Radiation Oncology
UNIVERSITY OF TORONTO

DEPARTMENT OF RADIATION ONCOLOGY

2021
EXTERNAL REVIEW
Self-Study Report

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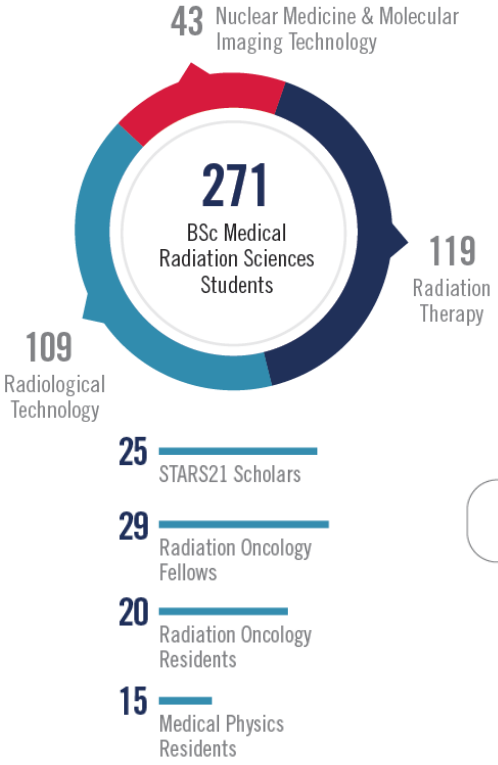
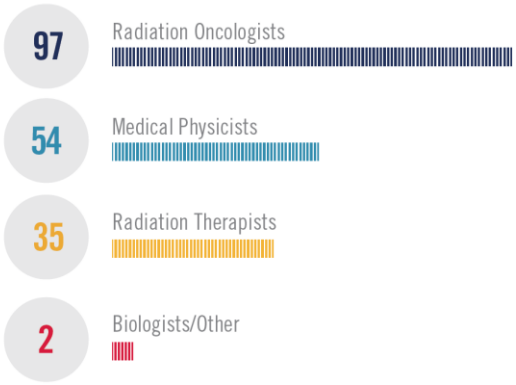
UTDRO BY THE NUMBERS

STUDENTS IN 2019–2020



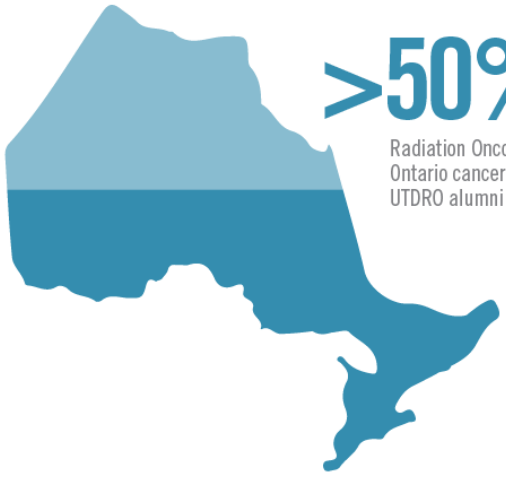
FACULTY IN 2019–2020



NETWORK

>2400
Total alumni

490
Attendees at ASTRO Alumni Event since 2016



>50%
Radiation Oncology heads of Ontario cancer centres are UTDRO alumni (8 out of 14)

RESEARCH

$202.2 Million
Funding from 2016–2020

1974
Publications during 2016–2020

>1200
Facebook followers

>2630
Twitter followers

EXECUTIVE SUMMARY

This Self-Study Report has been prepared as part of the external review of the Department of Radiation Oncology at the University of Toronto (UTDRO), which has been commissioned by the Dean of the Temerty Faculty of Medicine. The report covers the time period between July 1, 2016 to June 30, 2021, and provides a comprehensive overview of the department's organizational and financial structure, academic programs, student and faculty experience, future directions, as well as recommendations from the last external review and how the department has responded.

The Department of Radiation Oncology was established in 1991 upon its separation from the Department of Medical Imaging. Leadership of the newly formed department was undertaken by Dr. Bernard Cummings, who served two 5-year terms as Chair. Dr. Mary Gospodarowicz succeeded Dr. Cummings as Chair in 2001 and completed her second term in June 2012, whereupon Dr. Fei-Fei Liu was appointed as the third Chair of UTDRO, commencing her tenure in July 2012.

The department has thrived since its inception in 1991 and has grown from 41 to its current size of 188 multidisciplinary members of radiation oncologists (97), medical physicists (54), radiation therapists (35) and biologists/other (2). Since the beginning of Dr. Fei-Fei Liu's term in 2012, 43 radiation oncologists, 28 medical physicists, and 13 radiation therapists have been newly appointed to the department.

UTDRO is the academic base for six radiation oncology cancer centres across southern Ontario, plus one educational institute, the Michener Institute of Education at the University Health Network (UHN). In decreasing faculty numbers, they are:

1. Princess Margaret Cancer Centre (PM Cancer Centre) at UHN
2. Odette Cancer Centre (OCC) at Sunnybrook Health Sciences Centre
3. Carlo Fidani Regional Cancer Centre at Trillium Health Partners (THP)
4. Stronach Regional Cancer Centre at Southlake Regional Health Centre (Southlake)
5. Simcoe Muskoka Regional Cancer Program (SMRCP) at Royal Victoria Regional Health Centre
6. R.S. McLaughlin Durham Regional Cancer Centre (DRCC) at Lakeridge Health

The current faculty is one of the most diverse departments within the University of Toronto (U of T) Temerty Faculty of Medicine with respect to the number of professional groups, which in turn, is associated with a breadth of research expertise spanning from clinical studies and trials; quality of life; health services and outcomes research; basic and translational studies related to radiation response; to advanced methods of delivering high-precision radiation and imaging. The faculty has strong collaborations locally within the Toronto biomedical community, as well as nationally and internationally, in addition to internal collaborations within the UTDRO environment.

UTDRO offers educational programs at the undergraduate, graduate, and postgraduate levels. The joint U of T and Michener Institute Bachelor of Science in Medical Radiation Sciences (MRS) Program has a current enrollment of 273 students (as of April 2021) focused on one of three professional streams: Nuclear Medicine and Molecular Imaging Technology, Radiation Therapy, and Radiological Technology. In 2018, UTDRO made the difficult decision to discontinue its Master of Health Science in Medical Radiation Sciences (MHScMRS) Program due to multiple reasons, including patterns and trends in the practice environment, as well as financial considerations. As a professional master's program, it

provided a unique graduate level education experience for practicing radiation therapists, but only 12 radiation therapists participated over a 10-year period, with no anticipated increase in future enrollment.

UTDRO is also home to two residency programs: Medical Physics and Radiation Oncology. The UTDRO Medical Physics Residency Program is one of, if not the largest accredited physics residency program in Canada. It offers an intensive two-year clinical training program that prepares students for certification in clinical radiation oncology physics; the program currently has 12 residents. The Radiation Oncology Residency Program, the largest of its kind in Canada, currently has 23 residents enrolled over five years of training. Finally, the Radiation Oncology Fellowship Program attracts top talent from across the globe; current enrollment comprises of 35 fellows from 16 countries assigned at both OCC and the Princess Margaret.

In 2017, UTDRO completed a strategic planning process over a 6-month period, wherein following extensive internal and external consultations, a refreshed strategic plan entitled, *UTDRO 2022: Reflect. Transform. Lead*., was developed with the renewed vision of "Global leadership in radiation oncology by transforming practice through innovation and excellence in research and education," and a mission to "Prepare future radiation medicine leaders, contribute to our communities, and improve the health of individuals and populations through discovery, application, and communication of knowledge." UTDRO's new strategic direction focused on five key themes: (i) heighten the culture of academic excellence; (ii) prepare the radiation medicine leaders of tomorrow; (iii) accelerate uptake of cutting-edge knowledge in radiation medicine; (iv) collaborate for transformative reach and impact; and (v) enhance success through improved governance and operations.

The resulting strategic plan reinforced the faculty's commitment to teaching and strengthening the department's education offerings in order to impart the latest knowledge and develop the next generation of radiation medicine leaders. It also called for higher levels of individual and collective engagement by faculty, with enhanced collaboration amongst individuals, across departments and other important stakeholders. Specifically, it pushed for strategic aspiration in the core remits of education, research, systems influence, and operational excellence.

Over the last five years, UTDRO has continued to nurture and expand its national and international partnerships with various institutions. The academic programs have established partnerships with local hospitals and government organizations, as well as national associations and universities. On the international front, UTDRO faculty has an extensive network of collaborations across the continents of the Americas, Europe, Africa, Asia, as well as Australia. In particular, UTDRO faculty member Dr. Mary Gospodarowicz has played a highly prominent role in defining the need for access to radiotherapy as part of the global cancer control agenda, through her role as the President and Past-President of the Union for International Cancer Control (UICC).

The Administrative Office of UTDRO supports a broad range of functions, including the facilitation and administration of faculty appointments and promotion, communications, educational program administration, continuing education, and events coordination, as well as student registrarial and service functions. The office is led by a Business Manager who is responsible for overseeing all aspects of operations and finance for the department. Other staff include a Program Coordinator and Program Assistant to support the undergraduate MRS Program, an Education Officer and Postgraduate Coordinator to support the postgraduate programs, a Communication and Events Coordinator, and an Administrative Coordinator to provide general administrative support to the office.

The future of UTDRO is bright and exciting. Ongoing innovations in clinical care, research and education are enabling UTDRO to be on the frontiers of radiation medicine, embracing the latest technology and international best practices, and setting exemplary standards for patient care. The department continues to attract high caliber faculty with the successful hiring of numerous international and national recruitments since 2012. There is broader engagement across the six affiliated sites through initiatives such as the UTDRO Collaborative Research Seed Grant Program, Evening Journal Club, and vibrant participation at many UTDRO events including Graduation, the Annual General Meeting, as well as the Annual UTDRO Research Day. Revenue generation and fundraising continues to be a key priority for the Chair's second term as an increased and stable funding base is essential to successfully executing the department's academic mandate. Our refreshed strategic plan, *UTDRO 2022: Reflect. Transform. Lead*. will continue to guide us on our path of sustained excellence and help shape our department into one that delivers "Global leadership in radiation oncology by transforming practice through innovation and excellence in research and education."

CHAIR'S STATEMENT

It is my pleasure to provide this Self-Study Report as part of the 2021 External Review, which has been commissioned by the Dean of the Temerty Faculty of Medicine at the University of Toronto. Since July 1, 2012, I have had the honour of serving as the Chair of the U of T Department of Radiation Oncology (UTDRO). It has been a great privilege, and I am extremely proud of all the accomplishments of our talented multiprofessional faculty and trainees.

Over the past nine years, the department has achieved many milestones together as we continued to strive for excellence in education, research, and clinical practice. This is reflected in the successful completion of our previous 5-year External Review in March 2017, where the international review panel described UTDRO as one of the top academic cancer programs worldwide, "reaching the prowess and reputation of the top North American Departments of Radiation Oncology, including MD Anderson Cancer Center, and Memorial Sloan-Kettering Cancer Center".

The current Self-Study Report covers the time period between July 1, 2016 to June 30, 2021, highlighting our department's outstanding achievements and progress, as well as recommendations from the last external review and how we have responded to them. This Self-Study Report was a tremendous effort by the many leaders of our education and research programs, faculty, trainees, and administrative team. I am deeply grateful for everyone's immense contributions to both this report and the external review process.

Since the last external review, UTDRO has undergone a strategic planning process, leading to the development of a refreshed strategic plan entitled *UTDRO 2022: Reflect. Transform. Lead*. With a renewed vision of "Global leadership in radiation oncology by transforming practice through innovation and excellence in research and education," and a mission to "Prepare future radiation medicine leaders, contribute to our communities, and improve the health of individuals and populations through discovery, application, and communication of knowledge," the department has defined five specific goals that we will work towards to continue our global leadership role, and transform practice around the world: (i) heighten the culture of academic excellence; (ii) prepare the radiation medicine leaders of tomorrow; (iii) accelerate uptake of cutting-edge knowledge in radiation medicine; (iv) collaborate for transformative reach and impact; and (v) enhance success through improved governance and operations.

Despite a year of unprecedented challenges and uncertainty presented by the COVID-19 pandemic, UTDRO has continued to gain ground, making significant advances on our strategic plan. The global crisis has offered an important reflection point to explore new approaches to delivering quality patient care and education. At UTDRO, our educational programs quickly pivoted to remote learning, ensuring the continuation of teaching and learning. More than ever, I am impressed by our community's resilience, ingenuity, and passion as we adapted new practices to teach and navigate these uncharted waters together.

With our collective agility and strength, we have continued to push the boundaries in education, innovation, and clinical practice within the radiation oncology landscape. Our achievements are a result of the hard work, dedication, and collaboration of our multidisciplinary faculty, trainee, and staff. Comprised of radiation oncologists, medical physicists, radiation therapists, and scientists, diversity remains our greatest strength. Over the past five years, our collaborative spirit has led to major

achievements, including the first patient in Canada being treated on the MR-LINAC system at Odette Cancer Centre. Subsequently, the first-ever MRL Liver SBRT treatment was delivered in Canada at the Princess Margaret (PM) Cancer Centre. The PM also became the first centre in Canada to complete treatment for a patient with pancreatic cancer on the MRL. These multidisciplinary efforts represent a major milestone in advancing precision radiation medicine for patients in Canada.

Several of our academic programs underwent successful accreditation in the recent years. The Medical Physics Residency (2017), the Medical Radiation Sciences (2019), and the Radiation Oncology Residency (2020) Programs all received the highest level of accreditation from each of their respective accreditation bodies. Other highlights include the successful implementation of Competency by Design (CBD) in the Radiation Oncology Residency Program in July 2019.

Strategic partnerships between the Odette and Princess Margaret Cancer Centres have led to the development of the only Royal College-accredited Brachytherapy Area of Focused Competency (AFC) Fellowship Program in Canada, as well as a new continuing professional development course entitled "Technological Innovations in Prostate Cancer Radiotherapy", both in 2018. More recently, PM and OCC are developing an innovative MRgRT Training Program to help build global capacity for MR practice in partnership with Elekta (to be launched in 2022).

As I reflect upon my two terms as Chair of UTDRO, I am in awe of what we have accomplished together. Our department's successes would not be possible without our talented faculty, outstanding trainees, and staff. My sincere thanks to our Executive Vice Chair (Dr. Gregory Czarnota), Vice Chair of Research (Dr. Michael Milosevic), Vice Chair of Education (Dr. Rebecca Wong, then Dr. May Tsao), and Vice Chair of Clinical Affairs (Dr. Shun Wong, then Dr. Eileen Rakovitch), and the Executive Committee for all their wise counsel, immense assistance, and unwavering dedication in the past years. I am also grateful to the UTDRO administrative team, led by Evan Donohue and Meghan Ward, for ensuring the seamless operations of our many programs and initiatives.

As we adapt to the "new normal", UTDRO will steadfastly focus on delivering high quality education, while ensuring the safety and well-being of our trainees, faculty, and staff. While many lessons remain to be realized, we will continuously adapt and innovate to better equip our learners to thrive in a rapidly changing world. Quality education that creates future leaders in radiation medicine will be more important than ever.

Equity, diversity, inclusion, professionalism (EDI/P), and the well-being of our faculty, trainees, and staff continue to be important topics. In fact, diversity has been a key "secret ingredient" behind the success of UTDRO. We need to ensure that we maintain and continue to build on EDI/P issues, increase awareness and develop tactics to combat acts of micro-aggression, which threatens the well-being of our members. As we live in a society which appears to be progressively intolerant, it is critically important that UTDRO, in alignment with the University of Toronto, and the Temerty Faculty of Medicine, serve as an exemplar of embracing diversity, promoting inclusion/equity, as well as ensuring we all treat each other with the utmost in respect and civility.

UTDRO greatly appreciates the time and effort expended by the external reviewers, Dr. Ross Halperin (University of British Columbia) and Dr. Albert Koong (MD Anderson Cancer Center), as well as the Office of the Dean in the external review process. We hope you enjoy reading the Self-Study Report and look forward to discussing the UTDRO further with you in November 2021.
Respectfully submitted,

Dr. Fei-Fei Liu, MD FRCPC, FASTRO
Professor and Chair, Department of Radiation Oncology
Temerty Faculty of Medicine, University of Toronto

INTRODUCTION & CONTEXT

The Department of Radiation Oncology at the University of Toronto (UTDRO) was established in 1991 upon its separation from the Department of Medical Imaging. Dr. Bernard Cummings became the first Chair of the Department of Radiation Oncology in 1991, and Dr. Mary Gospodarowicz took office in July 2001. Dr. Fei-Fei Liu was appointed as the current Chair of the Department in July 2012 and was re-appointed for a second five-year term in 2017.

UTDRO is governed by the UTDRO Chair, who is supported by the Executive Vice Chair, three Vice Chairs (Clinical Affairs, Education, Research) and several committees to oversee the operations of the department (Appendix 1.1). The Chair reports to the Dean of the Temerty Faculty of Medicine (FoM). In this relationship, the Chair of UTDRO has received tremendous support from both the current Dean Trevor Young, as well as the previous Dean Catherine Whiteside. UTDRO has continued to align its academic mandate, culture, principles, and philosophies with the Temerty Faculty of Medicine's *Academic Strategic Plan 2018-2023: Leadership in Advancing New Knowledge, Better Health and Equity*, and the University of Toronto's *Towards 2030* reports.

The department has thrived since its inception in 1991 and has grown to its current size of 188 members from multidisciplinary professions, including radiation oncologists (97), medical physicists (54), radiation therapists (35) and biologists/other (2). Since the beginning of Dr. Fei-Fei Liu's term in 2012, 43 radiation oncologists, 28 medical physicists, and 13 radiation therapists have been newly appointed to the department.

UTDRO is the academic base for six radiation oncology cancer centres across southern Ontario, plus one educational institute, the Michener Institute of Education at UHN (see map). In decreasing faculty numbers, they are:

1) Princess Margaret Cancer Centre (PM Cancer Centre) at UHN
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The current faculty is one of the most diverse departments within the University of Toronto (U of T) Temerty Faculty of Medicine with respect to the number of professional groups, which in turn, is associated with a breadth of research expertise spanning from clinical studies and trials; quality of life; health services and outcomes research; basic and translational studies related to radiation response; to advanced methods of delivering high-precision radiation and imaging. The faculty has strong collaborations locally within the Toronto biomedical community, as well as nationally and internationally, in addition to internal collaborations within the UTDRO environment.

UTDRO offers educational programs at the undergraduate and postgraduate levels. The fully accredited 5-year Radiation Oncology Residency Program is the largest such program in Canada and amongst one of the largest in the world, with a current number of 23 trainees. At the recently completed Royal College of Physicians and Surgeons of Canada (Royal College) Accreditation visit in November 2020, the program received the highest level of accreditation. The residents benefit from engagement at two large

academic teaching centres in Toronto, the Princess Margaret and Odette Cancer Centres. The breadth of resources, in terms of both faculty, patient population and technology, which the trainees can experience and learn from during their five years, is unparalleled.

The UTDRO Radiation Oncology Fellowship Program is one of the largest and best-developed fellowship programs of its kind in the world, with a current number of 35 trainees from across the world. This program provides further clinical and/or research training to radiation oncology trainees, who have successfully completed their radiation oncology professional qualifying exams, and are either fully or nearly completing their clinical training in their country of origin. Exposure to the diverse faculty and peers fosters a collaborative environment that facilitates networking that further enhances the learner experience, as well as assist in launching careers. In 2017-2018, the Fellowship Program initiated the only Royal College-accredited training program in brachytherapy. Upon completion of the one-year Brachytherapy Area of Focused Competency (AFC) Program, an AFC fellow will be able to function as a competent specialist in brachytherapy, capable of an enhanced practice in this area of focused competence within the scope of radiation oncology. The brachytherapy AFC trainee will acquire a working knowledge of the theoretical and practical basis of brachytherapy, including its foundations in science and research, as it applies to medical practice.

The two-year Medical Physics Residency Program, launched in July 2007, aims to produce highly competent medical physicists, who combine a comprehensive understanding of clinical medical physics, and specific knowledge of radiation therapy and radiation oncology principles, and practice with enhanced leadership, research, and teaching skills. The program recently renewed its accreditation with the Committee on Accreditation of Medical Physics Education Programs (CAMPEP) in 2017 (until December 31, 2022). On average, 12 residents are enrolled at any one time, approximately equally divided between Year 1 and Year 2; current enrollment is at 12 residents.

The undergraduate BSc/Advanced Diploma in Medical Radiation Sciences (MRS) Program, the first of its kind in Canada, is a second-entry professional program built on a strong collaboration between the Temerty Faculty of Medicine at U of T and the Michener Institute of Education at UHN. This special partnership combines the strengths of both institutions and makes full use of their complementary resources and expertise to offer both a BSc Degree (from U of T) and an Advanced Diploma in Health Sciences (from Michener). This collaboration has contributed to the exceptional level of program integration for the education of all three MRS disciplines: Radiological Technology, Nuclear Medicine and Molecular Imaging Technology, and Radiation Therapy. The term of the Joint Program Agreement between U of T and Michener was renewed in January 2021 and is valid through to December 2025. Since 2002, the MRS Program has graduated 2,017 medical radiation technologists and therapists across the three streams. In parallel with the current 2021 UTDRO External Review, the MRS Program is undergoing a review through the University of Toronto Quality Assurance Process (UTQAP).

UTDRO faculty also actively participate in undergraduate medical education (UME) within the University of Toronto MD Program, which administers its hospital-based teaching through four academies. Three of these four are relevant to UTDRO based on the locations of the two cancer centres. Undergraduate medical students who are on-site at Princess Margaret Cancer Centre and the Odette Cancer Centre register with the Wightman-Berris and Peters-Boyd Academies, respectively. As of 2020, there are a total of 58 active staff radiation oncologists who contribute directly to the undergraduate medical education curriculum.

In addition to education programs, UTDRO also offers Continuing Education (CE) opportunities to its trainees and faculty. There are two annual scientific conferences for external audiences: Target Insight and RTi3. Target Insight highlights new developments in radiation medicine with a special focus on integration with our practice community. RTi3, now in its 18th year, has become the radiation therapy conference of choice, commanding between 150 and 225 participants from across the country and around the world annually. UTDRO also offers an annual 1-week long Clinical and Experimental Radiobiology Course taught by both local and international faculty. Designed for trainees and practicing professionals, it is a unique Canadian resource, relied upon to fulfill the radiobiology training requirements for most Canadian radiation oncology training programs. The Accelerated Education Program, under the auspices of the Princess Margaret Cancer Centre, offers intensive interactive workshops (1-3 days) focused on ahead-of-the-curve practice topics, as well as an Executive Personalized Learning Program (3-6 months) that allows visiting scholars to observe and become immersed in the Princess Margaret practice culture and environment. The UTDRO Evening Journal Club takes place three times per year, providing a forum to highlight active collaborations and their impact across UTDRO.

UTDRO 2022: Reflect. Transform. Lead.

In 2017, UTDRO concluded its strategic plan, *The Transformative Agenda: Roadmap to 2017*, which guided the department in achieving excellence in the areas of research, education, and systems influence over the preceding 5 years. In March 2018, UTDRO initiated a strategic planning process to re-envision its goals and strategies for the ensuing five years, taking into account the considerable changes that have occurred within the department, external environment, as well as insights derived from the 2017 External Review. The process was overseen by a 13-person Strategic Planning Steering Committee with representation across the disciplines (radiation oncologists, radiation therapists, medical physicists) and sites (Princess Margaret, Odette, community sites). Members included Drs. Fei-Fei Liu, Stephen Breen, Greg Czarnota, Laura D'Alimonte, Kathy Han, Michael Milosevic, Thomas Purdie, Arjun Sahgal, Christiaan Stevens, Kieng Tan, Rebecca Wong, Shun Wong, and Alena Wasney.

Faculty and trainee input was sought at all stages of the process by means of three different electronic surveys tailored to distinct audiences (126 responses), five workshops attended by 50 members of faculty, interviews with seven health system leaders (e.g. administrators, policy influencers, academics, clinicians, collaborators, innovators), and individual input. Analysis of the data confirmed the excellence of UTDRO's performance, as well as its inherent innovative qualities. At the same time, a number of challenges were identified as needing to be addressed as part of the strategic planning process. UTDRO's leadership coalesced around an exciting strategy that was aligned with the University of Toronto's and Temerty Faculty of Medicine's academic plans and would take the department to new levels of leadership and contribution. This led to the development of a refreshed strategic plan entitled, *UTDRO 2022: Reflect. Transform. Lead*., with the renewed vision of "Global leadership in radiation oncology by transforming practice through innovation and excellence in research and education," and a mission to "Prepare future radiation medicine leaders, contribute to our communities, and improve the health of individuals and populations through discovery, application, and communication of knowledge." We defined five specific goals that we will work towards to continue our global leadership role, and transform practice around the world:

1. Heighten the culture of academic excellence.
2. Prepare the radiation medicine leaders of tomorrow.
3. Accelerate uptake of cutting-edge knowledge in radiation medicine.
4. Collaborate for transformative reach and impact.
5. Enhance success through improved governance and operations.

The refreshed strategic plan was launched at the widely attended 27th UTDRO Annual General Meeting (AGM) in November 2018, and broadly disseminated through various communication channels (e.g. social media, e-newsletter, UTDRO website).

Significant progress has been made since the launch of the new strategic plan. UTDRO has focused on building from individual excellence to embrace the power of the entire department, while leveraging the increasing quest for alignment of vision across the Toronto Academic Health System Network (TAHSN); exploring the opportunities presented by the potential of "big data"; leveraging the diversity of expertise within UTDRO; as well as pursuing funding opportunities through significant partnerships both nationally and internationally. UTDRO has also continued to foster an environment that is supportive and enabling; encouraging all learners, staff, and faculty to manage their health and well-being.

Feedback from the recent virtual faculty town halls and online faculty survey in preparation for the 2021 UTDRO Faculty Report highlighted that the majority of faculty were familiar with the contents of the refreshed strategic plan. Many felt that they identified with the stated goals and themes of the new strategic plan and were engaged to participate. Most importantly, many indicated that UTDRO has been successful in executing the refreshed plan thus far. The five pillars of activities continue to guide UTDRO in fulfilling its academic mandate, and will be further evaluated and renewed at the end of Dr. Fei-Fei Liu's second term.

Self-Study Participation

The Dean of the Temerty Faculty of Medicine at the University of Toronto commissioned the external review of the Department of Radiation Oncology in January 2020, with an external review date slated for January 2021. Due to the COVID-19 pandemic, the external review was postponed until November 2021.

The external review process provides an opportunity for the department to reflect on its strengths and challenges, range of activities, and nature of its future plan, as well as obtain external feedback to guide the continual improvement of its academic and operational portfolios. It also provides an opportunity for all faculty, trainees, and staff to deeply engage in conversations about the department's scholarly direction and what opportunities and challenges are facing the department. Significant efforts were made to engage as many faculty members, trainees, staff, and internal and external stakeholders as possible in all stages of the external review process (Table 1).

Table 1: Stakeholder Participation in the UTDRO External Review Process

Activity	Stakeholder(s)
Initial information meeting with Office of the Dean, Temerty FoM	• Dr. Fei-Fei Liu (Chair, UTDRO) • Evan Donohue (Business Manager, UTDRO)
Confirmation of Terms of Reference and nomination of external reviewers (Canadian and international) to Temerty FoM for selection and approval	• Dr. Fei-Fei Liu (Chair, UTDRO) • Evan Donohue (Business Manager, UTDRO) • Dr. Greg Czarnota (Executive Vice Chair, UTDRO) • Drs. Rebecca Wong, Michael Milosevic, Shun Wong (Vice Chairs, UTDRO)
Oversight and coordination of external review activities: • Project management • Departmental communication • Stakeholder outreach and engagement • Data compilation and analysis • Preparation of Self-Study Report	• Dr. Fei-Fei Liu (Chair, UTDRO) • Meghan Ward/Evan Donohue (Business Manager, UTDRO) • Roe Schwim (Project Manager, External) • Dr. Emma Ito (Consultant, External) • Eileen Brosnan (Administrative Coordinator, UTDRO)
• Data compilation and analysis • Writing of report sections	• Meghan Ward/Evan Donohue (Business Manager, UTDRO) • Program Directors and Clinical Leads, UTDRO • Vice Chairs, UTDRO • Dr. Emma Ito (Consultant, External) • Eileen Brosnan (Administrative Coordinator, UTDRO) • David Lu (Research Analyst, External) • Dr. Linda Stone (Academic Affairs Coordinator, Temerty FoM) • Carmen Sebert (Associate Director, Strategic Initiatives, Advancement Office, Temerty FoM)
• Conducting 2 virtual faculty town halls • Developing and conducting online faculty survey • Data compilation and analysis • Preparation of Faculty Report	• Faculty Statement Working Group: - Dr. Alex Louie (Working Group Chair; Radiation Oncology, PM) - Dr. Laura Dawson (Radiation Oncology, PM) - Dr. Katharina Sixel (Medical Physics, DRCC) - Dr. James Chow (Medical Physics, OCC)

	- Merrylee McGuffin (Radiation Therapy, OCC) - Grace Lee (Radiation Therapy, PM) - Dr. Mark Ruschin (Medical Physics, OCC) • Meghan Ward (Business Manager, UTDRO) • Roe Schwim (Project Manager, External)
• Developing and conducting online learner survey • Data compilation and analysis • Preparation of Learner Report	• Learner Statement Working Group: - Dr. May Tsao (Vice Chair, Education, UTDRO) - Dr. Jennifer Croke (Director, Fellowship Program) - Dr. Gerard Morton (Director, Brachytherapy AFC Program) - Dr. Andrea Bezjak (Director, Radiation Oncology Residency Program) - Dr. Hany Soliman (Associate Director, Radiation Oncology Residency Program, OCC) - Dr. Derek Tsang (Director, UME Program) - Dr. Hedi Mohseni (Chief Medical Physics Resident, SRCC) - Dr. Meredith Giuliani (Associate Director, Radiation Oncology Residency Program, PM) - Dr. Andrea McNiven (Director, Medical Physics Residency Program) - Dr. Michael Tjong (Chief Radiation Oncology Resident, PM) - Dr. Rachel Glicksman (Co-Chief Radiation Oncology Fellow, OCC) - Dr. Michael Wang (Co-Chief Radiation Oncology Fellow, OCC) - Dr. Enrique Gutierrez (Co-Chief Radiation Oncology Fellow, PM) - Dr. Mariana Petruccelli (Co-Chief Radiation Oncology Fellow, PM) • Meghan Ward (Business Manager, UTDRO) • Dr. Emma Ito (Consultant, External)
Review of draft Self-Study Report before submission to Office of the Dean	• Dr. Fei-Fei Liu (Chair, UTDRO) • Meghan Ward (Business Manager, UTDRO) • UTDRO Executive Committee

In alignment with the Temerty Faculty of Medicine's pursuit for Excellence through Equity, equity, diversity, and inclusion (EDI) best practices were incorporated into the various aspects of our review process. UTDRO's position on Equity, Inclusion and Professionalism, and program-wide EDI efforts are further described in the Equity, Inclusion & Professionalism section.

The final Self-Study Report is a reflective, forward-looking critical analysis of the department and its activities and achievements over the preceding 5 years. The report is based on the UTDRO External Review Terms of Reference (Appendix 1.2), which establishes the parameters of the external review process and provides the framework of the Self-Study Report. The External Reviewers are asked to comment explicitly upon what is stated in the Terms of Reference.

Recommendations from Previous External Review

The Department of Radiation Oncology at the University of Toronto successfully completed its 5-Year External Review in March 2017, recommending the re-appointment of Dr. Fei-Fei Liu as Chair for a second five-year term. The international team of reviewers, Drs. Glenn Bauman (Western University), Daphne Haas-Kogan (Dana-Farber Cancer Institute), and Sandy McEwan (University of Alberta), described UTDRO as one of the top academic cancer programs internationally, "reaching the prowess and reputation of the top North American Departments of Radiation Oncology, including MD Anderson Cancer Center and Memorial Sloan Kettering Cancer Center". In particular, UTDRO's enviable Radiation Oncology Residency Program and the undergraduate Medical Radiation Sciences Program were described as the "jewels in the crown" of UTDRO. The department's breadth and depth of academic impact were described as exemplary with its education and research programs achieving some of the highest standards internationally. The reviewers remarked that "Few, if any, Radiation Oncology Departments can pride themselves in such a large number of significant achievements. Many of us in radiation oncology look to UTDRO for leadership, guidance, and direction in a myriad of topics from translational medicine to quality improvement, to physics innovations."

The External Reviewers put forward several useful suggestions for programmatic improvement, as well as a recommendation to refresh the department's strategic plan at the time, *The Transformative Agenda: Roadmap to 2017*. The following recommendations and observations from the 2017 UTDRO External Reviewers Report (Appendix 1.3) have been addressed by the department:

Organization and Financial Structure

Review the UTDRO Executive Structure and Function

In the previous review, it was noted that the UTDRO Executive Committee was very large, meets infrequently and was regarded by members as a largely informational committee. The External Reviewers recommended reframing the membership and role of the Executive Committee, as well as its sub-committees to function as operational and strategic committees to support the Chair, in addition to their informational roles. Since the review, the Terms of Reference for the UTDRO Executive Committee and its sub-committees have been reviewed, along with all of their activities to appropriately balance the strategic and operational *vs*. informational focus of each of the committees.

Develop a Stable and Sustainable Funding Model for UTDRO to Ensure its Long-Term Viability and Growth

Strategies to maintain sustainable and stable funding continue to be a key focus for UTDRO. Since the 2017 External Review, the Chair has worked in collaboration with the Temerty FoM Dean, partner hospitals, and the MOHLTC (Ministry of Health and Long-Term Care) to explore additional revenue opportunities. In 2017, the Chair met with the MOHLTC Human Health Resource (HHR) Planning Group, wherein UTDRO's immense impact and ability to disseminate its innovations and excellence in clinical care delivery across the province was commended. As a result, UTDRO was able to secure a modest increase in base funding from the MOHLTC, which has been maintained for the last 5 years. In response to the previous external review, the Temerty FoM also committed to ensuring the financial stability of the department and supporting the resources required to execute its academic mission, including financial support to create an Executive Vice Chair position to assist the Chair in these

activities, as well as funds for enhanced administrative support to assist in the implementation of Competency by Design within the Radiation Oncology Residency Program.

Other revenue-generating strategies that are being explored include, but are not limited to strengthening industry alliances and revenue-generating courses, such as the new MRgRT Training Program, and further expanding the Clinical and Experimental Radiobiology Course to a paying international audience. International trainees represent a significant opportunity for expansion of our global impact, as well as acquiring incremental funding for our educational programs. Additional options for revenue generation include international partnerships, CMEs, and philanthropy. The Chair will continue to work with the U of T Advancement Office to focus on building engagement with our alumni community.

The establishment of an Endowed Chair in UTDRO (e.g. for Chair him/herself in the future) would also assist in recruiting and retaining the highest quality faculty and ensuring sustainable financial support for the department. In the 2017 External Review, it was commented that the Chair of UTDRO carries significant responsibilities for maintaining and expanding on the successes of her predecessors, and that the resources available to the Chair did not appear to be commensurate with her responsibilities. The reviewers noted that this resource constraint potentially limited the strategic opportunities for UTDRO.

Radiation Oncology Residency Program

The reviewers from the 2017 UTDRO External Review were highly complimentary of the Radiation Oncology Residency Program, commenting that it was recognized nationally and internationally for its excellence. Several program strengths were identified by the reviewers, including access to internationally renowned faculty, unparalleled opportunity to participate in the full spectrum of clinical care within the radiation oncology discipline, access to unique and cutting-edge technology platforms and the opportunity to participate in research. The following recommendations were put forth by the reviewers to be addressed by the program:

Develop a Career Counseling and Mentorship Program for Residents

At the time of the previous external review, it was noted that residents voiced concerns regarding inconsistent mentorship and career planning support, and that a more systematic approach to mentoring was desirable. In 2016, UTDRO piloted a nascent Mentorship Program for junior radiation oncology faculty (on staff <5 years) at the Princess Margaret consisting of: (i) an orientation handbook; (ii) educational faculty development sessions; and (iii) direct, one-to-one selection and declaration of a mentor. Furthermore, a needs assessment, led by Dr. Jennifer Croke, was conducted in 2017 to determine the perceived mentorship needs and experiences of our radiation oncology residents and faculty. The findings from this study, which are now published in *Clinical Oncology* (doi.org/10.1016/j.clon.2019.09.050), would inform the development and implementation of our current Resident Mentorship Program.

Based on the success of the pilot and needs assessment results, a formal Resident Mentorship Program was implemented in 2019. Led by Dr. Jennifer Croke, the Mentorship Program aims to support and guide our residents as they progress through training; enhance their professional and personal development; and build radiation oncology leaders of tomorrow. Each resident is guided to identify a faculty mentor in their PGY1 year; mentees and mentors are provided guidance regarding their roles and responsibilities within the relationship. A formal mentorship agreement is signed by both the mentor and mentee, and filed with the Program Coordinator. Additionally, a confidential Resident Development Action Plan template was created to identify mentee goals and objectives with corresponding strategies and timelines.

As of June 2021, 22 residents and 20 faculty mentors have participated in the program; two mentors have more than one mentee. Amongst the 20 mentors, 8 are located at PM, 11 at OCC, and 1 at RVH. A mentorship social/networking event is being planned as previous plans had been placed on hold due to the COVID-19 pandemic.

In 2020, UTDRO also created a virtual Medical Student Mentorship Program open to U of T MD Program trainees due to the hiatus in medical student placements during the COVID-19 pandemic. The goal of this program was to pair medical students interested in learning about radiation oncology with UTDRO faculty members, who could discuss the profession, facilitate (virtual) observerships, and to expose medical learners to the specialty. Nine medical students were paired with nine UTDRO faculty members in June 2020. A one-month follow-up evaluation reported high satisfaction scores amongst the trainee participants. Based on the success of the Resident and Medical Student Mentorship Programs, UTDRO is exploring the feasibility of expanding the programs to trainees in other disciplines (e.g. medical physics residents, MRS trainees, radiation oncology fellows).

As a further source of mentorship for trainees, UTDRO initiated a formal Alumni Mentorship Program in 2021, led by Dr. Rebecca Wong. This program aims to encourage UTDRO trainees to access mentorship relationships externally, in addition to mentorship relationships within UTDRO. Specific goals of the program include providing networking opportunities for UTDRO trainees and alumni; engaging UTDRO alumni; assisting with trainee career development; and improving trainee satisfaction. Unfortunately, program activities were deferred due to the COVID-19 pandemic. An alumni mentor list is currently being compiled and matching with trainees is planned for the fall of 2021.

Enhance Administrative Support for Successful CBD Implementation

The reviewers emphasized that successful Competency by Design (CBD) implementation within UTDRO would require additional investment in administrative support as the current administrative structure is stretched to execute on existing residency training activities. In response, the Dean/Temerty FoM committed ongoing funding to support this important initiative, resulting in the successful launch of the CBD program in July 2019. The current roll-out of CBD has been effectively managed by the Program Director, Dr. Andrea Bezjak, who is supported by a very experienced Administrative Education Coordinator, Catherine Wong, and highly engaged leadership, including the Associate Program Directors, Drs. Meredith Guiliani, Hany Soliman, and now Jay Detsky, past and current Vice Chairs of Education, Drs. Rebecca Wong and May Tsao, as well as the Chair, Dr. Fei-Fei Liu.

Radiation Oncology Fellowship Program

Described as a “well-known and internationally recognized program of educational excellence within the Department of Radiation Oncology”, the Fellowship Program has aimed to address the recommendations put forth by the previous reviewers.

Define Metrics of Success and Impact of the Fellowship Program

The reviewers noted that success measures of the UTDRO Fellowship Program were largely indirect, and that formal metrics of success and impact of the program should be tracked and reported. In 2017, a review of the past 2 decades of the Fellowship Program was undertaken to identify characteristics of the program that were of value to the trainees, and to evaluate their training experience and perceived impact on professional development. Graduates of the Fellowship Program between 1991 and 2015 were the focus of the study. Current employment status of graduates was collected using online tools, and a web-

based questionnaire was distributed to graduates for whom active e-mails were identified; questions focused on training experience, and impact on career progression and academic productivity. Respondents were very satisfied with their training experience, and the vast majority would recommend the program to others. Most felt that completing the Fellowship was beneficial to their career development. The study also identified that UTDRO alumni were more likely to hold university, research, and leadership appointments, and authored significantly more publications than those with FRCPC (Fellow of The Royal College of Physicians of Canada) designation without fellowship training from UTDRO. Overall, the study validated the program's perceived success, with the majority of graduates reporting positive training experiences, benefits to scholarly output and professional development in their post-fellowship careers. Key features that would optimize the fellowship experience and its long-term impact on trainees were also identified in this study, which is now published in the *Journal of Cancer Education* (doi.org/10.1007/s13187-020-01767-5). The program continues to evaluate how best to regularly track impact measures, such as fellow awards, first-author publications, degrees granted, and career paths.

Harmonize Fellowship Stipends Across UTDRO

At the time of the previous external review, it was noted that the lack of a fixed pool of funding for fellows was a risk to the integrity of the program, and the perpetuation of funding inequity across the two sites (PM and OCC) was also a reputational risk. Harmonizing and unifying the Fellowship Program between the two sites remains a challenge. UTDRO has been advised by the U of T PGME Office that fellows in the same U of T department are allowed to be paid differently at different hospitals. The U of T Fellowship Education Advisory Committee (FEAC) recommends that the remuneration of clinical fellows be at a rate at least equivalent to that of a PGY1 trainee (as per the PARO (Professional Association of Residents of Ontario) Annual Salary Scale; $61,611.71/annum for 2021). As of 2021, PM ($86,710) and OCC ($76,210) salary rates for fellows are consistent with PGME guidelines. The Chair also continues to work alongside the Fellowship Director and Vice Chair of Education to explore various external funding strategies for fellowships, including partial and full self-funding.

Develop Collaborative Royal College Certifications of Special Competence within the Fellowship Program

In 2018, the Fellowship Program received accreditation from the Royal College for a one-year Brachytherapy Area of Focused Competency (AFC) Program, reflecting an effective collaboration between the PM and OCC sites, led by Dr. Gerard Morton. The AFC Program provides intensive training in all aspects of brachytherapy to enable the trainee to acquire all of the required competencies. Based on the success of this collaborative effort, the Fellowship Program is exploring the development of other programmatic fellowships that are not clinical site based, but focused on technical expertise (e.g. MR-LINAC, Stereotactic Body Radiotherapy).

Medical Physics Residency Program

Seek a CAMPEP-Accredited Stream within Medical Biophysics

In the 2017 External Review, the Medical Physics Residency Program was noted for its strong faculty (well-recognized as the largest and strongest group in the country), international reputation in clinical and applied physics research, as well as its strong technological and infrastructure bases across the two main sites (PM and OCC) and partner hospitals. Of particular strength was the support the trainees felt through the concerted mentoring efforts by the faculty.

One recommendation from the reviewers was to develop a CAMPEP-accredited medical physics stream within the Department of Medical Biophysics (MBP) at U of T to provide a "home grown" source of candidates for the Residency Program. Since the review, the UTDRO Chair and physics leadership at UTDRO have met with the MBP Chair and MBP Executive Committee to discuss the route by which MBP could pursue CAMPEP accreditation. Discussions are still ongoing and anticipated to be ultimately successful with the recent recruitment of Dr. Jan Seuntjens as the new Head of Medical Physics at the Princess Margaret Cancer Centre (starting full-time in September 2021). It is anticipated that this effort will be realized given his previous success at McGill University.

A deeper partnership with MBP has already begun, wherein several physics faculty at the Princess Margaret successfully obtained academic appointments at MBP in 2020. Drs. Jean-Pierre Bissonnette, Catherine Coolens, and Tom Purdie were cross-appointed as Associate Professors, while Drs. Alexandra Rink and Robert Weersink were cross-appointed as Assistant Professors. The access of medical physics researchers to graduate students provides tremendous collaborative opportunities for research and education activities within the physics group and MBP, bolstering research activities related to radiotherapy medical physics.

Medical Radiation Sciences Program

In the 2017 External Review, several program strengths were identified by the reviewers, including how articulate, committed, and engaged the students were in the program, as well as the dedication and passion of the MRS faculty. The following recommendations were put forth by the reviewers to be addressed by the program:

Further Integrate MRS Students into the Broader U of T Community

At the time of the previous external review, it was noted that MRS students view themselves as "Michener Students"; U of T seems more remote to students, and they do not feel a part of the University Community. This still continues to be a challenge. Students identify themselves more closely with Michener as they spend most of their time on the Michener campus given that the stream-specific equipment and labs are all on-site at Michener. Since the last review however, the MRS Program has made some changes to address this sense of community disconnect. The program examined the scheduling of classes and has since ensured that, where appropriate, classes are scheduled on the U of T campus. When in person, there are three to five courses held on U of T campus in the fall, whilst in the winter, two to three are located on U of T. In consultation with the Temerty Faculty of Medicine Registrar's Office, and the coincidental recruitment of a new Registrar, the alignment of the admissions and recruitment processes for the MRS Program has further improved over the years. The MRS Program Coordinator, who is responsible for all admissions and recruitment was physically relocated to the Temerty Medicine's Enrollment Services offices on the U of T Campus, which helped applicants recognize the University's role in the application process. The MRS Program orientation was held on U of T campus and highlighted the different services provided by both organizations. Students are asked to volunteer their services and to assist in U of T-led recruitment efforts on campus throughout the academic year. This has led to the development of the MRS Volunteer Awards, which are bestowed upon students who have contributed significantly to U of T-led activities.

Track the Career Outcomes of MRS Program Graduates

The MRS Program does not have a formal alumni association. Attempts were made to establish an alumni database after the previous external review, by engaging graduates at the MRS Pre-Convocation

Reception prior to the official Convocation ceremony. Due to the timing of the convocation and considering that many of the students have degrees already, the reception is not usually well attended. Additionally, the MRS Program did not have the resources within the office to support such a formal alumni process. Since then, the Temerty Faculty of Medicine has centralized the alumni processes for all programs and departments, so that departments can no longer maintain alumni databases independently. Rather than taking an "opt-in" approach, students automatically become student members of the Michener Alumni Association upon the start of classes. Unfortunately, due to privacy regulations, the MRS Program is not able to access MRS graduates from the Michener database. The program continues to learn of graduates' successes in an ad hoc manner and when appropriate, showcase them on social media platforms (e.g. MRS Facebook or MRS Instagram pages).

Expand the Role of Medical Imaging in Program Delivery

In response to the increased demands and evolution of Positron Emission Tomography (PET) and Theranostics in the Nuclear Medicine field, a PET/CT & Nuclear Theranostics Course is currently being developed to address these technologies. The goal of this course will be to strengthen the students' understanding of the role of PET/CT through a detailed description of the imaging procedures, as well as to appreciate the integrated role of theranostics.

Theranostics is a rapidly evolving branch of Nuclear Medicine. It utilizes dual-purpose radiopharmaceuticals that can be imaged for diagnosis, as well as delivery of targeted radiation therapy, aiming to provide a highly conformal and personalized treatment for cancer patients. Having both Nuclear Medicine-specific methodologies in a dedicated course should help to consolidate both the individual methodologies, as well as their integrated roles in patient care. The intent is to have this course developed and approved for the 2021 academic year, aiming for first delivery in summer 2023.

The Princess Margaret Cancer Centre Radiation Medicine Program's *Strategic Roadmap to 2026: Revolutionizing Radiation Care Through Digital Health* has articulated the establishment of a Centre of Excellence in Theranostics as one of its strategic priorities. The Centre will provide support for a full range of activities from research to the design of novel radiopharmaceuticals and clinical testing, and will combine the strengths of radiation oncology with theranostics to expand its clinical applications. The MRS Program has already consulted with the Project Lead, Dr. Rebecca Wong, on the development of the PET/CT & Nuclear Theranostics Course. The intent is to continue to engage with Dr. Wong and her team to ensure the course remains relevant as the field of theranostics expands.

Undergraduate Medical Education

Clarify Education-based Promotion Pathways for UTDRO Faculty

In the 2017 External Review, the reviewers commented that UTDRO is a strong champion of UME teaching at U of T and has been influential in ensuring that radiation oncology content is being integrated into the curriculum. They noted the variable participation in UME by UTDRO faculty, attributing this partially to a strong research culture and the lack of clarity amongst faculty regarding promotion along an education pathway. The reviewers recommended that information regarding education-based promotion pathways be included in career development for faculty involved in undergraduate medical education. Since the review, UTDRO has offered a seminar on "The Why's and How's of Academic Promotion" to all faculty in 2017. In addition, the nascent Mentorship Program for junior RO faculty (on staff <5 years) that was being piloted at the Princess Margaret in 2016 will be implemented for all faculty at UTDRO. Consisting of an orientation handbook, educational faculty development sessions, and direct,

one-to-one selection and declaration of a mentor, the proposed UTDRO-wide Faculty Mentorship Program will also focus on policies, procedures, and pathways for faculty promotion. As the Faculty Mentorship Program rolls out across the department, this knowledge gap will improve significantly.

STARS21 Program

Partner with Stakeholders to Establish a Sustainable Long-term Funding Model

In the 2017 External Review, it was recommended that the STARS21 Program continue to work with stakeholders to put the program on a stable financial footing to ensure long-term stability of this valued and highly productive training program. In recent years, STARS21, under the co-leadership of Drs. Anne Koch and Marianne Koritzinsky (which transitioned to Dr. Shane Harding in November 2019), has implemented several measures (see Quality Enhancement and Optimization) to address the programmatic issue of critical mass, while maintaining funding levels.

In brief, the program transitioned from a 2-year to 1-year funding model, allowing a greater pool of applicants to be considered and for a larger number of high-quality scholars to participate and contribute to STARS21. Capping the funding of trainees to 50% of the previous level has allowed STARS21 to maintain enrollment numbers and prolong financial stability, while a sustainable long-term funding model is being developed. Due to the negative financial impact of the COVID-19 pandemic on the academic research enterprise, future funding for STARS21 remains uncertain post-COVID. While local support from the Princess Margaret Research Institute and the Princess Margaret Radiation Medicine Program remains strong, national funding partners (e.g. TFRI, CIHR), which have funded the program in the past, have not signaled a clear intention to supporting such training programs. The Program Co-Directors will continue to engage their networks for new partnerships and funding opportunities to support STARS21.

Continuing Education and Professional Development Programs

Explore Mechanisms of Cost Recovery and Potential Revenue Generation for CE Events

UTDRO's continuing education (CE) events promote the dissemination of new knowledge and foster the adoption of best practices generated by the department's academic programs. CE events within UTDRO remain self-funded. They are fully dependent upon staffing resources to ensure that the delivery of CE programming achieves program goals and objectives, while remaining cost efficient. Raising funds to support the various CE activities remains a challenge, particularly in this time of fiscal constraint. UTDRO leadership continue to engage our diverse networks for new partnerships and funding opportunities to ensure the long-term sustainability of our various CE events.

Since 2017, the Target Insight (TI) Conference has only been held once due to low registration numbers and the COVID-19 pandemic. Opportunities to partner with ASTRO, ESTRO, CARO, ASCO, and the American Association of Cancer Education (AACE) might broaden our reach, further strengthen UTDRO's brand on the global stage, as well as bring potential financial support. In 2020-2021, many of UTDRO's CE activities transitioned to a virtual format. The synchronous online delivery of RTi3 and the Clinical and Experimental Radiobiology (CERB) Course has allowed for a broader audience, attracting more international participants than ever before. By leveraging the strengths of virtual events (e.g. wider reach, broader brand exposure, cost-effective, more versatile and networking opportunities), it might be therefore possible to establish a digital revenue stream for the department.

Explore Evolving CERB's Course Content into Complementary Formats

In the 2017 External Review, the Clinical and Experimental Radiobiology (CERB) Course, led by Dr. Marianne Koritzinsky, was noted by reviewers to be a unique educational offering that is a valued resource, not only to the local training program, but also to radiation oncology training programs nationally and internationally. It was recommended that continued development of this program and evolution of its content into complementary formats (e.g. streaming lectures, on-demand online course development) should continue to be explored, and the content should continue to be refreshed and aligned to the target audience (e.g. applied radiobiology for clinical practitioners).

