hypothesis**: Tissue-based WSI allows for a rapid IS test, and allows to examine the difference in complex T cell and stromal cell types in the tumour between high and low IS. **Aim:** To determine if WSI using IMC™ can be used to determine IS status and examine phenotypically complex cell types. **Methodology:** CRC patient tumours (n=10) were stained and imaged using the Hyperion XTi™ at Standard Biotools Inc. using Tissue Mode™ and Cell Mode™ imaging modalities. IS status and complex cell types were quantified using QuPath and MCD SmartViewer™. **Preliminary results:** Patients were able to be stratified by CD3 and CD8 T cell infiltration using MCD SmartViewer™ as a surrogate IS using tissue-level WSI. Cancer-associated fibroblast populations and cytotoxic T cell populations were able to be imaged by pixel-based clustering and compared between IS.

Skillset

- Experience in analysing **cyclic multiplex Immunohistochemistry, imaging mass cytometry, single-cell RNA sequencing, immunohistochemistry, and clinical** data sets using both deep-learning and conventional methods.
- **Microscopy imaging**
    - Optimising and staining multiplex immunohistochemistry panels using the Akoya Opal-TSA method on formalin-fixed paraffin-embedded (FFPE) sections
    - Optimising and staining imaging mass cytometry panels on FFPE sections, including antibody conjugation using the MaxPar conjugation kit and making antibody cocktails
    - Developing confocal microscopy models for cell migration using a collagen matrix, primary human cells, and cell tracking or proliferation dyes
    - Imaging using confocal and widefield microscopy using the:
        - Nikon A1+ Inverted Confocal Laser Scanning Microscope
        - Nikon Ti2E Inverted Fluorescence Microscope
        - Andor Dragonfly – Spinning Disk Microscope
        - Opera Phenix High-Content Screening System
        - Olympus LS FV1000 Confocal Microscope
        - Olympus LS FV3000 Confocal Microscope
    - Acquiring imaging mass cytometry images using
        - Hyperion Imaging Mass Cytometer
        - Hyperion XTi Imaging Mass Cytometer
- **Spatial, tissue, and cellular analysis** of high-plex microscopy images
    - FIJI / ImageJ and various ImageJ plugins
    - QuPath, with Cellpose cell segmentation plugin
    - Napari
    - Cell segmentation using either Deepcell, CellPose, Illastik, or Cell Profiler
    - MCD Viewer and MCD SmartViewer
    - HistoCat++
    - Spectre R Package
    - NIS Elements Viewer
    - Bodenmiller IMC data analysis workflow and Steinbock python package
    - **Coding Python packages and R packages for unique spatial analysis pipelines**
        - Feature extraction – Rphenograph, FlowSOM, SNN clustering methods
        - Dimensionality reduction – UMAP, tSNE
        - Visualisation of data on tissue
        - Nearest-neighbourhood analysis and visualisation
        - Cellular community
        - Cellular neighbourhood
        - Spatial context
        - Patch detection
- **Flow Cytometry and tissue culture**
    - Culturing fibroblasts from primary human colon tissue
    - Optimising dissociation techniques for lymphocytes and fibroblasts
    - Optimising and staining of high-plex flow cytometry panels for peripheral blood mononuclear cells and fibroblasts

    - Acquiring Flow Cytometry data using the Cytek Aurora platform
    - Analysis using FlowJo and OMIQ software
- **Human tissue processing**
    - Peripheral blood mononuclear cell isolation from human blood
        - Lymphoprep™ and Ficoll methods
    - Tissue dissociation targeting lymphocytes
        - centrifugation and Accutase™ digestion
    - Tissue dissociation targeting fibroblasts
        - Manual and enzymatic dissociation using Collagenase, Dispase, and DNAse for optimal flow cytometry or cell culturing

Academic qualifications

2021-present, PhD Candidate, University of Otago

- Title of thesis: Inflammatory alpha-smooth muscle^{+} fibroblasts limit intratumoural T cell infiltration in colorectal cancer
- Department: Microbiology and Immunology
- Supervisor: Professor Roslyn Kemp

2021, Master of Clinical Immunology (Dist), Victoria University of Wellington

- Title of thesis: Optimal sequencing of hormone therapies in prostate cancer treatment in New Zealand
- Department: School of Biological Sciences
- Supervisor: Professor Anne La Flamme, Dr Lisa Connor, Professor Roslyn Kemp

2019, Bachelor of Biomedical Science, Molecular Pathology and Human Genetics, Victoria University of Wellington

Professional positions held

2023-present, Volunteer Research Assistant, Dunedin Colorectal Cohort, Southern Blood and Cancer Service, New Zealand