As the course had to be delivered online in 2020 and 2021, this presented an opportunity to record the lectures and render them available to participants to stream. Most participants were still expected to attend the "live" lecture followed by the Q&A and interactive tutorial sessions. Understanding that attending the course "live" could be challenging for international students who live in other time zones, and for clinicians who might need to step away for clinical practice throughout the day, the decision was made to offer the lectures (and tutorials) for streaming until the final exam. This was a valuable experience and will be considered for future courses, even if the course returns to an in-person format in 2022. At the present time, the course has not taken the steps to make recordings permanently available to participants or others. The exact format for subsequent courses (in-person, virtual or hybrid) has not yet been decided and will be discussed by the CERB Scientific Planning Committee.

The course content continues to be refreshed every year – this is more relevant for some lectures than others. A CERB Curriculum Committee reviews the curriculum yearly and liaises with individual lecturers regarding content. The CERB Director also attends all the lectures to ensure that content is streamlined. Additional opportunities for the CERB course include exploring strategies to increase attendance from additional centres within Canada and beyond.

Faculty Development

Address the Gap in Faculty Knowledge Regarding the Promotion Process

Concerns over mentoring and promotion pathways were a common sentiment across all faculty members in the 2017 External Review, with evident lack of knowledge of policies, procedures, and pathways for promotion. Faculty perceived some opacity to the promotion process and resources available, as well as frustrations at the difficulties they had in achieving promotion. It was also noted that the administrative infrastructure supporting faculty development, mentoring and promotions was not appropriately financed or structured to support these activities for the large number of faculty members within UTDRO.

In response to these observations, UTDRO offered a seminar on "The Why's and How's of Academic Promotion" to all faculty in 2017 to clarify the policies, procedures, and pathways for promotion. UTDRO also piloted a nascent Mentorship Program for junior radiation oncology faculty at the Princess Margaret (see Faculty Mentorship) with the aim to: (i) assist with faculty career development; (ii) improve faculty satisfaction and retention; (iii) improve rates of academic promotion; and (iv) improve academic productivity. As of July 2021, 17 junior faculty have selected 16 mentors, while others are still at various stages of establishing their mentoring relationships. In 2020, the Faculty Mentorship Program was evaluated to understand participants' perceptions of the program (doi.org/10.1016/j.radonc.2021.07.003). Feedback from both mentees and mentors were overwhelmingly positive; participants expressed satisfaction with nearly all formal program components. The findings highlighted the importance and feasibility of establishing a culture of

mentorship within radiation oncology. As such, UTDRO is currently exploring the means to implement the Faculty Mentorship Program for other disciplines and UTDRO partner sites.

Since the review, a needs assessment led by Dr. Jennifer Croke, has also been conducted to determine the perceived mentorship needs and experiences of our radiation oncology residents and faculty (doi.org/10.1016/j.clon.2019.09.050). Furthermore, a formal assessment, led by Dr. Ewa Szumacher, was conducted in 2019 to better understand the Continuing Professional Development (CPD) needs of UTDRO faculty, and to determine how these needs could be generalized to other CPD programs (doi.org/10.1007/s13187-019-01607-1). The findings from both studies will help inform the development and implementation of the UTDRO-wide Faculty Mentorship Program. We anticipate that as the Faculty Mentorship Program rolls out across the department, the knowledge gap regarding the promotion process will decrease significantly.

Research

Expand the UTDRO Collaborative Research Seed Grant Program

The 2017 External Review highlighted the UTDRO Collaborative Research Seed Grant Program as a successful and productive initiative, which has proven particularly excellent for young investigators who are invested in bringing collaborations forward. It was recommended that new sources of funding be found for this critical endeavor rather than repurposing financial resources from other areas. Created by the current Chair in 2013 through joint funding contributions from the Odette, Southlake, and Princess Margaret Radiation Oncology partnerships, the Seed Grant Program is now funded by each of the five participating UTDRO clinical departments (approximately $20K annually per site). The additional contributions have enabled the funding of eight grants of $50K over the past five years to support a diverse range of projects jointly proposed by investigators at the Princess Margaret, Odette, Stronach, Simcoe Muskoka, and Carlo Fidani Peel Regional Cancer Centres. Efforts are ongoing to secure funding from industry or philanthropy that is independent of the five participating UTDRO clinical departments. Furthermore, the Chair will continue to meet with the respective CEOs and Department Heads to encourage continued participation by all hospital departments within UTDRO.

A comprehensive review of the Collaborative Research Seed Grant Program in 2019 demonstrated that it was achieving the primary goal of catalyzing innovative and research within the UTDRO community, leading to publications, new collaborations, and new external peer-reviewed funding. Overall, there was strong support for continuing the Collaborative Research Seed Grant Program by both faculty and the Heads of the participating UTDRO clinical departments that contribute the funding.

Maintain Support and Excellence of UTDRO Clinician Scientists

In the 2017 External Review, Clinician Scientists were noted by the reviewers to be critical to the research mission of UTDRO. As such, maintaining the support and excellence of the department's cadre of Clinician Scientists has been a key focus over the past 5 years. UTDRO has remained competitive in recruiting new Clinician Scientists and securing new funded Clinician Scientist positions. Many have been successful in establishing independent research programs and securing independent peer-reviewed funding. Key strategies for recruiting and ensuring the continued success of UTDRO Clinician Scientists have included providing protected time for research and research mentorship; 80% of their time should be protected for research and this is reviewed annually during each Clinician Scientist's performance evaluation. In addition, the UTDRO Faculty Mentorship Program has served as a useful forum to help

Clinician Scientists develop their careers, develop coping strategies to balance competing demands, and voice concerns about excessive workload or other issues independent of program leadership.

Relationships

Address the Odette and Princess Margaret Relationship to Advance the Academic Mandate of UTDRO

UTDRO continues to nurture collaborations and a sense of community amongst its six affiliated cancer centres (Princess Margaret, Odette, Southlake, Carlo Fidani, Simcoe Muskoka, Durham). While the emerging close and collaborative relationship between UTDRO and the community clinics was evident in the 2017 External Review, the relationship between the two main sites (PM and OCC) continues to be a challenge. It was remarked that the underlying tension between the two sites was not abating (this is a chronic issue also noted in the 2006 and 2011 external reviews), leading to lost opportunities for academic productivity and growth. The fundamental root cause is competition between the two centres for patients (hence, revenue), in the Greater Toronto Area. The reviewers had suggested that the main institutions (U of T, PM, OCC) should strike a task force at the Decanal/CEO level to address the Odette/Princess Margaret relationship to ensure the Chair can collaborate effectively to advance the academic mandate of UTDRO. In response to this recommendation, the Dean funded the Executive Vice Chair role (who is the Head of Radiation Oncology at OCC) in 2017, and met with the Chair of UTDRO and the OCC Head together on a regular basis during the next few years. To further build the relationship between the two sites, the Chair of UTDRO has also attempted to meet with the OCC Head of Radiation Oncology separately throughout the years. As well, the Chair has recently appointed OCC faculty into two key Vice Chair roles in 2021; namely, Dr. Eileen Rakovitch as the new Vice Chair of Clinical Affairs, and Dr. May Tsao as the new Vice Chair of Education. Building a strong strategic relationship between the two organizations will continue to be a work in progress as it prevents the department from realizing its full academic potential. Capitalizing on the common goals of each academic institution in a manner that synthesizes an improved culture of trust and collaboration should be a priority for the next UTDRO Chair.

Long-Range Planning

Update the UTDRO Strategic Plan

In 2017, UTDRO concluded its strategic plan, *The Transformative Agenda: Roadmap to 2017*, which guided the department in achieving excellence in the areas of research, education, and systems influence over the preceding 5 years. In March 2018, UTDRO initiated a strategic planning process to re-envision its goals and strategies for the ensuing five years, taking into account the considerable changes that have occurred within the department, external environment, as well as insights derived from the 2017 External Review. This led to the development of a refreshed strategic plan entitled, *UTDRO 2022: Reflect. Transform. Lead*., which was launched at the widely attended 27th UTDRO Annual General Meeting in November 2018, and broadly disseminated through various communication channels (e.g. social media, e-newsletter, UTDRO website). This exciting strategy is aligned with the University of Toronto's and Temerty Faculty of Medicine's academic plans and is anticipated to take the department to new levels of leadership and contribution.

ORGANIZATION & FINANCE STRUCTURE

Organization

The Department of Radiation Oncology at the University of Toronto is amongst the largest academic radiation medicine departments in the world, with 188 faculty members from multidisciplinary professions (Appendix 2.1). The diversity and interprofessional nature of the characteristics of the faculty are summarized in Appendix 2.2.

UTDRO faculty are located at one of its six affiliated radiation oncology cancer centres across southern Ontario. The two main academic institutions are the Princess Margaret (PM) Cancer Centre, University Health Network (UHN) (96 UTDRO-appointed faculty) and Odette Cancer Centre (OCC), Sunnybrook Health Sciences Centre (58 UTDRO-appointed faculty). The affiliated community-based cancer centres within the Greater Toronto Area (GTA) include the Carlo Fidani Regional Cancer Centre at Trillium Health Partners (THP; 11 UTDRO-appointed faculty), Simcoe Muskoka Regional Cancer Program (SMRCP) at Royal Victoria Regional Health Centre (8 UTDRO-appointed faculty), Stronach Regional Cancer Centre at Southlake Regional Health Centre (Southlake; 8 UTDRO-appointed faculty), and R.S. McLaughlin Durham Regional Cancer Centre (DRCC) at Lakeridge Health (1 UTDRO-appointed faculty). Additional UTDRO faculty are located at the Michener Institute of Education at UHN (3) and others (3). Five-year clinical updates from each of the six affiliated radiation oncology cancer centres can be found in the Clinical Reports section.

All radiation oncologists work in University of Toronto-affiliated hospitals. The majority are appointed at either the Princess Margaret or Odette Cancer Centres. In recent years, new RO faculty members have been appointed from affiliate community hospitals in the adjunct (part-time) category. Each hospital department has its own Head selected by the hospital committee on which the Temerty Faculty of Medicine has representation. The Chair of UTDRO does not have a direct-line management authority in the hospital departments; however, the current Chair of UTDRO also serves as the Chief of the Radiation Medicine Program at the Princess Margaret.

All medical physicists are appointed to the department to work in the affiliated hospitals, and radiation therapists work at either the hospital or at the Michener Institute of Education at UHN. Some basic scientists hold their primary appointment at UTDRO, with cross-appointments to the cognate Department of Medical Biophysics (MBP) and/or Institute of Medical Science (IMS), or *vice versa*.

The UTDRO Chair is supported by the Executive Vice Chair, three Vice Chairs (Clinical Affairs, Education, Research) and several committees to oversee the operations of the department (Appendix 1.1). The Chair reports to the Dean of the Temerty Faculty of Medicine (FoM). In this relationship, the Chair of UTDRO has received tremendous support from both the current Dean Trevor Young, as well as the previous Dean Catherine Whiteside.

The three Vice Chairs actively execute their respective mandates, ensuring consistency with the overall strategic plan of the department. The Executive Vice Chair position, which is financially supported by the Dean from the Temerty FoM, was established in response to the 2017 External Reviewers' recommendations to provide support to the Chair in executing the department's academic mission. The Chair, Executive Vice Chair and Vice Chairs meet on a quarterly basis. Together, they provide strategic

leadership for the department, advancing collaborations between the various clinical sites (Odette, Princess Margaret, SMRCP, Southlake, THP, DRCC), and executing the research and education mandates of UTDRO.

The UTDRO Executive Committee is advisory to the Chair, providing advice on major policy issues affecting the department. Members of the Committee also facilitate communication between the faculty and the Chair. In response to recommendations from the 2017 External Review, the Terms of Reference for the UTDRO Executive Committee and its sub-committees have been reviewed, along with all of their activities to appropriately balance the strategic and operational *vs*. informational focus of each of the committees. The current governance structure is outlined in Figure 1.

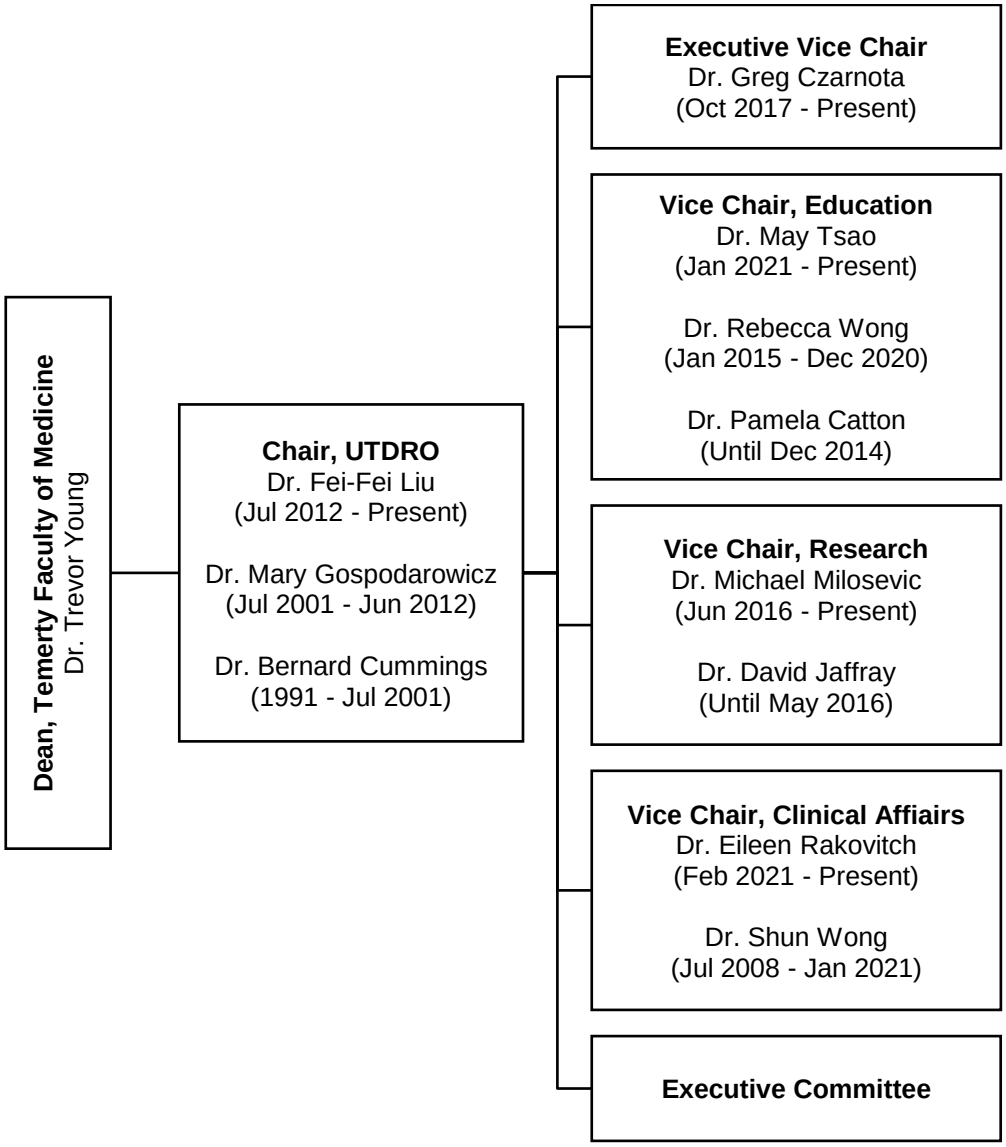

Figure 1: UTDRO Governance Structure

Administration

The Administrative Office of UTDRO is comprised of a Business Manager who oversees, in conjunction with program directors, four full-time (FTE) and two part-time (0.8 FTE) administrative staff who collectively support the operations of the UME Program, Postgraduate Medical Education programs, MRS Program, continuing education, as well as communications and events programming (Figure 2). Furthermore, this team also manages the financial operations of the department, as well as provides overall support to faculty including recruitment, promotions, and research activities. The numerous activities and events organized by UTDRO are also supported by various Committees comprising of Administrative Office and faculty members (see Appendix 1.1).

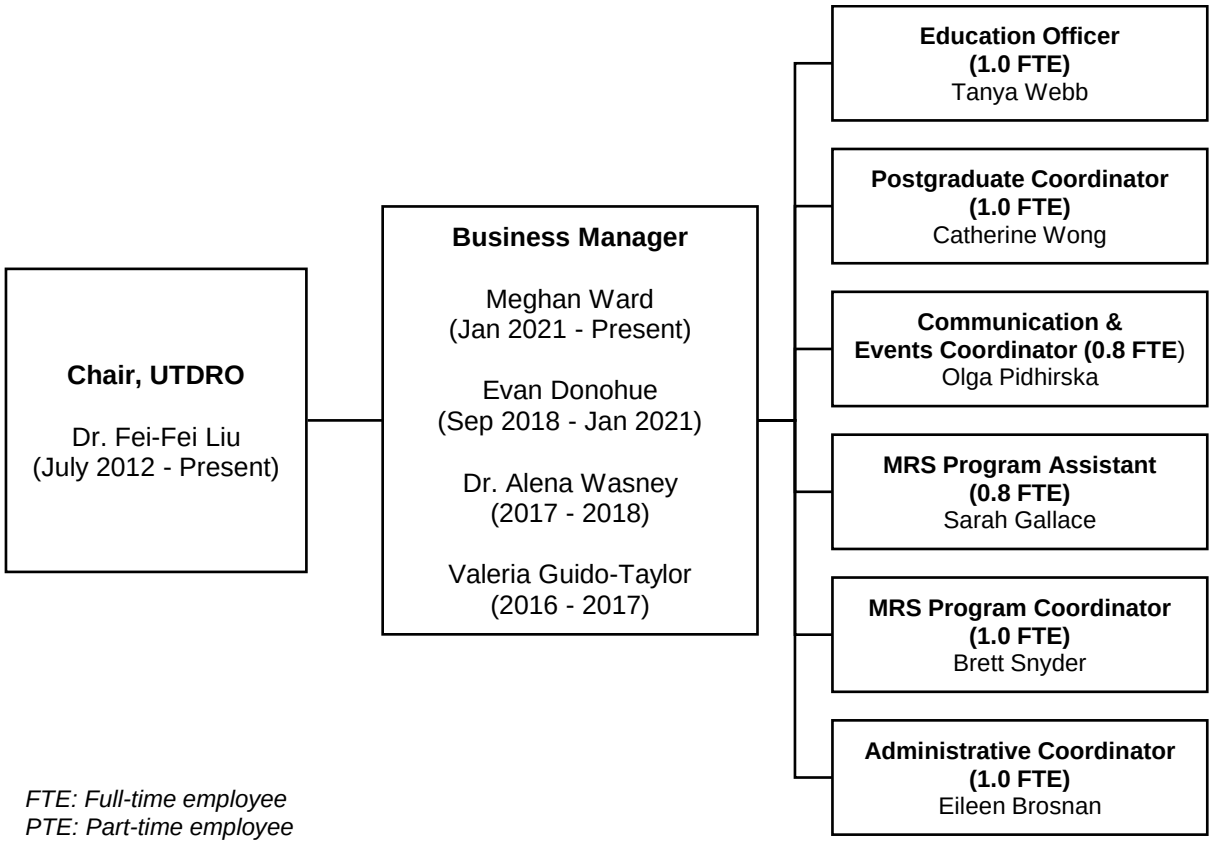

Figure 2: UTDRO Administrative Structure

The UTDRO Administrative Office has experienced considerable change over the recent five years. Three positions have been eliminated or modified for financial reasons: Communications Officer (FTE), Strategic Projects Coordinator (PTE casual), and Events Coordinator (PTE). The Business Manager position has also undergone significant turnover, with Evan Donohue providing excellent leadership and oversight of UTDRO operations from January 2013 to April 2016, followed by Valeria Guido-Taylor (May 2016 - April 2017) and Dr. Alena Wasney (July 2017 - September 2018). Evan Donohue returned to the role in September 2018 until January 2021 when he was seconded to University of Toronto Central (Simcoe Hall). Meghan Ward is currently assuming the role of Business Manager for a one-year term.

The Administrative Coordinator, Education Officers and Program Coordinators specifically support the education portfolios and the respective program directors and learners. Responsibilities include, but are not limited to recruitment, admissions, curriculum and program delivery, assessment of learning, awards administration, and support of initiatives for program review and enhancement.

Continuing education (CE) programs, such as the Clinical and Experimental Radiobiology Course and Target Insight and RTi3 conferences are designed and planned by UTDRO faculty with the support of a Communication and Events Coordinator (0.8 FTE) who coordinates and integrates these events with other UTDRO programs and events. Historically, this role was completed by one full-time Communications role and one part-time Events Coordinator. Over the last 5 years, there has been significant turnover across both portfolios. As such, the two interrelated portfolios were recently merged to improve operational effectiveness and efficiency within the department.

Over the past 5 years, the efforts of the Administrative Coordinator, Communication and Events Coordinator, Education Officers and Program Coordinators have ensured that faculty, trainees, and alumni are all connected and engaged in the UTDRO community. Each role has been integral to the development and delivery of the department's various CE offerings to faculty, alumni, and potential sponsors. There are five key UTDRO community events taking place annually: (i) an annual Welcome Event for the fellows and residents and their families near the beginning of the academic year; (ii) the Annual UTDRO Alumni Reception at ASTRO (American Society for Radiation Oncology); a marquee event that celebrates the accomplishments of UTDRO faculty and trainees, along with the 2000+ alumni community; (iii) later in the fall, there is an Annual General Meeting attended by faculty and their spousal partners, celebrating the academic achievements by faculty; (iv) in the spring of each academic year, there is the Annual UTDRO Research Day, showcasing research conducted by the trainees; and (v) at the end of each academic year, there is a graduation event, celebrating the completion of training of radiation oncology and medical physics residents, as well as the UTDRO fellows.

Resources and Infrastructure

The UTDRO Administrative Office is located on the 5th floor of the Stewart Building (149 College Street, Suite 504). The Temerty Faculty of Medicine funds the rental fees for this facility on an annual basis. Most of the administrative team (Figure 2) is situated at this location. Due to physical space limitations within Suite 504, several MRS staff do not have dedicated office space to execute the course management activities or to support and meet with students. Much of their program-related activities are conducted remotely from their clinical space in the hospital. The MRS Program Coordinator has been relocated to the Temerty FoM's Enrolment Services in Undergraduate Medical Education to facilitate integration with the Temerty FoM.

The office space is primarily an open concept for the administrative staff, with enclosed offices for the Business Manager, MRS Program Director, Postgraduate Coordinator, and Communication & Events Coordinator. Semi-private cubicles exist for the remaining administrative staff. UTDRO also has a state-of-the-art conference room on the 6th floor of the Stewart Building, which is fully equipped for telephone and videoconferencing. Prior to the COVID-19 pandemic, the conference room was used for various meetings, including UTDRO Executive, Appointments, and Promotions Committee meetings.

Faculty

Faculty membership of UTDRO includes several different professional groups of radiation oncologists, medical physicists, radiation therapists, scientists, and educators. Since its inception in 1991, the department has thrived, growing from 41 to its current size of 188 members. In 2020-2021, UTDRO faculty consisted of 97 radiation oncologists (52% of total), 54 medical physicists (29%), 35 radiation therapists (19%), and 2 other education/scientist faculty (1%), with 30 Full Professors, 33 Associate Professors, 81 Assistant Professors, as well as 37 Lecturers, and 7 Instructors.

Since the beginning of Dr. Fei-Fei Liu's term in 2012, 43 radiation oncologists, 28 medical physicists, and 13 radiation therapists have been newly appointed to the department (Figure 3) across the various affiliated sites (Figure 4), with relatively equitable distribution of women and men (Figure 5).

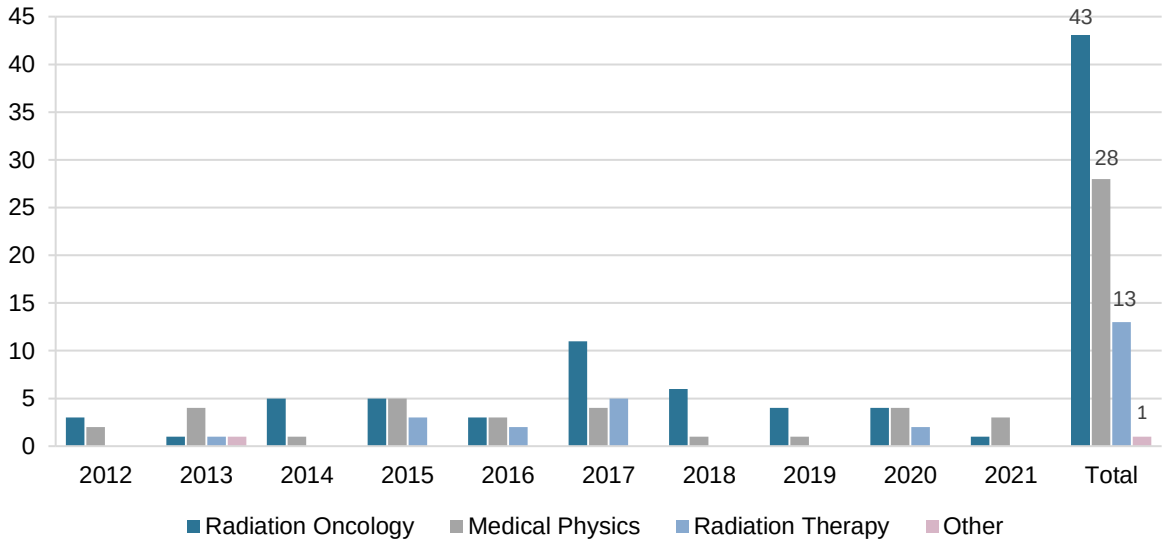

Figure 3: New Appointments in Relation to Discipline (2012-2021)

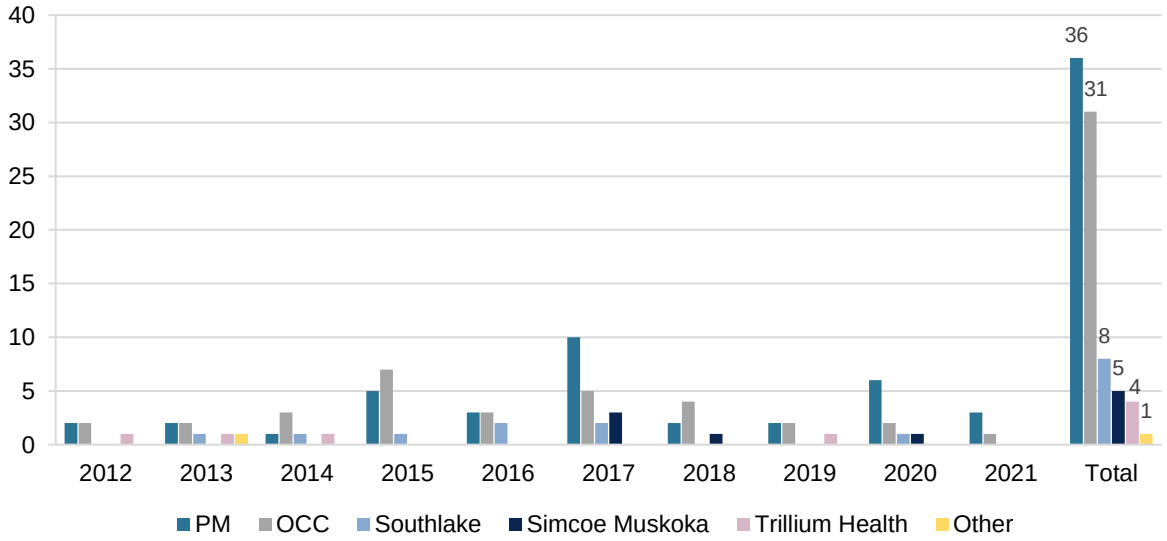

Figure 4: New Appointments in Relation to Site (2012-2021)

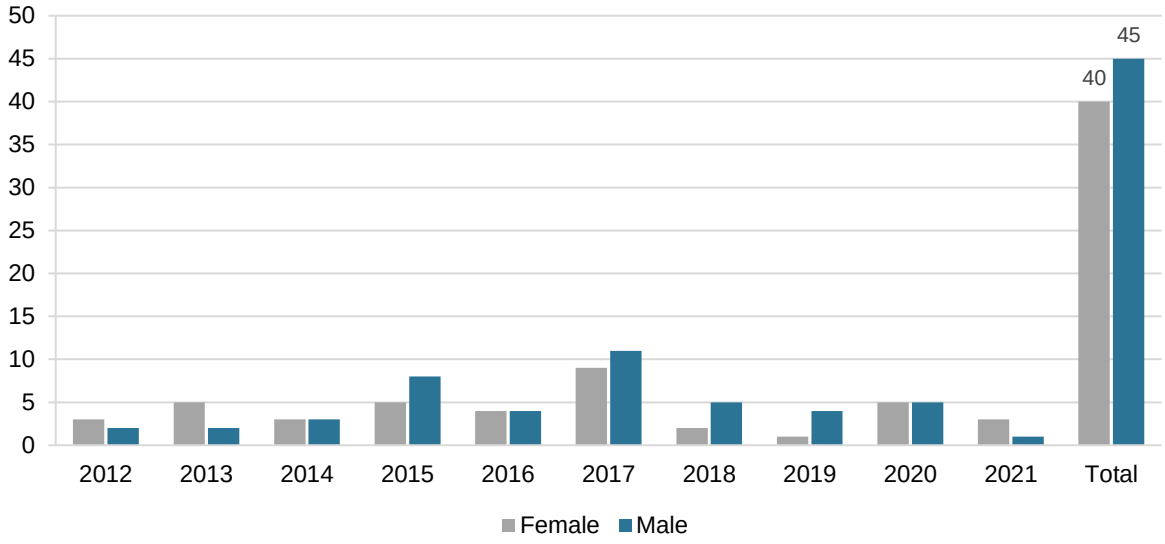

Figure 5: New Appointments in Relation to Gender (2012-2021)

Over the past years, UTDRO has continued its 30-years' track record of 100% successful academic promotions within the Temerty FoM, with a total of 37 promotions since 2013 (28 Associate Professors and 9 Professors). As Chair, Dr. Fei-Fei Liu has continued to foster equitable recruitment and promotion within the department across the various disciplines (Figure 6), genders (Figure 7), and sites (Figure 8). Most notable is the recent promotion of a radiation therapist (Sophie Huang) to Associate Professor, reflecting her exemplary contributions to research, quality assurance, and teaching at both the local and international levels. This is a significant achievement within the radiation therapy profession as there are only a handful of RTs at the Associate Professor rank worldwide; UTDRO has two RT Associate Professors (Dr. Tara Rosewall and Sophie Huang).

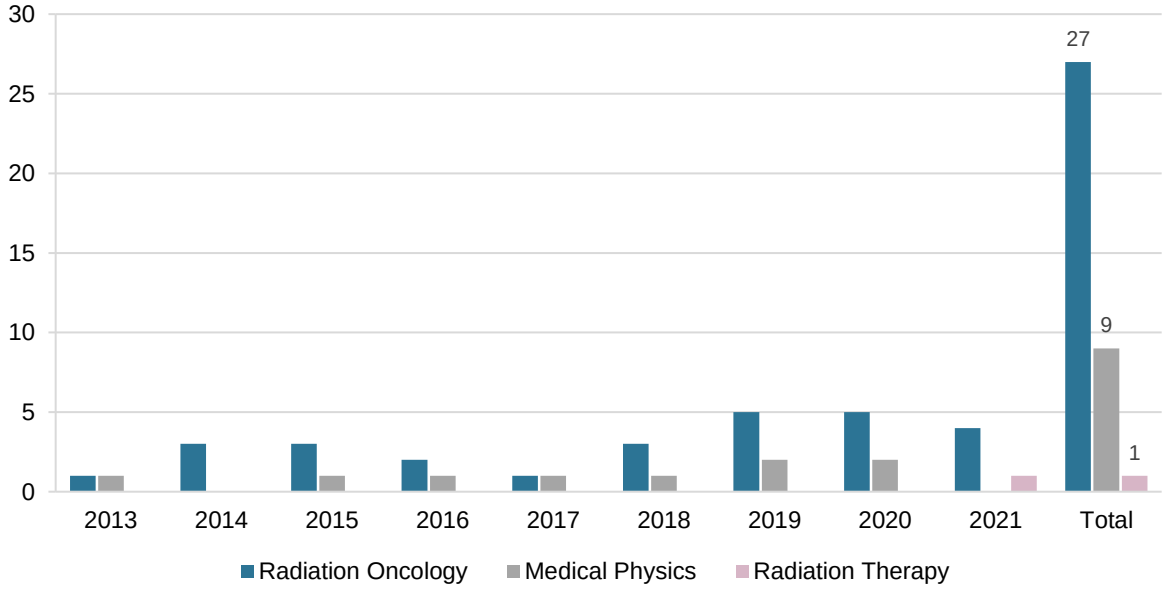

Figure 6: Promotions in Relation to Discipline (2013-2021)

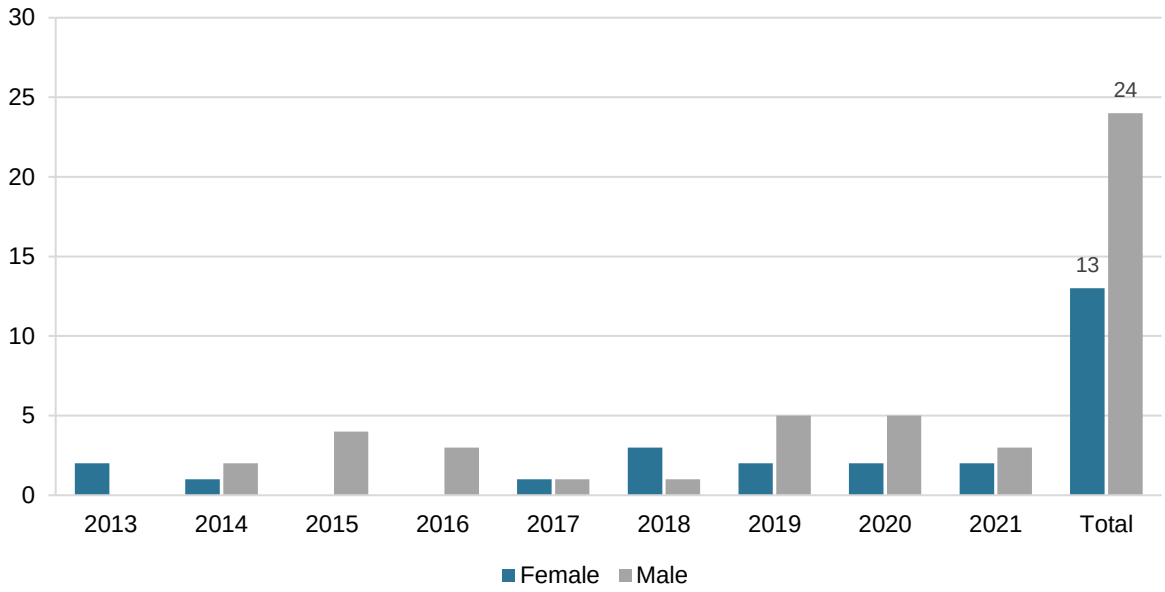

Figure 7: Promotions in Relation to Gender (2013-2021)

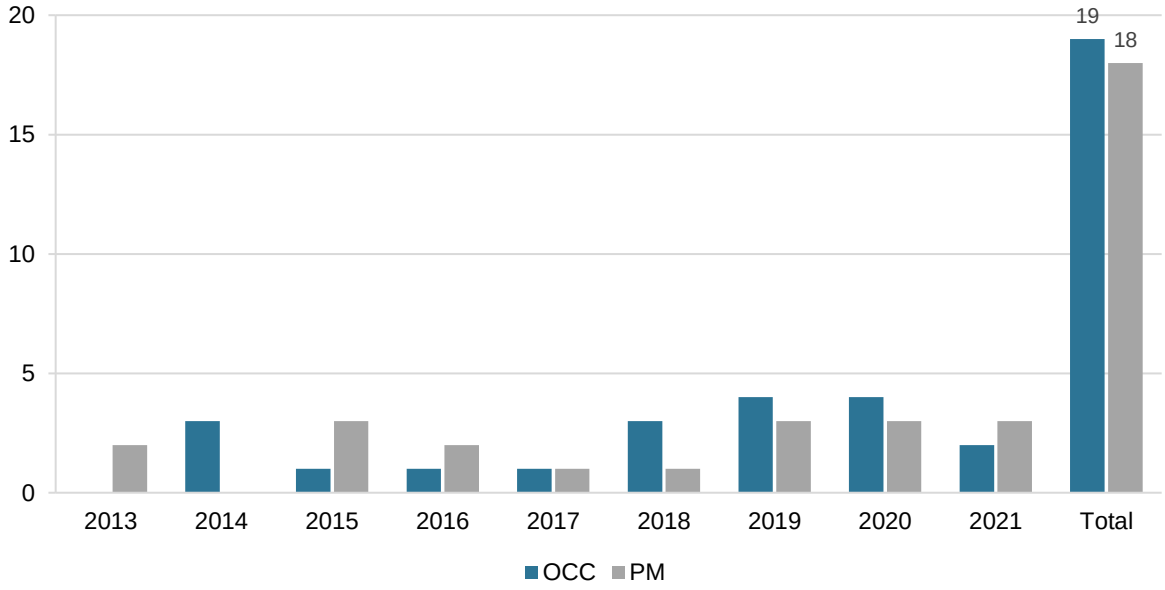

Figure 8: Promotions in Relation to Site (2013-2021)

Faculty Development

UTDRO leadership continues to encourage faculty to undertake additional training in a variety of disciplines. The 2017 External Review identified that concerns over mentoring and promotion pathways were a common element across all faculty members, with evident lack of knowledge of policies, procedures, and pathways for promotion.

In response to these observations, UTDRO piloted a nascent Mentorship Program for junior radiation oncology faculty (see Faculty Mentorship) at the Princess Margaret consisting of: (i) an orientation handbook; (ii) educational faculty development sessions; and (iii) direct, one-to-one selection and declaration of a mentor. Due to the success of this pilot, UTDRO is currently working to expand the Faculty Mentorship Program across all disciplines and sites. To further clarify the policies, procedures, and pathways for promotion, UTDRO also offered a seminar on "The Why's and How's of Academic Promotion" to all faculty in 2017.

Since the review, a needs assessment, led by Dr. Jennifer Croke, has also been conducted in 2017 to determine the perceived mentorship needs and experiences of our radiation oncology residents and faculty (doi.org/10.1016/j.clon.2019.09.050). Furthermore, a formal assessment, led by Dr. Ewa Szumacher, was conducted in 2019 to better understand the Continuing Professional Development (CPD) needs of UTDRO faculty, and to determine how these needs could be generalized to other CPD programs; this evaluation has since been published (doi.org/10.1007/s13187-019-01607-1). The study observed that a general lack of awareness and lack of access made participation in CPD programs difficult. Members also noted that topics were often impractical, irrelevant, or not inclusive of different professions. Some participants did not feel motivated to engage in CPD offerings due to a general lack of time and lack of incentive. The findings from both studies will help inform the development and implementation of the UTDRO-wide Faculty Mentorship Program. We anticipate that as the Faculty Mentorship Program rolls out across the department, the knowledge gap regarding the promotion process will improve.

Additional faculty development activities have included support of UTDRO faculty participation in the U of T Centre for Faculty Development – Education Scholars Program (ESP) (Cate Palmer (2015); Dr. Andrea McNiven (2016)), with Dr. Barbara-Ann Millar serving as the ESP Associate Director since 2011. Faculty with specific interest in pursuing higher degrees in education are similarly supported through hospital-based resources, such as a Master of Education (MEd) at Maastricht University (Dr. Jennifer Croke), Ontario Institute for Studies in Education (Dr. Rob Dinniwell), MSc Clinical Epidemiology from the Harvard TC Chan School of Public Health (Drs. Meredith Giuliani, Kathy Han, Derek Tsang), and PhD from the School of Health Professions Education at Maastricht University (Dr. Meredith Giuliani). In recognition of the need for expanded faculty development, a new Faculty Development and Continuous Education Program Director role was created in 2016. Drs. Barbara-Ann Millar and Ewa Szumacher were appointed as the inaugural Co-Directors of Faculty and Professional Development & Continuing Education in UTDRO.

The research activities undertaken by UTDRO faculty cover the broad spectrum from basic, translational, clinical, imaging, physics, to health sciences, and quality of life. All research activities are undertaken in the hospital-based departments, supported by peer-reviewed, industry, philanthropic, or other departmental resources. UTDRO faculty capture a significant amount of peer-reviewed funding ($50.6M/annum on average between 2016-2020); and the caliber of publication output is comparable to peers at Memorial Sloan-Kettering and MD Anderson Cancer Center (see UTDRO Peer-Reviewed Publications). The UTDRO Collaborative Research Seed Grant Program, which was established in 2013 by Dr. Fei-Fei Liu to promote research collaborations across different hospital sites, continues to capitalize on synergies within the UTDRO community. Fourteen competitions have taken place thus far, under the leadership of the Vice Chair of Research (Dr. Mike Milosevic), awarding seed funding to collaborative projects across five affiliated cancer centres (PM, OCC, Southlake, THP, SMRCP). This has successfully resulted in external awards and applications for external funding. Research findings stemming from the Collaborative Research Seed Grant Program are also shared in the quarterly UTDRO

Evening Journal Clubs, which were established in 2016 to further enhance collaborative opportunities between the various cancer centres within UTDRO; 30-50 faculty and trainees attend each time for this knowledge exchange opportunity.

Faculty Mentorship

Mentorship is a personal and career development relationship in which a more experienced faculty helps guide a junior staff member. A mentor advises on the career development of the mentee and assists them with achieving career goals, scholarly projects, academic promotion, and work-life balance. Mentorship relationships may be short or long-term, depending on the career paths of both mentor and mentee.

Mentorship within academic medicine is associated with increased career satisfaction, increased academic productivity (including academic promotion and publications), opportunities for networking, and improvements in faculty retention. Mentorship provides opportunities for professional fulfillment and meaningful work.

One example of an UTDRO faculty-led mentorship initiative is a pilot program at the Princess Margaret Cancer Centre led by Drs. Jennifer Croke and Jolie Ringash. The pilot Junior Faculty Mentorship Program supports the career development of new faculty members, as well as the career progression of current faculty. This program was adapted from the University of Toronto's Department of Medicine Mentorship Program and officially launched in April 2016. The overall objectives of the Faculty Mentorship Program are to: (i) assist with faculty career development; (ii) improve faculty satisfaction and retention; (iii) improve rates of academic promotion; and (iv) improve academic productivity.

The Faculty Mentorship Program is governed by a Mentorship Committee that is responsible for overseeing, adapting, and evaluating the program. The Program Chair is at either the Associate or Full Professor rank and assists mentees to identify appropriate mentors based on mutual needs, interests, and goals, and assists with conflict resolution. The Program Assistant is responsible for tracking mentor-mentee pairings and coordinating meetings. A formal mentorship agreement is signed by both the mentor and mentee and filed with the Program Assistant. Additionally, a confidential action plan is created to identify mentee goals and expectations with corresponding strategies and timelines. Mentors and mentees are provided with an orientation handbook, and mentees participate in educational faculty development sessions. In 2017-2019, an Annual Mentorship Breakfast was held jointly with the Faculty of Ophthalmology, where a guest speaker, typically one of the Royal College Mentors of the Year, was invited to the session.

After one year, the mentee and mentor will re-assess their relationship to determine whether it continues to benefit both or has reached a natural conclusion; in which case, a new partnership may be formed. As of July 2021, 17 junior faculty have selected 16 mentors at the Princess Margaret, while others are still at various stages of establishing their mentoring relationships.

In 2020, the Faculty Mentorship Program underwent a mixed-methods evaluation using a questionnaire followed by one-on-one semi-structured interviews to explore perceptions of the program (doi.org/10.1016/j.radonc.2021.07.003). Feedback from both mentees and mentors were overwhelmingly positive; participants expressed satisfaction with nearly all formal program components. The findings highlight the importance and feasibility of establishing a culture of mentorship within radiation oncology. Given the overlap in faculty between PM and UTDRO, this pilot initiative

has been beneficial to both sites in terms of career development. UTDRO is currently exploring implementing the Faculty Mentorship Program for other disciplines and UTDRO partner sites.

Faculty Recognition

Over the past 5 years, UTDRO has continued to celebrate the milestones and accomplishments of its faculty and trainees. The UTDRO Annual General Meeting in the fall is one occasion throughout the year that faculty who have made significant contributions to the program's education and research portfolios through exceptional leadership, commitment, and/or innovation, are recognized (Appendix 2.3). The UTDRO Education and Research Committees undergo an annual nomination process, whereby outstanding faculty members are nominated and selected for awards. The majority of these awards are non-monetary, but UTDRO is starting to develop endowments to support three monetary awards. When appropriate, the Chair and program leadership also nominate exemplary faculty for external awards. As such, the achievements of many of our faculty have been recognized extensively through various local, national, and international awards and appointments (Appendix 2.4).

Financial Structure

UTDRO continues to operate on a budget of less than $2 million per year (Table 2). Approximately half of the budget comes from the Temerty Faculty of Medicine (FoM), indirectly supported by grants received from the Government of Ontario for the Medical Radiation Sciences (MRS) Program. The funding supports the delivery of clinical and didactic courses for the program.

The MRS is the combined BSc/Diploma undergraduate education program for radiation therapists, radiation technologists and nuclear medicine technologists, jointly governed and taught at the University of Toronto and the Michener Institute of Education at UHN. The MRS is funded by the Ministry of Labour, Training and Skills Development (formerly known as the Ministry of Training, Colleges and University; MTCU) through Weighted Grant Units (WGU) funding for the BSc component of the joint program (to U of T) and the Ministry of Health for the Advanced Diploma component of the joint program (to Michener). As per the agreement between the Governing Council of U of T and Michener, the University collects the tuition, as well as the ancillary fees from the students. U of T subsequently transfers 50% of the tuition fees and 100% of Michener's ancillary fees to the Michener each year.

The remaining half of the UTDRO budget is derived from MOHLTC funding, as well as PGME funding from residents enrolled in the Residency Program, and conference revenues. The MOHLTC funding was established as part of the Ministry's response to the shortage of human resources for radiation therapy delivery identified in the 1980s. The original funding was $428,000/annum to establish UTDRO. The MOHLTC funding currently supports the stipend payments of the UTDRO Executive Leadership. The level of funding from the MOHLTC has remained constant over the last 30 years despite at least trebling in the size of faculty. In order to support the growth and change of programs within this limited level of funding, leadership stipends have been reduced to allow for growth in the number of leadership positions. Continuing education events remain self-funded. As such, staffing resources are utilized at all levels – from budget planning to prospectus development – to ensure that delivery of CE programming achieves program goals and objectives, while remaining cost efficient.

Table 2: UTDRO Five-Year Financial Budget

	Actuals ($)				
	2016-2017	**2017-2018**	**2018-2019**	**2019-2020**	**2020-2021**
Temerty FoM Budget	988,898	939,453	970,553	954,324	946,204
MOHLTC Budget	376,128	428,310	428,312	428,312	428,310
Teaching & Research Budget	101,043	101,043	97,586	60,738	60,738
Other Revenue	770,554	749,788	661,972	505,604	435,733
Total Revenue	**2,236,623**	**2,218,593**	**2,158,423**	**1,948,977**	**1,870,985**
Total Expenses	**2,174,118**	**2,108,080**	**2,188,401**	**2,134,358**	**1,749,041**
Actual/Planned Over Budget	128,543	30,193	24,065	-89,944	121,944
CFW at the End of April	306,484	336,676	360,742	277,798	399,741

MOHLTC: Ministry of Health and Long-Term Care; CFW: Carry forward

In addition to funding from the Temerty FoM and MOHLTC, there are occasional donations or bequests made to UTDRO and these funds are held in an account at the University Foundation. More substantial charitable donations are directed to the Hospital Foundations and considerable fiscal support is provided to the hospital departments through both the Princess Margaret Cancer Centre Foundation and the Sunnybrook Foundation.

Fortunately, research funding received by UTDRO faculty has steadily increased over the past five years despite a more competitive funding environment. The total peer-reviewed research funding awarded to UTDRO investigators was approximately $250 million in the last five years; all such funding is directed to support specific projects.

Salary support for radiation oncologists comes from the MOHLTC to the provincial professional organization, the Ontario Association of Radiation Oncologists (OARO) (see Ontario Clinician Scientist Program). The funding envelope provided by the Ministry to OARO includes funding for non-clinical activities such as research, education, and administration, with a separate funding envelope provided for Clinician Scientists. The stipends flow directly from the MOHLTC to the cancer centres; the University has no role in this funding stream. The position of OARO-funded Clinician Scientists is undertaken through a competitive process based on scientific merit across the province. OARO Clinician Scientists should have at least 80% of time dedicated to research, a track record of research success, and support from their departments and/or from directors of the respective hospital research institute. The University/Hospital affiliation agreement mandates that all medical staff at fully affiliated academic hospitals must hold a university appointment.

Challenges and Opportunities

Over the recent five years, base funding administered by the Temerty FoM and distributed to the department has been consistent; however, claw backs from the Temerty FoM ranging from 5% to 13% over the last five fiscal years have presented challenges to planning for future growth within UTDRO. The reduction in carryforwards to the department has hampered its ability to fulfill its mandate and strategic plan. Without significant changes in the funding model, the existing structural deficit will lead to a cumulative deficit of $843,000 in the ensuing 5 years.

Deployment of additional staffing and other resources will be necessary in order to incentivize and support the growth of UTDRO programs. Over the last five years, and looking forward, some UTDRO programs have had and will experience curriculum changes in response to the external environment that will impact administrative operations. For instance, with the migration to Competency-Based Residency Training in Radiation Oncology, there has been increased reporting requirements, along with documentation workload. Another example is the new MRgRT Training Program that will be launched in 2022 in partnership with Elekta. This program requires significant administrative support during the development phase and course coordination once it goes live. There are no additional staff being hired for this program; hence, the work will need to be absorbed amongst the current team. While this is and will continue to be a challenge with the existing resources, administrative staff have identified opportunities for streamlining procedures. Dedication of appointed staff resources to specific programs and portfolios have facilitated process improvements, while enabling the sharing of best practices and ideas to achieve efficiencies within a team context.

It is important to note that this model of dedicating resources and achieving efficiencies have relied on appointed staffing resources. It has been a challenge to achieve long-term efficiencies in portfolios

assigned to short-term staff. Financial constraints within the context of a unionized environment are not permissive conditions for long-term staff resource planning. Additional financial resources would create the opportunity to optimize staff resource utilization and enable the delivery of efficient administrative support to the department's faculty, as well as current and prospective learners.

Strategies to maintain sustainable and stable funding continues to be a key focus for UTDRO. Since the 2017 External Review, the Chair has worked in collaboration with the Temerty FoM Dean, partner hospitals, and the MOHLTC to explore additional revenue opportunities. A meeting with the Human Health Resource (HHR) Planning Group at the MOHLTC in 2017 was successful, wherein the MOHLTC was clearly appreciative and laudatory regarding the ability of UTDRO to disseminate its innovations and excellence in clinical care delivery across the province; thereby ensuring access to high quality radiotherapy care for all Ontario patients. Accordingly, UTDRO was able to secure a modest increase in base funding from the MOHLTC, which has been maintained for the last 5 years. In response to recommendations made in the 2017 External Review, the Temerty FoM committed to ensuring the financial stability of the department to support the resources required to execute its academic mission, including financial support to create an Executive Vice Chair position to assist the Chair in these activities, as well as funds for enhanced administrative support to assist in the implementation of Competency by Design within the Radiation Oncology Residency Program.

Other revenue-generating strategies that are being explored include, but are not limited to strengthening industry alliances and monetizing courses/programs, such as the new MRgRT Training Program, and further expanding the Clinical and Experimental Radiobiology Course to a paying international audience. International trainees represent a significant opportunity for expansion of our global impact, as well as acquiring incremental funding for our educational programs. Additional options for revenue generation include international partnerships, CMEs, and of course, philanthropy. The Chair will continue to work with the U of T Advancement Office to focus on building engagement with our alumni community, including the successful ASTRO Alumni Event, which has been ongoing for the past 12 years (see Alumni and Advancement).

The future of operations in UTDRO post-pandemic will also lead to unique opportunities for retention. The administrative and executive team members were able to quickly pivot to working from home by utilizing online technologies. UTDRO expects that a hybrid model of working remotely and working on-site will be the future. This model would work well with the nature of the administration team, and assist in retention of administrative unionized staff by encouraging options for an attractive work-life balance.

Equity, Inclusion & Professionalism

Since the initial establishment of the UTDRO Equity Director in 2008, the scope was expanded in 2012 to include professionalism and social responsibility; in 2015, conflict of interest (COI) guidelines were also added. In 2020, the office evolved to add inclusion as part of its mandate. The primary goal of the office is to ensure that UTDRO faculty, staff and trainees have access to support in addressing and fulfilling the University of Toronto's mandate on Equity, Inclusion and Professionalism (EIP). This role also ensures that all UTDRO learners have transparent access to faculty COI declarations, and that these conflicts have been successfully managed.

Equity refers to the principle of providing a welcoming and accommodating environment to all, including LGBTQ, racialized persons or persons of colour, and persons with disabilities. Inclusion means that all people be respected, valued, and appreciated regardless of their disabilities, abilities, race, gender, age, or other needs. Professionalism is reflected by a set of skills and behaviours that validate the trust put in us by our patients, our students, our colleagues, and our society. We strive to fulfill this by developing leaders, contributing to our communities, and improving the health of individuals and populations through the discovery, application, and communication of knowledge.

Over the past five years, UTDRO has continued to foster a healthy departmental community and strengthen the faculty and trainee experience. In February 2021, Dr. Charles Catton concluded his six-year term as EIP Director (July 2015-February 2021). Under the leadership of the new EIP Director, Dr. Danielle Rodin, UTDRO continues to maintain its commitment to promoting a department with a zero-tolerance policy towards homophobia, sexism and racial injustice. In alignment with the Temerty Faculty of Medicine's Office of Inclusion & Diversity's Statement of Solidarity and the Ontario Medical Association's anti-racism statement, UTDRO is also committed to recognizing the acts of resistance and collective pain of our Black and Indigenous community members.

Activities

The 2018-2023 Academic Strategic Plan of the Temerty FoM specifically identified Excellence through Equity as a strategic domain of focus. Over the past five years, UTDRO has continued to align its culture, principles, and philosophies with that of the Temerty FoM Office of Inclusion and Diversity and their Equity, Diversity and Inclusion Action Plan, as well as other external professional bodies, such as the CPSO (College of Physicians & Surgeons of Ontario).

In the spring of 2016, the Temerty FoM launched the Voice of the Resident Survey as a follow-up to the 10-year Annual Exit Survey of Residents. Since then, the "Voice of the …" surveys have been implemented across the different segments in the Temerty FoM. In the spring of 2018, the Voice of the Faculty Survey was conducted with the results being shared in January of 2019 (Appendix 2.5). The UTDRO Voice of the Faculty results were presented at the UTDRO Executive in January 2019 with guests Dr. Lisa Robinson, Associate Dean of Inclusion and Diversity (Temerty FoM) and Anita Balakrishna, Director of Equity, Diversity, and Inclusion (Temerty FoM).

In response to the survey results, the UTDRO Executive established the Respect and Civility (R&C) Working Group in April 2019, co-chaired by Drs. Rebecca Wong and Charles Catton, with membership from across the hospital sites, disciplines, and seniorities. Members included:

- Dr. Charles Catton (Co-Chair)

- Dr. Rebecca Wong (Co-Chair)
- Darby Erler
- Dr. Juhu Kamra
- Winnie Li
- Dr. Patricia Lindsay
- Dr. Claire McCann
- Cate Palmer
- Dr. Danielle Rodin
- Dr. Danny Vesprini

The mandate for the R&C Working Group was to make recommendations to the UTDRO Executive with immediately actionable, short-term, and long-term goals to improve the culture of respect, civility, inclusion, and equity across UTDRO. The R&C Working Group met regularly between April to June 2019 to review and discuss the Voice of the Faculty Survey, solicit feedback and perspectives from peers and the community, and discuss personal experiences at various centres and programs, both internal and external to the University, to establish its recommendations, which were presented to the UTDRO Executive on July 25, 2019.

The key findings for UTDRO faculty were:

- Low overall score on quality of professional life, and work experience at hospital sites.
- Low score on culture of respect at the workplace, especially when compared to other departments.
- Significant experiences, observed and received, by faculty of bullying, harassment, and incivility.
- Incidents of sexism and sexual harassment.

The R&C Working Group acknowledged that the influence of culture must account for the fact that education, research, and patient care occur outside the auspices of UTDRO. It also acknowledged that the University Department has direct involvement and representation in the MD Full-Time hiring process, but not in the Status Only appointments. Therefore, the approaches need to reflect the areas and processes in which UTDRO has jurisdiction and involvement.

The following areas were identified as those with the highest opportunity for positive influence on culture and practice:

- Hiring practices and onboarding
- Reappointment process (MD and Status Only)
- Continuing appointments
- Promotions
- Reporting processes (University and partner institutions)
- Education programs and evaluations

The recommendations of the R&C Working Group with short-term or immediate applicability, and longer-term goals are outlined below.

Equity

- Establish gender and cultural representation guidelines for the MD Hiring Committees, and internal committees where appropriate.
- Establish gender goal of 50% female candidates for the MD applicant pool available for final consideration when feasible; accounting for the overall applicant pool and available candidates.

- Establish goal for gender balance on MD Hiring Committees and MD hiring.

Professionalism

- Define professionalism as a department.
- Highlight and require sign off by faculty member on professionalism, respect, and civility as a principle in the offer letter for all categories of appointments and reappointments.
- Establish process for Chief/Division Head/Manager to attest in writing that there are no unmanaged or unresolved issues of professionalism at times of reappointment, Continuing Appointment Review (CAR), and promotion.
- Expand referee requests, especially trainee references, to also note professionalism as a criterion.
- Create departmental onboarding and welcome framing expectations, including professionalism.
- Explore the possibility of incorporating self-reporting of professionalism in annual activity reporting system or COI annual process.

Education Programs

- Ensure all trainee evaluation of faculty include mechanism or items relevant to eliciting feedback on professionalism with definition as a criterion.
- Ensure feedback is accessible, made available to Department Chief/Heads.
- Establish best practices within programs and implement across programs as applicable.
- Expand on the collection and collation of feedback across the programs through various activities (e.g. rotation evaluation, exit interviews, bi-annual reviews).
- Build a 2-year plan to include professionalism best practice into CE activities (e.g. Journal Club, RMP rounds, Odette interdisciplinary rounds).
- Build a remediation process to support the development of faculty and offer tools that builds understanding of self-awareness and leadership style development (e.g. Insights).
- Incorporate professionalism and feedback into faculty development activities.

Communication and Engagement

- Highlight and communicate search processes for committee membership and leadership appointments.
- Communication to department of professionalism as a criterion for promotion.
- Reaffirm with hospital partners the requirement and process to report incidents to the University.
- Communicate and make available to faculty, the hospital processes for reporting an incident or concern.
- Develop clear messaging of department commitment to professionalism and equity issues on UTDRO website.
- Create an annual survey to gauge effectiveness of recommendations and areas for improvement.
- Share and discuss the results of this survey openly through rounds and newsletters.

Since the launch of the recommendations, notable progress has been made in each of the four pillars. Key highlights are described below.

In response to the Temerty FoM Voice of the Learner Survey results (spring 2019), the UTDRO Residency Committee and residents led its own Resident Survey in the spring of 2020 to better understand trainees' experiences with intimidation, harassment, and discrimination within the program. Key findings from the survey included:

- Most residents endorse several examples of unprofessional behaviour as per Post-Graduate Medical Education (PGME) criteria.
- 44% of residents believe concerns are not kept confidential.
- 50% of residents expressed that fear of retribution is a barrier to reporting harassment.
- There were learners who did not feel comfortable addressing concerns with anyone.
- Learners felt that there are no/minimal consequences for staff for unprofessional behaviour, and that they are not enforced.
- PGME process perceived to be limited in its ability to effect change.
- Staff gossip about residents were unhelpful.
- Disparaging comments regarding gender or ethnicity.
- Failure to acknowledge power dynamic.
- Staff did not display understanding of the explicit and implicit expectations residents hear, and how other experiences inform this (e.g. gossip about other residents being lazy).

These results were communicated by Drs. Andrea Bezjak (Residency Program Director), Rebecca Wong (Vice Chair, Education, UTDRO), and Dr. Glen Bandiera (Associate Dean, PGME, Temerty FoM) to the UTDRO Executive and faculty at the Princess Margaret Cancer Centre and Odette Cancer Centres in September 2020 to inform decision-making and increasing awareness of these issues concerning the UTDRO Residency Program.

A similar Voice of the MRS Students Survey was launched in March 2019. In January 2020, the MRS Program began to review/discuss the survey results with a plan to address a number of areas. However, this was suspended due to the COVID-19 pandemic. A second Voice of the MRS Students Survey is currently circulating amongst the MRS students; the results are anticipated in the fall of 2021.

On the communication/engagement and educational front, a workshop entitled, “Equity, Diversity and Inclusion (EDI) in the Health Professions & Health Sciences: A Journey of Awareness & Action” was organized by Dr. Meredith Giuliani in August 2020. The objectives of the workshop were to: (i) understand why EDI matters in health professions and health sciences education (i.e. what are the core issues/challenges); (ii) learn about key EDI language, terminology and frameworks (e.g. micro-aggression, implicit bias, anti-oppression, anti-racism, social justice); (iii) learn about the Temerty Faculty of Medicine initiatives to advance EDI in health professions/sciences education (i.e. strategic plan, specific initiatives and programs); and (iv) learn how to be an ally and practice inclusion as an educator (i.e. toolkit to interrupt/disrupt discrimination, harassment and exclusion).

Equity, inclusion, and professionalism best practices have been incorporated into several of our CE activities. At the 2018 UTDRO Research Day, Keynote speaker Dr. Shelly Dev presented “One Physician's Story: The Intersection of Medical Culture and Physician Wellness”, which delved into her own experience balancing mental health and wellness within an incredibly challenging and demanding field. The well-received session provided advice on the importance of refueling, and how to understand when certain coping mechanisms are no longer working.

The 2019 Princess Margaret Summer Series entitled, “Contemporary and Future Ethical Considerations in Medicine” was devoted to topics ranging from “Managing Conflict of Interest in an Innovative Organization”, “Key Ethics Considerations and Governance Over Research in a Learning Health System”, to “Ethics of Research Publication: A Journal Editor’s Perspective”. Subsequently, the 2020 Summer Series was themed “Heal Thyself: Wellness in Healthcare” and was presented by high profile educators and wellness experts. Topics ranged from “Racism in Healthcare”, “Respect, Civility &

Professionalism", "Difficult Doctor", to "Mental Health and Wellbeing: Current Perspectives for Trainees & Faculty". More recently, the 2021 Summer Seminar Series entitled, "The Hill We Must Climb: Eliminating Inequalities in Our Midst" was developed as a collaboration between UTDRO and the Princess Margaret, focusing on topics related to equity, discrimination, and professional culture – issues that have come into sharp focus over the last year. The series featured national and international experts who guided attendees through interactive sessions on these critical issues with the aim of sparking broad discussion on how we can foster and support a diverse and healthy workforce at the Princess Margaret and UTDRO.

In response to global events, such as "Black Lives Matter", Statements of Solidarity have been expressed by Dr. Charles Catton (former Director of EIP) in 2020. Likewise, in response to the Atlanta massacre, both Drs. Danielle Rodin (current Director of EIP) and Fei-Fei Liu penned Statements of Solidarity with the Asian community in 2021. These Statements continue to promote the importance of equity, diversity, inclusion, and professionalism core values within the UTDRO environment for both learners and faculty.

In further efforts to promote diversity and inclusion within UTDRO, affirmative action policies and processes have been developed to ensure that traditionally underrepresented groups have full opportunities for consideration for enrollment. Over the years, the UTDRO Fellowship Program has recruited candidates from Jordan, Zimbabwe, and Ghana. Fellows have come from existing international partnerships to build radiation medicine capacity in low- and middle-income countries, such as Ethiopia, Ghana, Zimbabwe, Nigeria, and Kenya (see Internal and External Relationships).

Opportunities

In the next 5 years, UTDRO will continue to support our students and faculty in the areas of equity, inclusion, and professionalism, as well as disclosure and management of COIs. UTDRO will continue to maintain an inclusive learning environment with a culture of respect, civility, professionalism, and diversity.

Future activities include implementation and operationalization of the recommendations of the Respect & Civility Working Group and alignment of UTDRO's equity, inclusion, and professionalism efforts with the Temerty FoM's activities.

This will first be implemented through a concerted effort towards awareness-building on the themes of discrimination, unconscious bias, micro-aggressions, mistreatment and promoting a positive workplace culture. Residents and fellows will participate in sessions on these topics during their academic half-day and orientation, with clear instructions on who to approach and how to raise concerns regarding such encounters, including those that may not rise to the level of "reporting". Clear instructions on the designated points of trusted contact within UTDRO and Temerty FoM will be presented and posted on the UTDRO website. There will also be guest speakers and "Journal Club" seminars on these topics throughout the year for both trainees and staff, with the intention to build awareness and skills, as well as to underscore the importance of these issues. The benefit of a positive culture that stresses the professionalism values of equity, diversity, and inclusion will also continue to be promoted through public statements from leadership on issues that arise.

A second major effort will focus on accountability. The EIP Director is now a member of the Appointment and Promotions Committees to ensure accountability for staff behaviour and to highlight positive professional behaviour. We will also provide an annual report-back to trainees and staff

regarding any equity issues that were brought forward, and departmental surveys will continue to evaluate the perceived impact of these efforts over time.

With the recent appointments of Dr. Pier Bryden as Senior Advisor of Clinical Affairs and Professional Values (Temerty FoM), Dr. Reena Pattani as Director of Learner Experience (Temerty FoM), and Dr. Julie Maggi as Director of Faculty Wellness (Temerty FoM), UTDRO will continue to work closely with the Temerty FoM Office of Inclusion and Diversity to promote a culture of respect, civility, professionalism, and diversity within the department. In addition, with Drs. Danielle Rodin and Fei-Fei Liu now members of the Temerty FoM Diversity Advisory Council, this will further facilitate the alignment of UTDRO's EDI efforts with that of the Temerty FoM.

Communications

UTDRO strategically uses various digital and print communication channels to disseminate critical departmental information, news, and opportunities to engage our diverse audiences on various academic, professional and research topics. These messages reflect the goals of UTDRO and are tailored to their intended internal and external recipients – faculty, trainees, prospective and current learners, administration, alumni, donors, and other stakeholders.

The digital communication platforms are comprised of the website, social media, email, and e-newsletters, which support the distribution of the annual report, event communications, alumni engagement, and reports such as the Strategic Plan and External Review. News items, including appointment announcements, faculty and trainee grant acquisitions, research projects and publications are also shared widely using all digital avenues. Prior to COVID-19, several of these initiatives were also printed and sent by mail.

The UTDRO Chair, alongside the Vice Chairs, Business Manager, and Communications and Events Coordinator, are responsible for overseeing the UTDRO website; digital communications, including social media, newsletters, and annual reports; event communications; alumni engagement; management of publications, such as the Strategic Plan, External Review Self-Study Report, and news stories; and marketing initiatives to promote the department, and provide information to prospective and current learners. The team ensures that the image of the department reflects its constituencies and that its various communications meet the Temerty Faculty of Medicine and University of Toronto policies and standards.

Activities

Annual Report

Each year, UTDRO releases an annual report for current faculty and alumni. This report is produced annually in both print and digital format. The stories in the annual report reflect activities within the programs and highlights research conducted by each discipline at UTDRO. The annual reports for the previous 5 years are available on the UTDRO website:

- Annual Report 2015-2016
- Annual Report 2016-2017
- Annual Report 2017-2018
- Annual Report 2018-2019
- Annual Report 2019-2020

Newsletter

A newsletter is produced every quarter, and is used to showcase appointments of new leadership, faculty, and staff, research accomplishments, and other notable events and updates. This is produced in-house and distributed *via* the department email marketing system to all faculty, trainees, and administrative support staff.

- Summer 2016
- Spring 2017
- Summer 2017
- Winter 2018

- Spring 2018
- Summer 2018
- Fall 2018
- Spring 2019
- Winter 2020
- Fall 2020
- Spring 2021

Social Media

Since 2013, UTDRO has been following a social media strategy to increase engagement and awareness of our programs, events, and accomplishments. UTDRO has a Twitter account with 2,640 followers and a Facebook page with 1,242 followers (as of August 2021). Within the field of medicine, Twitter is the social media platform of choice for sharing information, research, and achievements. Through experimentation with live-tweeting at conferences with event-specific hashtags (e.g. #RTi3Conference), UTDRO has been able to create an exciting and dynamic forum to further publicize these well-attended events. In addition to Twitter and Facebook, UTDRO has also leveraged YouTube to broadcast videos that promote events, as well as conferences and innovations within the research portfolio.

For student recruitment and engagement in the undergraduate Medical Radiation Sciences (MRS) Program, separate Facebook and Instagram pages have been established and populated with information specifically pertaining to that audience.

Website

In the last 5 years, the UTDRO website, which caters to internal and external audiences, has been completely overhauled in order to better meet departmental needs, implement a responsive design, and to comply with the standards set by the Accessibility for Ontarians with Disabilities Act (AODA). This project was accomplished through extensive consultation with representatives from each program and area, a web team, as well as an in-house AODA advisor.

Print Materials

Prior to the COVID-19 pandemic, print collateral was produced in-house and used for the purposes of marketing and program support. This included the production of the annual reports, External Review Self-Study Reports, educational program handbooks, and supplementary abstract guidebooks for events.

Challenges

The challenges for the communications portfolio fall under four categories:

i. **Operational:** These challenges include limited resources and budget; the majority of the tasks are undertaken in-house, which affects production speed.

ii. **Access to Information:** Since faculty members and trainees are positioned at various clinical sites around the Greater Toronto Area (GTA), the flow of information between the sites and towards UTDRO is limited. This affects the types of stories that UTDRO is able to communicate, as well as the department's ability to produce materials in a timely manner.

iii. **Access to Audience:** With the COVID-19 pandemic shifting many working environments, tasks, and events online, digital burnout has been a growing barrier to information flow. All communications materials are now funneled through online channels, which creates an overabundance of messages, and makes it difficult to stand out.

iv. **Identity:** Although, UTDRO is top ranking in its reputation among Canadian Radiation Oncology Departments, its global presence needs strengthening. The department continues to develop its brand and enhance the department's visibility on the global stage. Proposed strategies include but are not limited to ensuring all faculty have the UTDRO logo on their posters and slide decks when presenting at conferences or meetings.

Opportunities

As a result of the COVID-19 pandemic, new technologies and processes were discovered that have allowed the UTDRO community to connect and collaborate more rapidly and efficiently than ever before. These include using teleconferencing technology, such as Zoom and Microsoft Teams, and file-sharing systems, such as Microsoft SharePoint.

Planning our post-pandemic communications strategy includes examining how best to maintain engagement, attendance, and collaboration. We are examining the possibility of continuing to offer meetings, information sessions, and CE events virtually or as a hybrid model of in person and virtual, to allow higher attendance and greater flexibility for work-life balance, which ultimately results in improved communication flow.

Alumni & Advancement

The UTDRO alumni activities are overseen by the UTDRO Chair, alongside the Business Manager and Communications and Events Coordinator, who work closely with the University Advancement Office within the Temerty Faculty of Medicine. The alumni programs and activities at Temerty FoM are vehicles to support the engagement of future alumni, alumni, and donors, to identify and cultivate prospective donors and to steward current donors. The core priorities of the Alumni Relations Team at Temerty FoM are to engage alumni for the first time, and to deepen engagement with alumni who are already engaged. Over the past five years, UTDRO has worked together with the Advancement Office to revitalize and strengthen our relationship with our alumni, including creating opportunities to involve them in our programs and establishing outreach and engagement activities.

As of spring 2021, the UTDRO alumni community is comprised of 2,411 members who are located on all continents except Antarctica. These alumni have graduated from at least one of the following programs in the last 25 years:

- Radiation Oncology Residency
- Medical Physics Residency
- Fellowship in Radiation Oncology
- Master of Health Science in Medical Radiation Sciences
- Bachelor of Science in Medical Radiation Sciences

In the last five years, 322 unique alumni (approximately 13% of the total) have been engaged. Engagement is counted in the form of event attendance, participation in meetings with advancement, volunteerism and donating. In particular, 134 alumni have remained engaged consistently over the last 4 years.

Activities

Over the past five years, UTDRO has partnered with the Advancement Office to deliver a variety of outreach and engagement activities. Successful partnerships include the annual ASTRO Alumni Reception and the annual graduation event.

Since 2010, UTDRO has been hosting an annual social networking event to coincide with the annual American Society for Radiation Oncology (ASTRO) Conference. The ASTRO Conference is the largest meeting of the radiation medicine community globally, and many UTDRO's alumni and past faculty attend this meeting. This social event is hosted by the UTDRO Chair and is held at a venue near the ASTRO Conference site. In the last five years, 490 members of the UTDRO community, including alumni, have attended this social networking event. This event serves multiple purposes:

- Engaging the alumni community and informing them of the activities of the department.
- Fundraising for the department and its various scholarships.
- Collecting information for the alumni database.
- Facilitating discussions regarding future collaborations.
- Fostering a sense of belonging amongst our alumni community.

UTDRO celebrated its 25th anniversary in 2016. This momentous occasion was leveraged to engage alumni through various social media activities, including a series of YouTube testimonials from alumni

and a LinkedIn alumni group to network and share career-related information. The ASTRO Alumni event also served to bring together alumni to celebrate UTDRO's milestones.

In addition to the annual social event at ASTRO, UTDRO alumni also participate in various CE activities. They are invited to our conferences as delegates and speakers. They are also invited to participate as faculty members and mentors to our trainees and students. Furthermore, to acknowledge the achievements of our alumni, many of whom have gone on to have distinguished careers, UTDRO launched a UTDRO Alumni Award in 2018. The award recognizes excellence in professional creativity, education, research, and global health in individuals following their graduation from one of our training programs. The recipient of this award embodies the UTDRO values and has achieved impact on multiple fronts, which has in turn benefited the radiation medicine community at large, and ultimately our patients. The inaugural winner of the UTDRO Alumni Award was Dr. Mei Ling Yap, who was a fellow within the department.

In partnership with the University Advancement Office and Medicine Communications team, UTDRO strives to produce content that demonstrates the impact of the department and amplify stories across the Temerty FoM and U of T communication channels. This includes the Temerty FoM's Twitter (27,200 followers), Instagram (9,900 followers) and Facebook (7,340 followers). Examples of stories about UTDRO posted to the Temerty FoM website and promoted across platforms and channels include:

- It's Prostate Cancer. But is it Deadly? (January 2017)
- Smarter Radiation Therapy with Artificial Intelligence (August 2018)
- Millions of Women in Low- and Middle-Income Countries will Need Radiotherapy for Cervical Cancer Despite Vaccination (May 2019)
- Advancing Radiation Oncology: Dr. Kathy Han (June 2019)
- Faces of U of T Medicine: Fei-Fei Liu (August 2020)

Over the past five years, $1,784,852 has been raised for the priorities of the department. While the majority of funding came from hospital partnerships, there was also unrestricted funding from several industry partners, as well as philanthropic donations. The most notable philanthropic gift of $100,000 established an endowed Rising Star Research Award, recognizing an early career faculty member who has demonstrated outstanding ability, innovation, and the potential for sustained excellence in radiation oncology research. Additionally, there are currently six faculty members in UTDRO that hold Hospital-University Named Chairs or a University Named Chair (Table 3):

Table 3: UTDRO Faculty with Hospital-University or University Named Chairs

Faculty	Chair Name	Site
Alexander Sun (2019-Present) Andrea Bezjak (2004-2019)	Addie MacNaughton Chair in Thoracic Radiation Oncology	UHN (Princess Margaret Cancer Centre)
Eileen Rakovitch (2011-2021)	L. C. Campbell Chair in Breast Cancer Research	Sunnybrook Health Sciences Centre
Fei-Fei Liu (2019-Present)	Peter and Shelagh Godsoe Chair in Radiation Medicine	UHN (Princess Margaret Cancer Centre)
John Waldron (2019-Present) Brian O'Sullivan (1999-2019)	Bartley-Smith/Wharton Chair in Head & Neck Radiation Oncology	UHN (Princess Margaret Cancer Centre)

Scott Bratman (2020-Present) Fei-Fei Liu (2001-2019)	Dr. Mariano Antonio Elia Chair in Head and Neck Cancer Research	UHN (Princess Margaret Cancer Centre)
David Hodgson (2016-Present)	POGO Chair in Childhood Cancer Control at the University of Toronto	University of Toronto
Jan Seuntjens (2021-Present) David Jaffray (2002-2021)	Orey and Mary Fidani Family Chair in Radiation Physics	UHN (Princess Margaret Cancer Centre)

Several gifts have been received by the Temerty FoM in the last five years that have a wide impact across departments, benefitting many of our faculty members and learners. As the University enters a new campaign, we anticipate these faculty-wide gifts will become more common, to the benefit of all departments.

One example is the $16.4M multi-year commitment from Hold'em for Life Charity Challenge made in 2019, supporting residents and clinical fellows conducting cancer research. Two trainees from UTDRO successfully competed for, and received, these $50,000 fellowships for the 2020-21 academic year.

On September 24, 2020, the University announced a historic $250 million Temerty Foundation gift – the largest in Canadian history. This gift will advance biomedical research and innovation, medical education, and health care in Toronto, Canada and beyond. The faculty members and learners of UTDRO, like many clinical departments, will benefit from this investment as there is significant funding for fundamental, translational, and clinical research. In the short term, $10M of the Temerty Foundation gift was designated to assist with urgent COVID-19 priorities, such as isolation accommodation during the spring/summer 2020 wave of COVID-19. During this time, one trainee from UTDRO accessed isolation accommodation in a hotel, allowing them a safe place to isolate from vulnerable family members and roommates while they worked on the frontline in the hospital. Additionally, three international fellows from the department also received a contract extension to continue working in Toronto until it was safe to travel to their home countries.

Challenges

The alumni activities at UTDRO continue to face challenges, with its mandate and purpose often lost or forgotten. Without a formal academic committee focused on alumni relations, engaging alumni is considered an afterthought, and is often passed down to the administrative team. This is a missed opportunity since the strongest connections with our alumni are in fact, with the faculty members, and not the administrative team.

In addition, UTDRO alumni do not always associate with the University Department as their primary place of training. In particular, students in the undergraduate MRS Program attend the majority of their classes at the Michener Institute, and upon graduation, they consider themselves Michener alumni. Similarly, residents and fellows spend their time training at the hospital sites; hence, the association is much stronger with the hospitals than with UTDRO after graduation.

Fundraising in the age of COVID-19 has been a challenge with events moving online, enforced social distancing measures, and financial resources being redirected to fight the ongoing pandemic. Raising the subject of contributions and soliciting donors for gifts in the midst of a crisis has been a sensitive topic.

New fundraising strategies to respond to the impact of the pandemic will need to be implemented to replace lost revenue from many of our existing initiatives.

Opportunities

As the global pandemic continues to limit the ability to hold in-person fundraising events to elicit financial support and build relationships, UTDRO is challenged to rethink the way it drives donations and host fundraising events moving forward. The department plans to continue exploring creative and strategic ways to leverage virtual fundraising events and campaigns to engage with donors and prospects, while keeping them safe and maintain fundraising momentum.

The establishment of an Endowed Chair in UTDRO (e.g. for Chair him/herself in the future) would also assist in recruiting and retaining the highest-quality faculty and ensuring sustainable financial support for the department. In the 2017 External Review, it was commented that the Chair of UTDRO carries significant responsibilities for maintaining and expanding on the successes of her predecessors, and that the resources available to the Chair did not seem to commensurate with her responsibilities. The reviewers noted that it was possible to see that this lack of resources could lead to a potential loss of strategic opportunities; hence this would need to be an area of focus for the new Chair, along with the Dean.

ACADEMIC PROGRAMS

UTDRO is the academic home to a comprehensive range of training programs in radiation medicine, where the mission is to train the leaders of tomorrow. For the practicing professional, continuous medical education offerings are provided through multiple formats with a strong focus on interdisciplinary learning. As a result of the 30 years of cumulative training of residents and fellows, UTDRO has an alumni network of 2,400+ members, spanning across the country and the world, shaping the practice of radiation medicine globally.

The five pre- and post-certification professional training programs include:

1. A joint BSc and Advanced Diploma in Radiation Therapy, Radiological Technology, and Nuclear Medicine and Molecular Imaging Technology in Medical Radiation Sciences (MRS)
2. Postgraduate residency in radiation oncology
3. Postgraduate residency in medical physics
4. Fellowship in radiation oncology
5. STARS21 (formerly EIRR21), a research capacity building program in radiation research first initiated in 2003, and initially funded through a Canadian Institutes of Health Research (CIHR) grant.

Our faculty also contributes significantly to the U of T undergraduate medical education curriculum. In addition, through cross appointments to multiple U of T graduate departments, including Medical Biophysics, Dana Lana School of Public Health, Institute of Health Policy, Management and Evaluation (IHPME), Institute of Medical Science (IMS), and Institute of Biomaterials and Biomedical Engineering (IBBME), our faculty provides supervision to MSc and PhD candidates in radiation medicine, medical biophysics, and clinical epidemiology. UTDRO also offers an annual 1-week long Clinical and Experimental Radiobiology Course taught by both local and international faculty. Designed for trainees and practicing professionals, it is a unique Canadian resource, relied upon to fulfill the radiobiology training requirements for most Canadian radiation oncology training programs.

Our continuous medical education program includes offerings using different formats designed to reach our peers nationally and internationally. There are two annual scientific conferences for external audiences, Target Insight and RTi3. Target Insight highlights new developments in radiation medicine with a special focus on integration with our practice community. RTi3, now in its 18th year, has become the Radiation Therapy Conference of choice, commanding between 150 and 225 participants from across the country and around the world annually. The Accelerated Education Program, under the auspices of the Princess Margaret Cancer Centre, offers intensive interactive workshops (1-3 days) focused on ahead-of-the-curve practice topics, as well as an Executive Personalized Learning Program (3-6 months) that allows visiting scholars to observe and become immersed in the Princess Margaret practice culture and environment. The UTDRO Evening Journal Club takes place three times per year, providing a forum to highlight active collaborations and their impact across UTDRO.

In 2018, UTDRO made the difficult decision to discontinue its Master of Health Science in Medical Radiation Sciences (MHScMRS) Program due to past patterns and anticipated trends in our practice environment (e.g. low enrollment, competing resource demands). As an innovative professional master's program and the first of its kind in North America, the program provided a unique graduate level

education experience for practicing radiation therapists, but only graduated 12 radiation therapists over 10 years.

UTDRO delivers its spectrum of academic programs by effectively leveraging existing human and physical resources at its affiliated radiation oncology cancer centres and those offered by the University of Toronto; these are described further in the subsequent sections of this report. Recognizing that resources are limited, each program aims to utilize its available resources as effectively, purposefully, and efficiently as possible to meet the needs of its faculty and learners.

Strategy to Enhance Education

In the preceding years, the UTDRO educational strategy has been focused on heightening the department's culture of academic excellence and preparing the radiation medicine leaders of tomorrow as defined by our refreshed strategic plan, *UTDRO 2022: Reflect. Transform. Lead*. Specific strategies have included:

- Clarifying roles and expectations with respect to faculty engagement in learning and teaching.
- Strengthening the faculty performance management process to include specific academic objectives.
- Engaging current faculty in high quality professional development activities aligned with their individual academic goals.
- Extending academic opportunities for radiation therapists.
- Fostering a culture of mentorship and academic support.
- Emphasizing the importance of high-impact scholarly publications.
- Establishing mechanism(s) for cross discipline/institution dialogue regarding the future role of the radiation medicine discipline with associated professional groups nationally and internationally.
- Creating enriched and flexible complementary curriculum for learners in areas such as leadership and management.
- Implementing leading-edge adult education methods and approaches in the delivery of all educational offerings.
- Nurturing research talent across disciplines and career continuum.

Each of these strategies has been actively pursued and is expected to advance the UTDRO strategic aspiration to be known as the educator of choice internationally for radiation medicine professionals and researchers. In addition, to maintain an excellent learning environment, UTDRO relies on services and support systems that are offered to its students and trainees through the Temerty Faculty of Medicine and the University of Toronto (Appendix 3.1).

Faculty

There is broad engagement in education across the department wherein >80% of faculty provide teaching hours in the undergraduate curriculum, as well as actively participate in resident or fellowship training. In 2020-2021, UTDRO faculty consisted of 97 radiation oncologists, 54 physicists and 35 therapists, with 30 Full Professors, 33 Associate Professors, 81 Assistant Professors, as well as 37 Lecturers, and 7 Instructors. Over the past years, we have continued our 30-years' track record of 100% successful promotions within the Temerty FoM. Special note is made of the growing depth of expertise among radiation therapists; the promotion of Dr. Tara Rosewall to the rank of Associate Professor was a

Canadian first, and 12 and 2 radiation therapists now hold the academic ranks of Assistant Professor and Associate Professor, respectively.

The high caliber of UTDRO faculty is corroborated by the various educational awards and distinctions bestowed upon our members and programs (Appendix 3.2). Some highlights include:

- Canadian Medical Association (CMA) Award for Young Leaders (2016, Dr. Meredith Giuliani)
- American Association of Physicist in Medicine (AAPM) Education Innovation Award (2016, Dr. Marco Carlone, Nicole Harnett)
- Colin Woolf Award for Sustained Excellence in Teaching of CPD (2017, Dr. Barbara-Ann Millar)
- University of Toronto's most distinguished rank – "University Professor" (2017, Dr. Mary Gospodarowicz)
- Sunnybrook Education Advisory Council (SEAC) Allan Knight Life-Time Achievement in Teaching Award (2018, Dr. Edward Chow)
- SEAC Educating Beyond Sunnybrook Award (2018, Dr. Ewa Szumacher)
- AAPM Education Innovation Award (2019, Dr. Andrea McNiven)
- President of American Association for Cancer Education (AACE) (2019, Dr. Ewa Szumacher)
- Professional Association of Residents of Ontario (PARO) Excellence in Clinical Teaching Award (2019, Dr. Jennifer Croke)
- Wightman-Berris Anderson Award in Program Innovation and Development Award (2019, Dr. Meredith Giuliani)
- Association of Faculties of Medicine of Canada (AFMC) Young Educators Award (2020, Dr. Meredith Giuliani)

External world class faculty are also invited on a regular basis to enrich the depth and breadth of UTDRO educational offerings and has been integral to the UTDRO strategy of curriculum design for our annual conferences, the Clinical and Experimental Radiobiology course, STARS21 Program, as well as the Accelerated Education Program courses. Examples include Dr. Michael Joiner (Wayne State University), Dr. Albert van der Kogel (University of Wisconsin-Madison), Dr. David Palma (Western University), Dr. Bob Bell (Former Ontario Deputy Minister of Health), Dr. Edgar Ben-Josef (University of Pennsylvania), and Dr. Caroline Chung (MD Anderson Cancer Center), to name a few.

Challenges and Opportunities

UTDRO has faculty across six geographic sites, which creates some challenges in communication, and collaboration both for its faculty and trainees. While it is recognized that the introduction of the radiation medicine discipline into undergraduate medical training is one of the most effective ways of attracting talented candidates, the relatively small faculty size creates pressure on the ability of UTDRO to drive engagement at all levels of training. Time pressures and competing research, clinical and administrative demands limit the amount and breadth of faculty development in the area of pedagogy.

Such challenges also bring opportunities for innovation. The multiple geographic sites translate into increased capacity and opportunity for our trainees to gain experience across a diverse practice setting (academic and community-based). The 2016 integration between UHN and the Michener Institute to form the Michener Institute of Education at UHN has provided opportunities to align resources and enhance existing and potential future educational offerings. International engagement also creates training opportunities to build global capacity in radiation medicine. Strategic alliances with careful and thoughtful planning would be expected to provide the highest yield. Key collaborations under

development include radiation therapy training in Ethiopia through the Toronto-Addis Ababa Academic Collaboration (TAAAC), select African countries including Kenya, Zimbabwe, Nigeria and Ghana, Jordan in the Middle East, as well as China in Asia.

While the COVID-19 pandemic presented unique challenges to medical education this past year, it has also offered an important reflection point to explore novel approaches to delivering quality patient care and education. At UTDRO, we embarked on curricular redesign to ensure the safety for our trainees, faculty, and patients, while maintaining the quality of training. With disruptions to face-to-face teaching, UTDRO faculty and staff successfully adapted the shift towards remote learning. Digital platforms were also leveraged to meet student admissions and recruitment objectives during the pandemic. We harnessed the talent and resources of the department to continue enabling improved access and equity, by fostering convergence across the disciplines and the rapid adoption of new technologies. We also continued to nurture an environment that is supportive and enabling, encouraging all learners, staff, and faculty to manage their health and well-being during these challenging times.

Medical Radiation Sciences Program

Program Overview

The University of Toronto Department of Radiation Oncology is committed to building capacity in research and professional expertise among all radiation medicine professional groups. In the recent decade, it has become evident that the role of the radiation therapist is rapidly changing, evolving, and growing within the radiation medicine enterprise. To maximize the potential of this professional group, UTDRO embarked on a long-term higher education strategy targeting medical radiation technology at the undergraduate pre-certification and postgraduate post-certification levels, in collaboration with other academic organizations, government, and leaders of the profession.

The undergraduate BSc/Advanced Diploma in Medical Radiation Sciences (MRS) was implemented in 1999, the first of its kind in Canada. As a second-entry professional program, the MRS builds on a strong collaboration between the Temerty Faculty of Medicine, University of Toronto and the Michener Institute of Education at UHN. This special partnership combines the strengths of the two institutions and makes full use of their complementary resources and expertise to offer both a BSc Degree (U of T) and an Advanced Diploma in Health Sciences (Michener). This collaboration has contributed to the exceptional level of program integration for the education of all three medical radiation science disciplines: Radiological Technology, Nuclear Medicine and Molecular Imaging Technology, and Radiation Therapy. In 2002, UTDRO assumed academic oversight for this program within the Temerty Faculty of Medicine. Since 2002, the MRS Program has graduated 2,017 medical radiation technologists and therapists across the three streams.

The term of the Joint Program Agreement between U of T and Michener was renewed on January 1, 2021 and is valid through to December 31, 2025.

Program Objectives

The objectives of the MRS Program as highlighted in the agreement are to:

- Deliver a leading Medical Radiation Sciences Program.
- Provide opportunities for faculty cross appointments and collaborative pedagogical activity.
- Encourage development of joint research opportunities.
- Prepare students for tomorrow's professional practice, for future leadership roles and graduates who pursue advanced degrees.
- Continuous improvement with a view towards innovations in the curriculum.

Program Governance

The Joint Strategic Executive Committee establishes the overall strategic direction of the MRS Program. Primary responsibilities are to:

- Develop the long-term strategy for the MRS Program; appreciating the strategic directions of both the University and the Michener.
- Ensure the implementation of the MRS Strategic Plan (Collaborative Program Renewal).
- Monitor the progress of the MRS Strategic Plan (Collaborative Program Renewal).
- Generate and deliver an annual MRS Program Report to institution-specific committees.
- Address future capital needs and resources for the MRS Program.

Membership

University of Toronto Representation

- Vice Dean, Clinical and Faculty Affairs, Temerty Faculty of Medicine
- Chair, Department of Radiation Oncology
- Director, Medical Radiation Sciences Program, Department of Radiation Oncology
- Business Manager, Department of Radiation Oncology

Michener Institute of Education, UHN

- Head, Academic Affairs and Operations
- Senior Director, Academic Operations & Quality, Dean of Students
- Academic Chair, Imaging Programs
- Academic Chair, Radiation Therapy and MRI Programs

Joint Department of Medical Imaging, UHN

- Chief, Education, Joint Department of Medical Imaging
- Clinical Director, Joint Department of Medical Imaging

The UTDRO MRS administrative structure is shown in Figure 9.

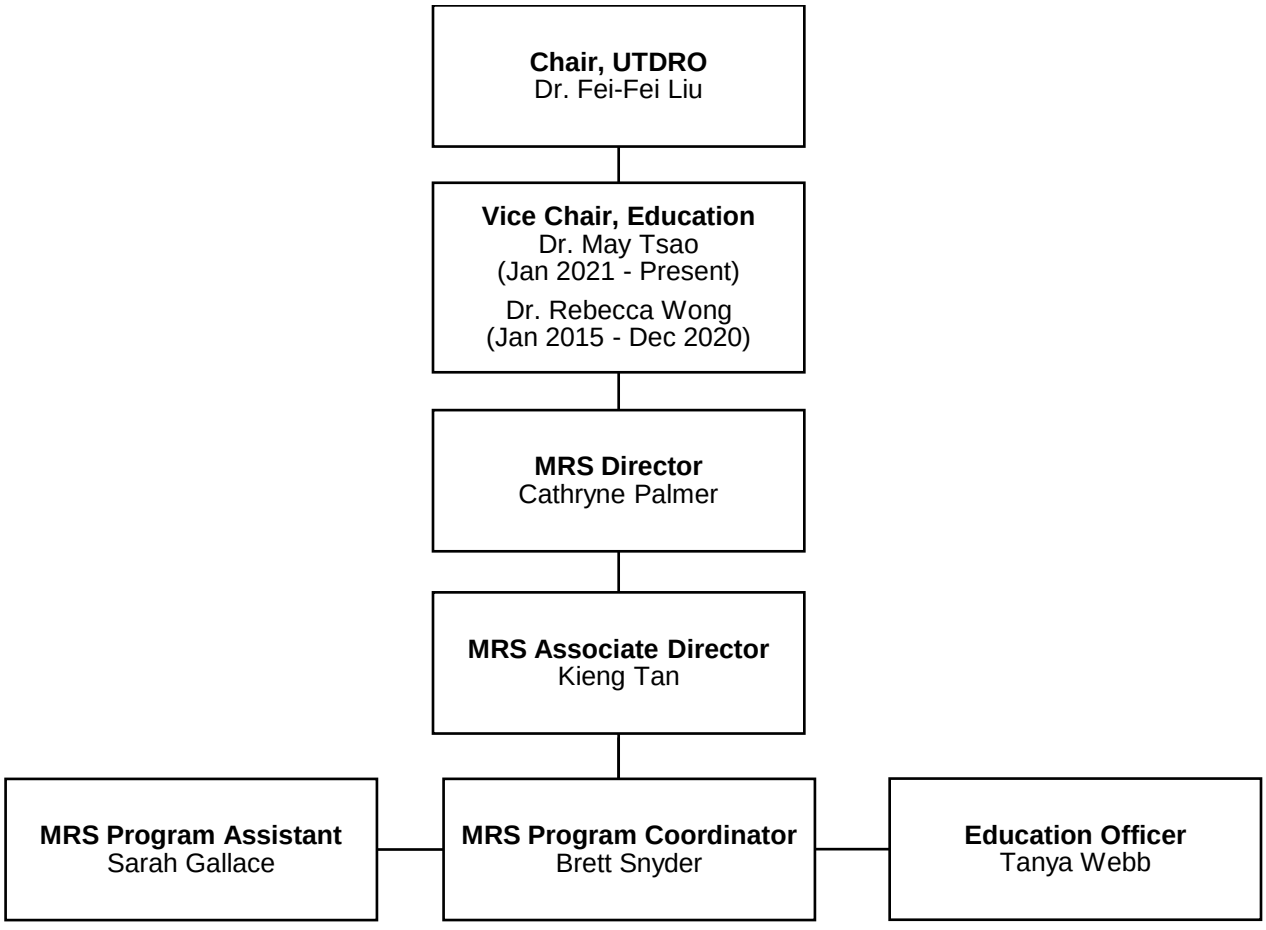

Figure 9: UTDRO Medical Radiation Sciences Organizational Structure

Admission Requirements and Recruitment

The MRS Program is a second-entry program designed for students with at least one year of university experience. Applicants must meet academic requirements, participate in the admissions interview process, and provide proof of English proficiency (if applicable).

The MRS Program has been designed to accommodate up to 114 students per cohort year; for the incoming cohort of September 2020, the enrollment was set at 40 in Radiological Technology, 48 in Radiation Therapy, and 16 in Nuclear Medicine and Molecular Imaging Technology. Interested individuals apply through the Ontario University Application Centre (OUAC), directly into one of the three streams.

Academic Requirements and Prerequisites

Application requirements, deadlines, and procedures for the MRS Program are described on the UTDRO website. To be eligible for admission to the MRS Program, applicants must present:

1. A minimum of one year (5.0 full course equivalents) of university education, with successful completion of 0.5 credit (typically one semester course) in each of:
    - Biology
    - Mathematics
    - Physics
    - Social Science
2. A minimum cumulative Grade Point Average (cGPA) of B-
3. Grade 12 U-level Chemistry or equivalent (Nuclear Medicine and Molecular Imaging Technology applicants only)

A review of the academic requirements (prerequisites) was completed in 2016 after analyzing admissions data and conducting an environmental scan of programs across Canada and anecdotal reports of potential barriers for applicants. The MRS Program received approval from the Education Committee of Faculty Council to modify the prerequisite requirements for the cohort starting September 2018, as indicated above.

English Language Requirements

As all lectures, seminars, and clinical laboratory sessions and activities are conducted in English, it is essential that students have adequate knowledge of written and spoken English. Applicants for whom English is a second language, are required to provide proof of English language proficiency. The MRS Program uses U of T's English Language Requirements with a minimum Test of English as a Foreign Language (TOEFL) score of 250, and Test of Written English (TWE) of 5.0.

Non-Academic Requirements

Prior to the pandemic, applicants who were academically competitive and met the academic requirements were invited to Multiple-Mini Interviews (MMI), where applicants are presented with a scenario or questions to complete in a series of timed mini-interview stations.

When the World Health Organization (WHO) declared the COVID-19 crisis a pandemic, the MRS Program needed to make immediate decisions on several of its activities, including the MMIs that were scheduled for the end of April 2020. Working in collaboration with the Undergraduate Medical Education (UME) and the Physician Assistant (PA) Programs, and building on the experiences of the

UME in the Temerty Faculty of Medicine, the MRS Program replaced the in-person MMIs with online admission interviews.

In the span of approximately six weeks, the MRS staff and administration developed interview questions, established a communication strategy to applicants, determined the technological requirements necessary, leveraged existing software to create a technical flow to manage the virtual interviews, conducted and collated approximately 630 interviews/videos, and created a rater presentation and evaluation package. This was a monumental achievement and an exemplar of the outstanding teamwork in the UTDRO Office. The MRS Program has decided to continue this process in the future in collaboration with the UME and PA Programs. A third-party vendor, VidCruiter, has been contracted to manage the technical workflow, video recordings and rater collation, which will ultimately relieve the burden on the UTDRO MRS Office staff to focus their time on other admission and recruitment activities.

Admissions Process

Each applicant's academic score is calculated by combining the applicant's cumulative grade point average (cGPA) (calculated with all undergraduate course results from all undergraduate years/programs), and the prerequisite subject course results. If an applicant's overall academic score is competitive, the applicant will be invited to participate in the online MRS admissions interview process. The final application score, with which applicants will be ranked, will be a combination of the academic score (weighted at 60%) and the interview score (weighted at 40%). Table 4 shows enrollment for the previous 3 years.

Table 4: Current MRS Student Enrollment

Enrollment	Radiological Technology	Nuclear Medicine	RadiationTherapy	Total
Class 2021 (2018)	38	12	36	86
Class 2022 (2019)	36	17	43	96
Class 2023 (2020)	35	12	43	90

As of May 20, 2021

Recruitment

The recruitment team is comprised of admissions and recruitment staff from both the Michener and University of Toronto. Pre-pandemic, off-campus visits to high school, university, and college recruitment fairs were a regular component of the fall recruitment activities. Campus tours were conducted regularly throughout the year; prospective students could arrange a tour through both institution's websites.

U of T representatives participated in events for prospective students on all three U of T campuses. These events were open to the public; they included the Fall Campus Days on each campus, Spring Campus Day at the Mississauga campus, and Spring Healthcare Open House at the downtown Toronto campus. In the spring, high school students would be invited to attend the University of Toronto Summer Mentorship Program (SMP) to learn about the MRS Program. The SMP provides high school students of Indigenous or African ancestry an opportunity to explore health sciences at the University of Toronto.

Annually, prospective students and families were invited to the Michener campus to attend the in-person fall Open House. Information sessions were organized for full-time programs; prospective students could tour the facility and meet current students. Michener's Admission's Office piloted a Facebook Live session during the 2017 Open House, which provided an opportunity to those who could not attend the event in person, to participate virtually in the campus tours and ask questions.

Currently, the Michener Open House is held virtually. Prospective students are directed to view pre-recorded videos that introduce Michener, each academic program, program admission requirements and instructions, and a virtual campus tour. The U of T Admissions team hosts weekly open Zoom meetings, where any interested applicants can join to pose admission questions and gather information regarding the program.

The MRS Program is advertised to prospective students through social media platforms, including Facebook and Instagram. During the fall recruitment period, each academic program has a program highlight week, where program-specific information is shared on social media platforms. Pre-recorded videos from faculty and current students provide their own unique experiences and views on the program. Program highlight weeks are well-received on social media and have an added benefit of informing prospective applicants and new students with program information on adaptions due to COVID-19.

Curriculum and Program Delivery

The four-year interprofessional degree is delivered over a three-calendar year period; comprised of didactic, simulated, and clinical courses. The integrated three-year curriculum aims to provide students in each of the three streams a core curriculum of broadly based theoretical and analytical foundation, along with stream-specific courses and clinical practice activities for their professional responsibilities.

The program provides breadth and depth of knowledge and develops analytical, critical, and evaluative skills. Professional values, responsibility, accountability, sensitivity, and ethical attitudes towards both the patients and the healthcare community are emphasized. Students learn to evaluate and consider the implications of their professional actions. The clinical practicum components integrate and apply the materials taught in lectures and labs, leading to the development of clinical competence. Each student is required to complete a minimum of 42 weeks of full-time clinical practice.

The curriculum emphasizes critical thinking, evidence-based practice and problem solving in the belief that these attributes play a crucial role in the optimal delivery of healthcare in today’s evolving healthcare environment. UTDRO has academic oversight of 50% of the curriculum, in particular, most of the Radiation Therapy stream, and the clinical courses for the Nuclear Medicine and Molecular Imaging Technology, and Radiological Technology streams.

Common courses delivering knowledge and imparting skills required by all three streams comprise the core curriculum and include instructions in anatomy, clinical behavioural sciences, interprofessional collaboration, patient care, physiology, relational anatomy, and in particular, an elective research methods course which is available to students with an excellent academic record. A Departmental Research Prize is awarded to the student with the highest grade in this course. Students in each discipline also undertake sets of courses focused on stream-specific material, including interprofessional courses that focus on communication, collaboration, leadership, and professionalism, an integrated imaging course for all three streams, a clinical simulation semester, with shortening of the clinical practical experience by the equivalent time. Clinical practice and experiences at the over 40 affiliated hospital

sites are specific to the discipline.

The curriculum mapping process is conducted as part of the MRS Program's continuous quality improvement practice. The didactic and clinical curricula are cross-referenced to each program stream's respective 2014 CAMRT National Competency Profiles and 2018 CMRITO Standards of Practice. Under the oversight of the MRS leadership, course leads are responsible for mapping their respective courses, indicating the learning objective that corresponds to the relevant external standards and standards of practice. All course outlines articulate learning objectives related to course-specific competencies, developed in alignment with the external standards outlined in the CAMRT National Competency Profile. The programs are in the process of updating their respective curriculum mapping documents to reflect the new 2019 CAMRT National Competency Profiles and the 2020 CMRITO Standards of Practice. To comply with accreditation requirements, the MRS programs will be submitting their updated curriculum mapping documents to Accreditation Canada by October 15, 2021.