- Coordination between surgeons and research lab groups to manage patient tissue and peripheral blood sample collection for research
- Processing of colorectal patient tumour tissue and peripheral blood for use by research lab groups

2022-present, Laboratory Demonstrator, University of Otago, New Zealand

- Assisting in lab setup and completion
- Assisting students with lab coursework and practical laboratory skills and techniques
- Lab demonstrator for MICR334 – Advanced Immunology
    - ~40 students per class
- Lab demonstrator for MICR223 – Infection and Immunity
    - ~40 students per class

- Lab demonstrator and head lab demonstrator for HUBS191 – Human Body Systems
    - ~50 students per class
- Lab demonstrator and head lab demonstrator for CELS191 – Cell and Molecular Biology
    - ~50 students per class

2023, Research Assistant, University of Otago, New Zealand

- Assisting in a human nutrition clinical trial: SOOTHE: Could mānuka honey soothe indigestion?
- Processing participant peripheral blood samples into a single-cell suspension

2022, Tutor for Undergraduate Students, University of Otago, New Zealand

- CELS191 – Cell and Molecular Biology tutor for Toroa College, a university hall of residence
- Working with students to ensure success in coursework and examination
- ~10 students per class

2020, Public Health Tutor, Pasifika Student Success Mentorship Programme, Victoria University of Wellington, New Zealand

- Co-ordinating tutorial sessions online with students
- Ensuring Pasifika students achieve their personal academic goals and can complete coursework effectively in a friendly and intuitive environment
- ~5 students per class

Professional distinctions and memberships (including honours, prizes, scholarships, boards or governance roles, etc)

Awards

2024, Best Abstract Presentation at the Tumour and Stromal Special Interest Group Meeting, Australia and New Zealand Society for Immunology (ASI) (**Runner-up**)] – '*Novel imaging modalities reveal cancer-associated fibroblasts affect T cell infiltration in colorectal cancer patients*'

- **Competitive award** chosen between invited abstract speakers

2024, Pharmac Emerging Researcher Award (**Runner-up**)] – 'Interactions Between Cancer-Associated Fibroblasts and T Cells in Human Colorectal Cancer'

- **Competitive award** chosen between 6 speakers from either a clinical or biomedical background

2024, New Zealand Society for Immunology, conference travel grant

- **Competitive award**; 1 of 10 awarded, national conference, awarded based on peer review of abstract

2023, Australian and New Zealand Society for Immunology, conference travel bursary

- **Competitive award**; 1 of 46 awarded, international conference, awarded based on peer review of abstract

2023, Pharmac Emerging Researcher Award (**Runner-up**)] – 'Interactions Between Cancer-Associated Fibroblasts and T Cells in Human Colorectal Cancer'

- **Competitive award** chosen between 8 speakers from either a clinical or biomedical background

2023, Australian Cytometry Society, conference travel award

- **Competitive award**; 1 of 6 awarded, international conference, awarded based on peer review of abstract

2023, University of Otago, DT Jones Travel Award

- Non-competitive award from the Department of Microbiology and Immunology, University of Otago for conference travel

2022, Australian and New Zealand Society for Immunology, ICB Cover Image Award

- **Competitive award**; 1 of 5 chosen for Immunology and Cell Biology journal cover picture, awarded based on editorial review
- Pratapa, A. Braubach, O. Marsh-Wakefield, F. **Costello, R.** Kemp, R. Ramsland, P. Elbourne, A. Truong, V.K. Eastwood, S. Koh, G.J.H. Issue Information. (2023). **Immunology & Cell Biology**, 101(1), 1-5. https://doi.org/10.1111/imcb.12524

Grants awarded as Principal Investigator

2023, Maurice Wilkins Centre, MWC Flexible Research Programme Category 4 – 'Examining Fibroblast and T Cell Spatial Interactions in Colorectal Cancer with Whole-Slide Imaging Mass Cytometry'

2023, Maurice Wilkins Centre, MWC Flexible Research Programme Category 3 – 'Multiplex IHC to study fibroblast:T cell interactions in colorectal cancer

Memberships and Scholarships

2024-present, Society for Immunotherapy of Cancer (SITC) Membership
2024-present, American Society for Clinical Oncology (ASCO) Membership
2024-present, American Association for Cancer Research (AACR), Associate Member
2024-present, Federation of Clinical Immunology Societies (FOCIS) Membership
2023-present, New Zealand Society of Oncology (NZSO) Membership
2023-present, Australasian Society of Cytometry (ACS) Membership
2022-present, Maurice Wilkins Centre Affiliate Investigator
2021, University of Otago Doctoral Scholarship
2020-present, Australia and New Zealand Society for Immunology (ASI) Membership