Student Awards

The MRS Program employs a longitudinal research curriculum to establish a sound foundational understanding of research methodology, development of transferable research skills, and examination of the impact of research on practice by applying knowledge translation strategies. These core curricular objectives are embedded within the four principal MRS research courses: MRS266H1/RMIP240 Introduction to Research Methods; MRS397H1/RPRD370 Research in Practice; MRS399Y1/RIRD370 Research Informing Practice; and MRS398Y1/RMRD370 Research Methods. Additionally, the transferable research skills (search strategies, critical analysis, effective communication) have been integrated and reinforced within other MRS courses. Over the past 5 years, MRS students' research productivity has led to various external awards, publications, and conference disseminations based on student research projects (Table 5).

Table 5: MRS Student Research Productivity (2016-2020)

External Awards	Published Abstracts	Manuscript Publications	Conference Dissemination
6	37	10	48

Over the past few years, MRS graduates have demonstrated exceptional national academic achievements. In 2015 and 2020, an MRS Radiation Therapy graduate received the annual award from the Canadian Association of Medical Radiation Technologists (CAMRT) for achieving the highest score in the country on their national certification examinations. A Radiation Therapy graduate received the highest mark in the province on the CAMRT national certification exam for Radiation Therapy in 2018 and was awarded a certificate by the Ontario Association of Medical Radiation Sciences (OAMRS). Additionally, in 2018, two Nuclear Medicine graduates tied for highest mark in the province on the CAMRT national certification exam for Nuclear Medicine. Examples of other notable internal, local, national, and international awards obtained by MRS students are listed in Table 6.

Table 6: Notable Awards Received by MRS Students (2016-2020)

Year	Recipient	Award
2016	Christos Chortogiannos	MRS Volunteer Award
	Jennifer Dang	MRS Research Award (Honourable Mention)
	Jennifer Dang	RTi3 Delegate's Choice for Best Poster Award
	Amanda Lamb	Princess Margaret Marlene Bate Award
	Simon Xie	MRS Research Award (Honourable Mention)
2017	Emily Binsell	MRS Volunteer Award
	Kitty Chan	CARO-CROF Best Poster Award
	Kitty Chan	JMIRS Editor's Choice Top 5 Article Award
	Devin Hindle	MRS Research Award (Honourable Mention)
	Mathew Ng	MRS Volunteer Award
	Alexandra Sara	Princess Margaret Marlene Bate Award
	Olive Wong	CARO-CROF Best Abstract by Radiation Therapy Award
	Olive Wong	CARO-CROF Radiation Therapist Travel Grant Award
2018	Nicole Barber	MRS Volunteer Award
	Nicole Barber	Princess Margaret Marlene Bate Award
	Harleen Dhillon	MRS Research Award (Honourable Mention)
	Colin Robertson	Clinical Project in Radiation Therapy (Honourable Mention)
2019	Payin Baidoe-Ansah	MRS Clinical Project, Honorable Mention in Radiation Therapy
	Andrew Belanger	MRS Clinical Project, Award for Excellence in Radiation Therapy
	Samantha Bulger	U of T Centre for Interprofessional Education Susan J. Wagner Student Leadership Award in Interprofessional Education
	Samantha Bulger	Princess Margaret Marlene Abate Award
	Meagan Robbins	MRS Research Award (Honorable Mention)
	Sandra Tea	MRS Bronze Medal (3rd Highest Academic Standing)
	Samantha Bulger Sajjad Rassool Sandra Tea	MRS Volunteer Awards
2020	Samantha Bulger	CAMRT Award of Excellence
	Joshua Francesco Torchia	MRS Clinical Project, Award for Excellence in Research
	Stephanie Mannella	Princess Margaret Marlene Abate Award
	Stephanie Mannell Masfa Tariq Chelsea Testa	MRS Volunteer Awards

Funding and Support

The Temerty Faculty of Medicine offers non-repayable bursary funding to students with financial need through the MRS Bursary Program. MRS students who are receiving government student aid, Ontario Student Assistance Program (OSAP), may also be eligible to receive additional financial assistance through the University of Toronto Financial Aid Program (UTAPS).

One-on-one financial counselling and debt management sessions are offered either in person, by phone or *via* online platforms, such as Zoom or Microsoft Teams. The University of Toronto Student Financial Services also encourages students to drop in at any time during office hours if they have a question or concerns about their financial situation.

Students are informed of these U of T services by direct email correspondence, webinars, and finance information sessions during the interview cycle and orientation week, as well as the website.

Michener offers over $84,000 in scholarships, bursaries, and awards for full-time students. Students are encouraged to apply for as many scholarships, bursaries, and awards for which they are eligible. Eleven unique program-specific scholarships are offered to students enrolled in the MRS Program and who meet conditions of eligibility as outlined in each scholarship.

In 2020, a new award was established at the Michener Institute. The MyHealth Award for an Outstanding Black Student is awarded to a Black student who demonstrates a commitment to Black community involvement, is in financial need, and through their education and career choices, strives to enhance Black lives.

The Institute of Education Research (TIER) at UHN offers the Dr. Daniel C. Andreae President's Award to a current Michener student who is enrolled in a full-time advanced diploma program and in good academic standing. The award recognizes the importance of students' impact on their professions through patient-centred care, ethical practice, innovation, and research.

Full-time Michener students in good academic standing are eligible to apply for the Student Professional Development Grant. The grant financially supports students in enhancing their professional and personal experience, providing opportunities such as:

- Representing a club, program, or Michener at an academic competition.
- Presenting at or participating in a conference or professional gathering related to their program or professional development.
- Volunteering through a recognized organization utilizing professional/program competencies.

Quality Indicators

Graduates

Attrition

On average 81.7% of MRS students complete the program in the allotted 32 months of study, with an average of 7.7% students requiring a modification (e.g. clinical extension, a leave of absence for personal reasons) to the length of their studies (Figure 10). Some students (10.6% on average) discontinue the program due to the program not being the right fit, admission into another program, or dismissal.

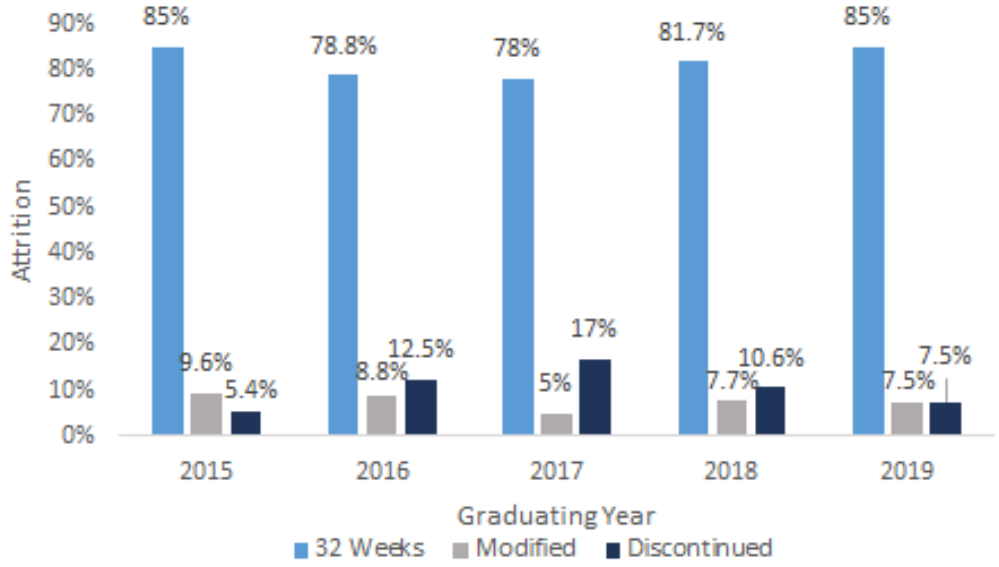

Figure 10: MRS Program Attrition (2015-2019)

National Certification Results

Upon graduation and to be eligible to practice in Canada, MRS students must sit a national examination. The examinations are held three times a year in January, May, and September. As part of program continuous quality improvement, each stream reviews results in comparison to past performance, in addition to the national average. Comparatively, the MRS Program annual success rate approximates the national averages (Figure 11). For Nuclear Medicine and Radiation Therapy, the number of MRS graduates far outweigh the number of national graduates from other programs, thereby impacting national average scores.

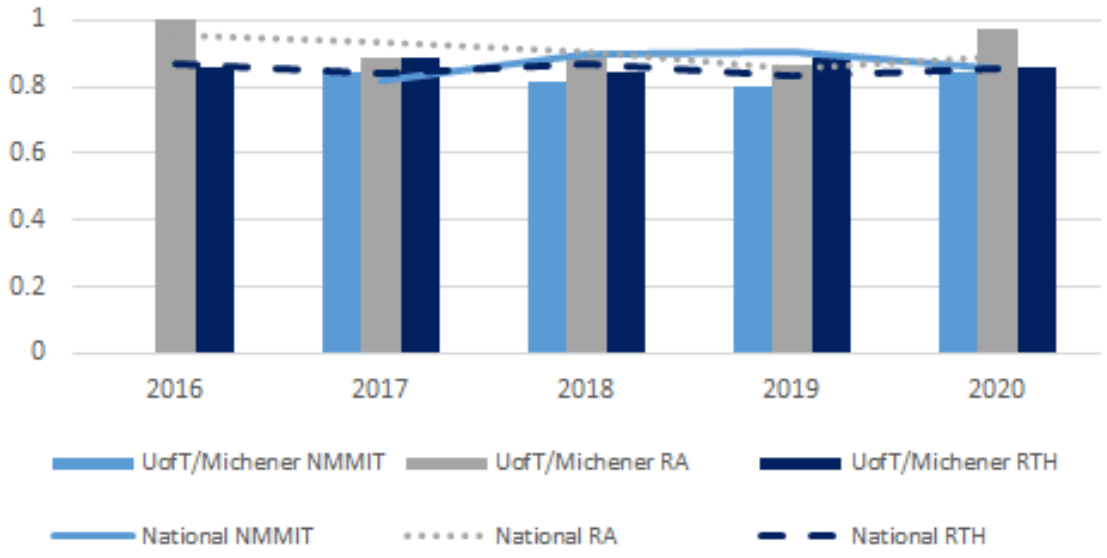

Figure 11: MRS Program Certification Exam Success Rates (2016-2020)

Employability
The program does not have rigorous data on how many or where the graduates are gaining employment. Traditionally, graduate surveys have had extremely poor response rates; hence, the surveys were discontinued. Anecdotally, the job market continues to improve for Nuclear Medicine and Molecular Imaging. The 2019 graduates all had employment opportunities prior to completing the program. Radiological Technology and Radiation Therapy employment opportunities for graduates continue to be contract or casual positions.

Faculty

Didactic Teaching
The faculty in the MRS Program are diverse. The didactic curriculum for the MRS Program is delivered by qualified stream-specific and interdisciplinary faculty from both the University of Toronto and the Michener Institute. Guest lecturers are also recruited to teach the students based on their expertise in specialized content to enrich student learning and fulfill curriculum requirements of the program.

Students complete course or faculty evaluations on all participants who teach in the MRS Program. The Teaching Effectiveness Scores (TES) are calculated each year (Table 7), and the faculty with the highest TES is recognized with an award at the UTDRO Annual General Meeting.

The overall Teaching Effectiveness Score for 2019-2020 was 4.49 out of 5.0, with several faculty/guest lecturers scoring 4.7 or more.

Table 7: Overall Teaching Effectiveness Scores (2015-2020)

2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
4.5	4.5	4.3	4.4	4.5

Clinical Teaching
There are opportunities for MRS students to recognize their clinical teachers in the various institutions with which they are affiliated. Students are encouraged to nominate exceptional clinical teachers through awards at their clinical placement sites, Michener, and UTDRO.

Through a new online evaluation process, accessed through the Michener intranet, students are also encouraged to evaluate the clinical placement site, as well as clinical teachers, generating more quantifiable data.

Accreditation and External Reviews

The accrediting body for the MRS Program is Accreditation Canada. In January 2019, the MRS Program underwent an accreditation review with EQual™, Accreditation Canada's health education accreditation program, resulting in an extremely positive outcome, whereby all three streams were afforded the maximum accreditation status with all criteria being met for each requirement.

In 2016, UTDRO underwent an external review with the reviewers commenting that the MRS Program was "...one of the "jewels in the crown" of the department." In parallel with the current 2021 UTDRO External Review, the MRS Program is undergoing a review through the University of Toronto Quality

Assurance Process (UTQAP). The purpose of UTQAP is to ensure that "…programs meet the highest academic standards." The UTQAP is an extensive review of the MRS Program; similar to the UTDRO External Review, but covering a longer period between 2013-2021. The 2013-2021 UTQAP MRS Self-Study Report can be accessed in Appendix 3.3.

Quality Enhancement and Optimization

The MRS Program implemented various curricular changes and innovations over the past five years.

MRS159H1/ANAT110 – Anatomy for Medical Radiation Sciences
The anatomy course was redesigned a couple of years ago when a new anatomy professor, Dr. Danielle Bentley, was assigned to the course. This redesign resulted in introducing a lab component to the course. Students have access to the newly renovated, high-tech anatomy labs with the new lab facility featuring 16 of the latest dissection tables, each with a computer screen. Using Anatomy TV on the computer associated with the dissection table, students progress inferiorly through 2D horizontal (transverse) sections of various body parts, relating these to the 3D anatomy of the prosected cadaver body part on the table. There are four labs in the anatomy course covering the body parts: thorax, abdomen, upper and lower limb, and brain (neuroanatomy). Due to the pandemic, the anatomy course, as were all courses, were moved into the virtual environment and unfortunately, the labs could not be conducted for the 2020 cohort.

MRS 2.0 Curriculum Redesign Project
Beginning in August 2016, a curriculum renewal project (internally referenced as "MRS 2.0") was established with the purpose of transforming the MRS Program in educating the next generation of imaging and therapy practitioners to meet and exceed the demands of the evolving healthcare environment.

With the assistance of a Project Management Team, a comprehensive internal/external assessment and gap analysis was conducted, with specific direction to:

- Understand environment demands for imaging and therapy practitioner competencies.
- Develop joint U of T and Michener curriculum competencies.
- Understand the gaps in the current curriculum to meet environmental demands.
- Engage subject-matter and clinical faculty expertise in the design of a customizable forward-thinking curriculum.
- Develop and implement a new curriculum for the September 2018-2019 intake.

Appendix 3.4 details the in-depth analysis of the MRS 2.0 project, project outcomes, and the key deliverables.

PET/CT & Nuclear Theranostics Course
In response to the increased demands and evolution of Positron Emission Tomography (PET) and Theranostics in the Nuclear Medicine field, a PET/CT & Nuclear Theranostics Course is currently being developed with the aim of strengthening students' understanding of the role of PET/CT and appreciation of the integrated role of theranostics, a rapidly evolving branch of Nuclear Medicine. Incorporating both Nuclear Medicine-specific methodologies in a dedicated course should help consolidate both the individual methodologies, as well as their integrated roles in patient care. The intent is to have this course developed and approved for the 2021 academic year, aiming for first delivery in summer 2023. As this

will be a mandatory Nuclear Medicine and Molecular Imaging Technology stream-specific course, it will replace one of the three Selectives.

Challenges and Opportunities

Admissions and Enrollment

Enrollment to the MRS Program continues to be a strategic focus for MRS leadership, and several different strategies are currently being explored and implemented. The Nuclear Medicine and Molecular Imaging Technology stream of the MRS Program, the only one of its kind in Ontario, currently enrolls 16 students annually. The changing landscape for nuclear medicine is resulting in increased health human resource needs across the province, and the MRS Program is currently exploring strategies to increase enrolment in this stream. The MRS Program is reviewing the recruitment strategy by targeting certain regions across the province (e.g. Northern Ontario) to ensure representation from more rural and remote areas. MRS leadership is also considering the potential impacts of the recent closure of the radiation therapy program, offered by Laurentian University/Michener, on the MRS Program and specifically on enrollment. A social media presence on Facebook and Instagram continues to gain momentum, and potential prospects are using this forum to seek information regarding the program. The entire admissions process has been and continues to be streamlined to provide a more coordinated approach between the University and Michener – focusing on improved customer/learner service.

UTQAP MRS Self-Study Report

The process of drafting the UTQAP MRS Self-Study Report (Appendix 3.3) for the Medical Radiation Sciences Program has highlighted the many strengths of the program and the opportunities that exist for growth. The reflection has also identified areas where improvement is required.

Opportunity

Through the self-study process, a need for the MRS Program to have a more explicit and coordinated Equity, Diversity, and Inclusion (EDI) strategy was identified. What has been accomplished to date has been *ad hoc*. There is a need for ongoing faculty development associated with EDI. Mapping of EDI-related content in the curriculum is definitely warranted, and would require expertise to assist in the development of new EDI-related initiatives.

Areas for Improvement

The UTQAP MRS Faculty Report highlighted a disconnect between what the faculty perceive needing to be enhanced in the curriculum and what is being delivered. While faculty suggested the need for enhanced interprofessional education and research, these topics have been identified as areas of focus in the MRS 2.0 curriculum renewal project. While there could be several reasons for this disconnect, MRS Program leadership recognizes the need to communicate more broadly regarding changes in the program, and to consider an annual faculty retreat to ensure that all faculty are adequately informed.

As indicated in the Faculty Human Resources and the MRS Office Space sections of the UTQAP MRS Self-Study Report, there should be serious attention paid to developing a more organized approach to the people and space that is the MRS Office. This will create a community of support and resource to both faculty and staff, as well as signal to the students a more unified University of Toronto presence.

Areas for Enhancement

The practice of Medical Radiation Sciences is constantly evolving and the responsibility on educational programs to ensure that curriculum keeps pace, is continual. The MRS Program endeavours to ensure a curriculum that meets the needs of the students, graduates, and employers. The timing of introducing content into the curriculum depends on resources (faculty course/content development time) and the curriculum approvals processes at both institutions. As such, the MRS Program will be strategically examining opportunities for the following curricular content based on upcoming trends in practice:

- Artificial Intelligence (AI) and Machine Learning (ML) – several short courses are available for practitioners; a basic appreciation of AI and ML can be delivered in the undergraduate program.
- PET/CT and Theranostics course (already in development).
- Lasting changes to Infection, Prevention, and Control (IPAC) measures on future practice.
- Changes to treatment protocols/procedures post-COVID-19.
- Increase the readiness of Radiological Technology students for practice on CT due to the growing demand of CT scans.
- Enhance content on MR-guided Radiation Therapy.
- Enhance content on Proton Therapy.

Radiation Oncology Residency Program

Program Overview

The UTDRO Radiation Oncology (RO) Residency Program, the largest residency training program in Canada, is a fully accredited 5-year specialty training program of the Royal College of Physicians and Surgeons of Canada (Royal College). At the recently completed (November 2020) Royal College Accreditation Review of the U of T Postgraduate Programs, the UTDRO RO Residency Program received full accreditation for the entire eligible time period (8 years). The residents benefit from engagement at two large academic teaching centres in Toronto: the Princess Margaret Cancer Centre (PM) at UHN, and the Odette Cancer Centre (OCC) at Sunnybrook Health Sciences Centre. The breadth of resources, in terms of both faculty, patient population, and technology, which the trainees can experience and learn from during their five years, is unparalleled.

Program Objectives

Objectives of the Radiation Oncology Residency Program are:

- To attract dynamic enquiring individuals who are enthusiastic about radiation oncology.
- To train residents to become well rounded and competent specialists with highly developed skills and excellence in multiple CanMEDs roles.
- To enable residents to grow and learn clinically, while also pursuing scholarly enquiry.
- For graduates to contribute to advancing the radiation oncology profession and become future leaders in the field.

Residents have access to cutting-edge resources (e.g. MR-LINAC, MR simulation, brachytherapy), as well as faculty who are international experts in their fields. There are significant opportunities to engage in research and a variety of scholarly pursuits throughout their training. There are opportunities to pursue further academic training, such as master's and PhD degrees. One of the strengths of the program is the exposure to multidisciplinary and multiprofessional collaboration and training. Residents learn and work jointly with the UTDRO physics residents and radiation oncology fellows, many of whom are trained abroad, and hence, bring an international perspective to share with the residents. Clinical and research collaborations with other oncology specialties, such as medical oncology, surgical oncology, and palliative care, are strong and numerous. The residents are immersed in a culture of life-long learning combined with clinical and academic excellence.

Program Governance

- Program Director: Dr. Andrea Bezjak (since September 1, 2016)
- Administrative Education Coordinator: Catherine Wong
- Associate Program Directors: Dr. Meredith Giuliani (PM), Dr. Hany Soliman (OCC), Dr. Jay Detsky (OCC; as of July 1, 2021)

The Program Director directly reports to the Vice Chair of Education, and in turn, the Department Chair, with guidance from the Vice Dean of Postgraduate Medical Education (PGME) at the Temerty Faculty of Medicine, U of T (Figure 12). The program is overseen by the Residency Program Committee (RPC), which is responsible for maintaining the quality of the program, and standards for accreditation. It has

broad representation from across the faculty and residents, including the Program Director (RPC Chair), Vice Chair of Education (ex officio), Associate Chairs, Director of Physics Education, Chief Resident, Assistant Chief Residents, Chief Fellow, Resident Elect, and faculty at large from the Princes Margaret, Odette, Stronach Regional Cancer Centre, and Royal Victoria Hospital (RVH). The RPC meets 10-12 times throughout the year.

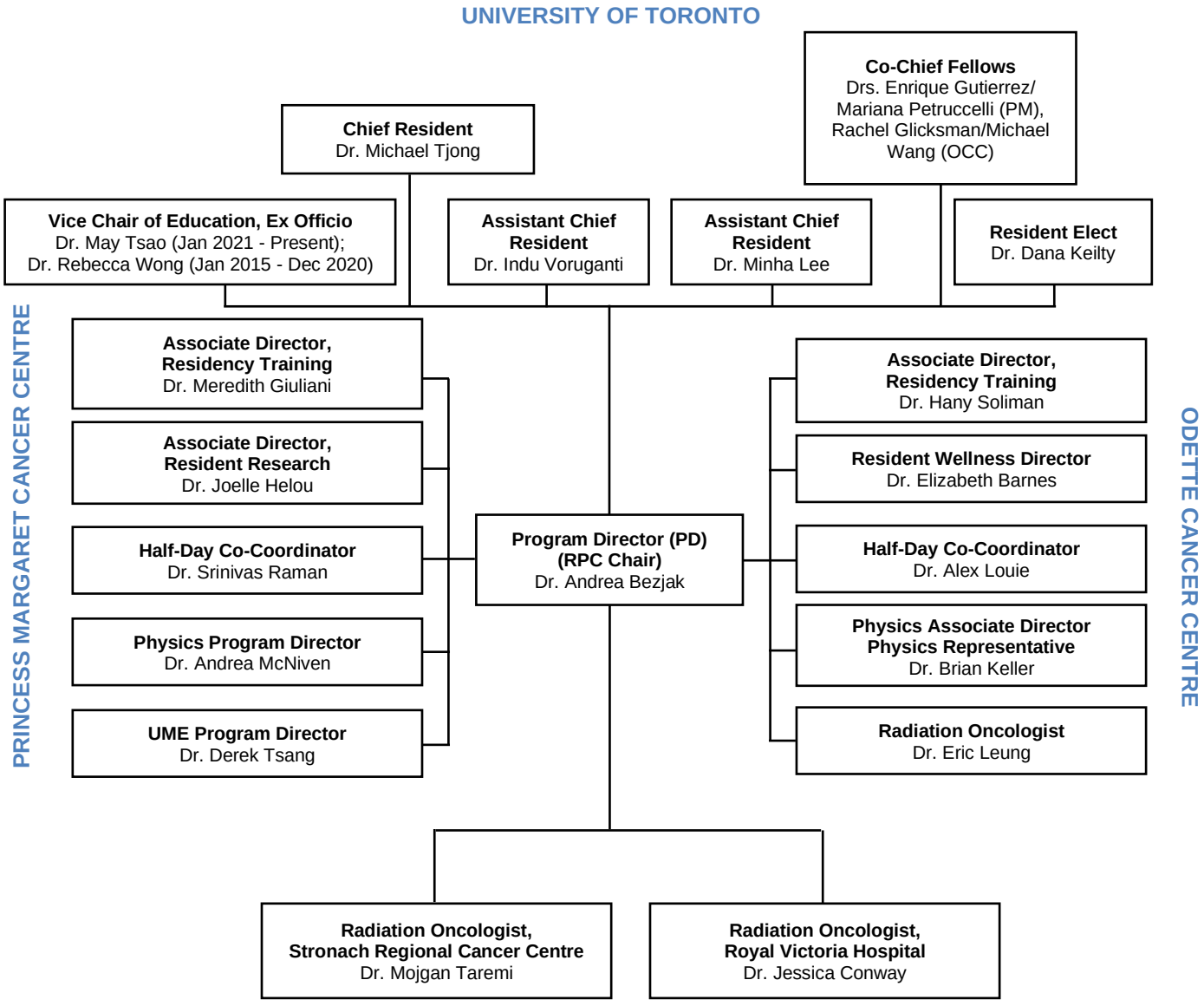

Figure 12: Residency Program Committee Membership (Academic Year 2020-2021)

Admission Requirements and Recruitment

Medical students enter the UTDRO RO Residency Program by applying through the Canadian Residency Matching Service (CaRMS) (Table 8). The program typically offers four CaRMS PGY1 positions annually; the total number of Canadian Radiation Oncology PGY1 positions is 21. In previous years, the

program only considered Canadian Medical Graduates (CMGs) for these positions after having closed the International Medical Graduate (IMG) intake stream in 2012; this decision was guided by discussions with the national CARO (Canadian Association of Radiation Oncology) Human Resources Committee in response to the surplus of graduates compared to job availabilities at the time. Given the recently improved job market and projected need for more graduates nationally, the program received funding for one IMG position with the support of the U of T PGME. As such, the program had three PGY1 positions reserved for CMG applicants (due to funding issues within the U of T PGME, it was the program's turn to have one less CMG position; a one-time only anticipated occurrence) and one IMG position (through a separate funding stream) for the July 2021 intake. Eligible candidates sponsored by their country of origin were also considered through the International Program of U of T PGME.

Table 8: Number of Applicants to the RO Residency Program through CaRMS

Year	# of Applications Received			# of PGY1 Residents at UTDRO		
	CMG	IMG	Sponsored	CMG	IMG	Sponsored
2017-2018	19	-	2	4	-	-
2018-2019	39	-	4	4	-	2
2019-2020	31	-	2	4	-	-
2020-2021	30	-	1	4	-	-
2021-2022	26	28	1	3	1	1

CMG: Canadian Medical Graduates; IMG: International Medical Graduates; Sponsored: trainee from a country that has an agreement with the Temerty Faculty of Medicine.

The Residency Program Selection Committee oversees the selection of trainees into the program. The Program Director and members of the Selection Committee, comprised of radiation oncologists, medical physics faculty, and residents, review all applications. Selection Committee members are asked to review Best Practices in Selection and Admissions guidelines, complete a module on Unconscious Bias, and declare any potential conflicts before reviewing the applications. Each application is assessed by five assessors independently, using a standardized set of selection criteria, which includes academic record, clinical skills, interpersonal skills, motivation and innovation, scholarly productivity, intellectual curiosity, understanding of the specialty, commitment to further academic training, and leadership potential. A standardized form is completed by the reviewers for each candidate; scores are then aggregated, and the top applicants are invited for interviews.

The Interview Team includes several panels of interviewers who meet either all or half of the candidates (depending on the number of candidates). The Interview Team is comprised of multidisciplinary faculty and trainees from both the Princess Margaret and OCC; since 2012, the UTDRO Chair has participated in the interview process. Typically, including for the July 2020 intake, the interviews were conducted in person over one day (with all radiation oncology interview dates coordinated nationally to facilitate travel of candidates across the country to attend the interviews). Due to restrictions during the COVID-19 pandemic, interviews were held virtually in 2021. All candidates were asked a standardized, preset list of questions, which were agreed upon by the Interview Team with a standardized scoring scheme for each candidate. The Selection Committee then created a final ranking, combining the pre-interview (from the written application) and interview scores, which was then submitted to CaRMS.

In the past 4 years, there has been an increase in the number of applicants to the UTDRO RO Residency Program, as well as the field of radiation oncology in general (in comparison to previous years). The low number of applicants and unfilled spots nationally in 2016 and 2017 were likely due to concerns amongst medical students regarding employment opportunities upon the completion of training.

The majority of graduates proceed to another year (occasionally more) of fellowship training (some stay at UTDRO; most go to other Canadian or USA programs), followed by staff positions within UTDRO (6 of 15 Canadian graduates during 2017-2020 were hired on staff at the Princess Margaret (4) or at Odette (2)), other radiation oncology centres within the Greater Toronto Area (Oshawa, Barrie, Southlake, Credit Valley Hospital), elsewhere in Canada, or in the United States (Table 9).

Table 9: Number of Graduates and Hires in Staff Positions at PM and OCC

Year	# of Graduates	PM Hires	OCC Hires
2016-2017	7	1	-
2017-2018	6	2	1
2018-2019	5	-	1
2019-2020	2	1	-

Curriculum Delivery and Program Delivery

There are currently two cohorts of residents: (i) residents who entered the program under the traditional time-based requirements, and (ii) those who entered the program under the new Competency by Design (CBD) requirements of training. CBD was introduced across all Canadian Radiation Oncology programs in July 2019 (except for Queen's University, which was part of the earlier pilot). Thus, the current (as of spring 2021) PGY3, PGY4 and PGY5 residents follow the traditional time-based requirements, which comprise of 18 months “off service” followed by radiation oncology rotations through part of the PGY2 and all of the PGY3, PGY4 and PGY5 years. These residents will sit both the written and oral Royal College exams at the end of their PGY5 year. In contrast, the current (spring 2021) PGY1 and PGY2 residents follow the CBD requirements of Transition to Discipline (2 blocks), Foundations (rest of the PGY1 year), Core of Discipline (starting at the beginning of the PGY2 year), Royal College written exam in the spring of the PGY4 year, oral exam in the fall of the PGY5 year, and then Transition to Practice for the remainder of the PGY5 year.

As a result of this move to earlier radiation oncology exposure, we have restructured and harmonized the Longitudinal and Applied Physics curriculum, and moved the Physics curriculum to start in the PGY1 year. The Clinical and Experimental Radiobiology course has also been moved into the PGY1 year, as has the Foundations Block, which is comprised of lectures on pathology and clinical research methodology; we will be introducing radiology as of next year.

Didactic lectures are delivered during the weekly Academic Half Day (AHD), which are held Friday mornings and is mandatory for all residents. Due to the COVID-19 pandemic, the AHD has been delivered virtually *via* Zoom since March 2020. AHD is comprised of two aspects – the lectures and case-based drills. The lectures (typically organized around themes, such as breast cancer, lung cancer etc.) are taught by UTDRO faculty, as well as faculty from other departments (e.g. surgery, medical

oncology, radiology, palliative care) and professions (e.g. allied health, physics, therapy). The other component of the weekly AHD is the case-based "treatment planning drills", where a staff radiation oncologist will present 1-2 cases to 2 residents with a series of questions regarding management and treatment planning, in a format that follows the Royal College oral exam. This provides a case-based quiz to help prepare residents for the oral exams, and to reinforce principles and knowledge regarding treatment planning. Residents are provided feedback on their answers to help guide their learning, as well as oral exam skills. The AHD curriculum for the past academic year is included in Appendix 4.1.

Student Awards

UTDRO radiation oncology residents are supported in their research projects by their supervisors and departmental research support resources (e.g. statistical support). Residents are encouraged to apply for various research awards. Over the past years, many residents have been successful in obtaining different internal, local, national, as well as international awards (Table 10).

Table 10: Notable Awards Received by UTDRO Radiation Oncology Residents (2016-2020)

Year	Recipient	Award
2016	Jenna Adleman	CARO Book Prize – CanMEDS Non-Medical Expert Leadership Education in Radiation Oncology Residency Training
	Rachel Glicksman	PGME Postgraduate Research Award – Joseph M. West Family Memorial Fund
	Rachel Glicksman	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
	Ezra Hahn	Princess Margaret Cancer Centre Robert V. Brady Award (Resident Excellence in Clinical Care)
	Ezra Hahn	CARO Book Prize – Clinical Care and Epidemiology
	Ezra Hahn	PGME Postgraduate Research Award – Ellen Epstein Rykov Memorial Prize
	Jonathan Klein	Canada Graduate Scholarship: Master's CIHR
	Jonathan Klein	ASTRO Resident Poster Viewing Recognition Award (3rd place)
	Syliva Ng	PGME Postgraduate Research Award – Heidi Sternbach Scholarship and Joseph M. West Family Memorial Fund
	Mark Niglas	CARO Book Prize – CanMEDS Non-Medical Expert Leadership Education in Radiation Oncology Residency Training
	Srinivas Raman	UTDRO B.J. Cummings Award for Research Excellence
	Srinivas Raman	MASCC/ISOO Young Investigator Award
	Hamid Raziee	PGME Postgraduate Research Award – Joseph M. West Family Memorial Fund
	Danielle Rodin	Royal College Detweiler Travelling Fellowship
	Danielle Rodin	PGME Postgraduate Social Responsibility Award
	Danielle Rodin	CARO Fellowship Award
	Danielle Rodin	International Cancer Expert Crops (ICEC) Ellen Stovall Early Career Leaders Award
	Jonathan So	CARO Book Prize – Biology and Technology
2017	Ezra Hahn	UTDRO B.J. Cummings Award for Research Excellence
	Jennifer Kwan	UTDRO Chair's Award for Academic Excellence in Research
	Pencilla Lang	CARO Book Prize – Clinical Care and Epidemiology

	Pencilla Lang	UTDRO W.J. Simpson Award for Academic Excellence in Research by a Radiation Oncology Resident
	Pencilla Lang	Elected to CARO Board of Directors
	Aruz Mesci	ABBVIE-CARO Uro-Oncologic Radiation Award
	Srinivas Raman	CARO-CROF Fellowship Award
	Srinivas Raman	RSNA Resident/Fellow Research Award
	Horia Vulpe	PGME Robert Sheppard Awards for Health Equity and Social Justice
2018	Jenna Adleman	CBME Residency Education Implementation Award
	Jenna Adleman	Princess Margaret Cancer Education Research and Innovation Seed Grant
	Jay Detsky	PGME Postgraduate Research Award
	Rachel Glicksman	UTDRO B.J. Cummings Award for Research Excellence
	Rachel Glicksman	CARO Jean Roy Memorial Award
	Rachel Glicksman	RSNA Resident/Fellow Research Award
	Jennifer Kwan	PGME Postgraduate Research Award
	Pencilla Lang	UTDRO W.J. Simpson Award for Academic Excellence in Research by a Radiation Oncology Resident
	Pencilla Lang	CARO Book Prize – Biology and Technology
	Pencilla Lang	CARO-CROF: Fellowship Award
	Pencilla Lang	PGME Postgraduate Research Award
	Sylvia Ng	Princess Margaret Cancer Centre Robert V. Brady Award for Best Resident
	Aruz Mesci	PGME Postgraduate Research Award
	Michael Tjong	Sanofi-CARO Award
	Michael Tjong	PGME Robert Sheppard Awards for Health Equity and Social Justice
	Kang Liang Zeng	CARO Book Prize – Clinical Care and Epidemiology
2019	Adrian Cozma	STARS21 Post-Graduate Trainee Award, Princess Margaret Cancer Centre and the Terry Fox Foundation
	Rachel Glicksman	Princess Margaret Cancer Centre Robert V. Brady Award for Best Resident
	Rachel Glicksman	UTDRO Chair's Award for Academic Excellence in Research
	Dana Keilty	STARS21 Research Day 1st Place Poster Award
	Jennifer Kwan	CIHR Vanier Canada Graduate Scholarship
	Jennifer Kwan	European Radiation Research Society Young Investigator Award
	Jennifer Kwan	PGME Postgraduate Research Award – Joseph M. West Family Memorial Fund
	Nauman Malik	UTDRO W.J. Simpson Award for Academic Excellence in Research by a Radiation Oncology Resident
	Michael Tjong	PGME Postgraduate Research Award – Joseph M. West Family Memorial Fund
	Michael Tjong	ABBVIE-CARO Uro-Oncologic Radiation Awards
	Indu Voruganti	STARS21 Post-Graduate Trainee Award, Princess Margaret Cancer Centre and the Terry Fox Foundation
	Kang Liang Zeng	EORTC Quality of Life in Cancer Clinical Trial Conference Travel Award
2020	Rachel Glicksman	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)

	Rachel Glicksman	U of T Hold'em for Life Oncology Fellowship
	Rachel Glicksman	CARO Best Resident Oral Presentation
	Rachel Glicksman	Conquer Cancer Endowed Merit Award, American Society of Clinical Oncology Foundation
	Jennifer Kwan	CIHR National Poster Presentation Competition Honourable Mention Award
	Jennifer Kwan	Canadian Cancer Society Innovation to Impact Grant
	Jennifer Kwan	UTDRO W.J. Simpson Award for Academic Excellence in Research by a Radiation Oncology Resident
	David Mak	American Association for Cancer Education (AACE) Grant in Research, Education, Advocacy, and Direct Service (READS)
	Amir Safavi	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
	Amir Safavi	STARS21 Post-Graduate Trainee Award, Princess Margaret Cancer Centre and the Terry Fox Foundation
	Amir Safavi	RMP Trainee Excellence in Education Award
	Michael Tjong	RMP Distinction in Technical Improvement Award
	Indu Voruganti	Post-Graduate Trainee Award, Mack Foundation Resident Bursary, UHN
	Yonatan Weiss	Princess Margaret Cancer Centre Robert V. Brady Award for Best Resident
	Yonatan Weiss	CROF Travel Award
	Kang Liang Zeng	UTDRO W.J. Simpson Award for Academic Excellence in Research by a Radiation Oncology Resident
	Eric Zhao	STARS21 Post-Graduate Trainee Award, Princess Margaret Cancer Centre and the Terry Fox Foundation

Funding and Support

Residents are funded to attend national and international radiation oncology conferences to present their research projects. There are also opportunities for PGY5 residents to attend one of the major conferences even if they are not presenting to allow networking opportunities for fellowship or employment prospects.

Residents in their final PGY5 year are also able to attend the Examination Preparatory course with time allocation and course fee supported by the program; for this coming academic year, the Residency Program will support both PGY4 and PGY5. The Residency Program will also offer financial support to attend approved courses or conferences offered within the University of Toronto or affiliated academic hospitals. Finally, residents are financially supported to maintain their Advanced Cardiac Life Support certification.

Assessment of Learning

Residents are evaluated throughout the five-year RO Residency Program utilizing various methods, including written and oral examinations, simulation, OSCE examinations, clinical evaluations, and multisource feedback. The written exams include physics exams following each module completion, Radiobiology Exam, "Longitudinal" Clinical Knowledge Exam in the PGY2 and PGY3 years, and most recently the nationally developed Short Answer Question and Case-based Exam. The oral exams include end of rotation exams, and the Planning Exams given in the PGY4 and PGY5 years. It is the requirement

of the program that a resident passes certain exams before promotion to the subsequent year (e.g. passing the PGY5 Planning Exam before being allowed to sit the Royal College Exam). Appendix 4.2 details the 2020-2021 PGY1-5 Assessment Map.

Quality Indicators

The UTDRO RO Residency Program received the highest level of accreditation at the recently completed Royal College Accreditation visit in November 2020 – achieving the status of "Accredited program with follow-up by regular accreditation review". There were 9 standards with many requirements and indicators, with our program showing evidence of meeting all but 2 indicators (3.3.1.3 "Teachers contribute to the promotion and maintenance of a positive learning environment" and 9.1.1.3 "The process includes reflection on the potential impact of the hidden curriculum"). The accreditors felt that the program was aware of these issues and was already exploring strategies to address them. They noted the issues were relatively minor in scope and frequency, and expected to see results of our progress at the next Royal College Review in 8 years. Currently, the program is addressing these issues by increasing faculty awareness, ensuring that residents are aware of ways to bring up issues in a safe and confidential fashion, empowering mentors to support the residents, holding workshops on "Microaggression, Unconscious Biases and Discrimination", and liaising with the PGME teams on learner experience, as well as UTDRO's Equity, Inclusion and Professionalism Director on these issues. This will continue to be a focus of our work in the near future.

Another measure of quality is the success of the residents in their clinical and academic pursuits. The UTDRO RO Residency Program has had a 95% pass rate for the Royal College Specialty Examination for the last 5 years; all graduates were successful in obtaining their FRCPC certification and advancing to the next phase of their careers. Several residents have been successful in completing additional further degree qualifications during their training, including a PhD and several MSc degrees. The academic output of the residents far exceeds the expectation of the training requirements (i.e. one research project developed to the level of a manuscript). Many residents are first authors on papers published within specialty related journals. Appendix 4.3 lists notable resident publications during 2016-2021.

The faculty in the RO Residency Program are diverse and are consistently highly rated by the residents (Appendix 4.4). Over the last five years, the mean teaching evaluation and effectiveness scores have ranged between 4.41 and 4.78 at both sites (Table 11)

Table 11: Teaching Effectiveness Scores (2016-2021)

Site	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
Princess Margaret Cancer Centre, University Health Network	4.65	4.53	4.57	4.41	4.56
Odette Cancer Centre, Sunnybrook Health Sciences Centre	4.74	4.60	4.78	4.51	4.56

Quality Enhancement and Optimization

The RO Residency Program has undergone several curricular changes and innovations, both prior to and after the introduction of CBD. Examples of improvements over the past five years include, but not are not limited to:

- As a first step to declaring a priority towards fostering a supportive learning and practice culture within the Residency Program, the Residency Wellness Committee led by Professor Emeritus Dr. Ida Ackerman was formally launched in 2018. Under her leadership, the Wellness Committee has actively provided support and events designed to promote an improved culture of wellbeing and satisfaction amongst the residents. In 2020, Dr. Ackerman stepped down as Chair, and her role was assumed by Dr. Toni Barnes from OCC. The committee members from PM and the community cancer centres, as well as resident members meet regularly to identify opportunities for addressing resident wellbeing.
- Moving Academic Half Day to Friday AM to facilitate attendance, and increased involvement of the AHD Coordinators to shape the curriculum.
- Increasing emphasis on in-the-moment feedback, including completion of STAPLERs and EPAs (for both CBD and traditional resident cohorts).
- Introducing changes to rotations, including site and focus (e.g. surgical oncology rotation moved to MSH).
- Development of guides for supervisors related to organizing rotations and clinic coverage.
- Involving fellows more in the education of residents.

Challenges and Opportunities

The COVID-19 pandemic has presented unprecedented challenges to healthcare and education. The UTDRO RO Residency Program has worked hard to support its residents and advocate for their needs and wellbeing. The Royal College Accreditation and the CBD/traditional cohort (in effect, having a "double program) have created additional demands on the program's time and attention. The program is fortunate to have many dedicated and capable individuals, including a very experienced Administrative Education Coordinator, Catherine Wong, and supportive and engaged leaders, including the past and current Vice Chairs of Education, Drs. Rebecca Wong and May Tsao, and the Chair, Dr. Fei-Fei Liu. They have dedicated significant amounts of time and attention to the residents and their needs, as well as the overall needs of the program. The U of T PGME team is another source for guidance and support to the program, and we continue to work closely with them on all aspects of the RO Residency Program.

CBD is indeed an opportunity to make further changes to the RO Residency Program. In particular, the program would like to emphasize the "in-the-moment feedback" and the coaching aspect of CBD, as they provide ways for trainees to further improve their skills; nurturing a "growth mindset" that will serve them well in their future careers. Interdisciplinary and interprofessional learning and teamwork are integral to our practice environment; hence, these experiences can be further harnessed to benefit resident learnings. The program has embarked on the creation of modules to facilitate case-based learning (e.g. pediatric radiation oncology cases). Quality and safety are two topics, which we wish to emphasize further. The program is looking forward to the Transition to Practice (TTP) period as an opportunity to better prepare its graduates for their respective career paths. Once the restrictions of the COVID-19 pandemic conclude, we plan to incorporate the positive elements of the virtual environment into our program (e.g. facilitate remote learning or a virtual CaRMS process). Ongoing engagement of faculty and trainees, and nurturing a culture of life-long learning will position our graduates to continue advancing our profession and become future leaders in the field of radiation oncology.

Medical Physics Residency Program

Program Overview

The Residency Program in Medical Physics started in July 2007 by combining existing long-standing medical physics residency programs at the Princess Margaret Cancer Centre and Sunnybrook Health Sciences Centre – Odette Cancer Centre (OCC). Three affiliate sites then joined the program in subsequent years, with residents training at Durham Regional Cancer Centre (DRCC), the Carlo Fidani Regional Cancer Centre (CFRCC), and the Stronach Regional Cancer Centre (SRCC). The goal of the joint program is to produce highly competent medical physicists, who will achieve a comprehensive understanding of clinical medical physics; knowledge of radiation therapy and radiation oncology principles and practice, as well as enhanced leadership, research and teaching skills. On March 10, 2008, the program was first accredited through the Committee on Accreditation of Medical Physics Education Programs (CAMPEP). This accreditation was most recently renewed in 2017, and the program is currently accredited until December 31, 2022. Maintenance of this accreditation is essential as the Canadian College of Physicists in Medicine (CCPM), the certification body in Canada for medical physics, has mandated that graduation from a CAMPEP-accredited residency program, or graduate school, as an eligibility requirement for board certification. This is also a requirement for certification by the American Board of Radiology (ABR). On average, 12 residents are enrolled at any one time, equally divided between Year 1 and Year 2, across the five sites. As such, the UTDRO Medical Physics Residency Program is one of, if not the largest accredited physics residency program in Canada (a total of 13 programs across Canada).

Program Objectives

The goal of the program is to train highly competent medical physicists with enhanced leadership, research and teaching skills, consistent with the UTDRO strategic plan, *UTDRO 2022: Reflect. Transform. Lead.* There is also a strong focus on interprofessional development with interaction with fellow trainees and faculty from all disciplines of radiation oncology, medical physics, and radiation therapy.

Program Governance

Dr. Jean-Pierre Bissonnette completed his term as Program Director in February 2016. After an internal search, Dr. Andrea McNiven was appointed as Program Director, effective February 1, 2016. The Site Coordinators for each of the five sites have been stable for the last 5 years. The structure of the program is outlined in Figure 13. A Chief Resident is also selected each year by the Physics Residency Program Committee (PRPC) to ensure appropriate representation on the committee.

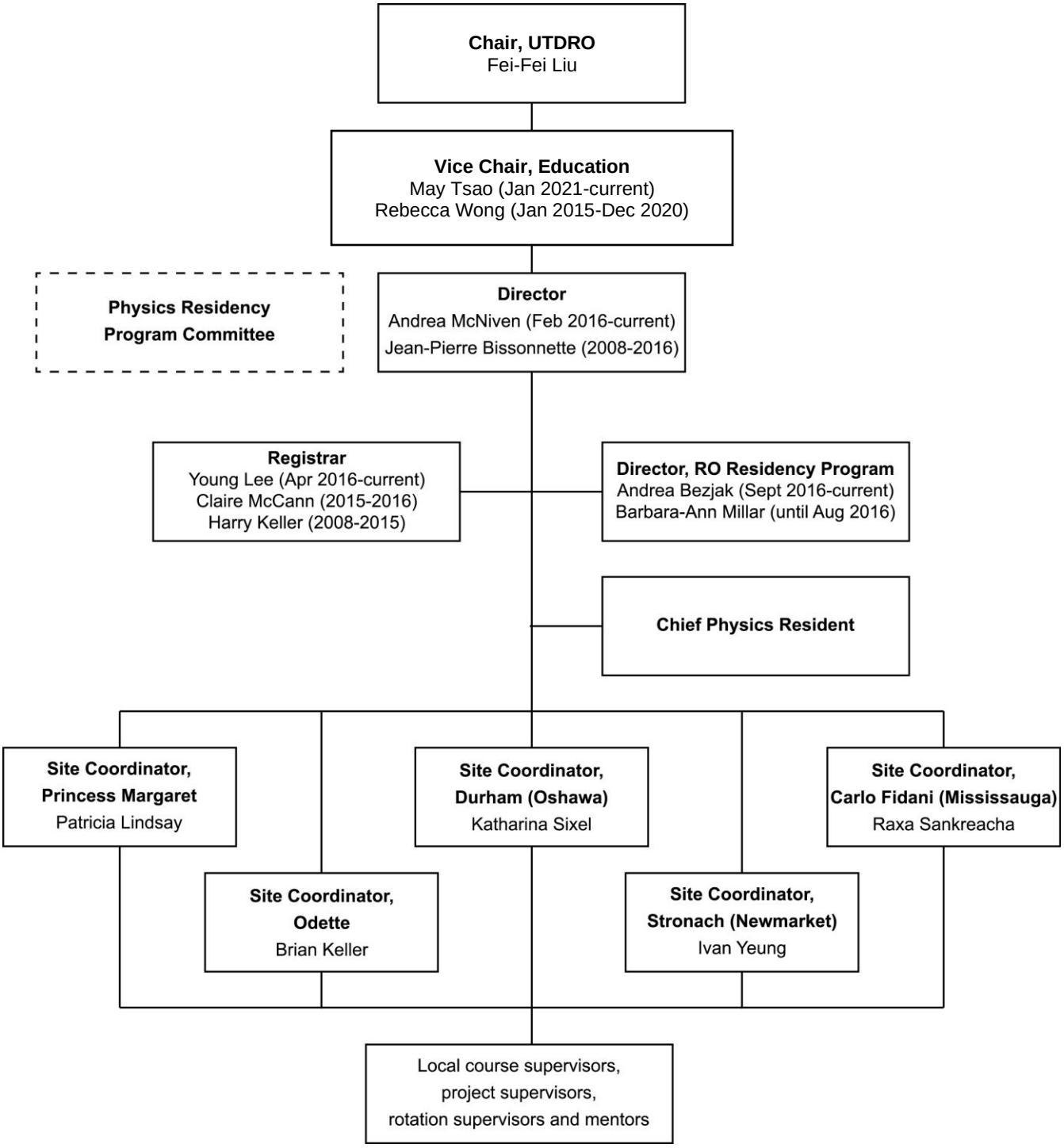

Figure 13: UTDRO Physics Residency Program Leadership

Admission Requirements and Recruitment

As a CAMPEP-accredited program, minimum eligibility is defined by CAMPEP, in that program applicants must have graduated from an accredited graduate program (MSc or PhD), completed a CAMPEP certificate program, or have met some pre-requisite course work if their graduate school was

not CAMPEP accredited. These courses include three upper-level physics undergraduate courses (3rd or 4th year), and content in 6 required courses (radiological physics and dosimetry, radiation protection and safety, fundamentals of medical imaging, radiobiology, anatomy and physiology, radiation therapy physics). All applicants must meet these minimum requirements. The preferred entry requirements are a PhD in medical physics or related field from a CAMPEP-accredited graduate program.

The two-year program has two potential start dates, September 1st and January 1st. Application deadlines are early January and end of September/beginning of October. Starting in 2019, the program has participated in the Medical Physics Matching Program (MedPhys Match) for the September entry date. This is a North American matching program, run by the National Matching Services Inc. The UTDRO program has held interviews towards the end of the matching period, end of February or early March. The results are shared with programs and applicants at the end of March. For unmatched positions, the program will post again to fill those positions. Participation in the MedPhys Match fulfills a CAMPEP accreditation standard to demonstrate non-exploitative hiring processes. The results of recruitment and graduation must be published as part of the CAMPEP requirements; the application history is detailed in Table 12.

Table 12: Recruitment Statistics Since Initial Accreditation by CAMPEP

Year	Number of Applicants	Number of Students Accepted	Number of Graduates	Number of Students Certified	Clinical Staff	Disposition (Academic)	Disposition (Industry)	Other
2008	59	3	4	3	4	0	0	0
2009	42	6	4	4	4	0	0	0
2010	26	2	3	3	3	0	0	0
2011	59	6	7	5	5	2	0	0
2012	41	3	2	0	2	0	0	1
2013	39	5	7	4	7	0	0	0
2014	53	5	3	2	3	0	0	0
2015	54	5	6	3	6	0	0	0
2016	40	4	3	7	2	0	0	0
2017	20	3	7	2	7	0	0	0
2018	38	5	4	5	4	0	0	0
2019	40	6	4	4	4	0	0	0
2020	39	6	5	6	5	1	0	0

Note: Number of former residents certified in a specific year is not expected to align with number of graduates, as residents are typically not eligible for certification until the calendar year after graduation.

The Program Registrar reviews credentials and determines eligibility of applicants. A shortlist is then created by the Admissions Committee for interview. The interview process includes a panel interview, after which acceptable candidates for the program are identified. Each centre completes their own ranking of candidates, and for the September entry dates, the centres submit their rankings to the Program Director who enters the rankings in the MedPhys Match system. For other start dates, a matching system is used (applicant ranking of sites combined with sites' ranking of the applicants) to place the residents at specific training sites.

The decision to join MedPhys Match was made after consideration by the PRPC of application numbers and trends, a survey of Canadian graduate students on residency application practices, and an initial step in 2018 to move the hiring date earlier in the year to capture applicants also participating in the MedPhys Match. In 2019, the program posted 5 positions in the MedPhys Match, and successfully matched four, with one position at Stronach Regional Cancer Centre unmatched. This was subsequently filled in a second posting. A candidate who matched at OCC violated the match to pursue a position in research and that position was also filled outside of the match. In 2020, six positions were offered in the MedPhys Match, with single positions at both Credit Valley and Oshawa going unmatched, which were again, successfully filled subsequently. In 2021, five positions were available in the MedPhys Match; 2 positions at the Princess Margaret Cancer Centre went unfilled, and recruitment is currently in process.

Challenges faced by UTDRO centres on an absence of direct entry into the Residency Program since U of T does not have a CAMPEP-accredited graduate program. Ryerson University has an accredited graduate program, but to date, only one candidate has joined our program directly from Ryerson. This absence also limits the number of students from non-CAMPEP programs who can be accepted by UTDRO. As noted previously, six mandatory courses are required. However, if courses can be remediated locally (by using CAMPEP-accredited courses), then applicants could enter the UTDRO program with only 4 of the 6 courses completed; since up to 2 courses may be remediated during the Residency Program.

Curriculum and Program Delivery

The UTDRO Physics Residency Program is an intensive two-year practical training program that prepares students to become future leaders in medical physics. Through clinical rotations, a research project in clinical physics, and educational components, students are equipped with fundamental knowledge of the disciplines of radiation oncology and radiation therapy. Physics residents learn to recognize, understand, and address scientific, clinical, and technical problems by working directly with experienced radiation oncologists, medical physicists, and radiation therapists.

The program duration is 2 years, and includes a mix of didactic courses, clinical rotations, and clinical projects. Each resident chooses a faculty member to serve as their mentor, who acts as a guide throughout the program. During the first two academic terms, physics residents may take didactic courses if they did not have all of the six prerequisites. As well, all residents complete rotations in Equipment (Dosimetry Instrumentation, LINACs and Imaging), Treatment Planning, Radiation Safety and Protection, Quality Management, Brachytherapy and Site-Specific Rotations in Treatment Planning. In the first year, residents take the Clinical and Experimental Radiobiology Course offered by UTDRO, and the case-based Applied Physics course in second year. Depending on course offerings, the residents will also take the Accelerator Technology (ATec) Course offered by the Accelerated Education Program at the Princess Margaret Cancer Centre; preferably taken during the first year. One distinguishing feature of the program is that residents interact in a multidisciplinary environment, involving radiation oncologists and radiation therapists during the Applied Physics Course, and the interdisciplinary components of the clinical rotations that follow specific patients from first clinic to treatment. Additional clinical projects involve acceptance and commissioning of new equipment. All residents also select a research supervisor and will complete a clinical project as part of their residency training.

Student Awards

Over the past years, many of our physics residents have been successful in obtaining various internal, local, and national awards (Table 13).

Table 13: Notable Awards Received by UTDRO Physics Residents (2016-2020)

Year	Recipient	Award
2016	Dominique Fortin	UTDRO J.R. Cunningham Award for Excellence in Academic Research by a Physics Trainee
2017	Anthony Lausch	Canadian Organization of Medical Physicists (COMP) Best Papers Session Award
	Ekaterina Tchistiakova	UTDRO J.R. Cunningham Award for Excellence in Academic Research by a Physics Trainee
2018	Leigh Conroy	UTDRO J.R. Cunningham Award for Excellence in Academic Research by a Physics Trainee
2019	Leigh Conroy	UTDRO J.R. Cunningham Award for Excellence in Academic Research by a Physics Trainee
	Leigh Conroy	UTDRO B.J. Cummings Award for Research Excellence
	Jeff Winter	RMP Trainee Excellence in Education Award
2020	Lee Macdonald	UTDRO J.R. Cunningham Award for Excellence in Academic Research by a Physics Trainee

Funding and Support

Residents must be registered with the University of Toronto Postgraduate Medical Education office throughout their two years. Residents are employed by their training site, and their salary (which varies by training site) is partially provided by the Ministry of Health and Long-Term Care (MOHLTC) and the local cancer centre. The total funding the residents receive is not uniform, as their employment conditions are different at the five training sites. At Odette Cancer Centre, Lakeridge Health, and the Princess Margaret, the residents are full-time employees and receive benefits and pay into a pension plan (HOOPP). At Odette Cancer Centre and Lakeridge Health, they are also members of the Professional Institute of the Public Service of Canada (PIPSC) union (as are physicists at those centres), and the salary is currently higher than at the Princess Margaret. At Southlake Regional Cancer Centre and Credit Valley – Trillium Health Partners, the residents are contract employees and receive a percentage of pay in lieu of benefits. This heterogeneity in funding might impact on recruitment to specific sites.

Each training site must support residents' attendance (according to their own local reimbursement and travel policies) at a minimum of one national or international conference during the course of their residency.

The Residency Program draws upon the resources of the largest academic radiation oncology program in Canada. The residents work in an environment where critical thinking is emphasized, the results of research are communicated freely, and incorporated rapidly into treatment protocols. Each resident has a medical physicist advisor to guide them and monitor their progress through the program.

Assessment of Learning

Resident knowledge is evaluated at regular resident question and answer sessions as indicated in the program syllabus, which occur on a bi-weekly basis. Residents are also assessed at each major clinical rotation. Comprehensive oral examinations are held at the end of each academic year. Residents are forwarded to the Year-2 final exam by their Site Coordinator if all other components of the residency have been successfully completed (i.e. courses, clinical rotations, projects, and tutorials). After successful completion of the Year-2 exam, they are considered to have fulfilled all program requirements. Residents who have successfully completed the program will receive a completion certificate indicating that they have completed the CAMPEP-accredited program, and then would be eligible to write the national certification exam.

Quality Indicators

Including those who were enrolled at the time of accreditation, the program has had 60 graduates; there was one withdrawal due to medical reasons. All graduates have completed the program in the scheduled 24 months, except for 4 extensions of 3-4 months in order for them to successfully complete all aspects of the program. All graduates have successfully found employment in clinical medical physics, except for one who was recruited directly into industry. Some initial jobs are contract positions, but the majority of residents find a full-time position within a year of graduation. In 2020, there were five graduates; all had job offers prior to graduation, four for full-time employment, one for an 18-month contract. Additionally, amongst the 60 graduates who have been eligible to complete certification, 96.7% have successfully completed certification to date, obtaining certification in either Canada (Canadian College of Physicists in Medicine; CCPM) or the USA (American Board of Radiology; ABR). All five of the program's 2020 graduates successfully obtained CCPM membership. One of the other previous graduates has partially completed the ABR certification process.

All residents must present an abstract at the UTDRO Research Day at least once during their two-year program. Additionally, residents are also supported to attend a minimum of one national or international conference during their two years. Over the past five years, all residents have had at least one abstract at a national or international conference. Approximately half of the residents also have a publication from their clinical project or other residency work; although many are not published until after graduation.

Quality Enhancement and Optimization

Resident feedback is obtained on a regular basis; since the last program review, resident feedback has led to minor changes to rotations and scheduling. This has included some refinement of the resident tutorial topics and transition of some topics to clinical rotations. Additionally, resident feedback has led to the implementation of Resident Days, where residents from all training sites gather for a select topic of common interest. In 2020, to encourage interaction between all residents, a resident-led Physics Residency Journal Club was introduced, assisted by a faculty advisor. Enabled by Chief Resident, Dr. Hedi Mohseni and Faculty Advisor, Dr. Anthony Lausch, this Journal Club will continue to evolve based on resident and faculty feedback. This opportunity to regularly engage with others has been well received, particularly during this past year, which has been difficult due to COVID-19 and limitations of travel between centres.

Full transition to electronic assessment forms for rotations using Elentra, a community-source integrated teaching and learning platform, is currently underway, along with a review of clinical rotation

descriptions and objectives, which should also assist in increasing uniformity of curriculum delivery across all five training sites. This would improve tracking, reporting capabilities, as well as compliance with form completion for rotation and supervisor evaluations. Residents will not receive their own evaluations, until they have completed the evaluations for rotations and supervisors.

Challenges and Opportunities

Recruitment

As already stated, recruitment may be a challenge due to student eligibility based on CAMPEP standards and the lack of a local feeder program that supplies well-documented qualified candidates. In addition to competing against other programs within the MedPhys Match in Canada, we are also competing against institutions in the United States. During the program's participation in the MedPhys Match, we have observed that approximately 40% of the ranked candidates will be matched to USA residency programs. Canadians are eligible for most American programs, as many will support visas; however, in Ontario, only Canadian citizens or Permanent Residents are eligible for funding provided by MOHLTC.

It is also a programmatic challenge in that each centre hires their own resident directly, and there is some variability in benefits and pay across the centres. Recruiting to Toronto may also be impacted by the cost of living. Many physics residency programs also do not require tuition payment. An advantage of being registered with U of T PGME is that trainees can readily rotate at other centres across UTDRO, as well as access U of T resources, such as the library or other facilities.

Curriculum and Assessment

Completing the transition to electronic evaluation of rotations in Elentra and migrating to the use of Microsoft SharePoint will improve the central documentation process; this is anticipated to be completed in 2021. Furthermore, opportunities to standardize delivery of some of the curriculum across the five sites still exist; the review of rotations in Elentra will assist in this process. Opportunities for shared teaching for select rotations exist and will be explored (e.g. more coordinated delivery of the Quality Management rotation). Variations in the size, nature of the participating sites (academic *vs*. community), and range of available hardware and software also offer opportunities for collaboration. One example of innovation during the past few years is the creation of a case bank for planning that has been shared amongst the various sites so residents can use their local treatment planning system to plan cases for disease sites that are not treated locally. This has been piloted for the head and neck site group, and will provide an opportunity to increase the uniformity in curriculum delivery across the five sites, while ensuring residents can attain hands-on experience using different software systems.

The transition to Competency by Design (CBD) in the UTDRO Radiation Oncology Residency Program also offers opportunities and challenges for our program. In some cases, the restructuring of the RO physics curriculum has reduced opportunities for involvement of the physics residents with the RO residents. As such, increasing interprofessional education activities will be a goal in the ensuing years. Some of the changes in the timing of the physics curriculum delivery to radiation oncology residents may offer more opportunities to potentially engage the physics residents in teaching opportunities, of which there is significant interest. The physics residents at the Princess Margaret are already engaged in teaching this year; the program anticipates expanding this opportunity once the COVID-19 pandemic has resolved.

Radiation Oncology Fellowship Program

Program Overview

The UTDRO Radiation Oncology (RO) Fellowship Program is one of the largest and best-developed fellowship programs of its kind in the world. It has a reputation for excellence; hence, continues to attract high caliber applicants from around the globe. Fellows are offered a myriad of opportunities to develop their skills in subspecialty expertise in radiation oncology, technical radiotherapy, research methodology, publication, grantsmanship, education, and leadership. Exposure to the diverse faculty and peers fosters a collaborative environment that facilitates networking, which enhances the learner experience, as well as launching careers.

In the current 2020-2021 academic year, there are 26 fellows between the two main sites, the Princess Margaret (PM) and Odette (OCC) Cancer Centres. Over the recent decades, the UTDRO Fellowship Program has attracted a large number of excellent candidates from across the continents, including Australia, New Zealand, UK and Western Europe, Africa, Asia, South America, USA, and Canada. With its cadre of fellows and the number of faculty involved in a broad spectrum of research and teaching, it offers an unprecedented opportunity to interact with individuals across multiple disciplines of radiation medicine and science. It also provides opportunities for enhancing expertise across a spectrum of clinical radiation oncology, in addition to further training in research, acquiring leadership skills, as well as developing networking opportunities with peers and faculty.

The University of Toronto has the only Royal College accredited training program in brachytherapy. The U of T application was submitted to the Royal College in November 2017 and was approved in the spring of 2018. Upon completion of the one-year Brachytherapy Area of Focused Competency (AFC) Program, an AFC fellow will be able to function as a competent specialist in brachytherapy, capable of an enhanced practice in this area of focused competence within the scope of radiation oncology. The brachytherapy AFC trainee will acquire a working knowledge of the theoretical and practical basis of brachytherapy, including its foundations in science and research, as it applies to medical practice.

Program Objectives

The overarching objectives of the UTDRO Fellowship Program include the provision of in-depth training in clinical, education, and research expertise, with a view towards training future leaders in radiation oncology around the world.

The specific objectives are:

- To develop clinical expertise in subspecialty disease sites.
- To enhance specific expertise in technical radiotherapy (e.g. brachytherapy, stereotactic radiotherapy, gamma-knife).
- To provide a foundation in clinical and translational research methodology.
- To enable pursuit (where applicable) of graduate degrees, such as a MSc (or PhD), awarded by a U of T graduate department.
- To provide the development of clinical, research, education, and leadership networks.

Please note that the U of T Brachytherapy AFC Program has its own specific goals and objectives developed in collaboration between UTDRO and the Royal College of Physicians and Surgeons of Canada (Appendix 5.1).

Program Governance

- Program Director: Dr. Jennifer Croke
- Vice Chair, Education: Dr. Rebecca Wong (January 2015 - December 2020); Dr. May Tsao (January 2021 - Present)
- Administrative Education Coordinators: Catherine Wong and Eileen Brosnan
- Brachytherapy AFC Program Director: Dr. Gerard Morton

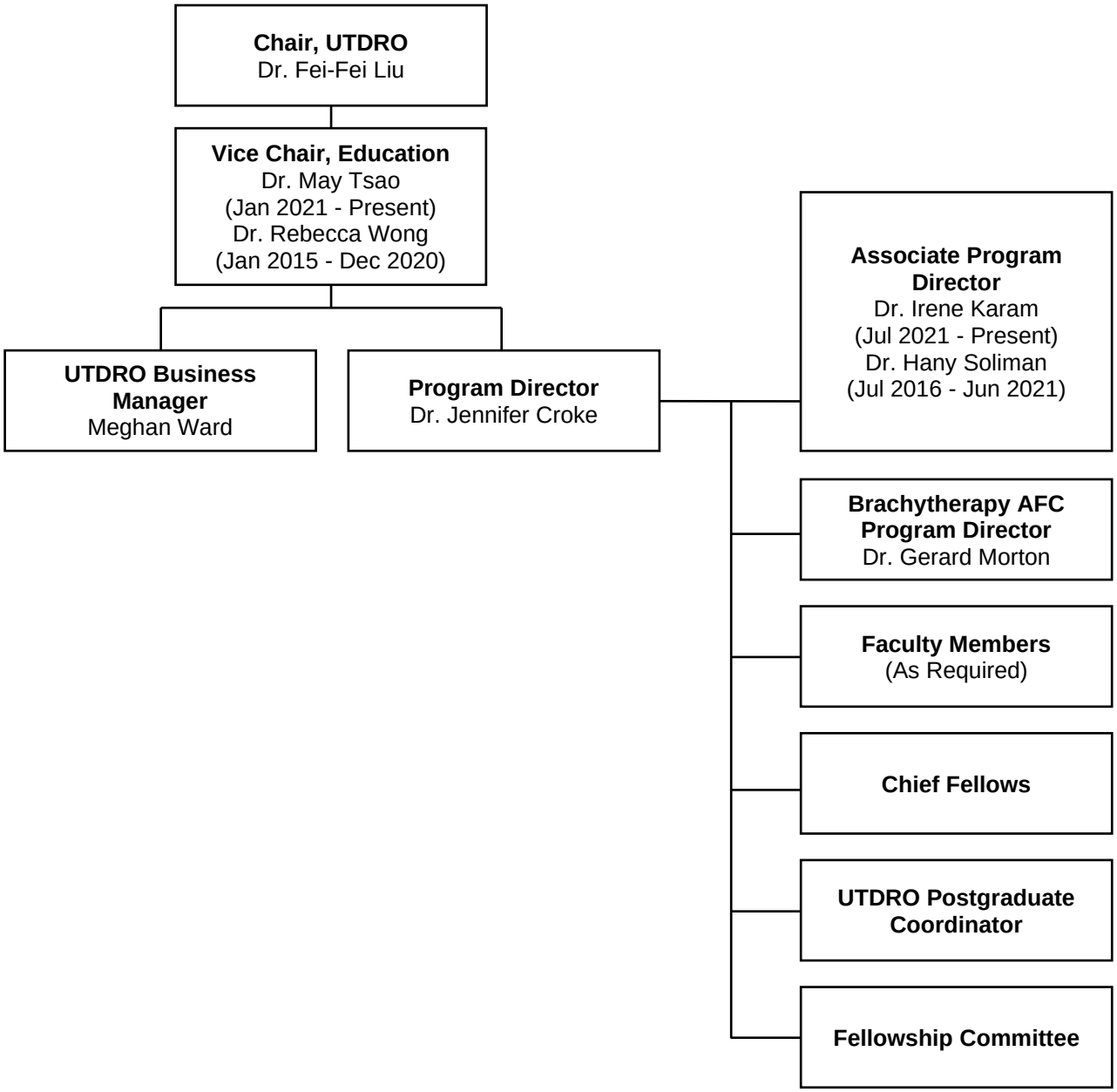

Figure 14: UTDRO Fellowship Program Structure

Admission Requirements and Recruitment

Fellowship recruitment admission requirements for this program are as follows:

- Minimum requirement of successful completion of specialty certification in the country of origin.
- Funding availability; the enrolment numbers have varied from year to year, dependent upon funding support. In recent years, upwards of 20 fellows have been selected based on a competitive process.

Applications Process

All applicants must submit a CV, Letter of Intent, and three letters of reference. There are two intake periods every year: January and July, with applications due 12 months before the intake period.

The Fellowship Program Director reviews all complete applications. There are two streams: Radiation Oncology Fellowship applications and Brachytherapy AFC applications. A short-list of applicants meeting minimum requirements are then reviewed and ranked by a Selection Committee based on quality of previous experience, potential to excel in the UTDRO environment, and the candidate's potential alignment with program objectives. Based on a competitive ranking, a final shortlist of candidates is generated for interviews, and then a subset of final successful candidates is selected based on matching the final candidates with availability of a specific fellowship funding position. The UTDRO Program Director and AFC Program Director review applicants declaring interest in the Brachytherapy AFC Program separately. The same process outlined above is then followed.

Enrollment Numbers

Over the past 5 years, the number of applications received has ranged from 32-87 per intake period (Table 14). The number of accepted fellows per year has ranged from 26 to 33.

Table 14: UTDRO Fellowship Program Enrollment Numbers

Year	# of Applications (Jan)	# of Applications (Jul)	Total # of Accepted Fellows
2016-2017	33	65	33
2017-2018	32	59	26
2018-2019	42	87	32
2019-2020	32	67	29; 1 Brachytherapy AFC
2020-2021	43	64	26; 1 Brachytherapy AFC

Curriculum and Program Delivery

In general, there is no specific curriculum for Fellowship training. Training is provided primarily through the supervisor(s)/trainee relationship:

- Fellows are supervised by one or two faculty members (supervisors) from either the PM or OCC.
- The supervisors are always radiation oncologists, although medical physicists or medical radiation therapists may also serve as co-supervisors.
- There are over 70 potential supervisors in the Department of Radiation Oncology.
- All Fellows have specific goals and objectives for their Fellowship defined prior to commencement of training.

- For Fellows pursuing a graduate degree, appropriate faculty supervisors are identified, and protected time is provided to allow successful completion of the degree.
- Each Fellow is expected to complete at least one prospective or retrospective research project during the fellowship that is suitable for publication in a peer-reviewed journal under the supervising faculty. Fellows are expected to attend/participate in the Annual UTDRO Research Day.
- Fellows are required to participate in the Fellowship Research Seminars and Journal Clubs. These are held bi-weekly on Wednesday evenings from 6:00-7:30 PM (Appendix 5.2).
- The Princess Margaret Global Oncology Leadership Development Program has been created to equip fellows with the skills, networks, and opportunities to develop leadership skills. It is not specific to UTDRO; however, fellows are encouraged to apply and participate.

The Brachytherapy AFC Program has a more structured format for Fellowship delivery and is described in Appendix 5.3. The trainee attains competence in two or more different clinical disease sites or techniques. Trainees select at least two of the following at which to attain competence:

- Prostate High Dose-Rate (HDR) Brachytherapy
- Prostate Low Dose-Rate (LDR) Brachytherapy
- Gynecological Interstitial High Dose-Rate (HDR) Brachytherapy
- Gynecological Intracavitary High Dose-Rate (HDR) Brachytherapy

The curriculum involves 2 days per week primarily in the HDR Brachytherapy Suite, one day in the Ambulatory Clinic, one half-day dedicated to brachytherapy planning, one half-day dedicated to Rounds, workshops, and didactic teaching sessions, and one day for scholarly activities.

The trainees are involved in all aspects of brachytherapy, with graded responsibility from initially observing and assisting, to performing the entire procedure initially under supervision, and then eventually independently. The trainee performs procedures in a variety of disease states and conditions. Service demands on trainees are limited and primarily focused on clinical activities that enhance AFC-specific competencies.

The trainee has a faculty supervisor for each site (prostate and gynecology), but interacts with all brachytherapy staff and faculty. Radiation oncology and medical physics faculty deliver didactic sessions on various brachytherapy topics (e.g. brachytherapy systems, optimization, radiobiology, sources).

Student Awards

Fellows are encouraged to apply for research awards and grants as applicable under faculty supervision. Many of our UTDRO Fellows have successfully captured various internal, national, or international awards (Table 15).

Table 15: Notable Awards Received by UTDRO Fellows (2016-2020)

Year	Recipient	Award
2016	Daniel Glick	CARO Best Fellow Oral Presentation
	Ali Hosni	ASCO Merit Award

	Fabio Moraes	ASTRO Practical Radiation Oncology Reviewer Apprenticeship Program
	Fabio Moraes	Union for International Cancer Control Young Leader Award
	Fabio Moraes	ESTRO Mobility Grant
	Fabio Moraes	American Society of Hematology Abstract Achievement Award
	Lucas Mendez	Ride for Dad (Huronia) Award
2017	Adam Gladwish	Resident's Award for Excellent in Clinical Teaching by a Fellow
	Michael Jones	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
	Magali Lecavalier-Barsoum	UTDRO R.S. Bush Award for Academic Excellence in Research by a Radiation Oncology Fellow
	Fabio Moraes	PGME Postgraduate Medical Trainee Leadership Award
	Fabio Moraes	BNAM Young Physician Leader Award
	Fabio Moraes	IASLC Academy Award
	Fabio Moraes	Canadian Society on Lymphoproliferative Disorders Young Investigators Research Award
	Pablo Munoz	Kidney Cancer Research Network of Canada Research Trainee Award
	Aravindhan Sundaramurthy	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
	Anil Tibdewal	CARO-CROF Best Abstract in Supportive Care
2018	Andrew Bang	Royal College Detweiler Travelling Fellowship
	Andrew Bang	STARS21 Travel Award
	Andrew Bang	STARS21 Research Grant – Clinical Fellow Category
	Ning-Ning Lu	CARO-SANOFI Grant
	Fabio Moraes	CARO Best Fellow Oral Presentation
	Fabio Moraes	RSNA Roentgen Resident/Fellow Research Award
	Fabio Moraes	UTDRO R.S. Bush Award for Academic Excellence in Research by a Radiation Oncology Fellow
	Nhu-Tram Nguyen	Best Poster Award for Academic Excellence in Research, UTDRO Research Day
	Mark Niglas	Residents' Award for Excellence in Clinical Teaching by a Fellow
	Noelia Salgado	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
2019	Soha Atallah	CARO Best CanPRO Oral Abstract Award
	Archya Dasgupta	UTDRO R.S. Bush Award for Academic Excellence in Research by a Radiation Oncology Fellow
	Ezra Hahn	Residents' Award for Excellence in Clinical Teaching by a Fellow
	Jelena Lukovic	Novartis Oncology Young Canadian Investigator Award
	Jelena Lukovic	ASCO Merit Award
	Jelena Lukovic	Princess Margaret Cancer Program Best Fellow Award
	Jelena Lukovic	UTDRO Best Poster Award for Academic Excellence in Research
	Lucas Mendez	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
2020	Ahmed Abugharib	SpineFest Second Best Abstract Award, Clinical
	Samuel Bergeron-Gravel	UTDRO Residents' Award for Excellence in Clinical Teaching by a Fellow
	Piero Bettoli	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
	Hanbo Chen	CARO Virtual Scientific Meeting (VSM) Award

	Hanbo Chen	CARO Best Abstract in Survivorship
	Hanbo Chen	CARO Best of the Fellow Presentation Session
	Hanbo Chen	U of T Hold'em for Life Oncology Fellowship
	Rachel Glicksman	PGME Postgraduate Research Award – Joseph M. West Family Memorial Fund
	Rachel Glicksman	CARO VSM Award
	Rachel Glicksman	ASCO Conquer Cancer Foundation Merit Award
	Rachel Glicksman	AbbVie-CARO Uro-Oncologic Radiation Award (ACURA)
	Shivakumar Gudi	UTDRO R.S. Bush Award for Academic Excellence in Research by a Radiation Oncology Fellow
	Meetakshi Gupta	UTDRO Chair's Award for Academic Excellence in Research
	Meetakshi Gupta	U of T Hold'em for Life Oncology Fellowship

Funding and Support

Fellowship support is derived from the supervisors themselves (*via* research grants or philanthropy) or hospital departmental Academic Enrichment Funds. Fellows are permitted to be partially or completely self-funded provided they show evidence that the source originates from a grant, bursary, or from their host centre. All self-funded Fellows, however, must be supported at the same level as internally funded Fellows.

Brachytherapy AFC trainees are funded through a variety of mechanisms, including support from their home institutions, grant support, and donated funds. This covers salary support, as well as the Royal College charge of $2000 per year. No budget has been set aside to support departmental administrative costs.

Assessment of Learning

As a non-accredited program for certified specialists, there is no formal assessment of learning for the Fellowship Program; however, fellows are invited to evaluate the program at completion of their fellowship training period. Additionally, fellows meet one-on-one with the Program Director for an exit interview where feedback is sought regarding their Fellowship experience. Assessment of graduate student supervision is performed with the UTDRO Program within the relevant U of T graduate department.

Fellows enrolled in the Brachytherapy AFC Program complete a Competency Portfolio and the AFC Director completes the Final In-Training Evaluation Report (FITER) prior to the trainee receiving their Diploma (DRCPSC) in Brachytherapy by the Royal College.

Quality Indicators

Given the consistently high number of applicants, and the strong reputation of the UTDRO Fellowship Program, we would consider this program to be successful. Almost all Fellows complete the entire duration of training; early departure is strongly discouraged. Additional metrics include:

- Number of peer-reviewed publications produced by Fellows

- Number and monetary value of awards and grants received by Fellows

Quality Enhancement and Optimization

The Radiation Oncology Fellowship Program has undergone several curricular changes and innovations over the past five years. Examples of improvements include, but not are not limited to:

- Creation of Co-chief Fellow positions at both PM and OCC sites.
- Ongoing assessment of the needs for each Fellow is undertaken within the first 3 months, and thereafter as required.
- Changes to clinical and research schedules will be monitored in conjunction with faculty supervisors as required.

Challenges and Opportunities

The Fellowship Program has successfully enhanced the clinical and academic goals, as well as the international profile of UTDRO. The program's ability to attract high numbers of qualified applicants annually in excess of the number of available positions is a reflection of its international reputation, which has been successfully sustained despite its size.

Challenges

Future expansion may be constrained by:

- Availability of current and possibly future workspace for fellows.
- Until recently, there has been a high degree of administrative support turnover, which has stabilized of late.
- Level of funding; the Fellows' remuneration was previously based on the PARO (Professional Association of Residents of Ontario) scale that has outpaced the level of fellowship funding.
- Perceived lack of dedicated time for research and increasing demand on clinical service.
- Perceived competition of clinical training with the Residency Program.
- Limited financial support for program education activities and research/conferences.
- Harmonizing and unifying the UTDRO Fellowship Program between the two academic cancer centres.
- Maintaining a critical mass of trainees within the Brachytherapy AFC to maintain the program and securing funds to enable ongoing administrative support.

Opportunities

- Expand Fellows' role in undergraduate and graduate teaching.
- Increase the number of available projects for research.
- Build programmatic fellowships that are not clinical site based, but focused on technical expertise (e.g. Stereotactic Body Radiotherapy, Brachytherapy, MR-LINAC).
- Develop additional metrics of program evaluation.
- Maintain funding by encouraging partial and full self-funding.
- Charge a fee for Brachytherapy AFC fellows to assist in the cost of program maintenance.
- Increase defined clinical fellowship period in order to have more time to complete research endeavours.
- Increase opportunities for collaboration within UTDRO: for example, fellowships which can take place at both PM and OCC.
- Build inter-university/program collaborative fellowships.

- Formalize mentorship and wellness programs for fellows.

Undergraduate Medical Education

Program Overview

The Department of Radiation Oncology within the Temerty Faculty of Medicine actively participates in undergraduate medical education (UME). The core departments of UTDRO are distributed across two academic cancer centres within the City of Toronto, while faculty from the community UTDRO sites also participate in UME teaching in the Greater Toronto Area (Table 16). As of 2020, there are a total of 58 active staff radiation oncologists who contribute directly to the undergraduate medical education curriculum.

Table 16: Affiliations of UTDRO Faculty Involved in UME Curriculum

Cancer Centre	MD Program Academy
Core Sites	
Odette Cancer Centre Sunnybrook Health Sciences Centre	Peters-Boyd Academy
Princess Margaret Cancer Centre University Health Network	Wightman-Berris Academy
Community Sites	
Carlo Fidani Regional Cancer Centre Trillium Health Partners	Mississauga Academy of Medicine
Simcoe Muskoka Regional Cancer Centre Royal Victoria Hospital	
Stronach Regional Cancer Centre Southlake Regional Health Centre	

The University of Toronto MD Program administers its hospital-based teaching through four academies. Three of these four are relevant to UTDRO based on the locations of the two cancer centres. Undergraduate medical students who are on-site at Princess Margaret Cancer Centre and the Odette Cancer Centre register with the Wightman-Berris and Peters-Boyd Academies, respectively.

The majority of teaching occurs in the clinical setting with students rotating amongst faculty members in one- to six-week rotations (Table 17). Students participating in these rotations do so within a number of programs administered by the Temerty Faculty of Medicine and other national and international medical schools. Our faculty also contribute to formal, didactic undergraduate medical student teaching both through the Wightman-Berris and Peters-Boyd Academies, and the Mississauga Academy of Medicine, as well as to the MD Program as a whole through “Cancer Week” in the Year-2 curriculum.

Table 17: UTDRO Faculty Involved in UME Clinical Rotations

	2016-17	2017-18	2018-19	2019-20	Total
Participating Faculty	57	58	60	58	N/A
Total Faculty Hours (Clinic Teaching)	2,658	3,496	2,409	1,538	10,101
Electives (Includes Clerkship, Electives, and Visiting)	22	34	19	19	94
TTR Selectives	14	12	11	5	42
CARO-CROF	2	1	1	1	5
Observers (In-Person)	17	43	24	14	98
Total Clinical Rotations	55	90	55	51	251

Program Objectives

- To provide a foundational experience to all medical students regarding the role of radiation oncologists in the diagnosis and management of cancer patients.
- To facilitate career exploration opportunities in radiation oncology.
- To provide basic oncology teaching to medical trainees who are potentially interested in radiation oncology.
- To support the Undergraduate Medical Education programs at the University of Toronto Temerty Faculty of Medicine.

Program Governance

The Vice Chair of Education oversees all education programs in UTDRO, including Undergraduate Medical Education (Figure 15). The Director of Undergraduate Education coordinates medical student learning activities with the Program Coordinator in the UTDRO Office. The Director also liaises with MD Program staff to organize formal didactic teaching in oncology to the entire undergraduate cohort.

For small group learning based at each of the three academies, coordination is undertaken by the leads at the corresponding cancer centres. The lead faculty member at each cancer centre also manages day-to-day operations of medical student schedules and supervision.

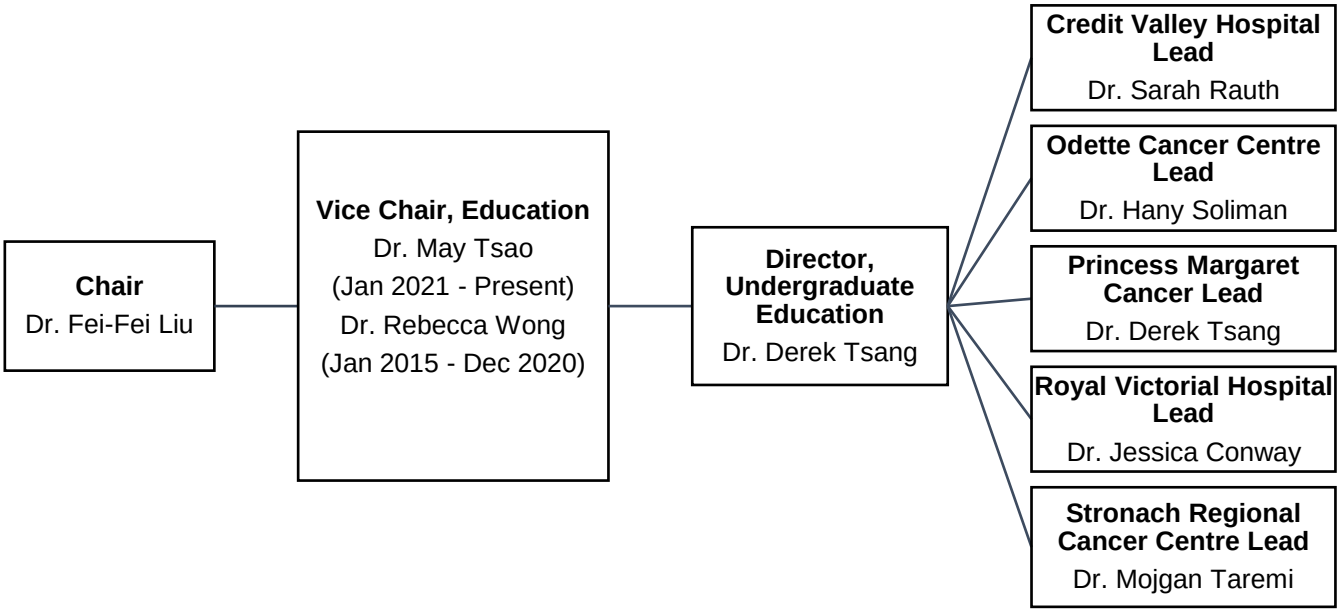

Figure 15: Undergraduate Medical Education Program Leadership

Admission Requirements and Recruitment

The University of Toronto MD Program receives at least 2,000 applications for admission annually. Each application undergoes independent file review by several individuals. Suitable candidates are offered an interview with a faculty and medical student team. These interviews are conducted over the months from January to March for each year.

UTDRO faculty are involved in various activities related to the MD Program admission process. One faculty member (Dr. Barbara-Ann Millar) participates on the MD Admissions Committee, representing Post-Graduate Medical Education (2018-2019, 2019-2020). Drs. Jennifer Croke, Derek Tsang and Alex Louie were admission file reviewers (2018-2019, 2019-2020); Drs. Meredith Giuliani and David Shultz also participated as reviewers in 2016-2017. Resident trainees, Drs. Gordon Locke, Rachel Glicksman, Jennifer Kwan, Kang Liang Zeng, Jay Detsky and Yonatan Weiss (2016-2017), also participated as admission file reviewers, in addition to Dr. Minha Lee (2018-2019) and Dr. Marissa Sherwood (2019-2020).

Curriculum and Program Delivery

Undergraduate medical education is divided into the Foundations Program (Years 1 and 2, junior medical students) and clerkship teaching (Years 3 and 4, senior medical students). There are several pathways where undergraduate medical students are exposed to radiation oncology teaching in the MD Program.

Foundations (Year-1 and Year-2 Curriculum)

Cancer Week is a week-long collection of integrated lectures designed to provide medical students with a holistic summary of the psychosocial and multidisciplinary aspects of oncology care. It falls under the "Complexity and Chronicity" Course of the MD curriculum. Topics that are covered include cancer staging, screening, radiation and systemic therapy, survivorship, and psychosocial oncology. The week is also summarized with an oncology case-based learning (CBL) module that focused specifically on cancer survivorship in a lymphoma patient. Cancer week was initiated in 2018 under the leadership of UTDRO's previous UME Director, Dr. Meredith Giuliani, and continues to be co-led by Dr. Derek Tsang (UTDRO) and Dr. Susanna Yee-Shan Cheng (Department of Medicine).

In 2021, a dedicated, asynchronous virtual lecture on radiation oncology was undertaken by Dr. Srinivas Raman, delivered for the first time in May 2021. This lecture introduces radiation oncology to many trainees for the first time and allows UTDRO to continue to highlight our specialty.

Enriching Education Experiences (Observerships)

The Department of Radiation Oncology participates in the MD Program's Enriching Education Experiences (EEEs) Program. Prior to the COVID-19 pandemic, these observerships were coordinated through the UTDRO Office, supervisor, and student. During the pandemic, in-person EEEs were suspended and virtual observerships were offered to interested Year-1 and Year-2 students. These opportunities included shadowing of virtual patient encounters, an informal chat with a faculty mentor, and an opportunity to view radiotherapy planning.

Oncology Interest Group

The Oncology Interest Group (OIG) at University of Toronto is a group governed and coordinated by medical students for their peers to learn about the fields of surgical, medical, and radiation oncology. They facilitate mentorship opportunities and host semi-annual events with invited speakers from various oncology disciplines. UTDRO resident physicians and faculty members regularly participate in live (annual breakfast event) or virtual OIG events to introduce radiation oncology and answer questions from interested students.

Clerkship Electives

Year-3 and Year-4 students have the opportunity to rotate through a clinical elective in the Department of Radiation Oncology. The intent of a general elective is to provide exposure to students to the field of radiation oncology. The students work with a number of faculty to provide exposure to new patient clinics, follow-up clinics, planning and review. The duration of the rotation varies from two (minimum) to six weeks. Electives provide students with an immersive experience in radiation oncology practice.

Students are responsible for arranging and completing a total of 12 weeks of electives during their designated fourth-year Elective period. Students must complete Electives from three different disciplines, with a "discipline" defined as being any one of the CaRMS direct entry programs.

The COVID-19 pandemic limited the ability of UTDRO to carry on regular elective opportunities in early 2020. The placements for Year-3 and Year-4 students have since resumed in 2021.

Clerkship Selectives (Transition to Residency)

Medical students devote the final 14 weeks of the four-year MD Program towards consolidating the concepts they have learned on functioning as physicians, and putting them into practice in real-world

settings, in preparation for their residency program. The majority of Transition to Residency (TTR) consists of ten weeks assigned for selectives (two of which are three weeks in duration and the final one is four weeks long). In addition, there are four weeks for centralized teaching, divided into two blocks of one week each and a third block of two weeks.

The selectives promote workplace-based learning, where students have increased (graded) responsibility under supervision. These experiences allow the students to bring together many different areas of knowledge and skill in the care of patients or populations, as they prepare for the increased responsibility of their PGY1 programs.

Students are required to complete at least one of the selectives in a community setting, and at least one of the selectives in either a medicine or surgery-based area. Students may use one of their selectives to satisfy the requirement for three different direct-entry program electives in their UME Program.

UTDRO offers a TTR selective, "Radiation Oncology for the Non-Oncologist", to provide a broad overview of our specialty to graduating medical students as they transition into residency and medical practice. TTR selectives geared towards future radiation oncology residents are not offered because those students will already have had suitable exposure to our specialty through previous elective experiences.

As part of TTR, medical students are required to submit answers to written questions and reflections about specific teaching cases designed to address various domains of the CanMEDS framework. These cases are graded by resident physicians across different specialties, including UTDRO residents, who provide specific feedback to medical students.

Association of Faculties of Medicine in Canada (AFMC) Electives

Senior medical students from Canadian medical schools outside Toronto may complete electives at UTDRO to gain on-site exposure to our learning programs. These opportunities allow students to participate in clinical care away from their home school, and to acquire additional experience in preparation for residency applications. The AFMC suspended visiting electives effective March 20, 2020; thereby reducing the intensity of visit electives in UTDRO.

Physician Assistant Education

The UTDRO takes an active role in the education of physician assistant (PA) students from Western University, McMaster University, and the University of Toronto, with on-site placements for students learning about oncology care.

Virtual Medical Student Mentorship Program

Due to the hiatus in medical student placements during the COVID-19 pandemic, UTDRO created a Medical Student Mentorship Program open to University of Toronto MD Program trainees. The goal of this program was to pair medical students interested in learning more about radiation oncology with UTDRO faculty members, who could discuss the profession, facilitate (virtual) observerships, and to expose medical learners to the specialty. Nine medical students were paired with nine UTDRO faculty members in June 2020 (Drs. Danielle Rodin, David Shultz, Jason Wong, Jay Detsky, Jennifer Croke, Meredith Giuliani, Michael Milosevic, Rebecca Wong, Tatiana Conrad). One month after the pairings were made, a follow-up questionnaire was sent to all students. Five responses were received (56%); the median student satisfaction score was 8 out of 10.

Student and Faculty Awards

Faculty Awards

The Department of Radiation Oncology administers the following awards relevant to Undergraduate Medical Education on an annual basis:

- *Undergraduate Medical Education – Outstanding Contribution to the Program*: The awardee is chosen by the UTDRO Education Committee and is based on hours of teaching and contribution to the teaching endeavours of the UME Program.

- *Undergraduate Medical Education – Best Clinical Teaching*: This award is selected based on Teaching Effectiveness Scores, as submitted by medical students for UTDRO faculty.

Faculty award winners since 2013 are listed in Table 18.

Table 18: UME Faculty Award Winners

Year	Outstanding Contribution	Best Clinical Teaching
2013-2014	Robert Dinniwell	Hany Soliman
2014-2015	Ida Ackerman	Barbara-Ann Millar
2015-2016	John Cho	Normand Laperriere
2016-2017	Alejandro Berlin	Andrea Bezjak
2017-2018	Eric Leung	Tatiana Conrad
2018-2019	Jennifer Croke	Patrick Cheung and Andrew Hope
2019-2020	Jay Detsky	Jennifer Croke

Student Awards

The Canadian Association of Radiation Oncology (CARO) and the Canadian Radiation Oncology Foundation (CROF) have established a funded award to provide an outstanding clinical experience in radiation oncology for Canadian medical students to assist them in future career selection.

Based on the highly successful Ivan Smith Summer Studentship previously stewarded by Cancer Care Ontario, this program offers a six-week summer clinical elective for Canadian medical students between their second and third year. During the COVID-19 pandemic, 2020 placements were deferred, and 2021 placements will be converted into virtual research electives.

There is an open competition for funded slots and students are allocated to participating residency programs across Canada. This award selection process is governed by the CARO Education Committee. National award winners hosted at UTDRO are listed in Table 19.

Table 19: CARO-CROF Award Winners Hosted at UTDRO

Year	Student(s)
2017	A. Koven and A. Rahmani
2018	R. Stephens
2019	S. Kang
2020	S. Surangiwala and O. Krystia (cancelled due to COVID-19)

Funding and Support

Part-time administrative support for the UTDRO UME Program Coordinator, Catherine Wong, is available centrally from UTDRO. The duties of this coordinator are shared with the UTDRO Residency Program.

Assessment of Learning

There are three main forms of assessment in the UME Program.

Evaluations of Students

Medical students receive written end-of placement evaluations through the MedSIS electronic assessment system. These evaluations are completed with input from all of the rotation supervisors, and centralized feedback is coordinated by the rotation supervisor at the UTDRO site.

Evaluations of Program and Faculty – Clerkship Rotations

- The medical students provide electronic assessment of the placement upon rotation completion.
- The medical students provide electronic assessment of teaching effectiveness (TES) for each faculty supervisor upon rotation completion. Faculty receive annual feedback on teaching performance, provided they have a minimum of 3 assessments to provide anonymity. They also receive 3-year or 5-year rolling TES scores to ensure more faculty receive feedback on their teaching, given the requirement for aggregation of evaluations. A complete report is also sent to the UTDRO Chair and site leads annually.

Evaluations of Faculty – Didactic Teaching

For UTDRO faculty who teach Year-1 or Year-2 programs in the medical school (Foundations), assessment of their teaching is conducted by the MD Program and available to the faculty in their MedSIS portal or sent directly to the faculty member.

Quality Indicators

In the past several years, the UME Program (Table 20) and participating UTDRO faculty (Table 21) have been well rated by students at both education sites.

Table 20: UME Program Evaluation Summary

	2015-2020 (5-Year Averages)		
Education Site	**OCC**	**PM**	**Total**
Number of Program Evaluations	48	84	132
Exposed me to a range of clinical problems in oncology	4.7	4.5	4.6
Gave me a greater understanding for the principles of oncology	4.6	4.5	4.5
Gave me opportunity to see the technical side of radiation oncology	4.4	4.3	4.3
Provided me with adequate contact with radiation oncology faculty	4.7	4.5	4.6
Gave me the opportunity to see how a hospital multiprofessional team works	4.6	4.4	4.5
Gave me knowledge or skills which will be helpful even outside oncology	4.5	4.4	4.4
Provided me with adequate time to ask questions and have discussion	4.6	4.6	4.6
Gave me adequate time to attend rounds, conferences, lectures, etc.	4.3	4.3	4.3
Was adequately organized and scheduled	4.6	4.4	4.5
Was adequately supervised	4.7	4.5	4.6
Met my learning needs in general	4.6	4.5	4.5
Interested me in radiation oncology as a career	4.5	4.4	4.4
Mean (5-Point Scale)	4.5	4.5	4.5

Table 21: Aggregate Teaching Effectiveness Scores

	2016-2020		
Education Site	**OCC**	**PM**	**Total**
Number of Teaching Evaluations	172	419	591
Communicated Ideas	4.6	4.6	4.6
Demonstrated breadth of knowledge and ability to analyze information	4.6	4.7	4.7
Questioned and challenged house staff	4.3	4.4	4.4
Provided direction and feedback	4.4	4.4	4.4
Encouraged house staff to take appropriate responsibility	4.5	4.5	4.5
Provided a good role model as a clinician	4.6	4.6	4.6
Mean (5-Point Scale)	4.5	4.5	4.5

Challenges and Opportunities

University of Toronto MD Program Clerkship Activities

The COVID-19 pandemic limited the ability of UTDRO to carry on regular elective opportunities in early 2020. On March 15, 2020, all selective and elective clinical placements at University of Toronto were discontinued. MD Program student learning activities for graduating students (Year 4) were

stopped early due to the pandemic. All unpaid, pre-licensure student placements (physician and other health professions) were also halted.

During the recovery of clinical and teaching operations, University of Toronto MD students had the following in-person opportunities to learn and experience clinical radiation oncology:

- Electives were scheduled from November 9, 2020 through February 28, 2021.
- Transition to Residency (TTR) selectives for Year-4 students proceeded as planned in early 2021.

Virtual activities were previously discussed above.

In 2022, a unique, one-time circumstance will occur whereby the first month of TTR selectives will occur prior to the submission of residency (CaRMS) applications. This provides an additional opportunity for students to gain exposure to our specialty, with the possibility that some trainees may discover radiation oncology as a potential option for residency close to the due date for CaRMS applications. As such, we will be creating a new TTR selective, "Radiation Oncology Enrichment", for this group of prospective learners. Post-CaRMS, the TTR selective will remain the default "Radiation Oncology for the Non-Oncologist".

Canadian Medical Student Electives

The AFMC declared that there will be no visiting electives in Canada for the Class of 2021 for the duration of the 2020-2021 academic year. However, as vaccinations roll out in 2021, we hope that visiting electives will resume in the 2021-2022 academic year, and UTDRO looks forward to welcoming Canadian medical students back into our clinics.

Community Site Electives

We had established Stronach Regional Cancer Centre as a site for UTDRO students in 2018-2019 to complete electives. Due to administrative requirements, tracking is not yet in place for medical student placements in other UTDRO sites (Credit Valley Hospital, Mississauga; Royal Victoria Hospital, Barrie; Lakeridge Health, Oshawa). An advantage of centralized tracking of these rotations through the UTDRO Office is the ability to track teaching evaluations over time. The UME Director will work with coordinators at each site to implement this centralized tracking in the future.

Interest in Radiation Oncology

Maintaining active interest in radiation oncology as a specialty for medical students is of prime importance. Continued efforts will be required to mentor prospective trainees and foster ongoing interest. Our program will continue virtual and in-person observerships, engage with faculty members to participate in electives and selectives, and continue engagement with student-led oncology interest groups to highlight our specialty.

Cancer Week

Starting in 2021, radiation oncology was allocated dedicated didactic teaching time for the first time, in the form of an asynchronous, virtual lecture. At present, there are 50 minutes dedicated to medical oncology teaching, while only 25 minutes is dedicated to radiation oncology teaching. In the coming years, we will advocate to achieve parity in teaching time between these two specialties, as well as potentially convert the asynchronous lecture into a live or in-person lecture.

STARS21 Program

Program Overview

The Strategic Training in Transdisciplinary Radiation Science for the 21st Century (STARS21), formerly known as Excellence in Radiation Research for the 21st Century (EIRR21), has been designed to provide graduate students, postdoctoral fellows (post-PhD or post-MD), residents, and clinical fellows the skills essential to conduct innovative translational and transdisciplinary research in radiation medicine, as well as the leadership and collaboration proficiencies necessary to define them as the future leaders of Canada's scientific community. We value the integration of trainees in biology, genomics, chemistry, pharmacology, informatics, health policy, medical physics, radiation oncology, imaging, biostatistics, and clinical outcomes research in a learning community that resembles the multidisciplinary nature of today's team-based science. Radiation medicine represents a unique example of multidisciplinary science, where training in translational and transdisciplinary research is crucial.

From 2003 to 2015, CIHR funded 52 strategic training initiatives for health research (STIHRs) in order to build research capacity in Canada. Eight of these 52 STIHRs were cancer-specific and one focused on radiation research, Excellence in Radiation Research for the 21st Century (EIRR21). EIRR21 was established by Dr. Fei-Fei Liu in 2003 and was successfully renewed in 2009 for a total of $1.95M ($325,000/annum) with support from the Terry Fox Research Institute (TFRI). In 2012, the co-directorship was transferred to Drs. Anne Koch and Marianne Koritzinsky, and in 2019, Dr. Marianne Koritzinsky stepped down and co-directorship was transferred to Dr. Shane Harding. In 2015, following the termination of the STIHR Programs by CIHR, the program was awarded transitional funding from TFRI of $150,000/annum for 4 years. This award was contingent on receipt of matching funds, which the EIRR21 Program received from the Princess Margaret Research Institute (PMRI) and the Radiation Medicine Program (RMP), each providing $75,000/annum in supporting funds. As a result of this transitional phase and new strategic direction outlined by TFRI, the EIRR21 Program underwent a rebranding exercise and name change that was implemented in the 2016-2017 academic year. The program is now called the Strategic Training in Transdisciplinary Radiation Science for the 21st Century, "STARS21" for short. In June 2019, TFRI withdrew ongoing support for STARS21; however, the program was awarded $75,000 per annum for 2 years from PMRI and $50,000 per annum for 2 years from RMP. The 2019-2020 STARS21 trainees were funded with the new commitments from PMRI and RMP, remaining funds from TFRI (approved by a no-cost extension), and the UTDRO Gifford Fund. The 2020-2021 STARS21 trainee cohort was funded with commitments from PMRI and RMP, and the UTDRO Gifford Fund.