Governance and Leadership Roles

2024-present, Student Representative, New Zealand branch of Australia and New Zealand Society for Immunology (NZASI)

- Providing a communication pathway between student members of NZASI and it's committee to improve membership services to students

2023-present, Committee Member, Fiordland Tramping and Outdoor Recreation Club

- Consultation for community- and government-led conversation projects in the Fiordland area of New Zealand
- Co-ordination of member hiking, cycling, mountaineering, and climbing trips and courses
- **Volunteer** for conservation projects in hard-to-access areas, including stoat trapping in the Gertrude and Homer Valleys as part of the Rock Wren conservation project

Outreach

First Year Health Science Outreach Evening, Dunedin, New Zealand (**2024**, May 27)

- Microbiology and Immunology booth volunteer
- Informing potential students about the Bachelor of Science and Bachelor of Biomedical Science programmes at the Department of Microbiology and Immunology

Dunedin Colorectal Cohort Seminar, Dunedin, New Zealand (**2023**, November 27)

- Joint seminar with Sonya Fenton, Dunedin Colorectal Cohort
- Presenting our work and techniques with the clinicians at Dunedin Hospital

Fiordland Tramping and Outdoor Recreation Club Winter Talks, Department of Conservation, Te Anau, New Zealand (**2023**, August 31)

- Invited speaker
- Discussing a personal journey of tramping and photography in Fiordland to the public.
- Discussing various challenges in tramping in the remote region

Gut Health Network Forum, Dunedin, New Zealand (**2023,** May 27)

- Discussing our work with patients and their families affected by colorectal cancer and other gut diseases
- Presentation of our work in colorectal cancer to patients – 'Immune Cells in Colorectal Cancer'
- Ensuring patients are informed how their donations are used in our research and how important their donations our to our research

Queenstown Research Week Volunteer, Queenstown, New Zealand (**2022**, August 31-September 2)

- Discussing University of Otago services and projects with conference attendees throughout the conference
- Helping set up and close the University of Otago conference booth, including transport of booth items from the university to Queenstown.

Conference oral and poster presentations

16. **Costello, R.,** Fenton, S., Chwee, Y.J., Lim, L., Howell, D., Raza, Q., Rhodes, J., Slatter, T., McGuire, H., Ward-Hartstonge, K., Kemp, R. (**2024**, November 25-29) '*New imaging modalities identify alpha-smooth muscle actin+ cancer-associated fibroblasts that affect CD8 T cell infiltration into tumours of colorectal cancer patients* [**Oral Presentation**] Australian and New Zealand Society for Immunology Annual Meeting 2024. Sydney, Australia. Selected based on peer review of abstract.

15. **Costello, R.,** Chwee, Y.J., Fenton, S., H., McGuire, H., Lim, L., Howell, D., Raza, Q., Kemp, R. (**2024**, November 25-29) '*Predicting Colorectal Patient Prognoses by Functional Characterisation of Heterogeneous Cell Types and Their Spatial Interaction Using a New Technique: Whole Slide Imaging Mass Cytometry*' [**Poster Presentation**] Australian and New Zealand Society for Immunology Annual Meeting 2024. Sydney, Australia

14. **Costello, R.,** Fenton, S., Chwee, Y.J., Lim, L., Howell, D., Raza, Q., Ward-Hartstonge, K., Rhodes, J., Slatter, T., Danielson, K., McGuire, H., Kemp, R. (**2024**, October 16-19) '*Interactions Between Cancer-Associated Fibroblasts and T Cells in Human Colorectal Cancer'* [**Oral Presentation, Pharmac Emerging Researcher Award (Runner-up)**] New Zealand Society of Oncology Conference Pharmac Emerging Researcher Awards 2024. Auckland, New Zealand. Selected based on peer review of abstract.

13. **Costello, R.,** Chwee, Y.J., Fenton, S., H., McGuire, H., Lim, L., Howell, D., Raza, Q., Kemp, R. (**2024**, April 5-10) '*Predicting Colorectal Patient Prognoses by Functional Characterisation of Heterogeneous Cell Types and Their Spatial Interaction Using a New Technique: Whole Slide Imaging Mass Cytometry*' [**Poster Presentation**] American Association for Cancer Research Annual Meeting 2024. San Diego, United States. Selected based on peer review of abstract.

12. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter, T., Danielson, K., Prsa, H., McGuire, H., Kemp, R. (**2023**, December 4-8) '*The effect of Cancer-Associated Fibroblasts on T Cells in colorectal cancer patients using a two-point Immunoscore and multiparameter imaging'* [**Poster Presentation**] Australasian Society for Immunology Conference 2023. Auckland, New Zealand. Selected based on peer review of abstract.

11. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter, T., Danielson, K., Prsa, H., McGuire, H., Kemp, R. (**2023**, September 21-23) '*Interactions Between Cancer-Associated Fibroblasts and T Cells in Human Colorectal Cancer*' [**Oral Presentation, Pharmac Emerging Researcher Award (Runner-up)**] New Zealand Society of Oncology Conference Pharmac Emerging Researcher Awards 2023. Napier, New Zealand. Selected based on peer review of abstract.

10. **Costello, R.,** Devery, B., Prsa, H., Smith, N., Rhodes, J., Fenton, S., Miller, M. Slatter, T., Danielson, K., McGuire, H., Kemp, R. (**2023**, September 21-23) '*Understanding the Complexity of the Tumour Microenvironment of Colorectal Cancer Patients*' [**Oral Presentation**] New Zealand Society of Oncology Tumour Microenvironment Interest Group Meeting 2023. Napier, New Zealand. Selected based on peer review of abstract.

9. Ombasa, L., Miller, J.C., Houghton, L.A., Ware, L., Abbotts-Holmes, H., Gearry, R.B., Bayer, S.B., Schultz, M., McNabb, W.C., Gasser, O., Highton, A.J., **Costello, R**., Frampton, C.M.A., Evans, J.C., Houghton, L.A., Roy, N.C. (**2023**, August 27 – September 1) 'Study of Mānuka Honey for Digestive Health (SOOTHE)' [**Poster Presentation**] Queenstown Research Week 2023. Queenstown, New Zealand. Selected based on peer review of abstract.

8. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter, T., Danielson, K., Prsa, H., McGuire, H., Kemp, R. (**2023**, August 27-30) '*The effect of Cancer-Associated Fibroblasts on T Cells in colorectal cancer patients using a two-point Immunoscore and multiparameter imaging'* [**Oral Presentation**] Australasian Cytometry Society Conference 2023. Queenstown, New Zealand. Selected based on peer review of abstract.

7. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter,T., Danielson, K., McGuire, H., Kemp, R. (**2023**, July 23) 'The effect of Cancer-Associated Fibroblasts on T Cells in colorectal cancer patients using a two-point Immunoscore and multiparameter imaging' [**Poster presentation**] University of Otago School of Biomedical Sciences Symposium 2023. Dunedin, New Zealand. Selected based on peer review of abstract.

6. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter,T., Danielson, K., McGuire, H., Kemp, R. (**2023**, May 23) 'The Role of Cancer-Associated Fibroblasts in the Immune Response to Colorectal Cancer' [**Oral Presentation**] New Zealand Society of Oncology Colorectal Special Interest Group Meeting 2023. Online, based in New Zealand. Selected based on peer review of abstract.

5. **Costello, R.,** Devery, B. Norton, S. Kemp, R. (**2023**, February 20) 'Understanding the Complexity of the Tumour Microenvironment of Colorectal Cancer Patients' [**Oral Presentation, MWC 'Cancer Immunology' research theme, Flagship 1 projects**] Maurice Wilkins Centre Symposium 2023. Dunedin, New Zealand. Selected based on peer review of abstract.

4. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter,T., Danielson, K., Kemp, R. (**2023**, February 20) 'Understanding Cancer-Associated Fibroblast Influence on T Cells with Two-Point Immunoscore in Colorectal Cancer Patients' [**Poster Presentation**] Maurice Wilkins Centre Symposium 2023. Dunedin, New Zealand. Selected based on peer review of abstract.

3. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter,T., Danielson, K., Kemp, R. (**2022**, November 25) 'The Role of Cancer-Associated Fibroblasts in the Immune Response to Colorectal Cancer' [**Oral Presentation**] Southern Colorectal Symposium 2022. Invercargill, New Zealand. Selected based on peer review of abstract.

2. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter,T., Danielson, K., Kemp, R. (**2022**, August 31 to September 2) 'Association of Cancer-Associated Fibroblast Phenotype and Frequency with Two-Point Immunoscore in Colorectal Cancer Patients' [**Poster Presentation**] Queenstown Research Week 2022. Queenstown, New Zealand. Selected based on peer review of abstract.

1. **Costello, R.,** Rhodes, J., Fenton, S., Miller, M. Slatter,T., Danielson, K., Kemp, R. (**2022**, July 7-8) 'Association of Cancer-Associated Fibroblast Phenotype and Frequency with Two-Point Immunoscore in Colorectal Cancer Patients' [**Oral Presentation**] Australian and New Zealand Society for Immunology Meeting 2022. Dunedin, New Zealand. Selected based on peer review of abstract.