Program Objectives

The overarching goal of the STARS21 Program is to build research capacity in the realm of radiation medicine. We aim to address an unmet need for education in translational and transdisciplinary cancer research. The STARS21 Program recruits and trains innovative transdisciplinary researchers who will form the next generation of investigators in developing and implementing an integrated perspective that encompasses novel diagnostic, therapeutic, and evaluative approaches to radiation medicine. The transdisciplinary nature allows the inclusion of a broad range of trainees in recognition of the reality that radiation medicine is rarely applied in isolation. Over the past year, our objectives have been to: (i) implement an excellent yearly training program; (ii) expand our international brand by harnessing virtual

platforms and simultaneously enhance inclusion; and (iii) develop the program for long-term sustainability.

Program Governance

The STARS21 Program is co-directed by Dr. Anne Koch, Staff Radiation Oncologist and Clinician-Investigator at Princess Margaret Cancer Centre, and Dr. Shane Harding, Scientist at Princess Margaret Cancer Centre. The Program Co-Directors continue to be assisted by an external Scientific Advisory Board (SAB; Table 22), the Program Advisory Committee (PAC; Table 23), and a scholar liaison (Parasvi Patel, 2019-2021). The PAC conducts most of its business *via* email, but schedules 1-2 in-person/virtual meetings per year when major programmatic issues and strategic directions are discussed. Discussions have been limited to email over the past year due to the COVID-19 pandemic. The SAB advises the STARS21 Program on strategies for continued improvement and achieving the objectives of the program. In order to ensure continued excellence in the STARS21 Program, the program undergoes an annual external review by the SAB. This takes place concomitantly with the Annual STARS21 Research Day.

Table 22: STARS21 Scientific Advisory Board

Name	Appointment
Jim Woodgett (Chair)	Director of the SLRI, Toronto
Michael Joiner	Professor, Wayne State University, USA
Wendy Woodward	Professor, University of Texas MD Anderson Cancer Center, USA

Table 23: STARS21 Program Advisory Committee

Name	Appointment
Anne Koch (STARS21 Co-Director)	• Clinician-Investigator and Radiation Oncologist, Princess Margaret Cancer Centre • Assistant Professor, Department of Radiation Oncology, University of Toronto
Shane Harding (STARS21 Co-Director)	• Scientist, Princess Margaret Cancer Centre • Assistant Professor, Departments of Medical Biophysics, Radiation Oncology and Immunology, University of Toronto
Brad Wouters	• Senior Scientist, Princess Margaret Cancer Centre • Executive VP Science and Research, University Health Network
Fei-Fei Liu	• Chief of Radiation Medicine Program and Senior Scientist, Princess Margaret Cancer Centre • Professor and Chair, Department of Radiation Oncology, University Health Network
Jan Seuntjens	• Director of Medical Physics Unit, McGill University Health Centre • Professor, Department of Oncology, Medical Physics Unit, McGill University Health Centre
Andrea Bezjak	• Radiation Oncologist, Princess Margaret Cancer Centre • Director, Residency Program, Department of Radiation Oncology, University of Toronto • Professor, Departments of Radiation Oncology and Health Policy, Management and Evaluation, University of Toronto
Kevin Bennewith	• Scientist, BC Cancer Agency • Associate Professor, Department of Pathology and Laboratory Medicine, University of British Columbia

Mentors

As a result of the new competition model implemented in 2017, principal investigators (PIs) of accepted trainees are automatically added to the list of mentors for up to three years. This year, the program has welcomed 10 new mentors to the program, for a total of 44 active mentors (Appendix 6.1). While membership is automatically granted to PIs of successful candidates, quality of mentors is also assessed during the application process. They must be able to demonstrate scientific expertise, successful track record in both publications and research funding from peer-reviewed agencies, and training of graduate students or post-doctoral fellows (post-PhD or post-MD). Mentorship status is granted for a period of 3 years, whereby participation in various STARS21 activities is expected. This could include but is not limited to presenting in a Brainstorming session, reviewing competition applications, participating in the Annual Research Day as a poster competition judge or project judge, or reviewing travel award applications. A database has been developed to track this participation and will reviewed on an annual basis so that mentors can be advised of their status and encouraged to participate in upcoming activities.

Location and Partnerships

Location

Funded trainees conduct research at several sites within Toronto; all Toronto-based STARS21 mentors have cross-appointments to one of these research institutes, and the relevant graduate schools. Affiliated research locations include:

- Princess Margaret Cancer Centre, University Health Network (UHN)
- Odette Cancer Centre, Sunnybrook Health Sciences Research Institute
- Toronto Western Hospital
- SickKids Research Institute
- The cognate University of Toronto (U of T) graduate departments include:
    - Medical Biophysics
    - Molecular Genetics
    - Institute of Medical Sciences (IMS)
    - Pharmaceutical Sciences
    - Institute of Health Policy Management & Evaluation (IHPME)
- BC Cancer Agency Research, University of British Columbia
- McGill University Health Centre
- University of Alberta
- Queen’s University
- Royal Victoria Regional Health Centre
- Polytechnique Montreal University
- Beatrice Hunter Cancer Research Institute (Halifax, Nova Scotia)
- University of Manchester (UK)
- University of Texas MD Anderson Cancer Centre

Based on previous recommendations from the SAB, STARS21 has expanded further, with research and training being conducted at Polytechnique Montreal University, University of Texas MD Anderson Cancer Centre, and BC Cancer Agency Research at the University of British Columbia. In previous years, research and training has also been conducted at the University of Alberta and Queen’s University. While not monetarily supported, providing this program nationally and internationally improves our knowledge dissemination and diversity of trainees and mentors.

Partnerships

The expansion of STARS21 and its vision can only be successfully implemented by establishing financial and intellectual partnerships with relevant departments and research institutes. STARS21 has excellent support from the University of Toronto, including UTDRO, which in 2006 provided partnership funding in the form of the Lawrence, Ila & William Gifford Scholarship in Radiation Oncology. To date, this scholarship has provided full salary support for 34 scholars, who fulfill the scholarship criteria. STARS21 has been fully supported by the Terry Fox Research Institute, Princess Margaret Research Institute, and the Radiation Medicine Program at the Princess Margaret. This has allowed for the delivery and development of STARS21 until 2020.

In addition to funding partnerships, STARS21 has initiated discussions with numerous programs across Canada to build capacity in transdisciplinary research. In an effort to expand the scope our program nationally and internationally without additional cost, STARS21 has invited scholars from external institutions to participate. In the 2020-2021 academic year, we had participants from the University of British Columbia, McGill University, University of Manchester, Beatrice Hunter Cancer Research Institute, and University of Texas MD Anderson Cancer Centre. As well, since 2013, part of the STARS21 Program has been offered as a module within the U of T Institute of Medical Science graduate program. In 2019, the IMS module was converted into a 0.25 full credit equivalent (FCE) course entitled "MSC1110H Strategic Training in Transdisciplinary Radiation Science for 21st Century" (Appendix 6.2). In light of the COVID-19 pandemic, it was decided to defer the course offering for the 2020-2021 academic year. The course will be offered to IMS students for the 2021-2022 academic year, pending ongoing support for the broader STARS21 Program. The overall objective of the course is to develop an understanding of the transdisciplinary nature of radiation science, both in practical clinical application and in research. This foundational knowledge will be built upon by placing radiation science in the context of the greater scientific enterprise academically and within society. The course format includes 13-15 biweekly lectures from November 2020 to May 2021, and participation in Research Day, which typically occurs in June. Each lecture is 1.5 hours in length, for a total of 19.5-22.5 hours over the academic year. To earn the university credit, students will be required to participate and submit relevant coursework (e.g. Journal Club Presentation, Research Day Presentation). This course format provides operational benefits, such as efficient registration and tracking of students, and academic acknowledgement for faculty.

In 2016, STARS21 collaborated with the Curriculum Committee of the Department of Medical Biophysics (MBP) to develop a platform to offer STARS21 to MBP graduate students. It was decided to pilot the involvement of MBP by offering STARS21 for audit. To date, we have had two students audit the program from MBP. These students are not eligible to receive funding towards stipends or travel from the program, but receive university credit. A STARS21 mentor is not required.

Admission Requirements and Recruitment

Application Process and Eligibility

Historically, graduate students, postdoctoral fellows, residents, or clinical fellows supervised by a mentor in the program were eligible to participate following acceptance in a competitive process. In 2017, the program removed this restriction and opened the competition to any trainee conducting transdisciplinary cancer research related to the radiation sciences. However, in 2020, due to the impact of the COVID-19 pandemic on funding sources, the program limited the competition to any trainee conducting transdisciplinary cancer research with a radiation sciences focus *and* affiliated with the

sponsoring institutions. All applications are judged by a review panel and decisions are based on the trainees' academic excellence, aptitude for translational and transdisciplinary cancer research, leadership potential, as well as the scientific merit of their research project and its relevance to radiation medicine. These attributes are determined from the applicants' transcripts, curriculum vitae, research proposal, and letters of reference. Applicants who are clinical residents are judged by a separate panel of reviewers, which takes into account their different level of research experience. Accepted MSc/PhD/postdoctoral trainees receive an award towards their stipend and are eligible to apply for additional travel support to enhance their transdisciplinary and scientific skills. Clinical residents receive contribution towards travel only. For one academic year, the trainees follow a unique curriculum alongside their research activities.

Applicants to the STARS21 Program must:

- Be working towards an MSc, PhD, MD, Clinical Fellowship, Post-Doctoral Fellowship, or in a Residency Program.
- Be conducting transdisciplinary research related to radiation sciences.
- Be affiliated with the sponsoring institutions (RMP and PMRI).
- Supervisors of accepted trainees will be granted status as STARS21 mentors for 3 years. Mentors are expected to contribute to the STARS21 Program through invited presentations and review panels.

Funding Levels

From 2010-2012, scholars were eligible to apply to remain in the program with full funding for two years; leading to an average of 4 new scholars per year. From 2013-2019, scholar stipends were reduced to one year of full funding; this allowed for an increase in enrollment, which grew to an average of 16 new scholars in the program per year, including the U of T IMS students. For 2020-2021, scholar stipends were further reduced to 50% of full funding for one year in an effort to prolong financial stability during the COVID-19 pandemic. The STARS21 Program encourages application from various disciplines. Until 2019, both Canadian and international students were eligible to apply for the program. Unfortunately, due to the impact of the COVID-19 pandemic on funding sources, it was decided to limit eligibility to trainees affiliated with the sponsoring institutions (PMRI and RMP) only.

Curriculum and Program Delivery

Brainstorm Sessions

The STARS21 Brainstorm Sessions (Appendix 6.3) are at the core of the program curriculum and are held biweekly from September to June. These Brainstorm Sessions provide a forum for scholars to interact on a regular basis and exchange scientific ideas on an informal basis. Such sessions impart skills not offered through standard university courses, and can be led by non-academic experts, such as executive coaches or diversity officers; thereby, exposing STARS21 scholars to individuals from a broad spectrum of backgrounds. Each year, new speakers are invited to present on novel research practices, and comment on the relevance to current translational research, thereby providing insights into future directions. Speakers are experts in their field of study and represent various areas of research, industry, academia, and health professions. In addition to the standard curriculum topics (e.g. Cancer: The Big Picture, Entrepreneurship, Science Communication), scholars are invited to submit ideas for a "Hot Topic" in current translational research of their interest, and an expert on the topic is invited to deliver a seminar. Each year, three "Hot Topic" sessions are held. They are highly rated by scholars, with an average rating of >4.5 out of 5 in 2019-2020 and 2020-2021 (Appendix 6.4).

In 2019-2020, Brainstorm Sessions scheduled from March 18, 2020 and onwards were hosted virtually *via* Cisco Webex, a videoconferencing platform. In 2020-2021, all Brainstorm Sessions were hosted virtually *via* Zoom. The shift from in-person to virtual sessions was implemented for physical distancing purposes required during the COVID-19 pandemic. A total of 19 Brainstorm Sessions have been hosted virtually since 2019 (Appendix 6.3). Each speaker was contacted 2 weeks prior to their scheduled session to re-confirm availability for the virtual session. The shift to a virtual platform was successful, with overall ratings of >4.5 out of 5 for 2019-2020 and 2020-2021. Informal feedback collected throughout these years suggested that although in-person sessions are definitively more interactive, the virtual sessions have remained engaging and valuable. Interestingly, scholars rated speakers from virtual sessions higher than speakers from in-person sessions; overall 4.6 out of 5 for virtual sessions *vs*. 4.3 out of 5 for in-person sessions in 2019-2020. When asked for feedback on the shift to a virtual platform, scholars reported minimal issues connecting to the virtual platform, and there was good engagement and participation during the virtual sessions. We anticipate that at least 50% of our course content could be transformed into virtual content in the future. Overall, scholars rated the Brainstorm Sessions very well (on average 4.5 out of 5 for 2016-2020 sessions). Approximately 87% of scholars assessed that the sessions were pitched at the right level, and 96% would recommend the various sessions to future scholars. A full summary is provided in Appendix 6.4.

Every year, STARS21 endeavors to better integrate the didactic portion of the sessions with some element of interactivity to improve scholar engagement, and this has been an ongoing challenge to navigate. As of 2019, groups of 2-3 scholars were assigned to each Brainstorm Session and tasked with liaising with the assigned speakers to build an interactive component into the session to transition away from a lecture heavy session. Scholars utilized a variety of methods to generate discussion and expand on the interactivity between presenters and trainees. These included: questionnaires, discussion points, presenting some of the content alongside speakers, breakout sessions and group work. Informal feedback from scholars indicated a preference for this format as it allowed for more opportunities to interact with not only the presenter, but also their fellow scholars. Speakers were very open to the format and connecting with the lead scholars prior to the sessions. Moving forward, we will continue with this format.

Team Projects

There are two team projects that scholars complete throughout the year. The purpose of the first team assignment is to introduce scholars to one another and learn more about their individual research projects. Each scholar prepares a short 3-minute presentation introducing themselves and their research project. These presentations were performed in the three scholar-led sessions following the welcome session at the beginning of the year. It allows trainees to better understand the breadth of ongoing research, and assess how their own work might connect to that of their colleagues. The second team project is completed throughout the academic year, which is presented at the annual STARS21 Research Day. The overall objective of the team project is to arm STARS21 scholars with the unique experiences and distinct backgrounds, to collaborate, think, and create beyond their usual realm of scientific endeavors, and acquire critical communication skills to different audiences, including the media. This year, scholars were tasked with developing a 5-minute video on integrating individual research projects into a chosen theme in order to demonstrate effective thematic presentation skills. Group members are expected to describe how their individual research projects integrate with their chosen theme and how this forms a cohesive transdisciplinary radiation-focused program. The overall goal was to create a cohesive story around the work of individuals similar to what a department head may need to navigate.

Professional Development of Students

Since 2015, the STARS21 Program has included a "Career Development" session in the curriculum whereby program alumni, mentors, and affiliated scientists are invited to speak to scholars regarding their experience with the STARS21 Program and the paths they took to their current roles in their careers. The format of this session is very informal, and scholars are placed in groups and rotate between the invited discussants. This session has been highly regarded and valued by both scholars and discussants. The 2019-2020 career development event was cancelled in an effort to practice physical distancing measures during the COVID-19 pandemic. As well, it was decided to explore different methods of facilitating an effective interactive session in a virtual format. This year, Drs. Derek Tsang, Mary Gospodarowicz, Courtney Jones, Naomi Matsura, Wendy Woodward, and Anastasia Tikhonova were invited to speak at the career development event on May 4, 2021. Each speaker gave a short presentation on key aspects of career development and then broke out into smaller virtual groups. This has worked well in other meeting settings, allowing for a small, focused discussion among a limited number of individuals per group. Subsequently returning to a main room discussion has helped to coalesce ideas discussed in individual breakouts for the entire group.

Program Requirements and Learning Outcomes

Scholars must attend at least 75% of the program's Brainstorm Sessions. In addition, scholars must participate (in-person or virtually) in the annual group project research poster competition at the STARS21 Research Day. For the 2019-2020 and 2020-2021 academic years, the STARS21 Research Day was held virtually, and therefore the annual research poster competition was cancelled.

Infrastructure

The ability to deliver educational content nationally and internationally relies heavily on our ability to harness technology. This has become especially important during the COVID-19 pandemic, in a time when the program is delivered 100% virtually. In an effort to drive this strategic priority forward and to better engage our international scholars, we continued to use the video conferencing platform, Zoom, this past year to better incorporate them into the classroom. Zoom was selected for its open accessibility, user-friendly interface, and interactive features. Zoom has also become a platform for many users, including those external to UHN. Enabling this two-way connectivity supported greater interactivity between remote scholars and the classroom, as well as speakers. Survey Monkey has been utilized as a tool to collect speaker evaluations.

The STARS21 website continues to be hosted on the UTDRO website. This has allowed for greater ease from a back-end perspective and provides an opportunity to better develop an online platform for program scholars and alumni to interact.

Community Development

The STARS21 scholars are encouraged to network with the growing program alumni who are accessible and learn from their experiences. Developing a network of excellence in transdisciplinary radiation medicine research is an ongoing programmatic strategic priority. In an effort to better engage our alumni, we have continued to incorporate more alumni into the curriculum as speakers. For example, invited speakers this past year included Dr. Shane Harding (Scientist at Princess Margaret Cancer Centre), Dr. Srinivas Raman (Staff Radiation Oncologist and Clinician Scientist at Princess Margaret Cancer Centre), and Dr. Paul Boutros (Scientist at UCLA). Dr. Harding graduated from the program in 2010, Dr. Raman graduated in 2016, and Dr. Boutros graduated in 2007. To better engage our STARS21 mentors, we have continued to invite current and past mentors to participate in the curriculum. For example, invited

speakers this past year included Dr. Marianne Koritzinsky, Dr. Shane Harding, Dr. Kevin Bennewith, Dr. Derek Tsang, and Dr. Scott Bratman.

The STARS21 LinkedIn Page now boasts 103 members and continues to grow. We encourage current scholars to post updates of their academic activities and share interesting articles for others to read. As part of the application process, we incorporate LinkedIn details for greater ease of incorporating scholars to the group.

This past year, STARS21 has assumed a more active presence on Twitter. The STARS21 Twitter Page now boasts 161 followers and continues to grow. Several posts highlighting scholar biographies, interesting publications, career development articles, as well as scholar, alumni and mentor achievements are posted weekly. Not only does our Twitter page inform current scholars about research activities of their fellow colleagues and allow our alumni community to keep engaged with the STARS21 Program, but it also allows the broader national research community to learn about our program and the important research conducted by our scholars. As part of the application process, we now incorporate Twitter details for greater ease of incorporating scholars to our Twitter account.

Student Awards

In addition to the scholar stipends, scholars are eligible to apply for two travel award competitions that are held each academic year and on a rolling basis in 2020-2021 ($4,000/annum). Travel awards are intended for STARS21 scholars attending conferences, workshops, or visiting laboratories to expand scientific skill sets. Furthermore, residents (who do not receive a stipend) are offered a travel allowance of $2,000/annum to attend and present their research at conferences.

To factor in the impact of the COVID-19 pandemic, recipients of the travel award can utilize the award for fees associated with online conferences or workshops, as many events have been converted to an online format. Any trainee receiving travel support is expected to share knowledge and experiences gained with other trainees.

Funding and Support

To date, there are a total of 193 STARS21 trainees who have graduated from the program. Co-funded by the Princess Margaret Research Institute (PMRI) and Radiation Medicine Program (RMP), STARS21 provides stipend support to accepted trainees for 1 year. Eligible trainees must be affiliated with the sponsoring institutions (PMRI and RMP) and are offered 50% funding. Scholars in graduate school or a Post-Doctoral Fellowship are eligible to receive funding through STARS21. MSc students receive up to $12,500, PhD students receive up to $15,000, Clinical Fellows receive up to $15,000, PDFs receive up to $20,000, and residents receive up to $2000 for online or in-person conference-related purposes. First-year continuing program alumni receive a stipend top-up of $1,500. Resident alumni affiliated with the sponsoring institutions (PMRI and RMP) receive a stipend top-up of $1000 for online or in-person conference-related purposes. For the 2020-2021 academic year, residents and returning alumni, or alumni in the program for 2 years or more, not affiliated with the sponsoring institutions (PMRI and RMP) did not receive a stipend top-up.

Starting with the 2017-2018 competition year, in an effort to be more inclusive, the program opened the competition up to any trainee. Successful candidates submit an LOI and CV along with a brief description of their research project, followed by an invitation to submit a full application. Full

applications require transcripts from all previous programs, 3 letters of reference, and a 2-page description of their full research project. The PIs of successful candidates become STARS21 Program mentors and are required to contribute to the program in order to maintain their mentor status.

Due to the impact of the COVID-19 pandemic on financial support for research, funding for the STARS21 Program for future years remains undetermined. Currently, our primary goal is to establish a sustainable long-term funding model post-COVID. While local support through PMRI and RMP remains strong, national funding partners (e.g. TFRI, CIHR) that have funded the program in the past remain unclear in their commitment to supporting training programs. We will continue to engage our network with an eye to expanding this support where possible.

Assessment of Learning

Despite trainee testimonials on the importance of the STARS21 Program on their career development, a substantial challenge that these types of training programs have faced is the lack of a uniform and objective evaluation of impact and excellence. In fact, there is a dearth of evaluation tools for transdisciplinary training programs in the education literature, which we have begun to address in our previous publications: C P'ng et al. *IJROBP* 2012; M Koritzinsky et al. *CBE Life Sci Educ* 2016; P Patel et al. *IJROBP* 2021. To better evaluate the impact of the STARS21 Program, new evaluation tools have been developed and implemented. From 2015-2020, we piloted a tool to evaluate research competencies and assess the overall impact of the program on trainees. Pre- and post-questionnaires were sent to scholars to rate on a 5-point scale (1=not at all, to 5=extremely), both the level of proficiency they had with various research components that we value and address in the STARS21 curriculum, as well as rating the level of importance scholars assign to each of these competencies. The results of this questionnaire determined that participation in the STARS21 Program positively impacts learners' proficiencies in all areas. Prospective data have been collected over the past 5 years using this novel evaluation tool, and we plan to submit our analysis for publication shortly. Overall, 92% of trainees indicated that the breadth and depth of the curriculum was just right, and that it was current and relevant. Each year, 100% of trainees indicated that they would recommend the program to their peers. Both new and returning trainees demonstrated significant increases (p-value ≤ 0.05) in proficiency in all measured areas of transdisciplinary radiation medicine, interprofessional collaboration, transdisciplinary cancer research, translational cancer research, scientific communication, personalized medicine, and research commercialization. The largest increases (over 1-point) in proficiency were associated with transdisciplinary radiation medicine and research commercialization for both new and returning trainees. The ratings of importance assigned to each of these competencies were high both for the pre- and post-curriculum evaluations. Appendix 6.5 provides a summary of the pre- and post-proficiencies and the average importance ratings from 2015-2020.

Program Evaluation

During the 2018-2019 academic year, we conducted a program evaluation in order to evaluate the success of the program, as well as its impact on scholars. We surveyed both program alumni and mentors, as well as conducted semi-structured interviews with both program alumni and mentors who participated in the program from 2003-2018. In total, 46 alumni and 12 mentors completed the survey. Furthermore, 12 alumni and 7 mentors participated in the semi-structured interviews, respectively. Multiple alumni emphasized the uniqueness and value of the program during the interviews.

> "…first of all, it's quite a unique program for radiation medicine program trainees and meeting other trainees in a multitude of different disciplines that make up this program whether or not it's physics or biology or more clinical medicine. And I think just having the opportunity to

> understand perspectives from other disciplines and build those connections is very important. And also, all the soft skills training that they place into a curriculum. These are all skills that you need for a successful career in research. And so, I think they are definitely hitting on a lot of very important skill development."

Career development was also a major theme emphasized during the interviews with alumni. One alumnus mentioned:

> "…was probably the first opportunity I had to explore scientific communication and in a really hands-on way and again in a group setting too. So definitely, that had an impact on my career choice. It was helpful as far as being able to demonstrate proficiency in some of those areas or training in scientific communication. So that was probably the biggest impact for me, just exposing me to alternative career paths outside of academia, but connected sometimes to academia and building those skills."

Program mentors further emphasized trainee growth and skill development during the interviews, such as "…all of my trainees have I think learned to be more critical thinkers, to be more broad-minded about the research world."

The manuscript describing the 15-year impact of our training program was published in the *IJROBP* in January 2021 (doi.org/10.1016/j.ijrobp.2021.01.010). The results demonstrated that approximately 87% of alumni valued interdisciplinary collaboration, and 80% indicated that STARS21 had encouraged them to pursue such collaborations. Alumni emphasized that STARS21 assisted their career development, and the majority of alumni and mentors would recommend STARS21 to other trainees (4.48 and 4.58, respectively; 5=strongly agree). The time invested in the program was perceived by mentors as worthwhile for the knowledge and skills gained by trainees (4.67; 5=strongly agree), and 64% of mentors indicated that these benefits were associated with improved trainee research productivity. From the alumni and mentor perspectives, the valuable skills acquired from STARS21 included scientific communication (85% and 83%, respectively) and networking (83% and 92%, respectively). Overall, STARS21 is an innovative research training program that promotes interdisciplinary collaboration in radiation medicine research, which is valued by alumni and mentor respondents. Alumni can acquire important skill sets for career development, with a large proportion of the alumni currently engaged in radiation research around the world.

Quality and Availability of Graduate Student Supervision

The STARS21 Program relies on individual mentors to supervise scholars in the progression of their research projects. The Program Directors are available to scholars for guidance and support, but are not directly responsible for the scholar's supervision.

Quality Indicators

Graduates

In 2013, the STARS21 Program transitioned from a 2-year funding to a 1-year funding model, whereby all scholars graduated after one year of full stipend support in the program. Following their first year, scholars may decide to continue in the program as an alumnus and receive a modest top-up of $1,500 (previously $2,500); if they do not continue, scholars must graduate from the program.

From 2015-2020, the STARS21 Program on average has had 69% of scholars continue as alumni in the program for at least one additional year. Alumni participate in the STARS21 curriculum alongside new scholars.

Student In-Course Reports on Teaching

In addition to the overall programmatic evaluation tool, we also conduct teaching effectiveness evaluations. A summary of the Brainstorm Session speaker evaluations is provided in Appendix 6.4.

Quality of the Educational Experience and Teaching

Program trainees report a high degree of satisfaction and productivity and participate in impactful research. Alumni continue to contribute to research capacity in Canada. STARS21 sessions are rated highly on average of 4.5 on a 5-point scale from 2015-2020.

Academic Productivity by Trainees

Appendix 6.6 lists publications authored by STARS21 scholars while enrolled in the program between 2016-2020. Scholars published on average one paper per year, including several papers in high impact journals, such as *PNAS*, *Molecular Cell*, *Nature* and *Science*. In the past, STARS21 trainees have been awarded prestigious grants, such as the John Polanyi Prize from U of T, Vanier Canada Graduate Scholarship, and NSERC Post-Graduate Canadian Scholarship (Doctoral) Award. Several are now leading their own research programs supported by highly competitive peer-reviewed funding, including CCSRI Impact Grant, TFRI Program Grant, CIHR Operating Grant, and NSERC Discovery Grants.

Quality Enhancement and Optimization

In recent years, STARS21 has implemented various measures to address the programmatic issue of critical mass, while maintaining funding levels.

The first is the transition from a 2-year to 1-year funding model. This allowed for a greater pool of applicants to be considered and allowed for a larger number of high-quality scholars to participate and contribute to the program. The second is the inclusion of residents in the STARS21 Program (radiation oncology and medical physics residents) who do not receive stipend funding, but are provided a small travel grant ($2,000). They compete to enter the program in a competitive manner, in order to maintain a high level of scholarly standards.

The third is the launch of the STARS21 Program as a course within U of T's IMS (Institute of Medical Sciences) Department. In 2020, the IMS module was converted into a 0.25 full credit equivalent (FCE) course entitled "MSC1110H Strategic Training in Transdisciplinary Radiation Science for 21st Century" (Appendix 6.2). These students are not eligible to receive funding towards stipend or travel from the program, but receive university credit. A STARS21 mentor is not required. The course will be offered to IMS students for the 2020-2021 academic year, pending ongoing support for the broader STARS21 Program. The overall objective of the course is to develop an understanding of the transdisciplinary nature of radiation science both in practical clinical application and in research. This foundational knowledge will place radiation science in the context of the greater scientific enterprise, academically and within society.

Next, the program has capped funding of trainees to 50% of the previous level, which has allowed STARS21 to maintain enrollment numbers and prolong financial stability, while a long-term funding

model is being developed. Last is the inclusion of international trainees in an effort to expand the scope of STARS21. In 2020-2021, the STARS21 Program transitioned into an international model whereby scholars from external institutions were invited to partake in the curriculum at no additional cost to either side. This year, the program had participants from University of British Columbia, McGill University, University of Manchester, Beatrice Hunter Cancer Research Institute at Dalhousie University, and University of Texas MD Anderson Cancer Centre.

Due to the negative financial impact of the COVID-19 pandemic on the academic research enterprise, future funding for the STARS21 Program remains uncertain. Currently, the program's primary goal is to establish a sustainable long-term funding model post-COVID. While local support from PMRI and RMP remains strong, national funding partners (e.g. TFRI, CIHR), which have funded the program in the past, remain unclear in their commitment to supporting such training programs. The Program Co-directors will continue to engage their networks for new partnerships and funding opportunities to support STARS21.

Challenges and Opportunities

Sustainability and recruitment of excellent candidates have always been the key challenges facing STARS21. We will continue to update the curriculum to encompass state-of-the-art research directions, recruit outstanding trainees, deliver an excellent training program, and develop STARS21 mentor composition to increase research excellence, diversity, mentorship, and program scope. Financial sustainability remains a strategic priority to ensure the continued growth and success of our program.

Goals and objectives:

- Establish a long-term funding model for the STARS21 program post-COVID.
- Continue to engage alumni as part of a strong effort to gather metrics of programmatic success.
- Expand our national and international reach to create a training network.

Master of Health Science in Medical Radiation Sciences

Program Overview

A variety of program pressures were in existence at the time of the 2017 External Review that are articulated in the subsequent sections. With these in mind, a decision was made in 2018 to permanently close the Master of Health Science in Medical Radiation Sciences (MHScMRS) Program. Following the appropriate governance process and input, a formal decision to close the MHScMRS Program was ratified by the University of Toronto in 2018. The sections below summarize the program activities up until its closure.

The MHScMRS Program was a professional master's program designed for practicing radiation therapists, providing a graduate level education experience. The blended delivery model combined technological and pedagogical strategies to engage small cohorts of students and expert clinical faculty in an immersive curriculum.

The program, which created an inclusive, interactive, and practical environment for radiation therapists to develop the advanced knowledge, skills, and judgement necessary to serve as leaders in the radiation medicine community, was launched in 2009; it was subsequently re-designed in 2013 in an attempt to broaden its reach. In 2015, a further curriculum redesign followed an environmental scan and stakeholder consultation. Despite these efforts, with four cohorts and 12 graduates in total, the decision was made to close the MHScMRS Program due to a lack of community interest, and challenges with financial sustainability.

Program Objectives

The MHScMRS Program was offered through the Institute of Medical Science (IMS) and UTDRO, and constitutes the first professional master's program for radiation therapists in North America. The program offered three specialization pathways – clinical, leadership, and research – approached through the lens of the role of radiation therapy in cancer care, while ensuring all graduates have a core foundation in all three pillars. The program was designed specifically to develop professional leaders who can meet the demands in contemporary radiation medicine practice. Using a blended delivery model, the program capitalized on online learning technologies and strategies to allow students to complete most of their studies from home, while continuing to work full-time as radiation therapists.

Program Governance

The MHScMRS Program was led by Nicole Harnett (Program Director) and Caitlin Gillan (Associate Director), who reported to the Vice Chair of Education, Dr. Rebecca Wong. The governance structure is shown in Figure 16.

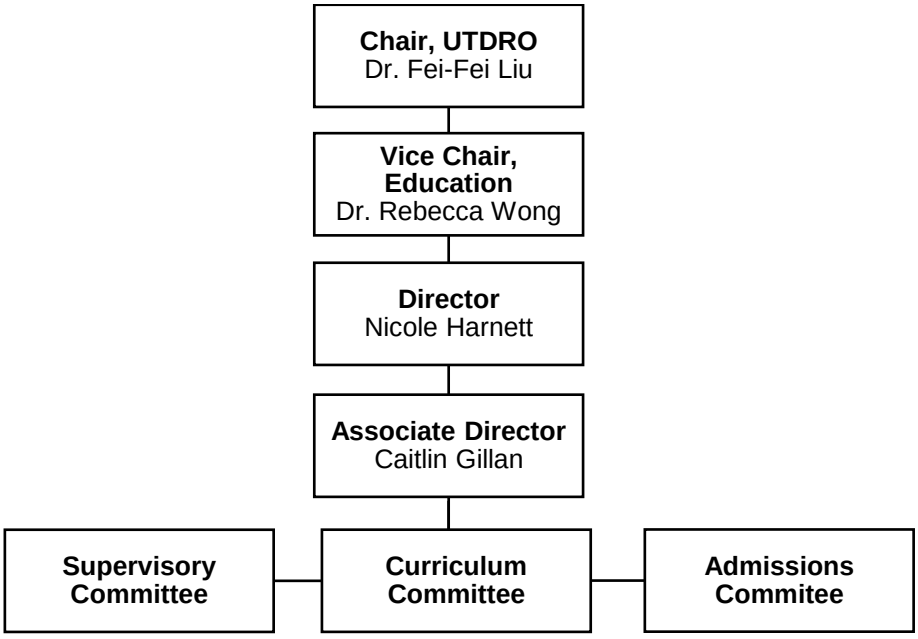

Figure 16: MHScMRS Organizational Structure

Admission Requirements and Recruitment

The MHScMRS Program's admissions criteria (eligibility) were as follows:

- Either hold relevant certification in radiation therapy in one's home jurisdiction of practice or provide evidence for eligibility *and*
- Have completed a recognized bachelor's degree in Medical Radiation Sciences or in an equivalent field.
- Have obtained a minimum average grade of B+ over the final two years of full-time undergraduate studies.
- Have performed a minimum of one year (900 hours) of professional practice within two years prior to application.

A further criterion for admission (if the applicant was from outside the U of T catchment area) was approval that the applicant's home clinical department has the necessary expertise, resources, and culture to support the applicant in engaging in advanced roles and research during the practicum element.

Student Enrolment and Selection

The ideal cohort size for the program was small at 4-5 students. When the program moved from a campus-based model to a blended learning format in 2013, the potential applicant pool expanded to include international students. Table 24 lists student enrollment between 2009-2018.

Applicants who had been out of post-secondary education for more than 5 years had their contributions to professional practice (elements of their curriculum vitae) assigned more weight than their undergraduate grades, as this was proven more reflective of the expectations of the program.

Table 24: MHScMRS Student Enrollment

Intake Year	# of Students Admitted	# of Graduates (Year)
2009	3	2 (2011)
2011	4	4 (2013)
2013	3	3 (2015)
2016	3	2 (2018), 1 (2019)
2018	*Program Permanently Closed	

Curriculum and Program Delivery

The program consisted of 8.0 full course equivalents (FCE) completed over a 2-year period. All three pathway options (Clinical, Research, and Leadership) had the same breakdown of core courses, electives, and immersive practica, as follows:

- Required coursework (4.5 FCEs), completed through a mix of online and face-to-face interactions
- Elective coursework (1.0 FCE), consisting of field-related courses
- A major research paper (0.5 FCE)
- Experience-based immersive practica (2.0 FCEs)

Online Delivery

This was the primary method of content delivery; faculty-student interactions were maximized using the "inverted classroom model", where most contents were managed asynchronously to allow live sessions to focus on interactive exploration and deeper learning.

Institutes

For one week in each of the first three semesters, students met in Toronto for a combination of live sessions, labs, and group work to foster engagement and build practical skills.

Practica

Immersive practicum experiences over the final eight months of the program further ensured that the student develops the relevant skills fundamental to a professional graduate degree. Depending on the pathway, practica could be structured in a number of ways, as long as the required time commitment, level of engagement, and objectives could be achieved:

- *Clinical*: based in a specialized disease site or technique, integrating advanced radiation therapy practice into specific patient populations or niche areas
- *Research*: based in a laboratory or clinical environment, usually engaged in discrete elements of a larger scale research project team
- *Leadership*: based in a clinical, government, or advocacy group, engaged in advancing relevant projects, policy development, or other areas of leadership

Funding and Support

As a professional program, many students maintained full-time employment throughout their studies. Thus, many traditional sources of funding (e.g. bursaries, government funding) were not available to

MHScMRS students. Depending on the jurisdiction and employment status, students could access funding through employers, government funds, and professional associations. Sources of funding available included:

- *CAMRT Foundation Grants*: Grants of varying amounts (depending on demand) through the national professional association.
- *Matthews Scholarship*: Scholarship of up to $10,000 per year at the Princess Margaret Cancer Centre.
- *OAMRS Beth Wastle Bursary*: Grants of varying amounts (depending on demand) through the provincial professional association.
- *Ontario Allied Health Professional Development Fund*: Provincial fund for allied health professionals, awarding up to $1,500 per year.

Assessment of Learning

For most courses, assessment was based on written work, major oral presentations, and other project work. Most assignments were structured according to traditional forms of communication in the academic world – business cases, grant applications, and journal manuscripts. Each course also had a formal participation grade requirement (maximum ~20% of the course grade), often assessed through participation in synchronous sessions, as well as through Blackboard functions. Multiple choice and short answer exams were a small part of several courses.

The practica were structured based on an individualized learning plan, developed by the student in collaboration with the Course Director and the Faculty Supervisory Committee. Assessment was based primarily on the submission of a portfolio of evidence compiled, and assessments from local supervisors.

For graduate student supervision, the Faculty Advisory Committee oversaw and guided the learners as they worked to achieve their learning goals in learners' electives, research, and clinical practica.

Quality Indicators

Comparable Programs

Few other graduate programs exist focusing specifically on radiation therapy, and those that do tend to be research-based MSc programs. Sheffield Hallam University (England) and Charles Sturt University (Australia) have well-established programs that are offered fully through distance education online models, weighted towards a final research project.

A survey and series of interviews conducted in the summer of 2015 determined that the MHScMRS Program was perceived to be academically rigorous. However, radiation therapists who wished to pursue more research-based or leadership roles would select other programs such as MBAs, MAs in Healthcare Leadership, or MEds in education; thereby further reducing candidates for the MHScMRS Program.

Program Attrition and Time to Completion

All 12 graduates registered and completed the 2-year full-time program within stated timeframe. The one student lost to attrition was a member of the first cohort, and departed after the first semester, due to difficulty in maintaining a desired work-life balance. With such an intentionally small student population, students benefited from strong support from program leadership. Individualized learning

plans were implemented when necessary, primarily to assist in the completion of the Major Research Project (MSC1509) and practica (MSC1510/11) courses.

Presentations While in the Program

Students in the program presented at multiple local, national, and international conferences, such as the RTi3 Radiation Therapy Conference, Canadian Association of Radiation Oncology Annual Scientific Meeting, and American Society for Therapeutic Radiation Oncology Annual Meetings. Some students published in peer-reviewed journals while in the program (primarily in the *Journal of Medical Imaging and Radiation Science*).

Publication and Grants Post-Graduation

Several of the graduates have published since graduation, including publications as first authors (including book chapters) and as collaborators. Grant opportunities for radiation therapists are few, but are slowly emerging – primarily through local institutions and professional associations. Several MHScMRS graduates have secured funding as either principal investigators or collaborators since 2012.

Post-Graduation Employment

A few graduates assumed novel advanced practice roles since graduation. Others have been appointed as faculty (at the level of Lecturer) in UTDRO; an impressive achievement for allied health professionals. Several graduates have been formally engaged as Stream Coordinators (graduate level) or Course Directors (undergraduate level) in academic courses within the UTDRO MRS Program.

Teaching and Program Evaluation

Regular quantitative evaluation (e.g. teaching effectiveness scores, course evaluations) was difficult given the small size of the MHScMRS Program; thus, the program was reliant on surveys, informal feedback, and polling of graduates. Anonymity was a challenge given the small class size; hence only aggregate data were reported.

Quality Enhancement and Optimization

Many attempts were made to improve participation since its inception in 2009; first in 2013, and then in 2016. Unfortunately, modifications in response to these assessments were unable to recruit or attract applicants, thereby leading to its closure in 2018.

Challenges and Opportunities

In 2009, UTDRO believed that the call for radiation therapy leaders will become more prevalent and geared this program to develop such practitioners. At that time, UTDRO designed its MHScMRS curriculum to facilitate such leadership, both nationally and internationally.

There were, however, significant challenges (e.g. low enrollment, competing resource demands) to execute such a small, specialized program, which ultimately led to its closure in 2018. Tremendous support from staff and faculty was necessary at all levels, including where the individual learner practices and learns. While the potential opportunity for this program to have an impact on professional practice at an international level was there, this was a resource-intensive program that was unable to be maintained financially. It was a difficult decision to close this program, but terminating unsustainable programs is just as important as establishing new programs.

Continuing Education and Professional Development Programs

Program Overview

The University of Toronto's Department of Radiation Oncology Continuing Education and Professional Development (CEPD) portfolio promotes the dissemination of new knowledge and fosters the adoption of best practices generated by UTDRO's academic programs. The focus of this portfolio is to stimulate the development of collaborative academic networks. Challenges for Continuing Education (CE) within an interprofessional department of radiation oncologists, physicists, therapists, and nurses, practicing at two geographically distinct clinical sites have been turned into opportunities to develop innovative, interprofessional learning initiatives, and to embark on a program of computer-based learning, which incorporates webcasting and videoconferencing opportunities. The following programs and events comprise the CEPD portfolio:

1. Target Insight Conference
2. RTi3 Conference
3. Accelerated Education Program
4. Clinical and Experimental Radiobiology Course
5. UTDRO Evening Journal Club
6. Other CEPD Activities
    - Conferences and Courses
    - Leadership roles/positions
    - Research and scholarship

Program Objectives

In accordance with the Temerty Faculty of Medicine's key strategic priorities for Continuing Professional Development, the objectives for the UTDRO CEPD Program include:

- *Leadership*: Promote lifelong learning across the continuum of health professional education.
- *Innovation*: Anticipate, foster, and support innovations that impact health outcomes.
- *Scholarship*: Foster the development of a collaborative network of research and scholarship in CEPD.
- *Community*: Integrate quality improvement and CEPD for better health outcomes.
- *Health Promotion*: Promote Indigenous, refugee, and vulnerable populations' health education and cultural competency across the continuum from Undergraduate Medical Education (UME) to CEPD.

Program Governance

UTDRO's CEPD portfolio includes faculty and professional development, as well as continuing education activities. To enable mastery in teaching, the roles of Director in CEPD and Faculty Development were created. Drs. Barbara-Ann Millar and Ewa Szumacher were appointed as the inaugural Co-Directors in 2016.

The CEPD Committee is responsible for designing, implementing, and evaluating best practices, innovative continuing education, and professional development activities for oncology healthcare professionals within the department, University, and community settings, and advises the Chair through

the Vice Chair of Education, on CEPD issues as they relate to UTDRO. The Committee is composed of members of UTDRO with a particular interest in the theory, scholarship, and best practice of continuing professional development to enhance the knowledge, skills and performance of oncology health professionals and improving patient care. Several educators within the department hold postgraduate degrees in medical education and have particular academic interests in professional development, interprofessional education, and practice-based learning. All of these elements are key in the clinical practice and academic environment within the department. This Committee meets bi-annually and reports to the Vice Chair of Education, UTDRO.

Challenges and Opportunities

In the 2017 UTDRO External Review, the reviewers were highly complimentary of UTDRO's various longstanding CEPD events and programs. It was recommended to coalesce and better align the outward facing CEPD activities clearly under the UTDRO brand, which may assist in marketing the program/events. Exploring mechanisms for cost recovery and potential revenue generation was also suggested. In the past several years, UTDRO has made strides in addressing these recommendations and are detailed in the subsequent sections.

Overall, the main challenges facing the CEPD portfolio can be attributed to the COVID-19 pandemic. Due to the evolving COVID-19 circumstances, all of our usual CEPD programs and events were suspended, with some events aborted in the final stages of planning (e.g. 2020 Target Insight and 2020 RTi3). Other challenges include continued lack of dedicated funding to support CEPD activities, as well as the scheduling of interprofessional events and programs.

Opportunities for future growth within the CEPD portfolio include:

- Continuing to strengthen our collaboration with the U of T CPD office and increase faculty and trainee participation in the programs/events they offer.
- Improving faculty engagement.
- Developing CPD collaborative programs with other cancer centres in Ontario.
- Exploring community and patient engagement in CPD offerings.
- Creating new leaders in CPD through the U of T CPD Leadership and Mentorship Program.
- Virtual delivery in 2020 and 2021 has opened the programs to people who would not have otherwise been able to attend, across Canada and internationally. Online and hybrid delivery models may be explored for future events.
- Raising funds (e.g. sponsorship, grants) to create more CEPD programs relevant to UTDRO (e.g. skill-based programs, such as leadership courses, SBRT planning and brachytherapy courses).

Target Insight Conference

Overview

UTDRO has hosted nine installments of the one-day Target Insight (TI) Conference since 2001. This meeting has attracted local and international influential practitioners, health policy experts and decision makers in the field of radiation medicine, including interdisciplinary healthcare providers, such as therapists, nurses, physicists, students, and administrators.

Target Insight has been a mechanism to present state-of-the-art information to the radiation oncology community. In the recent past, the content of TI has included best practices of advanced technologies,

such as IMRT, VMAT, IGRT, and brachytherapy. On average, the TI Conference brought in 120 attendees prior to 2017; since then, it has only been run once in 2017 with 142 attendees (Table 25).

Table 25: Target Insight Attendance

Year	Theme	Attendees
2012	Lung Cancer, Prostate Cancer, Liver & Spine, Gynecologic Cancer, Biologic Insights and Thoughts from the Trenches	157
2013	Rethinking Radiation Therapy in Metastatic Disease (2 days)	140
2014	4PRT – Photons, Protons, Particles and Progress in Radiation Therapy	107
2015	Applying Information and Technology to Cancer Care	91
2017	Personalized Radiation Medicine: From Theory to Practice	142
2018	--	-- *
2019	--	-- *
2020	Big Data: A Paradigm for Change	-- *
2021	--	-- *

**TI 2018 and 2019 were cancelled due to low registration numbers, and 2020 and 2021 were cancelled due to the COVID-19 pandemic. Data prior to 2017 has been included for comparison purposes since there was only one event for the period of 2017-2021.*

Objectives

This conference provides an interactive environment, providing participants opportunities for discussion and to have questions addressed.

- *Knowledge Dissemination*: To expose the radiation oncology community, especially the Canadian community, to exemplary international research in personalized radiation medicine in order to disseminate knowledge that will inform clinical care, professional practice, and treatment policies.
- *Foster Discussions*: To facilitate discussion on the barriers and enablers to implementing personalized medicine into routine clinical practice.
- *Best Practices Presentation*: To present the current best practices for implementing this new knowledge to clinical, research, and education areas.

Governance

Co-Chairs: Drs. Alejandro Berlin and Ewa Szumacher (Target Insight 2017)

Challenges

- Funding at host institutions and partner hospitals during this time of fiscal constraint remains an issue.
- Declining attendance.
- Marketing the conference.

Opportunities

- There may be opportunities to partner with ASTRO, ESTRO, CARO, ASCO, and American Association of Cancer Education (AACE).

- Among various groups of participants, there remains an ambition to advance clinical care and deliver high quality content.

RTi3 Conference

Overview

The RTi3 Conference is Canada's premier annual two-day meeting for the Radiation Therapy community. RTi3 is committed to advancing the science and practice of Radiation Therapy, showcasing the latest research and clinical innovations that focus on themes of "Inquire, Inspire and Innovate." The conference's objectives include:

- Disseminating the latest evidence in radiation therapy to inform and stimulate clinical practice.
- Providing learning opportunities for practitioners to update their clinical knowledge.
- Facilitating networking and communication and the development of professional communities of practice.

Objectives

- To gain new knowledge and understanding on the innovative application of radiotherapy technology, factors influencing clinical outcomes, quality improvement in radiotherapy, and patient and supportive care.
- To inform practice knowledge and clinical skills through lectures and workshops on current and new practice models and strategies.
- To discuss challenges and opportunities related to advanced practice initiatives, career specialization and development, and education, and research endeavours.

Governance

Co-Chairs are selected for a two-year term from UTDRO-appointed radiation therapist members on the RTi3 Planning Committee. Historically, one Co-Chair has been appointed from the Princess Margaret Cancer Centre and one from the Odette Cancer Centre. The Co-Chairs are responsible for spearheading the direction of the conference and all final decisions; Co-Chairs for 2021 were Darby Erler and Grace Lee.

Once a month, the Co-Chairs meet with the Planning Committee to update on progress and seek feedback on key decisions. On a weekly basis, the UTDRO Event Coordinator and Manager meet with the Co-Chairs to update on planning and executing on decisions.

Highlights

- Conference attendance has been steadily expanding since 2017, with 46% more attendees in 2021 compared to 2019 (Table 26). This is largely due to the flexibility offered by the digital delivery platform in 2021, which allowed professionals across Canada and worldwide to attend virtually.
- RTi3 has contributed significantly to the development of professional communities of practice and to the academic culture of radiation therapy locally, provincially, and nationally. The growth of this academic culture is supported by:
    - Publication of all abstracts in the *Journal of Medical Imaging and Radiation Sciences*.
    - Continued collaboration with the national professional body Canadian Association of Medical Radiation Technologists (CAMRT).
    - Conference accreditation through the Medical Dosimetrist Certification Board (MDCB) has allowed professionals to acquire credits towards their license.

- Established provincial following throughout Ontario, which is growing nationally and internationally with attendees from the United Kingdom, United States, and Australia.

- The free Pre-Conference Webinar, which replaced poorly attended in-person pre and post conference sessions, continues to be an excellent promotional tool for the conference with more than 100 attendees in 2021, which is a 13% increase from 2019.

Table 26: RTi3 Attendance

Year	# of Submitted Abstracts	Attendees
2017	69	147
2018	50	150
2019	69	153
2020	48	-- *
2021	52	224

**RTi3 2020 was cancelled due to the COVID-19 pandemic.*

Challenges

The cancellation of the Allied Health Professional Development Fund on March 2, 2020 by the Ontario Ministry of Health and lack of consistent departmental CE funding support at clinical sites across Canada continues to be a barrier to attract attendees, particularly for in-person events requiring travel. As this is unlikely to change in the immediate future, there remains a need to broaden reach and attract attendees from beyond the Greater Toronto Area. Due to restrictions to travel and public gatherings related to the COVID-19 pandemic, the RTi3 conference was cancelled in 2020. Since these restrictions continued in 2021, the decision was made to proceed with an entirely virtual conference for the first time. Though the virtual platform eliminated the barrier of travel, challenges remain with accommodating delegates in different time zones and replicating the synergy of an in-person audience and providing opportunities for discussion and networking.

Opportunities

The virtual platform was very well received at the 2021 conference. However, significant opportunity remains to engage attendees from provinces outside of Ontario. Even with the virtual format, >84% of attendees were from Ontario in 2021 (delegates attended from Saskatchewan, Quebec, PEI, Nova Scotia, New Brunswick, and Alberta). The Canadian Association of Medical Radiation Technologists (CAMRT) continues to partner with RTi3 and support the National Innovation Snapshot (NIS), a rapid-fire session providing radiation therapists from across Canada an opportunity to showcase their local, practice-based innovations to the wider community. There is potential to leverage the CAMRT partnership for greater promotion of RTi3 to their national membership, Also, collaboration with the Ontario Association of Medical Radiation Sciences (OAMRS) should be explored. RTi3 has been moderately successful in attracting international delegates (2021 had attendees from Belgium, Ireland, Norway, United Kingdom and United States); however there remains an opportunity to increase international attendance, especially from the United States. Many of the RTi3 Committee members participate in international collaborations and it may be possible to leverage these to develop contacts and promotional opportunities around the world.

Accelerated Education Program

Overview

The Accelerated Education Program (AEP) is an educational platform within the Radiation Medicine Program (RMP) at the PM Cancer Centre, endorsed and supported by UTDRO and its faculty. Its mandate is to deliver timely and accessible educational content to improve the quality of radiation therapy locally and across the globe.

Objectives

The AEP aims to be the premiere source for all radiation medicine professional development and continuing education needs.

Governance

AEP is led by the Program Director, Nicole Harnett. The program is guided by the AEP Steering Committee that meets monthly to discuss current activities and initiatives, as well as identify future opportunities (Table 27).

Table 27: AEP Steering Committee Membership

Title	Member
Director, AEP (Chair)	Nicole Harnett
RMP Chief and UTDRO Chair	Fei-Fei Liu
Director, Education, RMP	Rebecca Wong
Director, Operations, RMP	Colleen Dickie
Head, Radiation Therapy Department, RMP	Elen Moyo
Representative, Medical Physics Department, RMP	Jean-Pierre Bissonnette

Highlights

Immersive CE

High quality, immersive continuing education in radiation medicine continues to be an important part of advancing radiation therapy techniques.

New Courses

In response to the needs of our target community, AEP continues to develop and deliver new courses that meet learning needs related to precision radiation therapy. New topics since 2016 include several on-site courses focusing on:

- Stereotactic Body Radiotherapy (SBRT)
- Multidisciplinary approach to treating soft tissue sarcoma
- Integration of magnetic resonance into radiation therapy practice
- Image matching for radiation therapists

International Opportunities

In addition to the on-site courses, AEP also implemented its “on the road” activities, whereby teams travelled to deliver courses at other sites. In 2019, teams travelled to Beijing, China, and St. John’s, Newfoundland and Labrador to provide 2-day, interactive courses.

High Level Impact:
In 2018, AEP completed a program evaluation (doi.org/10.1016/j.ijrobp.2020.09.051) to ascertain the impact of its courses on participants. Interviews were conducted with participants (external to RMP/UTDRO), who attended an AEP course between 2010 and 2018. Participants reported that attendance at an AEP course could result in high level impact at their local centre, including the implementation of changes in practice as a result of attendance, and the potential for improvement in results/outcomes.

Increasing Attendance
Since 2016, a total of 17 on-site and "on the road" education courses have been held, bringing the overall total to 71 courses since the program's inception. These 17 courses have been attended by 504 radiation medicine professionals; amongst these, 402 were external attendees from numerous countries and continents (Table 28).

Table 28: AEP Course Attendance

Timeframe	Course	External Attendees	Internal Attendees	Total Attendees
Dec 2016*	RT for Oligometastases	13	23	36
Apr 2017	Liver SBRT	24	7	31
Apr 2017	Accelerator Technology	8	10	18
Oct 2017	Treatment of Sarcoma	4	10	14
Feb 2018	Accelerator Technology	4	3	7
Apr 2018	Liver SBRT	15	5	20
Nov 2018	Expanding use of SBRT	12	16	28
Jan 2019	Image Matching for RTTs	13	0	13
Jun 2019	Lung SBRT (Beijing)	30	0	30
Jun 2019	MR in Radiation Therapy	64	0	64
Sep 2019	Lung and Liver SBRT (St. John's)	28	0	28
Oct 2019	Liver SBRT	24	5	29
Nov 2019	Accelerator Technology	9	9	18
Jan 2020	Image Matching for RTTs	12	0	12
Jan 2021	fSRS for Intracranial Lesions	9	7	16
Feb 2021	Advancing RT in Atlantic Canada	126	0	126
Mar 2021	Accelerator Technology	7	7	14
	Total	402	102	504

**2016 data included to reflect the start of new program changes.*

High Satisfaction Rates
Ongoing and consistent evaluation methods show that participants continue to be extremely satisfied with their experiences in these courses. A program evaluation in 2018 demonstrated that participants were most satisfied with the level of interactivity, learning from and with an interprofessional group, and learning from the experiences of renowned experts from the Princess Margaret and external guest faculty. Teaching effectiveness scores of faculty remain very high (average of 4.6/5).

National Reputation as Expert Consultants in Advanced RT Techniques

With the rapid development and deployment of ever increasingly complex equipment and technologies to deliver advanced radiation therapy techniques, individual centres, municipal, provincial, and sometimes national jurisdictions, seek partnerships to build internal competence and capacity with these techniques. RMP and UTDRO are seen as global leaders in the development and implementation of best practices related to advanced radiation therapy techniques. This is true for the study and evaluation of techniques, but also for their approach to changes and to creating models of care that facilitate the delivery of the highest quality of care. As such, AEP (as the CE arm of RMP) is often sought out to provide expert consultation and support for jurisdictions as they develop their own internal capabilities related to advanced RT techniques. Two such examples include:

- Advancing Radiation Oncology Practice in Atlantic Canada (AROPAC) is a multi-year collaborative project funded by a donation from the Harrison McCain Foundation, whereby the regional cancer centres of the Atlantic region and PM facilitate the adoption of contemporary practices for the Atlantic province patients. Through a series of education and directed activities, the centres are continuing to build capabilities for SBRT/hypofractionated treatment approaches.
- Ongoing relationship with the Hong Kong Health Authority. Our relationship with the Hong Kong Health Authority, a multi-year government-funded initiative, focuses on the upskilling of radiation therapists related to advanced RT technologies, achieved through a combination of educational programming and multi-week on-site attachments.

Online Video Library with Numerous Resources

AEP has a strong online presence through its YouTube Channel that provides free access to videos on a broad range of topics related to radiation medicine practice. Since launching in 2013, 79 videos have been posted, and viewership continues to rise along with subscribers and minutes viewed (Figure 17).

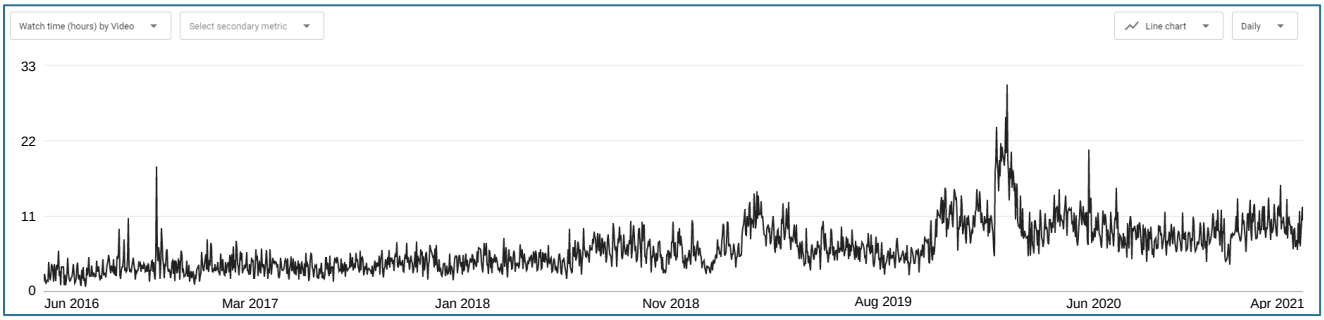

Figure 17: Total Views on AEP YouTube Channel Since 2016 (Watch Time – Hours by Video)

Challenges

In 2020, the COVID-19 pandemic forced AEP to re-evaluate its continued contribution to the CE landscape for radiation medicine. Following analysis and planning, AEP delivered its first two "virtual" courses. Each course successfully delivered a high quality, longitudinal course that blended both live and asynchronous elements to national and international audiences. The two courses were:

- January 2021: Fractionated Stereotactic Radiosurgery for the Treatment of Intracranial Lesions
- March 2021: Accelerator Technology Education Course

Plans are also currently underway for a virtual, hybrid-model course to learners in Shanghai, China.

Opportunities

AEP will focus its efforts on innovative course content using the successful "AEP course model", delivered using a virtual platform, and tools to deliver interactive learning and learner engagement. Courses planned for 2021-2022 are listed below.

2021 Courses

- January 11 and 25, 2021: Intracranial Fractionated Stereotactic Radiosurgery (CIHR sponsored)
- February 18-19, 2021; May 15 and Jun 17, 2021: AROPAC Atlantic Canada (McCain Foundation sponsored)
- March-April 2021: Accelerator Technology Course (ATec)

2022 Courses in Development

- Liver SBRT: March 3-5, 2022
- ATec: Spring 2022 (date TBD)
- Adaptive Radiotherapy (date TBD)

AEP will also design and deliver a platform that will facilitate a teaching material repository that will enable teaching and learning. Furthermore, the program will explore additional opportunities to serve as expert consultants in advanced RT techniques.

Clinical and Experimental Radiobiology Course

Overview

Since 2009, UTDRO has been offering a week-long intensive course entitled "Clinical and Experimental Radiobiology (CERB)". During this immersive course, trainees and early career professionals in radiation oncology, physics and biology learn the language and science of radiobiology, as well as its application in the clinic. The course, which has national stature, is taken by numerous radiation oncology residents across the country. CERB is also offered as a 0.5 FCE course through the Department of Medical Biophysics (MBP) at U of T.

With multidisciplinary faculty and students in the course, the rich discussions that take place in the classroom help connect concepts and theories that stem from basic biology to imaging and physics. The course content covers areas of radiobiology that are relevant to radiation oncology. This includes topics such as molecular and cellular responses to radiation-induced damage that influence cell death in both tumours and normal tissues, quantitation of radiation effects, fractionation of radiotherapy, retreatment issues, hypoxia, and combined modality treatment.

Objectives

The learning objectives of the course are such that after active engagement in this five-day program, participants will be better able to:

- Apply novel forms of therapy, including combination therapy with chemotherapy and targeted agents to improve patient outcomes.
- Improve the safety of radiation therapy and reduce side effects through an understanding of its biological principles.
- Describe the key aspects of radiation biology that are of particular relevance to the practice of radiation oncology.

- Predict the molecular and cellular responses to radiation-induced damage that influence cell death in both tumours and normal tissues.
- Quantify the radiation effects and the underlying biological basis for fractionation of radiotherapy and dose-response relationships in the clinic.
- Evaluate the biological basis for side effects that limit safe doses of treatment and retreatment.

Course instructors have their own specific objectives for their sessions (Appendix 7.1). Teaching faculty includes internationally recognized visiting Professors Drs. Mike Joiner and Albert van der Kogel, who are also key contributors to the leading textbook in the field (Basic Clinical Radiobiology, Ed: Joiner and van der Kogel). For the full faculty listing, see Appendix 7.2.

Governance

The CERB Course is led by Director, Dr. Marianne Koritzinsky, who is supported by the Scientific Planning Committee. The Scientific Planning Committee is consulted on program changes for the following year, which are based on Instructor and Program Evaluations. The Committee is comprised of seven UTDRO faculty and trainees who represent the target audience: researchers in radiation biology, radiation oncologists, medical physicists, radiation oncologists, physics residents, oncology residents, medical biophysics residents, and radiation oncology fellows. The UTDRO trainees are selected from the student pool of that year, so they can provide feedback to the program.

Curriculum and Program Delivery

For the last two years, the course has been delivered synchronously online by different faculty (Appendix 7.3); prior to this, the course was delivered in person. The course allows a two-week study period followed by a 3-hour examination. Residents seeking course credit are required to take the exam, while the exam is optional for all other registrants. In 2020 and 2021, an Optional Pre-Exam Question period was added a few days prior to the examination to answer any final questions from students.

Highlights

- Synchronous online course delivery in 2020 and 2021 attracted students from other Canadian universities in Alberta and British Columbia, as well as abroad in Jordan, Australia, Croatia, Germany, and China.
- Attendance has been steadily growing, reaching 105 students in 2021, which is a 110% increase from 2017 (Table 29).
- The course continues to be taken by a diverse audience, ranging from radiation oncology residents and fellows, as well as MBP students (Table 30).
- Taught by world-renowned faculty with subject-matter expertise from UTDRO, United States, and Europe.
- Program and Instructor evaluations are completed by students every year, and utilized to improve future course content, structure, and delivery.

Table 29: CERB Attendance (2017-2021)

Year	Format	Attendees
2017	In-person	50
2018	In-person	59
2019	In-person	70
2020	Switched to Online	81
2021	Online	105

CERB 2020 was initially offered in-person, but due to the COVID-19 pandemic, it was switched to online delivery a few days prior to the start date. Registrants were offered a refund due to these circumstances, and 81 students remained.

Table 30: 2021 CERB Attendees

Type of Attendee	Number of Attendees
U of T radiation oncology residents or fellows	28
U of T Medical Biophysics students (includes audit only students)	27
Other U of T program/affiliation registrants*	3
Faculty (U of T and external exceptions)	5
External program residents (non-U of T)	34
Other external registrants (non-U of T)*	8

**Other: PhD candidate, radiation oncology fellows, summer research student, oral and maxillofacial radiology resident, dentist, radiation oncologists, radiation oncology faculty*

Challenges

- The format of the course is very intensive as the content is delivered over an 8-hour day Monday to Thursday, plus a half-day on Friday (Appendix 7.3).
- Full participation requires preparation and self-study.
- Participants have disparate backgrounds, rendering different parts of the curriculum challenging for the various groups.
- Residents are encouraged to take the course twice, as PGY1 and PGY4. In PGY1, this course prepares them for the residency program; in PGY4, they are better positioned to appreciate the curriculum in the context of real-life practice.

Opportunities

- Explore strategies to increase attendance from additional centres within Canada and beyond.
- Investigate packaging course content into complementary formats (e.g. streaming lectures/tutorials, on-demand online course development) to broaden accessibility, particularly for international students who live in other time zones, and for clinicians who might need to step away for clinical practice throughout the day.

Evening Journal Club

Overview

UTDRO encompasses an academic community of six cancer centres in Southern Ontario (Princess Margaret, Odette, Southlake, Royal Victoria, Oshawa, and Credit Valley). Therefore, it is critically important to provide a forum to exchange clinical, research, and educational knowledge between the various centres. The UTDRO Evening Journal Club (EJC) is a quarterly meeting for all sites designed to establish collaborative interactions with members from different cancer centres to advance scholarly mandates.

Objectives

The purpose of the program is to develop knowledge exchange on clinical, research, and educational topics within UTDRO. The objectives are:

- To promote opportunities for collaboration within UTDRO.
- To provide a global overview of participants' areas of expertise.
- To highlight the technique and technical aspects of participant's areas of expertise.
- To highlight the collaborative process and innovations in participants' areas of expertise.
- To strengthen the UTDRO academic community through social interactions.

Governance

The UTDRO Evening Journal Club is co-chaired by Drs. Jennifer Croke (Princess Margaret) and Eric Leung (Odette). The program is governed by members of UTDRO. The Executive Committee includes the Vice Chair of Education (previously Dr. Rebecca Wong and currently Dr. May Tsao), the Co-Chairs listed above, and UTDRO administrative staff. The Co-Chairs from two geographic sites are responsible for organizing the academic presentations.

Curriculum and Program Delivery

The UTDRO Evening Journal Club has been held in person quarterly since its inception in 2016. However, there were no events in 2020 due to the COVID-19 pandemic; plans are underway to resume the series in 2021, either virtually or in person, dependent on the status of the pandemic. The format of the event has been as follows:

- Two to three presentations are delivered to provide a global overview of the topic of interest, highlighting the importance, relevance, current approaches, and future evolution with respect to the topic for the event.
- Speakers are encouraged to highlight successful collaboration between the six geographic sites of the UTDRO academic communities.
- The Co-Chairs moderate the sessions; audience participation and discussions are encouraged.

Highlights

Continued Program Interest

Registrations have been steady at an average of 36 UTDRO members per topic (Table 31).

Table 31: EJC Registrations by Year

Year	Theme	Registrants
2017	Health Professional Education: Useful Tools and Tactics in the Competency Based World	30
2018	The Academic Appointments and Promotions Journey	39
2019	UTDRO in Global Health	40
2019	Learner in Difficulty: A Practical Approach	25
2019	MR-LINAC: From Prototype to Clinical	47
2020	--	-- *
2021	--	-- *

**2020 programming was suspended due to COVID-19. 2021 planning is underway.*

Increased Knowledge Sharing
The UTDRO Evening Journal Club events allow for increasing collaborative opportunities between the various cancer centres constituting the department. The planning for each topic involves multiple interdepartmental meetings between the speakers of the site groups (and also input from those not on the speaker list), and this stimulates new opportunities and new ideas. The centres of UTDRO each have their individual strengths and interests, and sharing this with each other during the planning process can be advantageous to the department as a whole.

Improved Collaboration
During the event, the discussion of the chosen topics allows for those not only within the site groups, but also others in the department to learn about projects and initiatives that collaborative groups are building. This also show cases the success of such collaborations and motivates others to initiate their own collaborative work within the site groups.

Access to New Opportunities
The engaging and positive atmosphere helps to strengthen the relationship and communication between departments, which in turn, opens the door to new opportunities.

Challenges

Scheduling
The spirit of this event is to involve members of the different UTDRO cancer centres; however, there are scheduling challenges due to competing events.

Timing and Location
The start time has typically been ~6:30 PM at a venue in midtown Toronto. Most faculty must travel to this destination and therefore, it can be challenging to attend if there are competing clinical demands. This can also be a barrier for participation for UTDRO members working in centres outside Toronto. One challenge has been ensuring those who RSVP to the event actually attend, especially when food/beverage has been pre-ordered and already paid by UTDRO.

Selecting Relevant Topics
Although many members of UTDRO have expressed an interest in presenting for an EJC event, choosing a topic within a site group can be a challenge. This speaks to the academic diversity and success of each

site group amongst the centres. There are many different interests in each group, and multiple discussions have been necessary to select a topic that is not only of significant interest to other members of the department, but also a topic that will foster active audience participation.

COVID-19 Pandemic
Events have been postponed for the 2020-2021 years.

Opportunities

Virtual Event Delivery
As a result of the COVID-19 pandemic, plans are underway for resuming this event virtually in 2021. This delivery method may overcome the barriers described above in the Challenges section pertaining to engaging faculty from all UTDRO sites, and ensuring attendance from those who have registered.

Other Continuing Professional Development Activities

Overview

UTDRO faculty are actively involved in various CPD activities, including participating in, or organizing collaborative CPD conferences, programs, and courses at the local, national, and international levels. Faculty are also engaged in research exploring the various realms of continuing professional development. Many of our faculty have been recognized for their sustained commitment and excellence, innovation, and impact in the field of CPD. A comprehensive list of CPD activities is provided in Appendices 7.4-7.6, highlighting:

- Awards and distinctions
- Leadership roles/positions
- Research and scholarship

Highlights

Innovation

- In 2019, a formal needs assessment to better understand the CPD needs of UTDRO faculty and to determine how these needs could be generalized to other CPD programs was conducted and published (doi.org/10.1007/s13187-019-01607-1). The study observed a general lack of awareness, and lack of access made participation in CPD programs difficult. Members also noted that topics were often impractical, irrelevant, or not inclusive of different professions. Some participants did not feel motivated to engage in CPD offerings due to a general lack of time and incentive.
- UTDRO CME research projects were presented at the 2021 Society for Academic Continuing Medical Education (SACME) Annual Meeting:
    - Patient Engagement in the Continuing Professional Development Programs within UTDRO: A Qualitative Study (manuscript submitted).
    - Perceptions of Canadian Radiation Oncologists, Radiation Physicists, Radiation Therapists and Radiation Trainees about the Impact of Artificial Intelligence in Radiation Oncology – National Survey (doi.org/10.1016/j.jmir.2020.11.013).
- Other notable publications related to faculty development from UTDRO faculty include:
    - A Mandala of Faculty Development: Using Theory-Based Evaluation to Explore Contexts, Mechanisms and Outcomes (doi.org/10.1007/s10459-016-9690-9).

- Rebooting Kirkpatrick: Integrating Information System Theory into the Evaluation of Web-based Continuing Professional Development Interventions for Interprofessional Education (doi.org/10.1097/ceh.0000000000000154).
- Clinical Learning, Didactic Education, and Research Experiences of Radiation Oncology Resident Physicians in Canada (doi.org/10.1007/s13187-020-01799-x).
- Brachytherapy Education and Certification – A Canadian Approach (doi.org/10.1016/j.brachy.2020.05.004).
- Teaching the Teacher: The Impact of a Workshop Developed for Radiation Therapists (doi.org/10.1016/j.jmir.2018.02.003).

Interprofessional and Cross-Site Collaborations

- PM and OCC developed a new MRgRT Training Program in partnership with Elekta to be launched in 2022. Led by UTDRO faculty with expertise and leadership in MR, radiation therapy, and education content (Mikki Campbell, Laura D'Alimonte, Darby Erler, Nicole Harnett), this innovative program offers a 39-week curriculum for certified RTs (online didactic content with in-person clinical placements) that will help build global capacity for MR practice.
- A new two-day UTDRO CPD course, entitled "Technological Innovations in Prostate Cancer Radiotherapy" was offered in 2018. Co-directed by Drs. Charles Catton (PM) and Ewa Szumacher (OCC), the course was a prime example of an interprofessional CPD collaboration between urologists, radiation oncologists, and other healthcare providers who treat patients with prostate cancer between the two sites. The course, which highlighted inter-activity and interdisciplinary education principles, was well received by participants.
- A new cross-discipline Fellowship in Radiation and Geriatric Oncology, hosted at the OCC, was spearheaded by Dr. Ewa Szumacher and her colleagues, which graduated its first trainee in 2018.

Knowledge Mobilization

- Drs. David Wiljer and Ewa Szumacher led a virtual leadership workshop entitled "Essential Skills in Cancer Education: Leadership, Leading and Influencing Change in Cancer Education – A Comprehensive Interactive Hands-On Workshop" at the 2020 International Cancer Education Conference (ICEC). The workshop was well received with excellent evaluations.
- Dr. Ewa Szumacher and Tina Papadakos (local Co-Chairs) are involved in the planning of the virtual 2021 ICEC themed "Integrating Culture, Spirituality, and Social Support into Cancer Education to Improve Health Equity." Other UTDRO faculty have been involved in the planning of previous ICECs in 2017, 2018, 2019, and 2020.
- UTDRO educators were involved in the organization of the 2017 CARO Annual Scientific Meeting entitled "Improving Care through Education, Advocacy, Quality of Life and Beyond".
- Dr. Barbara-Ann Millar and Carina Feuz led an evening workshop on "The Learner in Difficulty – A Practical Approach" in 2019 for UTDRO faculty, as part of the U of T Centre for Faculty Development – Teaching for Learning & Collaboration (TLC) Program – Module 7.
- UTDRO faculty were involved in the planning and organization of the Canadian Geriatric Oncology Conferences in 2020 and 2021.
- Since 2018, Drs. Meredith Giuliani and Barbara-Ann Millar have been involved in the creation and delivery of international faculty development programming through the interdisciplinary ESTRO-CARO-RANZCR Course on Foundations of Leadership in Radiation Oncology.
- Several UTDRO faculty members were involved in the planning and organization of the Annual Sunnybrook Education Conference in 2017-2020.

- UTDRO faculty continue to lead or teach faculty development sessions within the Princess Margaret Cancer Program Young Leaders Program (Drs. Meredith Giuliani, Barbara-Ann Millar, Mary Gospodarowicz) and U of T Centre for Faculty Development programs, such as the Education Scholars Program (Dr. Barbara-Ann Millar), Stepping Stones Program (Cathryne Palmer), TLC Program (Cathryne Palmer, Dr. Barbara-Ann Millar, Carina Feuz), and New and Evolving Academic Leaders Program (Drs. Mary Gospodarowicz and Barbara-Ann Millar).

Global Impact

- The one-year Clinical Research Mentorship Program (CRMP) led by Dr. Rebecca Wong is designed to teach critical appraisal and introductory research skills to radiation oncology residents in Africa, and is delivered remotely by faculty using telehealth technologies (doi.org/10.1200/jgo.19.00240). To date, the program has had residents from Ghana, Zimbabwe, and Nigeria. Feedback from the trainees has been very positive and encouraging, with high teaching effectiveness scores, and participants demonstrating improvements in critical appraisal skills. The program aims to secure resources to expand its offerings in collaboration with AORTIC (African Organization for Research and Training in Cancer).
- Dr. Ewa Szumacher continues to be involved in collaborations with the American Association for Cancer Education (AACE) on several CPD global activities.
- Drs. Rebecca Wong, Andrea McNiven, and Cathryne Palmer have supported the development of a BSc Radiation Therapy Training Program in Ethiopia through the Toronto Addis Ababa Academic Collaboration (TAAAC) and Michener Institute of Education at UHN. A Radiotherapy Planning Program has also been developed with TAAAC for Ethiopian radiation oncology residents in their final year.
- Launched in 2017, Dr. Rebecca Wong continues to lead the Toronto-Eldoret Radiation seminar series designed to enhance the readiness of Kenyan radiation therapists and physics trainees to transition from 2D to 3D radiotherapy. The seminars are delivered remotely by site-based teams of therapists, physicists, and oncologists, and cover fundamental concepts and practical tips that are explained in the context of common malignancies in Kenya. This partnership is through the Academic Model Providing Access to Healthcare (AMPATH), with Indiana University and Moi University (Eldoret, Kenya).
- Drs. Andrea McNiven, Monique van Prooijen and colleagues continue to support the 2-year Physics Residency Training Program in Eldoret, Kenya in partnership with Moi Teaching and Referral Hospital.
- In 2020, the RMP at the Princess Margaret signed a MOU with the International Atomic Energy Agency (IAEA) to support radiation oncology collaborations; led by Drs. Danielle Rodin and Fei-Fei Liu.
- In 2017, the Princess Margaret formed a 5-year partnership with the University of Hong Kong-Shenzhen Hospital (HKU-SZH) in China to build local clinical and research capacity in radiation medicine by focusing on areas such as establishing a precision radiotherapy program, QA/QC system, tumour banking, as well as training programs for HKU-SZH radiation oncologists, physicists, and therapists. The collaboration is led by Drs. Brian O'Sullivan, Fei-Fei Liu, Laura Dawson, Rebecca Wong, Beibei Zhang, and Sophie Huang.
- Under the leadership of Dr. Danielle Rodin, the Global Oncology Leadership Development (GOLD) Program and CARO-ARRO Collaborative Global Oncology Enrichment Program were launched in 2020 through the Princess Margaret Global Cancer and Education Programs to build capacity and systems leadership in global oncology and cancer control.

Excellence in CPD

- Kieng Tan and Lisa Di Prospero received the 2015-2016 U of T Colin Woolf Award for Long-Term Contributions to CPD.
- Nicole Harnett and Dr. Marco Carlone received the 2016 AAPM Education Innovation Award.
- Dr. Hany Soliman received the 2016 Sunnybrook Education Advisory Council (SEAC) Teaching Award.
- Dr. Barbara-Ann Millar received the 2016-2017 U of T Colin Woolf Award for Sustained Excellence in Teaching of CPD.
- Mikki Campbell was awarded the 2017 Sunnybrook Health Sciences Centre Frima Starr-Paloc Education Award for Continuing Education.
- Dr. Edward Chow received the 2018 Sunnybrook Education Advisory Council (SEAC) Allan Knight Life-Time Achievement in Teaching Award.
- Dr. Andrea McNiven received the 2019 American Association of Physicist in Medicine (AAPM) Education Innovation Award.
- Dr. David Wiljer received the 2019 Colin R. Woolf Award for Excellence in Program Development and Coordination.
- Dr. Meredith Giuliani received the 2019 Wightman-Berris Anderson Award in Program Innovation and Development Award.
- Dr. Ewa Szumacher received the 2019-2020 U of T Excellence in Interprofessional CPD Award.

RESEARCH & SCHOLARSHIP

UTDRO Research Landscape

The University of Toronto Department of Radiation Oncology and its affiliated academic hospitals and radiation treatment programs comprise one of the largest and most productive academic radiation medicine programs worldwide. Much of the research originates from the Princess Margaret Cancer Centre (University Health Network) and Odette Cancer Centre (Sunnybrook Hospital) and their research institutes. Many UTDRO faculty members have laboratory space or are able to access resources and personnel within the research hospital environment. Research is conducted in collaboration with other University of Toronto clinical and basic science departments, as well as with external partners including national and international clinical trial groups, Ontario Health (formerly Cancer Care Ontario) and industry partners. Over the past five years, there has been increasing research engagement by UTDRO affiliated community radiation oncology programs at the Stronach Regional Cancer Centre (Newmarket), Simcoe Muskoka Regional Cancer Program (Barrie) and Carlo Fidani Peel Regional Cancer Centre (Mississauga). This is the result of a conscious effort to integrate activity within UTDRO through partnerships focused on collaborative, interdisciplinary clinical care, research, and education that are relevant to the general radiation treatment and cancer care communities in Canada and abroad.

UTDRO research spans the full spectrum from fundamental biological studies through translational biology and physics to clinical trials, health service, and education research. A unique strength of the UTDRO is the diversity of its 188 faculty members with respect to both expertise and professional or scientific background. In addition to radiation oncologists, medical physicists, and radiation medicine scientists, there are 35 radiation therapists with faculty appointments, including two with Associate Professor appointments (Dr. Tara Rosewall and Sophie Huang). Three radiation therapists (Drs. Tara Rosewall, William Tran, and Michael Velec) are appointed to the Princess Margaret or Sunnybrook Research Institute. Interdisciplinary research is actively encouraged, reflecting the culture that is foundational to the day-to-day care of patients.

UTDRO clinical faculty members are appointed with different expectations for research activity and productivity to balance departmental clinical, academic, and administrative demands. The job descriptions define a continuum from Clinical Teacher and Clinical Administrator with <25% of protected time for research, to Clinician Scientist with 80% protected time for research. UTDRO faculty are unable to supervise graduate students unless cross appointed to another University of Toronto program or department that is affiliated with the School of Graduate Studies (see Training the Next Generation of Radiation Medicine Researchers).

Research Administration and Organization

UTDRO research leadership is organized as shown in Figure 18. The UTDRO Vice Chair of Research and Director of Research assist the Chair in developing and executing the research objectives embedded within the strategic plan, *UTDRO 2022: Reflect. Transform. Lead*. The UTDRO Research Advisory Committee is advisory to the UTDRO Vice Chair of Research on all matters relating to research, including research priorities, emerging research areas relevant to radiation medicine, the use of research funds, and educational and knowledge translation activities to communicate UTDRO research successes and influence practice change.

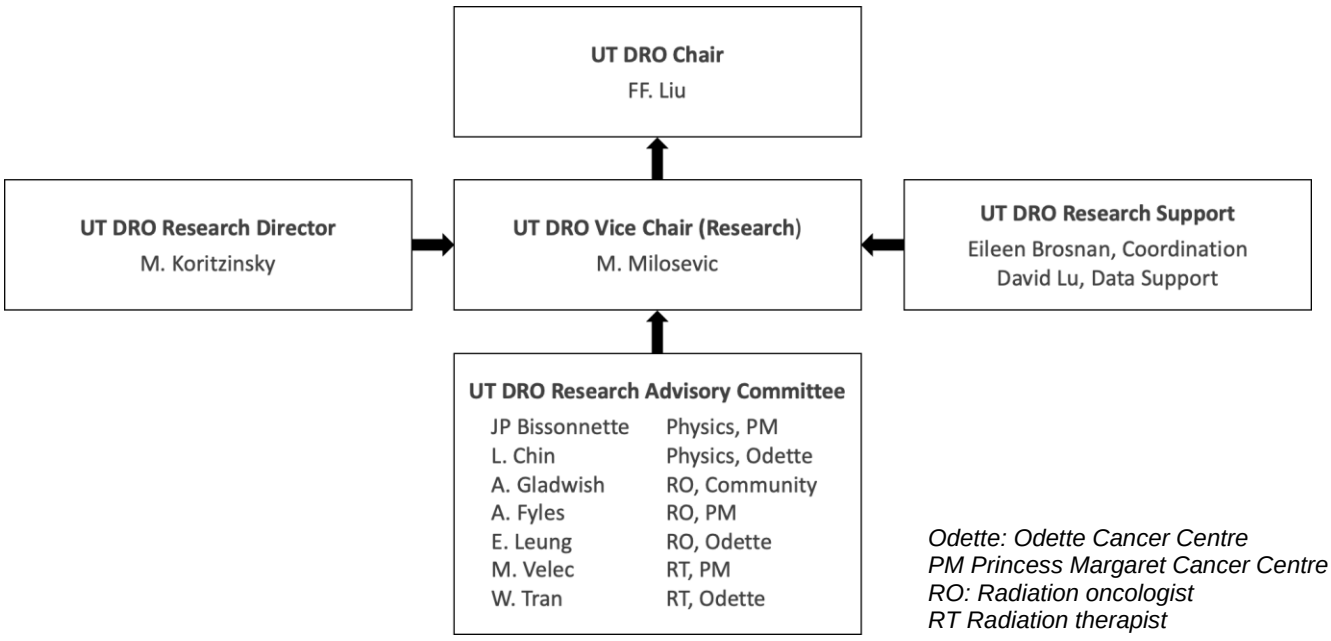

Figure 18: UTDRO Research Organization

UTDRO research is based largely at the Princess Margaret and Odette Cancer Centres, each with established, highly regarded research institutes to support discovery and innovation. Salary support for UTDRO radiation oncology investigators emanates from the Ontario Ministry of Health and Long-Term Care with both base funding plus a fee for service basis, and therefore is dependent on clinical practice volume. The Ontario Clinician Scientist Program provides partial salary support for radiation oncologists with independent research programs supported by external peer-reviewed grant funding. These positions are appointed on a competitive basis and reviewed every three years. Salary support for medical physicists and radiation therapists is provided by the hospitals. Operating and infrastructure research grants usually flow through the hospitals and not the University of Toronto. Philanthropic donations to support research are grounded in hospital-based foundations. Research facilities are provided and maintained by the hospitals with cost recovery from grants and other funding sources. This organization promotes alliance of investigators and programs with hospitals and local research institutes rather than with the university. Nonetheless, UTDRO is an important catalyst for transdisciplinary radiation medicine research by providing an academic home for investigators and promoting collaborations and partnerships in areas of common interest or around common themes.

Research Metrics

Key UTDRO measures of research productivity and research impact include:

- Peer-reviewed research funding
- Peer-reviewed publications
- Impact of peer-reviewed publications relative to other leading international radiation medicine programs
- Patents and commercialized inventions
- Graduate student supervision
- Faculty awards and acknowledgements

Priority Research Objectives

The priority UTDRO research objectives are outlined in the strategic plan, *UTDRO 2022: Reflect. Transform. Lead*. They were derived through extensive consultation with faculty and stakeholders and critical evaluation of departmental strengths and opportunities for future impact. The priority research goals are intended to support innovation from the "bench to bedside" along the entire patient trajectory from diagnosis through treatment to end-of-life care and long-term survivorship:

- Accelerate the uptake of discovery, including defining the economic case for clinical adoption and engaging a range of stakeholders.
- Catalyze collaborative research through joint funding models.
- Facilitate the creation of a centralized departmental resource repository to support collaborative research initiatives.
- Influence processes that facilitate cross-institutional collaboration such as common REB or data sharing capabilities.
- Strengthen relationships with key academic and system partners, including the University of Toronto Temerty Faculty of Medicine and School of Graduate Studies, and Ontario Health.
- Emphasize the importance of high-impact scholarly publications.
- Nurture research talent along the career continuum and across disciplines.
- Extend academic opportunities for radiation therapists.
- Foster a culture of mentorship and academic support.

Examples of initiatives and metrics related to these goals over the past five years include:

- Recruitment of highly qualified new Clinical Investigators and Clinician Scientists that align with the strategic plan and fill programmatic gaps necessary to maximize impact. Examples include Drs. Scott Bratman (circulating biomarkers), Jay Detsky (imaging biomarkers), Benjamin Lok (small cell lung cancer radiation sensitizers), Alexander Louie (health care economic modelling), Sylvia Ng (pancreatic and hepatobiliary cancer biology), and Danielle Rodin (global health and economic modelling).
- Recruitment of faculty at the Princess Margaret and Odette (Drs. Rodin and Louie) with internationally recognized expertise in health care economics.
- System-level leadership in Ontario working with Ontario Health to promote uptake of new radiation treatment technology, including the development of a business case for province-wide implementation of MR-guided brachytherapy for gynecological cancer.
- New cross-appointment of five medical physicists at the Princess Margaret to the University of Toronto Department of Medical Biophysics, which will enable new research opportunities and access to graduate students (See Training the Next Generation of Radiation Medicine Researchers).
- Appointment of two radiation therapy Clinician Scientists; over $950K in peer-reviewed research funding to radiation therapists; 192 peer-reviewed publications by radiation therapists (see UTDRO External Peer-Reviewed Research Grants and Radiation Therapy Publication Impact).
- Establishment of world-leading MR-guided radiotherapy programs at the Odette and Princess Margaret Cancer Centres catalyzed by the procurement of Elekta Unity MR-LINACs at both centres. This represents a unique opportunity for collaborative research within the UTDRO community.
- Review of the UTDRO Collaborative Research Seed Grant Program and revision of the Terms of Reference to promote higher quality grant submissions with involvement of all five UTDRO centres (see UTDRO Collaborative Research Seed Grant Program).

- Development of the quarterly UTDRO Evening Journal Club to highlight and promote collaborative research between the Princess Margaret and Odette faculty. Presentations have combined research and education with a focus on clinical implementation and practice change. Topics have included MR-LINAC technology and clinical implementation, MR-guided brachytherapy, and brain metastases and neurocognition, with presentations by radiation oncologists, medical physicists, and radiation therapists.

Ontario Clinician Scientist Program

The Ontario Ministry of Health and Long-Term Care provides financial support for radiation oncology Clinician Scientists in Ontario as part of the physician services agreement. These Clinician Scientist positions are intended to promote excellence and build capacity in radiation medicine research in Ontario by providing partial base salary support to radiation oncologists with independent research programs supported by external peer-reviewed funding. The positions are appointed on a competitive basis based on scientific merit and reviewed every three years. Currently, UTDRO investigators hold 14 of the available 26 positions and are recognized internationally for important contributions to their research fields (Table 32). At present, there are no comparable provincial programs to support medical physics or radiation therapy Clinician Scientists.

Table 32: UTDRO Ontario Clinician Scientists

Investigator	Research Focus
Alejandro Berlin	Biological/imaging-driven radiotherapy, informatics and clinical support systems
Scott Bratman	Circulating cell-free tumour DNA
Edward Chow	Palliative radiotherapy and symptom management
Laura Dawson	Liver SBRT
Kathy Han	Imaging biomarkers, MR-guided brachytherapy, molecular therapeutics
David Hodgson	Paediatric oncology, health service research
Stanley Liu	Prostate cancer radioresistance
Andrew Loblaw	Prostate cancer clinical trials
Benjamin Lok	Radiosensitizers for small cell lung cancer
Michael Milosevic	Tumour hypoxia, immune mediated radiation treatment, molecular therapeutics
Lawrence Paszat	Health service research
Eileen Rakovitch	Epidemiological and biomarker studies in DCIS
Arjun Saghal	Spinal SBRT and MR-guided radiotherapy
Shun Wong	Radiation treatment injury of the central nervous system

Drs. Fei-Fei Liu and Gregory Czarnota have both maintained productive laboratory research programs with independent peer-reviewed funding in addition to their administrative responsibilities.

Over the past 5 years, UTDRO has remained competitive in recruiting new Clinician Scientists and securing new funded Clinician Scientist positions. Examples of new Clinician Scientist appointments include Drs. Berlin, Bratman, and Lok, all of whom were recruited internationally because of their

outstanding research potential. All have been successful in establishing independent research programs and securing independent peer-reviewed funding.

Key strategies for recruiting and ensuring the continued success of UTDRO Clinician Scientists include providing protected time for research and research mentorship. Department Heads are required to attest that Ontario Clinician Scientists have protected time for research as a condition of maintaining salary support. The UTDRO job description for Clinician Scientists specifies 80% protected time for research and this is reviewed regularly during each Clinician Scientist's annual performance evaluation. Clinical and administrative responsibilities are reduced as needed to ensure protected time and high research productivity. In addition, there is a mentorship program for new faculty, including Clinician Scientists, that pairs recruits with experienced faculty. This is a useful forum to help Clinician Scientists develop their careers, develop coping strategies to balance competing demands, and voice concerns about excessive workload or other issues independent of program leadership.

Collaborative Research Seed Grant Program

The UTDRO Collaborative Research Seed Grant Program was established in 2013 by the current Chair to capitalize on synergies within the UTDRO community and promote new partnerships by providing seed funding to support projects with the potential to significantly impact radiation medicine science and improve patient outcomes. Over the past five years, eight grants of $50K each were awarded supporting a diverse range of projects jointly proposed by investigators at the Princess Margaret, Odette, Stronach, Simcoe Muskoka, and Carlo Fidani Peel Regional Cancer Centres (Table 33). Approximately $20K annually is contributed by each of the five participating UTDRO clinical departments to sustain the Seed Grant Program.

Table 33: UTDRO Collaborative Research Seed Grant Program

Year	Investigators	Project Title
2017	Joelle Helou (PM) Christiaan Stevens (RVH) Charles Catton (PM) Antonio Finelli (PM) Laura Dawson (PM) Abhijat Kitchlu (UHN)	Stereotactic Ablative Radiotherapy for Renal Tumours
2018	Jennifer Croke (PM) Meredith Giuliani (PM) Janet Papadakos (UHN) Sarah Rauth (Trillium) Julia Skliarenko (RVH) Tina Papadakos (PM)	Development and Implementation of a Brachytherapy Discharge Education Program to Build Healthcare Provider Patient Teaching Competency Toward Improving Patient Engagement and Quality of Care
2018	Beibei Zhang (Southlake) Charles Cho (Southlake) Timothy Craig (PM) Danny Vesprini (OCC) Melanie Davidson (OCC)	Reducing Acute Rectal Toxicity for Hypofractionated Prostate Radiotherapy – A Multi-institution Investigation of Reduced PTV Margin
2019	Tatiana Conrad (Southlake) Luluel Khan (CVH) David Shultz (PM) Derek Tsang (PM) Tiffany Tam (RVH)	Development of a Decision Aid for Patients with Extensive Brain Metastases – A Collaborative Study

2019	Jessica Conway (Simcoe Muskoka) Jennifer Croke (PM) Adam Gladwish (RVH) Eric Leung (OCC) Alexander Louie (OCC) Sarah Rauth (CVH)	Patient-Reported Financial Toxicity in Cervical Cancer Survivors Treated with Definitive Chemo-Radiation
2020	Eric Leung (OCC) Toni Barnes (OCC) Patrick Cheung (OCC) Melanie Davidson (OCC) Elysia Donovan (OCC) Anthony Fyles (PM) Adam Gladwish (RVH) Kathy Han (PM) Andrew Loblaw (OCC) Julia Skilarenko (RVH) Amandeep Taggar (OCC) Jasper Yuen (CVH)	SPARTACUS II – A Randomized Phase II Feasibility Trial on Hypofractionated Radiation versus Conventional Fractionation in Endometrial Cancers
2020	Srinivas Raman (PM) Anthony Brade (CVH) Patrick Cheung (OCC) Tatiana Conrad (Southlake) Jennifer Croke (PM) Andrew Hope (PM) Geoffrey Liu (PM) Alexander Louie (OCC) Philip Wong (PM) Frederick Yoon (RVH) Robert Wu (UHN)	Integrated Use of Wearable Diagnostics in Lung Cancer
2020	Eric Tseng (OCC) Melanie Davidson (OCC) Adam Gladwish (RVH) Joelle Helou (PM) Stanley Liu (OCC) Andrew Loblaw (OCC) Danny Vesprini (OCC) Jasper Yuen (CVH)	Post-Prostatectomy LINAC-Based Ultrahypofractionated Radiotherapy for Patients with Localized Prostate Cancer. A Treatment Feasibility and Outcomes Multicenter Study (PLUTO-MPC)

The Collaborative Research Seed Grant Program was reviewed in 2019 to determine whether it was achieving the primary goal of catalyzing innovative and research within the UTDRO community, leading to new collaborations and new external peer-reviewed funding. In addition to the primary goal of bringing people together across the UTDRO community, several manuscripts have been published or are in preparation. One success story has been a study to explore circulating HPV DNA as a biomarker of response to radiotherapy in patients with cervical cancer led by Drs. Kathy Han, Eric Leung, and Scott Bratman, which was published in *JCO Precision Oncology* (doi.org/10.1200/PO.18.00152) and subsequently funded by the Cancer Research Society. Another was a seed grant to provide preliminary data of hypofractionated pelvic radiotherapy to inform the design of a national clinical trial, which is currently being developed.

Overall, there was strong support for continuing the Collaborative Research Seed Grant Program by both faculty and the Heads of the participating UTDRO clinical departments that contribute funding. Efforts are ongoing to secure funding from industry or philanthropy that is independent of the clinical

departments, but these have not been successful to date because of the financial pressure facing UTDRO and competing priorities for new money.

External Peer-Reviewed Research Grants

Despite a more competitive funding environment, peer-reviewed research funding awarded to UTDRO investigators between July 1, 2015, and June 30, 2020, was stable at approximately $50M CAD annually (Table 34).

Table 34: UTDRO Annual Peer-Reviewed Research Funding 2016-2020

Year	Peer-Reviewed Grant Funding (CAD $)
2015-2016	47.5M
2016-2017	42.1M
2017-2018	52.6M
2018-2019	57.0M
2019-2020	50.5M

Includes support for principal investigators and co-co-principal investigators, but excludes large infrastructure grants.

UTDRO principal investigators were awarded 35 highly competitive grants from the Canadian Institute for Health Information (CIHR) totaling $24.6M and collaborated on an additional 40 grants totaling $33M. A research team led by Drs. Marianne Koritzinsky and Michael Milosevic was awarded a prestigious $6M Terry Fox New Frontiers Program Project Grant (PPG) to study how hypoxia interacts with immune cells and other elements of the tumour microenvironment to render cancers more aggressive, metastasize, and develop treatment resistance. The Hypoxia Program at the Princess Margaret Cancer Centre has been funded continuously since 1994, and is internationally recognized as an exemplary model of translational bench-to-bedside research.

Of note, peer-reviewed grants totaling over $950K were awarded to two radiation therapy principal investigators (Drs. Michael Velec and William Tran) to study deformable dose accumulation and adaptive radiotherapy, and develop imaging biomarkers for breast cancer leveraging AI-based radiogenomic models.

Peer-Reviewed Publications

UTDRO faculty published a total of 1,974 peer-reviewed papers over the past five years, corresponding to an average of 10.4 papers per faculty or 2.1 papers per faculty per year.

To compare the number and impact of UTDRO publications to other leading international radiation medicine programs (MD Anderson Cancer Center (MDACC) and Memorial Sloan Kettering Cancer Center (MSKCC)), a publication impact analysis was performed by the University Health Network Research Program Planning and Analysis Office for the preceding 5 years from 2016 to 2020 inclusive. Figure 19 is a term map showing the clustering of research themes identified by natural language processing of all manuscript titles (2016-2020) from UTDRO, MDACC, and MSKCC. Five broad clusters were identified: clinical trials and outcomes (red), fundamental biology (yellow), imaging (blue),

treatment planning and delivery (green), and system-level expertise/leadership (purple). These clusters are representative of the broader research themes in all three radiation medicine programs.

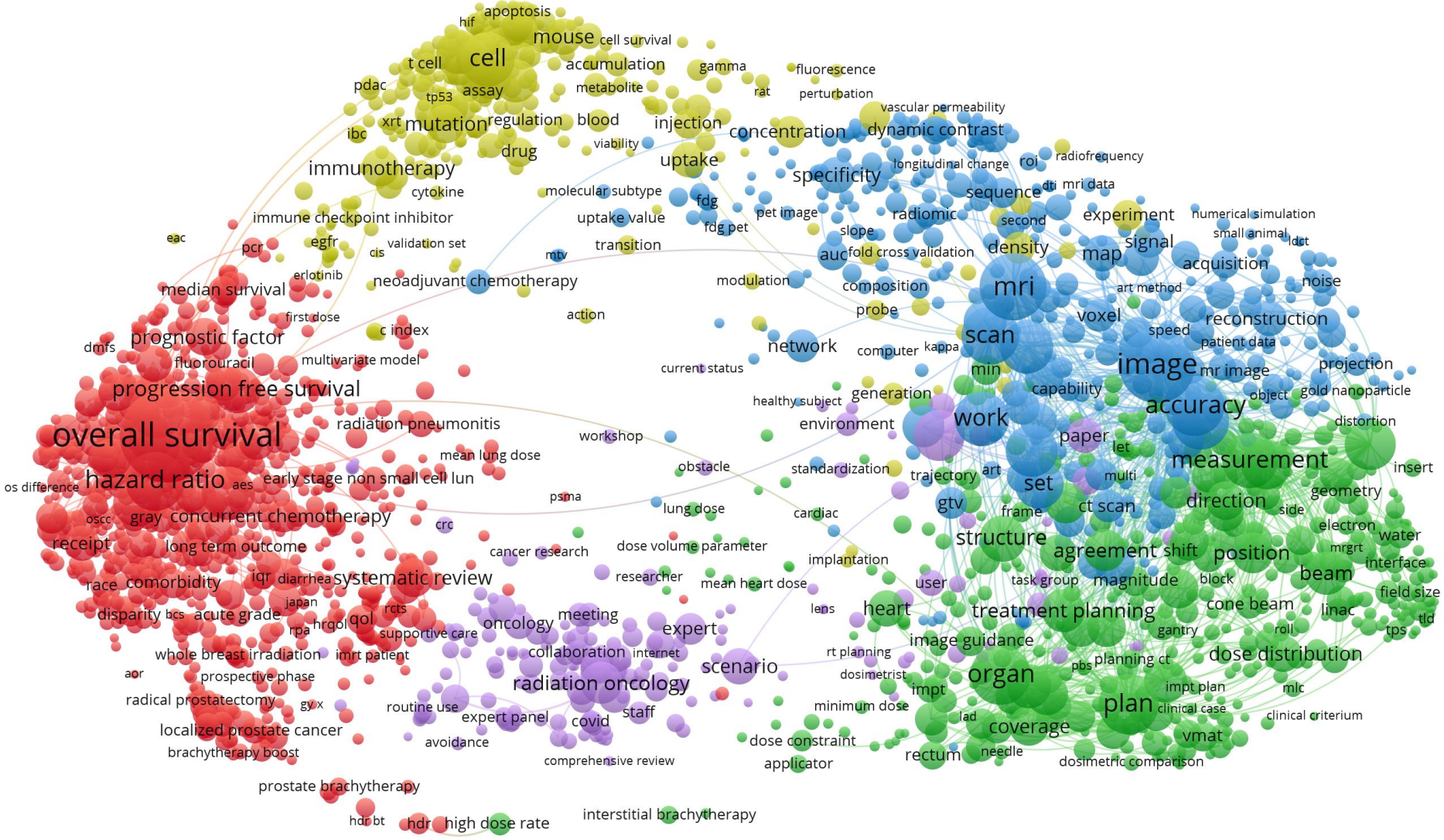

Figure 19: Term Map Showing Clustering of Research Themes Identified by Natural Language Processing of Manuscript Titles From UTDRO, MDACC and MSKCC (2016-2020)

A comparative analysis was performed separately for radiation oncology and medical physics. As shown below in Tables 35-36 and Figures 20-21, the number of peer-reviewed publications per investigator was similar to MDACC and MSKCC, but UTDRO published fewer papers in top quartile journals and had fewer highly cited papers.

Radiation Oncology Comparative Publication Impact

Table 35: Radiation Oncology Comparative Publication Impact Summary

2016-2020	MDACC	MSKCC	UTDRO
Publications per Investigator per Year	5.4	4.3	5.5
Mean Journal Impact Factor (JIF)	8.1	8.7	8.7
Top Quartile Journals (%)	58.6%	58.6%	51.2%
Cites per Paper	17.6	23.4	16.0
Highly Cited Papers (%)	22.0%	28.9%	19.6%

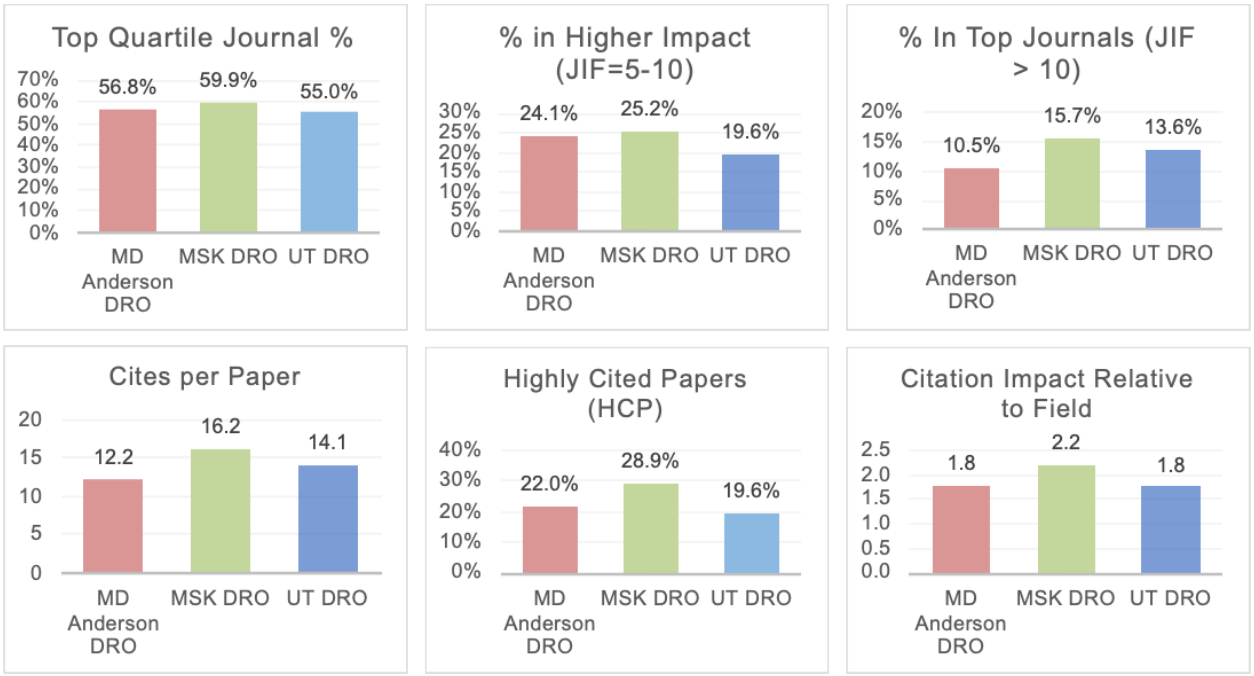

Figure 20: Radiation Oncology Comparative Publication Impact Metrics

Notes:

1. *Data provided by the Research Program Planning and Analysis Office of UHN Research Support Services.*
2. *Comparator institutions: MD Anderson Cancer Centre (MDACC), Houston; Memorial Sloan Kettering Cancer Centre (MSKCC), New York.*
3. *Data represent a 5-year average of papers published in 2016, 2017, 2018, 2019, and 2020.*
4. *Primary Author (PA): Investigator is listed as the first or last author.*
5. *Top Quartile Journals are those whose JIF places them amongst the top 25% in their journal category.*
6. *JIF for subject category describes the difference between a paper's JIF and the median JIF for the applicable subject area. A mean of 2 indicates papers were published in journals with a JIF twice the subject-area median.*
7. *Highly cited paper: When a paper's citation count places it amongst the top 10% of papers published in the year and field. High-impact groups commonly have >%25 of papers achieving this standing. The 50th percentile is used to calculate a ratio of actual to expected cites as Citation Impact Relative to Field.*

Medical Physics Comparative Publication Impact

Table 36: Medical Physics Comparative Publication Impact Summary

2016-2020	MDACC	MSKCC	UTDRO
Publications per Investigator per Year	1.9	2.8	2.8
Mean Journal Impact Factor (JIF)	6.9	6.1	5.5
Top Quartile Journals (%)	48.6%	45.5%	39.9%
Cites per Paper	13.0	13.7	10.5
Highly Cited Papers (%)	20.6%	20.4%	13.3%

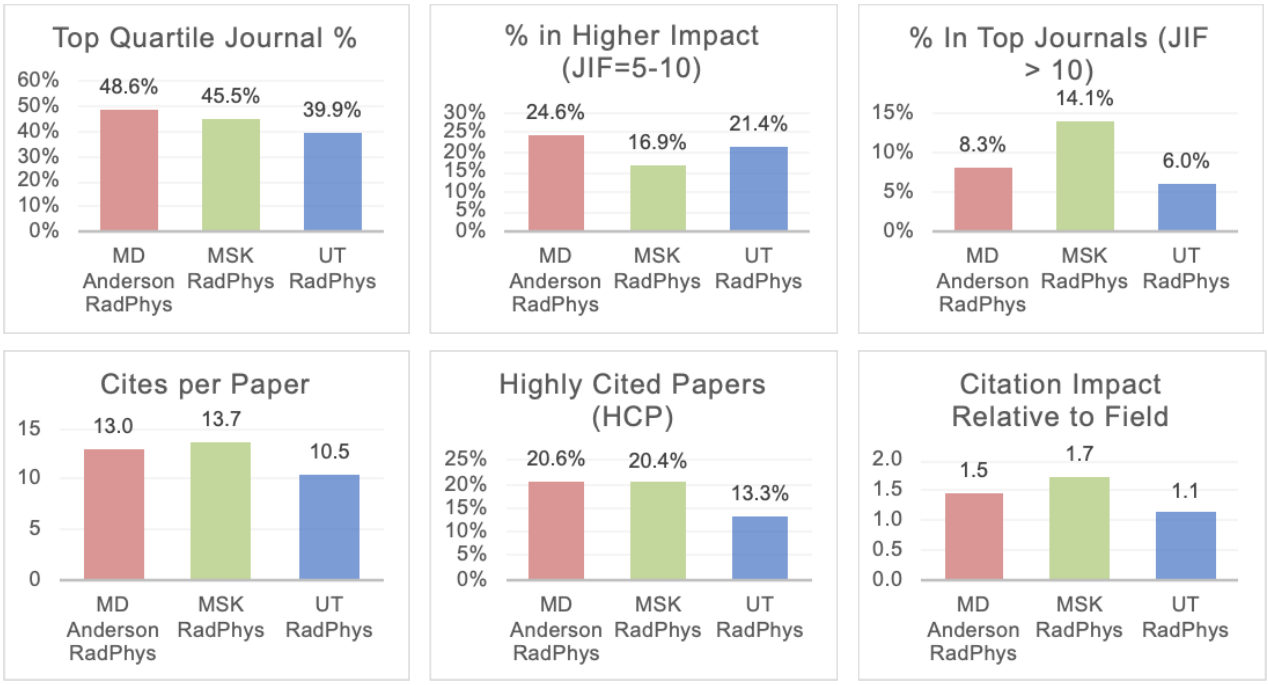

Figure 21: Medical Physics Comparative Publication Impact Metrics

Notes:

1. *Data provided by the Research Program Planning and Analysis Office of UHN Research Support Services.*
2. *Comparator institutions: MD Anderson Cancer Centre (MDACC), Houston; Memorial Sloan Kettering Cancer Centre (MSKCC), New York.*
3. *Data represent a 5-year average of papers published in 2016, 2017, 2018, 2019, and 2020.*
4. *Primary Author (PA): Investigator is listed as the first or last author.*
5. *Top Quartile Journals are those whose JIF places them amongst the top 25% in their journal category.*
6. *JIF for subject category describes the difference between a paper's JIF and the median JIF for the applicable subject area. A mean of 2 indicates papers were published in journals with a JIF twice the subject-area median.*
7. *Highly cited paper: When a paper's citation count places it amongst the top 10% of papers published in the year and field. High-impact groups commonly have >%25 of papers achieving this standing. The 50th percentile is used to calculate a ratio of actual to expected cites as Citation Impact Relative to Field.*

Radiation Therapy Publication Impact

There are 35 radiation therapists with UTDRO faculty appointments, including two with Associate Professor appointments (Dr. Tara Rosewall and Sophie Huang) and three with Princess Margaret or

Sunnybrook Research Institute appointments (Drs. Tara Rosewall, William Tran, and Michael Velec). UTDRO radiation therapists were the principal, co-principal, or senior responsible author of 105 papers from 2016 to 2020 and collaborated on 87 other papers. One of our radiation therapists (Sophie Huang) was recognized by ELSEVIER as being the lead author of one of the most cited articles in *Oral Oncology*. She also is one of the 25 most cited authors in *Radiotherapy and Oncology* since 2017.

No other program worldwide has capitalized on the academic potential of radiation therapists to the same extent, so a formal comparative publication analysis cannot be done. However, a recent report from one of the most academically productive UK radiation treatment centres reported only five papers annually (doi.org/10.1016/j.radi.2014.10.009), which further highlights the talent and commitment of UTDRO radiation therapists.

UTDRO radiation therapists have held national and international advisory roles that extend beyond the usual domain expertise of radiation therapists. For example, Dr. Tran was part of a national consensus committee for neoadjuvant breast cancer treatment and is leading a multi-centre trial involving Albert Einstein College of Medicine in New York through a collaboration with the International Immuno-Oncology Biomarker Working Group. Furthermore, Sophie Huang is a member of the American Society of Clinical Oncology/Chinese Society of Clinical Oncology (CSCO/ASCO) Treatment of Nasopharyngeal Cancer Guideline Committee.

Patents and Commercialization

Patents and commercialization of inventions are important metrics of research productivity and knowledge translation. There were 30 patents registered and an additional 9 invention disclosures by UTDRO inventors between 2016 and 2020. Most of these were for radiation treatment technology-based hardware or software innovations. However, there were also translational medicine inventions, including new approaches to cancer detection/classification/prognostication/therapy, prediction/therapy monitoring using methylome analysis of cell-free DNA, cancer outcome prediction using patient-derived xenograft tumour models, and methods of modulating the extracellular matrix to offset radiation-induced fibrosis.

A technology developed by UTDRO Associate Professor, Dr. Scott Bratman and collaborator Dr. Daniel de Carvalho to use methylation of circulating, cell-free tumour DNA and machine learning for cancer diagnosis and prognosis has led to the creation of a start-up company, Adela, which was launched earlier this year. Building on high-impact publications in *Nature* (doi.org/10.1038/s41586-018-0703-0), *Nature Medicine* (doi.org/10.1038/s41591-020-0932-2), and *Clinical Cancer Research* (doi.org/10.1158/1078-0432.CCR-21-0110), Adela's Series A financing was one of the largest in Canadian biotech history.

Research Awards and Distinctions

From 2016 to 2020, UTDRO faculty members received over 450 local, provincial, national, and international awards and distinctions for their contributions to research and the radiation medicine community in general (Appendix 2.4). These include the annual UTDRO Faculty Awards for research potential (Rising Star Award), Best Research Performance, Sustained Excellence in Research, Research Mentorship, and Research Leadership. Some of the prestigious national and international awards are summarized in Table 37.

Table 37: Notable UTDRO Faculty Research Awards and Other Distinctions (2016-2020)

Faculty	Year	Award or Distinction
Laura Dawson	2016	ASTRO Fellow Award (FASTRO)
Mary Gospodarowicz	2016	Canadian Oncology Society and Canadian Cancer Trials Group Dr. W. Gerald Cosbie Lectureship Award
Mary Gospodarowicz	2016	Canadian Cancer Society O. Harold Warwick Prize
Marianne Koritzinsky	2017	Radiation Research Society Michael Fry Award
Gerard Morton	2017	Jean Roy Memorial Lecturer
Brian O'Sullivan	2017	Canadian Cancer Society O. Harold Warwick Prize
Bradly Wouters	2017	Tier 1 Canada Research Chair
David Jaffray	2018	ASTRO Gold Medal Award
Andrew Loblaw	2018	ASCO Fellow Award
Eileen Rakovitch	2018	Israel Cancer Research Fund Women of Action Award
David Hodgson	2019	Honorary Fellow of the Royal College of Surgeons of Ireland
Fei-Fei Liu	2019	ASTRO Fellow Award (FASTRO)
Gerard Morton	2019	ABS Fellow Award
Philip Wong	2019	Tier 2 Canada Research Chair
Mary Gospodarowicz	2020	ICRU Gray Metal Award
Alexander Louie	2020	ASTRO Rising Star Award
Brian O'Sullivan	2020	ASTRO Gold Medal Award

Training the Next Generation of Radiation Medicine Researchers

The UTDRO research and educational programs are closely aligned. The UTDRO residency and fellowship programs place high expectations on trainees to engage in research supervised by UTDRO faculty and develop the research skills necessary for independent academic practice.

All radiation oncology residents are expected to develop one or more research proposal(s) during the five-year training program, conduct the research, and publish their findings in peer-reviewed journals. Many residents are involved in several research projects in addition to their clinical responsibilities. Residents can step away from clinical practice for up to six months to focus on research without extending their training beyond five years. There is also the opportunity to combine residency and formal graduate training, although this is not a requirement of the program. The UTDRO Associate Director of Residency Research (Dr. Joelle Helou) oversees resident research and mentors trainees to ensure that an appropriate balance is struck between the clinical and research aspects of the program. From 2016 to 2020, there were 199 peer-reviewed papers from current or recently graduated residents. Dr. Jennifer Kwan is an example of someone who has successfully combined a radiation oncology residency with a PhD completed in Dr. Fei-Fei Liu's laboratory. She was awarded a prestigious CIHR Vanier Canadian Graduate Scholarship in 2019 and has published in leading journals, including *Nature Reviews Drug Discovery*, *Nature Communications*, *JAMA Network Open*, *CMAJ*, *IJROBP*, *J Clin Immunol*, *Intl J Cancer*, *Computational Biol Med*, and *Scientific Reports*.

UTDRO is also home to approximately 30 radiation oncology clinical research fellows each year from around the world. This program provides further clinical and/or research training to new radiation oncologists who recently completed clinical training in their home country. UTDRO offers two

fellowship tracks for those interested in pursuing academic radiation oncology: (i) a one-year clinical research fellowship with involvement in one or more research projects without formal graduate training; and (ii) a two-year research fellowship with formal graduate education in the principles and conduct of scientific research. The latter requires concomitant completion of a graduate degree (generally an MSc) through the U of T School of Graduate Studies. Fellows in this track have 80% protected time for research. UTDRO fellows have gone on to establish independent research careers that are changing the radiation treatment paradigm in Canada and abroad. Dr. Mei Ling Yap is an example of a recent UTDRO fellow (2011-2013), now in Sydney Australia, who has leveraged her fellowship experience to become an internationally recognized young leader in health services research and global health with a particular focus on building capacity for radiation treatment in underdeveloped parts of the world. UTDRO fellows published over 100 peer-reviewed papers between 2016 and 2020.

UTDRO clinical faculty members can supervise research conducted by clinical trainees, but not graduate students (MSc or PhD) without cross appointment to another university department or institute affiliated with the U of T School of Graduate Studies. There are currently 43 UTDRO faculty members with a graduate school appointment through the Institute of Medical Sciences, Department of Medical Biophysics, or Institute of Biomedical Engineering. An additional 16 faculty have adjunct appointments at Ryerson University or York University. Over the past five years, UTDRO faculty members were primary thesis supervisors or participated as advisory committee members for 230 graduate students.

Historically, many UTDRO medical physicists have not had graduate school appointments and have not been able to supervise graduate students. This has been a significant impediment to academic productivity. Through a new collaboration between the Princess Margaret and the U of T Department of Medical Biophysics (MBP), five physicists were cross appointed to MBP in 2020. They will have partial salary support for five years to ensure protected time for research. This is a model, which if successful, can be expanded in the future. A CAMPEP-approved medical physics PhD program is currently being developed.

Transdisciplinary engagement is a cornerstone of radiation medicine research and a priority within UTDRO. Diversity of professional background and clinical/scientific expertise is a strong driver of transdisciplinary engagement and is embedded in the research training experience of clinicians and scientists at all levels. The UTDRO STARS21 Radiation Research Training Program exemplifies this model of transdisciplinary research. This program was initiated in 2003 and is designed to provide residents, clinical fellows, graduate students, and postdoctoral fellows with the essential skills to conduct innovative translational and transdisciplinary radiation medicine research, as well as the leadership and collaboration proficiencies necessary to define them as future leaders in Canada's biomedical community. The program facilitates the integration of trainees in various fields such as biology, genomics, chemistry, pharmacology, informatics, health policy, medical physics, radiation oncology, imaging, biostatistics, and clinical outcomes research, within a learning community that resembles the transdisciplinary nature of today's team-based science. From 2016-2021, 74 trainees (14-19 per year) participated in the program and published 161 peer-reviewed papers.

The UTDRO Research Day is held annually to celebrate the research accomplishments of all UTDRO trainees. It is one of the highlights of the UTDRO academic year and an important opportunity to highlight the diverse and innovative accomplishments of our trainees. The most impactful projects are acknowledged with special awards. In addition, the Bernard J. Cummings Award for Research Excellence is awarded annually to a UTDRO trainee who, over the course of his/her affiliation with

UTDRO, has demonstrated sustained excellence in research and is deemed most likely to have a major influence on radiation medicine research or clinical practice.

INTERNAL & EXTERNAL RELATIONSHIPS

Across its programs, UTDRO values partnerships and collaborations with other University of Toronto departments, government groups, professional organizations, and other academic institutions across all constituencies. Over the last five years, UTDRO has continued to nurture and expand its national and international partnerships with various institutions. Within the UTDRO campuses, it has played a significant role in enhancing both the clinical and academic ambitions of Simcoe Muskoka Regional Cancer Program in Barrie, Stronach Regional Cancer Centre in Newmarket, as well as Carlo Fidani Regional Cancer Centre in Mississauga. Locally, our faculty is engaged with many cognate departments in collaborative research and education programs. Perhaps the strongest collaborations are with the Departments of Head and Neck Otolaryngology, Gynecologic Oncology, Neurosurgery, and Medical Oncology with multiple translational and clinical trial research studies. Many of our faculty members are cross appointed to other university departments, such as Medical Biophysics (MBP), IBBME (Institute of Biomaterials and Biomedical Engineering), IMS (Institute of Medical Science), IHPME (Institute of Health Policy, Management and Evaluation), and ICES (Institute of Clinical Evaluative Sciences), to name a few.

Through our strong relationship with Ontario Health-Cancer Care Ontario (OH-CCO), members of our faculty are engaged in provincial and national efforts to improve the quality of modern radiation therapy through their leadership in quality initiatives within OH-CCO, CARO (Canadian Association of Radiation Oncology), and CPAC (Canadian Partners Against Cancer). UTDRO faculty also provides extensive teaching and mentorship to our provincial colleagues in the deployment of intensity-modulated radiation therapy (IMRT) and image-guided radiation therapy (IGRT) programs. OH-CCO has Community of Practice (CoP) initiatives across the province for multiple disease sites, which are led by our faculty. UTDRO faculty has also provided leadership in multiple practice guidelines for OH-CCO Program in Evidence-Based Care. These projects align the UTDRO and OH-CCO mission to promote access to high quality clinical care for all patients across the province.

UTDRO maintains a strong presence internationally through a variety of projects, such as partnerships through the Academic Model Providing Access to Healthcare (AMPATH), with the University of Indiana and Moi University in Eldoret, Kenya, to work towards increasing radiation capacity in Kenya. UTDRO has also established partnerships to educate and train radiation therapists in Ethiopia through the Toronto Addis Ababa Academic Collaboration (TAAAC) and Michener Institute of Education at UHN. Finally, Dr. Rebecca Wong has initiated a Clinical Research Mentorship Program (CRMP) with cancer centres based in Ghana, Zimbabwe, and Nigeria. More recently, UTDRO faculty have partnered with the University of Hong Kong-Shenzhen Hospital in China to build local clinical and research capacity in radiation medicine, as well as with the International Atomic Energy Agency (IAEA) to support radiation oncology collaborations. The principle of many of these international projects is based on leveraging existing partnerships through the Temerty FoM at U of T (e.g. AMPATH, TAAAC), as well as strong linkages through previous trainees. Many UTDRO faculty also hold major international professional organization leadership positions, making significant contributions to advancing the field of radiation medicine on a global scale (Appendix 8.1).

One highlight is Dr. Mary Gospodarowicz's important leadership role within the Union for International Cancer Control (UICC) in the International TNM Project for promoting a harmonized staging system for cancer categorization across the globe. This decades-long project also has active involvement from

many other faculty members, such as Drs. Brian O'Sullivan and Jim Brierley. In her role as the President (2012-2014) and Past-President (2014-2016) of UICC, Dr. Gospodarowicz also created the Global Task Force on Radiotherapy for Cancer Control (GTFRCC), which made a compelling argument for investment in radiotherapy resources in low- and middle-income countries based on economic analyses. This legacy project recruited the participation of many staff and trainees within UTDRO, and produced several high impact publications (doi.org/10.1016/s1470-2045(15)00222-3; doi.org/10.1016/S1470-2045(15)00285-5; doi.org/10.1016/j.clon.2016.11.009; doi.org/10.1016/s1470-2045(19)30308-0), as well as GlobalRT, a GTFRCC Young Leaders initiative led by Dr. Danielle Rodin; thereby raising awareness of this very important issue across the globe.

Over the last five years, UTDRO has continued to nurture collaborations and a sense of community amongst its six affiliated cancer centres (Princess Margaret, Odette, Southlake, Carlo Fidani, Simcoe Muskoka, Durham). While the emerging close and collaborative relationship between UTDRO and the community clinics was evident in the 2017 External Review, the relationship between the two main sites (PM and OCC) was noted as a significant strategic risk to UTDRO. It was remarked that the underlying tension between the two sites was not abating (this was also noted in the 2006 and 2011 external reviews), and the resulting issues of morale, declining relationships, and the potential loss of future academic productivity and growth should be resolved at the highest strategic level. The reviewers suggested that the main institutions (U of T, PM, OCC) strike a task force at the Decanal/CEO level to address the Odette/Princess Margaret relationship to ensure the Chair can collaborate effectively to advance the academic mandate of UTDRO. In response to these recommendations, the current Chair, Dr. Fei-Fei Liu, has continued to attempt to meet with Odette leadership and faculty on a regular basis; organize monthly meetings with the Temerty FoM Dean and Chief of OCC DRO; as well as promote communication, address misunderstandings, and increase engagement with the Odette site. Discussions were also undertaken in collaboration with the Dean to establish the Executive Vice Chair role for the Chief of OCC in 2017. As well, the Chair has recently appointed faculty from OCC into two key Vice Chair roles in 2021; namely, Dr. Eileen Rakovitch as the new Vice Chair of Clinical Affairs, and Dr. May Tsao as the new Vice Chair of Education.

Despite these challenges, there has been several examples of effective collaboration across the two sites since the last review. As described in the Continuing Professional Development Activities section, both sites worked tirelessly to establish a new Royal College-accredited Brachytherapy Area of Focused Competency (AFC) Fellowship Program, as well as a new two-day UTDRO CPD course entitled "Technological Innovations in Prostate Cancer Radiotherapy" in 2018. More recently, PM and OCC have developed a new MRgRT Training Program for radiation therapists in partnership with Elekta to be launched in 2022.

Building a strong strategic relationship between the two organizations continues to be a work in progress as it remains a barrier to the department realizing its full academic potential. Building on the commonalities of each academic institution in a manner that synthesizes an improved culture of trust and collaboration remains a priority for the current and next UTDRO Chair.

Program-Specific Partnerships in Education and Training

Many of the academic programs at UTDRO flourish with the ongoing relationships with several internal and external groups. These include departments within the University of Toronto, government agencies, professional organizations, and groups at international centres.

Medical Radiation Sciences Program

The undergraduate Medical Radiation Sciences (MRS) Program is funded by the Ministry of Health and Long-Term Care (MOHLTC), and is administered by two different academic institutions, which also relies on several different groups to deliver its curriculum. The UTDRO and the Michener Institute of Education at UHN co-lead this program. At the Temerty FoM, UTDRO seeks input and reports to the Vice Dean MD Program. Enrollment support is provided by the Undergraduate Medical Education Office, and student counseling is provided by the Office of Health Professions, Student Affairs, and the VP of Relations with Health Care Institutions. Some of the course content is created with assistance from the Department of Physiology, Department of Pharmacology and Toxicology, and Division of Anatomy. Other internal partners include the Medical Radiation Sciences Society which represents the student body, Council of Health Sciences, Office of the Vice Provost, students (WSIB, student incidents), and of course, the teaching faculty from both the Princess Margaret and Odette Cancer Centres.

The MRS Program also has relationships with the Centre for Interprofessional Education (UHN/U of T), and the Hospital/University Education Committee (TAHSN/U of T). Previous external reviews had indicated a lack of engagement with the medical imaging community. Upon appointment, the current UTDRO Chair (Dr. Fei-Fei Liu) immediately sought to enhance the involvement of medical imaging within the MRS Program. The Joint Department of Medical Imaging (JDMI) at University Health Network (UHN) was keen on collaborating with the MRS Program formally to develop an innovative and progressive curriculum. Leadership from JDMI have since become key contributors to the revised Governance Structure, which was further enhanced by the merger between UHN and Michener in January 2016 to form the Michener Institute of Education at UHN. For the MRS 2.0 curriculum renewal project, JDMI was instrumental to the overall success as they contributed a Project Management Team from their Strategy and Quality division. Over the last few years, the MRS Program has assisted with building research and education capacity within JDMI, by collaborating with individuals to develop research and teaching skills. This relationship continues to grow and flourish.

Additional external groups that provide important support for the program include: all the fully- and community-affiliated teaching hospitals/centres for the clinical placement of MRS students (MRS has close to 40 affiliations with clinical partner sites), Canadian Medical Association (Accreditation – until February 2018), and many external teaching faculty for selectives, subspecialty, and research courses.

The MRS Program has entered into agreements with several provinces to help with their health human resource strategies, especially for Radiation Therapy. The MRS Program has affiliation agreements with Saskatchewan Cancer Agency, Horizon Health Network (New Brunswick), and Eastern Health – Cancer Care Program (Newfoundland and Labrador). These provinces have funding opportunities available for successful applicants to complete the clinical placements in those provinces. Students complete the didactic requirements first in Toronto, and then return to their provinces for the clinical practicums.

Radiation Oncology Residency Program

The Radiation Oncology Residency Program is under the remit of the Office of the Dean of Postgraduate Medical Education (PGME) in the Temerty FoM at U of T. Residency training is funded by the MOHLTC, and training takes place at the Princess Margaret, Odette, and Southlake Regional Cancer Centres, Royal Victoria Regional Health Centre, Credit Valley at Trillium Partners, and SickKids Hospital. This program also has an inter-university agreement with Queen's University, University of Ottawa, and McMaster University wherein trainees from these three institutions complete part of their training at UTDRO's teaching hospitals.

Funding for visa trainees originates from their home country with an expectation of returning to service at the completion of training and is coordinated by the PGME. For specific areas of expertise within the residency training program and academic hospitals, there are inter-university agreements to allow residents from external residency programs to attend UTDRO for required elements of training. Examples of such arrangements include paediatric radiation oncology rotations at UTDRO for Queen's University residents. Within University of Toronto, residents from other subspecialties rotate through UTDRO programs, such as those from pathology, palliative care, medical oncology, gynaecology oncology, surgical oncology, internal medicine, emergency medicine, otolaryngology, radiology, urology, urgent care, medical genetics, and respirology. Radiation oncology is increasingly incorporated into medical students training both for career sampling and transition to residency.

Medical Physics Residency Program

The Medical Physics Residency Program is an integral education component of UTDRO; operated within the radiation programs at both the Odette and Princess Margaret Cancer Centres. Under a formal affiliation agreement with U of T, the Residency Program is also operated at three neighboring clinics (Southlake Regional Cancer Centre in Newmarket, Durham Regional Cancer Centre at Lakeridge Health in Oshawa, and the Carlo Fidani Regional Cancer Centre at Credit Valley Hospital in Mississauga) that share close ties with the two main sites. Medical physics residents are enrolled at the U of T and are employed in the radiation programs at their main clinical site. Residents may spend some time at other sites for specific rotations that cannot be offered at their home site. Salaries and benefits are paid according to the policies of the assigned clinical site. The MOHLTC partially funds the Residency Programs at all Ontario Cancer Centres.

Radiation Oncology Fellowship Program

The Radiation Oncology Fellowship Program works closely with both of the major clinical sites of the PM and Odette Cancer Centres, in addition to SickKids Hospital. Internationally, the Fellowship Program has fostered relationships with the Saudi Cultural Bureau, Kuwait Cultural Bureau, Chaim Sheba Medical Centre, Pontifica Universidad Catolica de Chile, King Hussein Cancer Centre (Jordan), and the RamBam Health Care Campus in Haifa, Israel. These relationships have been critical in attracting top ranked trainees, and even junior faculty, into our UTDRO Fellowship Program.

Undergraduate Medical Education Program

UTDRO actively participates in undergraduate medical education (UME) within the Temerty Faculty of Medicine at U of T. The core departments of UTDRO are distributed across two academic cancer centres within the City of Toronto, while faculty from the community UTDRO sites also participate in UME teaching in the Greater Toronto Area (Table 16). The University of Toronto MD Program administers its hospital-based teaching through four academies. Three of these four are relevant to UTDRO based on the locations of the two cancer centres. Undergraduate medical students who are on-site at the Princess Margaret and Odette Cancer Centres register with the Wightman-Berris and Peters-Boyd Academies, respectively.

The majority of teaching occurs in the clinical setting with students rotating amongst faculty members in one- to six-week rotations. Students participating in these rotations do so within a number of programs administered by the Temerty Faculty of Medicine and other national and international medical schools. Our faculty also contribute to formal, didactic undergraduate medical student teaching both through the Wightman-Berris and Peters-Boyd Academies, and the Mississauga Academy of Medicine, as well as to the MD Program as a whole through “Cancer Week” in the Year-2 curriculum. The Foundations Program

(Years 1 and 2, junior medical students) and clerkship teaching (Years 3 and 4, senior medical students) are delivered in partnership with various internal and external organizations, including the Oncology Interest Group (OIG) at U of T, Association of Faculties of Medicine in Canada (AFMC), Western University, and McMaster University.

CLINICAL REPORTS

Princess Margaret Cancer Centre

Program Overview

The Radiation Medicine Program (RMP) at the Princess Margaret (PM) Cancer Centre is comprised of 37 radiation oncologists, 30 medical physicists, and 196 radiation therapists. There are 4 nurse practitioners, 6 clinical specialist radiation therapists, 2 physician assistants, 21 clinical research program staff, 1 radiation therapy clinician scientist, >115 support staff, and numerous trainees and students in all disciplines. The clinical program is organized by clinical sites, namely lung, breast, GI, GU, CNS, head and neck, gynecological, lymphoma, skin, endocrine, eye, and pediatric. Specialized programs include the brachytherapy, stereotactic radiation therapy, oligo-metastases, gamma knife radiosurgery, pediatric radiation therapy, and palliative radiation oncology program (PROP). Given the common planning and treatment delivery aspects of different anatomical regions, our multidisciplinary clinical teams are organized into four super teams to ensure best practices for clinical decision-making.

The RMP clinical space houses 16 linear accelerators, a state-of-the-art Magnetic Resonance-guided Radiation Therapy (MRgRT) facility, MR-LINAC Unity (MRL), two Leksell Gamma Knife Perfexion units, one orthovoltage unit, 1 PET CT, 1 MRI 3T and 3 CT simulators, rendering it the largest radiation treatment centre in Canada, and second largest in North America. Our facility is globally unique with two MR-guided radiotherapy options, the MRgRT and MRL technologies, housed under the same roof. RMP also has the world's largest deployment of the RayStation Treatment Planning System, and is home to numerous innovative systems including, but not limited to: AutoPlanning (AI-driven automated treatment planning system licensed to RaySearch Laboratories), AQUA (clinical QA software platform acquired by Elekta), and EVOQ (automated QA system for radiation therapy plans).

Our multi-talented, interprofessional staff enables all aspects of our program to succeed. Led by the Program Chief, Dr. Fei-Fei Liu, the RMP Steering Committee defines the principles of operation, and policies of governance for the management of clinical, quality assurance and safety, research, educational, operational and IT activities.

Program Leadership

- Chief, RMP: Dr. Fei-Fei Liu

The structure of the RMP Steering Committee (Figure 22) is comprised of: Colleen Dickie (Director, Operations); Daniel Letourneau (Interim Head, Medical Physics); Tim Craig (Interim Associate Head, Medical Physics Clinical Affairs), Michael Milosevic (Director, Research); Rebecca Wong (Director, Education); Richard Tsang (Director, Clinical Operations); Elen Moyo (Director, Radiation Therapy); Derek Tsang (Director, Resource Allocation); John Waldron (Director, Quality and Safety); John Kim (Director, Strategy); Catarina Lam (Manager, RMP); Emma Ito (Lead, Analytics & Development); Keith Stewart (Vice President, Cancer and Director, Princess Margaret Cancer Program, UHN). Dr. Jan Seuntjens was recently recruited as the Head of Medical Physics at the Princess Margaret (starting full-time on September 1, 2021).

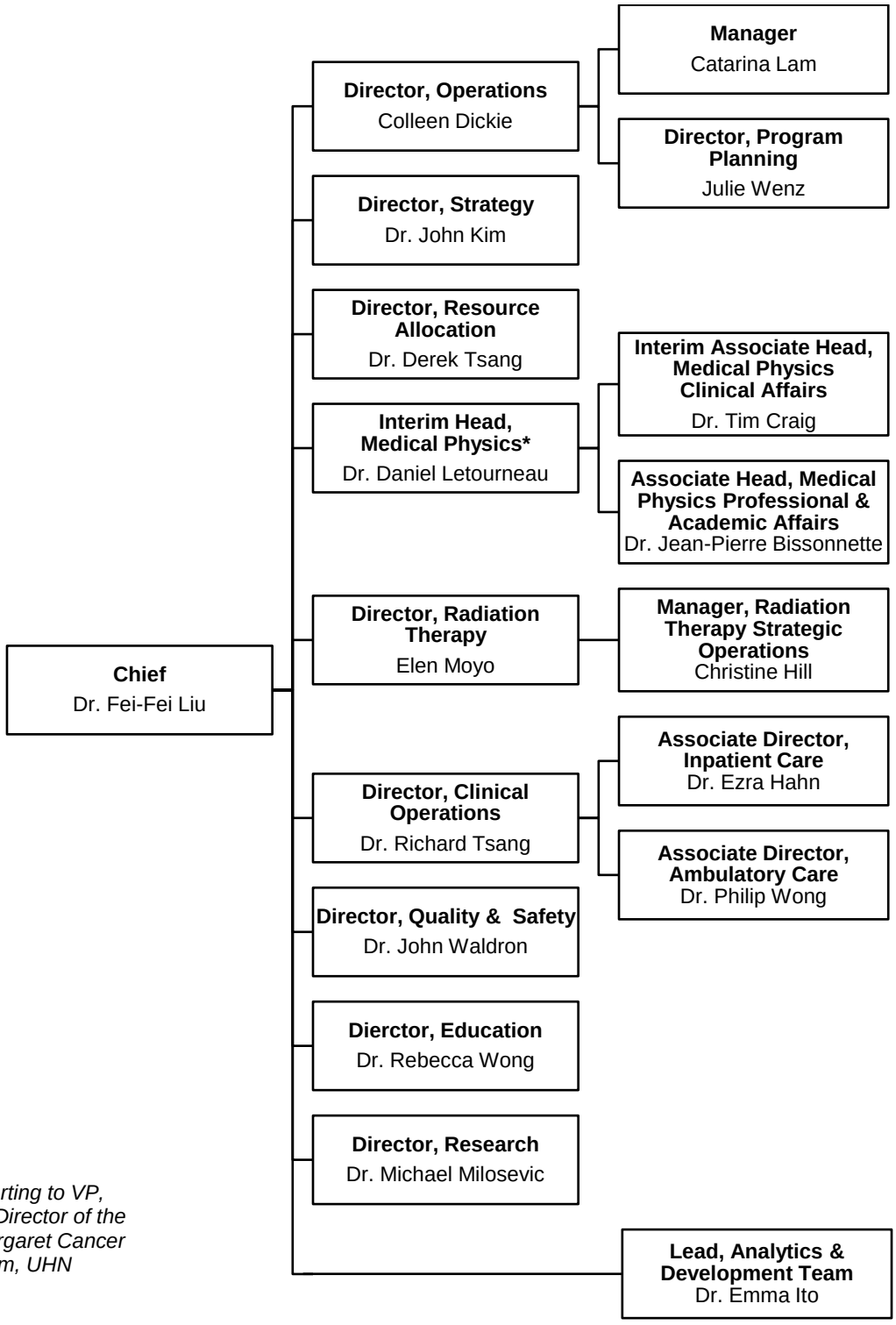

Figure 22: RMP Leadership Structure

The structure, terms of reference, membership, reporting structure, and meeting frequency of all RMP committees were examined and revised in the recent few years. Committees that report directly to

Steering are RMP Quality, Education, Operations, Research, and Radiation Safety. Committees that report to RMP Operations include Imaging, External Beam, Interventional RT Processes, Data and Technology, and DRO, Physics and Therapy Operations.

Innovations

RMP maintains a fleet of state-of-the-art equipment to enable high precision image-guided RT, including daily image guidance in all sites. RMP has kept pace with advancing technology with critical investments in equipment and facilities, which have significantly improved treatment innovation and capacity within the program.

In November 2017, RMP treated its first mask-based patients on the new Gamma Knife Icon, which was invented by Dr. David Jaffray and his team at the Princess Margaret. The ICON has allowed RMP to deliver frameless stereotactic fractionated radiotherapy, thereby allowing patients to be treated more comfortably, and larger tumours to be targeted more effectively. RMP has been able to expand the use of the Gamma Knife to a cohort of patients with primary CNS tumours, with dose distributions that are tighter than previously possible.

A team led by Drs. Thomas Purdie and Chris McIntosh developed AutoPlanning, a novel artificial intelligence (AI) technology for automated radiation therapy treatment planning. RT treatment plans generated manually can take hours or days. With AutoPlanning, plans can be ready for review within minutes, generating highly personalized plans best suited for each patient. This new technology allows the radiation team to plan more complex cases, and provide precision medicine to more patients. Based on its success, the AutoPlanning AI technology was licensed to RaySearch Laboratories in 2017 for incorporation into RaySearch's RayStation treatment planning system. A recent scholarly examination of AI planning for prostate cancer led to a *Nature Medicine* publication (doi.org/10.1038/s41591-021-01359-w), demonstrating that practitioners were less inclined to recommend an AI *vs*. human-generated plan, suggesting ongoing challenges with broad implementation of machine-based systems for clinical application.

RMP deployed the world's largest installation of RayStation, a next generation treatment planning system in 2019. Led by Dr. Tim Craig, all external beam treatment planning protocols were migrated to RayStation as of May 2019. RMP now has a platform that can support current state-of-the-art and future planning activities, including dose reconstruction, adaptive radiation therapy, and proton therapies.

The MR-LINAC (MRL) facility has been one of RMP's largest recent design-build projects, with more than 50 of our staff involved in its design and commissioning. In September 2019, RMP treated its very first patient on the MRL. This patient with prostate cancer received a new, personalized plan on each day of his treatment. Subsequently, RMP completed the first-ever MRL Liver SBRT treatment in Canada in March 2020. In February 2021, RMP also became the first centre in Canada to complete treatment for a patient with pancreatic cancer on the MRL. This multidisciplinary effort represents a major milestone in advancing precision radiation medicine for patients at the Princess Margaret.

The Case Expert Radiation Therapist (CERT) practice model is currently being rolled out across all disease sites within RMP to enable radiation therapists to deliver adaptive radiation therapy and person-centred care. The innovative model envisions a primary radiation therapist, who functions within the multidisciplinary radiation team, but is engaged in all aspects of the patient's journey, serving as a continuous advocate and steward for the patient through patient education, CT simulation, planning,

treatment delivery, patient care, and symptom management. In 2019, the Person-Centred Radiation Therapy Team, led by Elen Moyo, received the Ontario Association of Medical Radiation Sciences (OAMRS) Team Award for the development and implementation of the CERT practice model.

In 2020, RMP launched its national Proton Therapy Consultation Service led by Dr. Derek Tsang, Dr. Tim Craig, Dr. Victor Malkov, Amy Parent, and Michael Howell. The service will create a proton plan for any referred patient at the request of the patient's local oncologist to provide a quantitative estimate of dosimetric benefit for evaluation and educational purposes. RMP received its first proton consultation referral for a patient outside Ontario in June 2020. As of May 2021, the team has received 13 referrals.

RMP commenced the development and implementation of MOSAIQ Care Plans (CP) and SmartClinic, a mobile oncology workflow management tool in November 2020 to replace its in-house eBooking system. The project was initiated to improve patient and data flow within the program, ensuring alignment of RMP's data elements with Ontario Health's new QBP reporting requirements and to position RMP for a smooth transition into UHN's new Epic HIS. A multidisciplinary CP core team, led by Elen Moyo, Dr. Daniel Letourneau, and Dr. John Waldron, was established to drive this important initiative. Care Plans are anticipated to be fully launched by the end of 2021.

Drs. Srinivas Raman and Philip Wong received a $1.5M grant from the Canadian Supercluster ScaleAI to support their development of an automated radiation therapy (RT) scheduling and prioritization platform in collaboration with IVADO Labs, a software provider with expertise in AI solutions. The AI-powered RT platform will efficiently and automatically assign patients to CT-simulator and treatment appointments, while incorporating patient preferences into scheduling for compassionate care and prioritizing patients for treatment in the event of a bottleneck. This multidisciplinary project was launched in April 2021 and will involve many members of RMP through a newly formed Advanced Analytics and Automation Working Group. Completion of the platform will improve RMP's resource utilization and facilitate our management of potential patient backlogs and treatment delays caused by the COVID-19 pandemic.

In 2020-2021, we refreshed our strategic plan and launched RMP's *Strategic Roadmap for 2026: Revolutionizing Radiation Care through Digital Health* , which renews the core values and vision of our previous *Strategic Roadmap for 2020* and will guide us in our pursuit to improve patient care and outcomes through innovation in research, education, clinical practice, and system operations. Our renewed strategy captures our ambition to become a transformational leader in radiation medicine, while ensuring that our goals and directions are aligned with the strategic plans of the Princess Margaret, University Health Network, University of Toronto Temerty FoM, UTDRO, and OH-CCO. Over the next five years, RMP will push the boundaries of innovation to advance predictive health and adaptive radiotherapy, transform and personalize each patient's journey through digital technology, and build comprehensive programs of excellence for advanced particle therapy and theranostics; all enabled by systems that will maximize the wellbeing of our staff and drive collaboration and innovation in research, education, and clinical care.

Collaborations

Over the past five years, successful collaborations with regional Local Health Integration Network (LHIN) partners (e.g. Unity Health (St. Michael's Hospital, St. Joseph's Health Centre), Women's College Hospital, Southlake Regional Health Centre, Carlo Fidani Cancer Centre, Humber River Regional Hospital, Michael Garron Hospital) and others, with targeted outreach to referring partners

aimed to improve quality of care and access to radiotherapy within the region and beyond (Table 38). Ongoing initiatives to improve utilization, especially for palliation, include relationship building with referring specialists, family physicians and community partners, as well as formalizing existing partnerships.

Over the past several years, RMP staff have actively participated in Multidisciplinary Cancer Conferences (MCCs) at St. Michael's, St. Joseph's, Women's College, Michael Garron, Humber River, William Osler, SickKids, and Mount Sinai. RMP's Breast Site Group physicians continue to attend new patient clinics at St. Michael's. RMP staff provide telehealth consultations to patients across Ontario and other provinces, particularly for patients being considered for SBRT in centres or provinces where SBRT is not readily available.

Table 38: Collaborations with Hospital Partners

Hospital	Activities
Stronach Regional Cancer Centre	• Partnership formalized (MOU signed) in 2007; renewed in 2015 and 2020 • Cross-appointed physicians and medical physicists • Collaborative, multidisciplinary oligo-metastases brain clinic • First-ever joint symposium between RMP and Southlake was held in November 2016
Hospital for Sick Children	• Decades long partnership formalized (MOU signed) in 2016; renewal in progress (2021) • Cross-appointed physicians • New patient clinics • MCC • Inpatient consultations • Pediatric Cancer AfterCare Clinic collaboration • Collaboration for developing a particle therapy facility in Toronto with OH-CCO, MOHLTC, and other provincial leads
Royal Victoria Regional Health Centre	• Partnership formalized (MOU signed) in 2016; renewal in progress (2021) • Cross-appointed physicians (brachytherapy) • Collaboration for delivery of MR-guided brachytherapy for cervix cancer
St. Joseph's Health Centre	• MCCs for breast, GU, GI, hepato-pancreas biliary, thoracic (lung, esophagus)
St. Michael's Hospital	• Partnership formalized (MOU signed) in 2014 • MCCs for breast, GU, GI (combined with SJHC), CNS/pituitary, lymphoma • Breast new patient clinics • Inpatient consultations
Carlo Fidani Regional Cancer Centre	• GYN patients referred to RMP for brachytherapy following external beam treatment • MOU being signed by both institutions (2021) • Cross-appointed physicians • Collaborative, multidisciplinary oligo-metastases brain clinic
Women's College Hospital	• MCCs
Michael Garron Hospital (formerly Toronto East General Hospital)	• MCC for lymphoma since 2014
Humber River Hospital	• MCC for lymphoma since 2016

William Osler Health System	• MCC for lymphoma since 2021
Mount Sinai Hospital	• Integrated oncology program for many disease sites • MCCs for breast and sarcoma • Inpatient consultations

Through our strong relationship with OH-CCO, our staff are engaged in provincial and national efforts to improve the quality of modern radiation therapy through their leadership in quality initiatives within OH-CCO, CARO (Canadian Association of Radiation Oncology) and CPAC (Canadian Partners Against Cancer). RMP members also provide extensive teaching and mentorship to our provincial colleagues in the deployment of intensity-modulated radiation therapy (IMRT) and image-guided radiation therapy (IGRT) programs. RMP has sustained leadership in the IMRT QA Program; the program was extended for an additional 3 years to 2021. The OH-CCO Radiation Treatment Program (RTP) has Communities of Practice (CoP) initiatives across the province for multiple disease sites, many of which are led by our staff. RMP staff are also currently involved in the OH-CCO Relationship, Body Image, and Intimacy (RBI) Project (pilot started in June 2019) aimed at addressing the barriers that radiation therapists face when initiating or having RBI conversations with cancer patients. RMP members have also provided leadership in multiple practice guidelines for the OH-CCO Program in Evidence-Based Care. These projects align the missions of RMP and OH-CCO to promote access to high quality clinical care for all patients across the province.

In alignment with MOHLTC's Health System Funding Reform strategy, RMP is working closely with OH-CCO to develop and implement the Radiation Treatment Quality Based Procedures (RT-QBP) funding model. Targeted to fully roll out by 2022, RT-QBP is expected to drive consistent, equitable, and high-quality care for patients being treated with RT across Ontario. Many RMP staff are currently involved in various OH-CCO RT-QBP Expert Panels, Working Groups, and the Advisory Committee.

For decades, all the pediatric patients from SickKids requiring radiation therapy have received their treatments at the Princess Margaret/UHN. With recent advancements in proton beam therapy (PBT) technology, the Princess Margaret/UHN and SickKids have formed a partnership, in conjunction with OH-CCO and the Pediatric Oncology Group of Ontario (POGO) to jointly advance the agenda of developing Canada's first hospital-based PBT facility in downtown Toronto. In November 2018, RMP hosted the first-ever Ontario Proton Therapy Symposium in collaboration with the University of Toronto, SickKids, and POGO. The symposium, entitled "A Vision for Proton Therapy in Ontario" aimed to increase awareness of proton therapy and facilitate access to this important treatment option for cancer patients across Ontario. Hospital leaders, government administrators, and healthcare providers from MOHLTC, CCO, UHN, SickKids, POGO, and nine cancer centres across Ontario attended the well-received event. In February 2021, OHTAC (Ontario Health Technology Advisory Committee) released its recommendation to publicly fund PBT for pediatric cancers and a subset of adult cancers requiring curative radiation therapy in Ontario. MOHLTC has also approved a PBT Planning Grant in March 2021 for which UHN has stewardship/responsibility to lead the development of a Phase I Planning Proposal in collaboration with partners at OH-CCO, SickKids, and POGO.

RMP maintains a strong presence internationally through a variety of projects, such as partnerships through the Academic Model Providing Access to Healthcare (AMPATH), with Indiana University and Moi University (Eldoret, Kenya), to work towards increasing radiation capacity in Kenya. RMP is supporting the development of a BSc Radiation Therapy Training Program in Ethiopia through the

Toronto Addis Ababa Academic Collaboration (TAAAC). The Princess Margaret/UHN has contracts with the Shenzhen Municipality to improve cancer service delivery in Shenzhen, China, respectively.

Over the past 5 years, RMP has made a deliberate effort to formulate partnerships focused on collaborative, interdisciplinary clinical care, research, and education that are relevant to the general radiation treatment and cancer care communities in Canada and abroad. Within the UTDRO community, RMP has continued to nurture its relationship with Odette. Effective collaborations include establishment of a new Royal College-accredited Brachytherapy Area of Focused Competency (AFC) Fellowship Program, a new two-day UTDRO CPD course entitled "Technological Innovations in Prostate Cancer Radiotherapy", and a new MRgRT Training Program in partnership with Elekta that will be launched in 2022.

Research collaborations with other academic and industry-based research groups within UHN and the Princess Margaret (e.g. TECHNA Institute, Spatio-Temporal Targeting and Amplification of Radiation Research (STTARR) Facility, OICR), as well as with external partners including national and international clinical trial groups (e.g. CCTG, RTOG, Ontario Clinical Oncology Group), Institute for Clinical Evaluative Sciences (ICES), OH-CCO and numerous industry partners (e.g. Elekta, Varian, RaySearch) have increased the program's research capacity, innovation, and competitive advantage. In 2018, RMP joined the international Elekta MRL Consortium to contribute to the Technical Working Groups and Tumour Site Groups. RMP staff are currently leading the development of liver treatment techniques within this MRL Consortium. RMP's research portfolio is closely aligned with that of UTDRO. The UTDRO Collaborative Research Seed Grant Program has enhanced research collaborations with Odette and Stronach, as well as the Simcoe Muskoka and Credit Valley Cancer Centres.

Faculty

Over the past five years, RMP continued to exhibit excellence, innovation, and leadership in patient-centred care, research, and education, exemplified by the high level of productivity and achievements of our staff. Many of our faculty hold or have held major local, provincial, national, and international professional organization leadership positions (Appendix 8.1). Notable internal appointments have included: PM Medical Director (Dr. Mary Gospodarowicz); Chair of UHN Medical Advisory Board (Dr. Fei-Fei Liu); PM Site Group Leaders for CNS, Lung, Head and Neck, Endocrine, Upper GI, Breast, and GU; UHN MSA leadership (Dr. John Waldron); Executive Vice President of UHN Technology and Innovation (Dr. David Jaffray); Program Lead of PM Fitzhenry Brain Metastasis Program (Dr. David Shultz); Director of PM Cancer Education (Dr. Meredith Giuliani); Medical Director of PM Data Science, Outcomes, and Smart Cancer Care (Dr. Alejandro Berlin); Director of PM Global Cancer Program (Dr. Danielle Rodin); inaugural PM Allied Health Clinician Scientist (Dr. Michael Velec); and Research and Development Leader for JDMI and RMP (Dr. Tara Rosewall), to name a few.

Notable external appointments have included those at OH-CCO: Provincial Head of RTP (Dr. Padraig Warde); Ontario Head and Neck Cancer Lead (Dr. John Kim); RTP Physics Clinical Quality Lead (Dr. Jean-Pierre Bissonnette); and leaders of various OH-CCO Community of Practice (CoP). Other leadership positions include, but are not limited to: ASTRO President (Dr. Laura Dawson); CARO President (Dr. Jolie Ringash); Alternate Provincial Director on the Canadian Association of Physician Assistants Board of Directors (Maitry Patel); POGO Medical Director (Dr. David Hodgson); Chair of Royal College Radiation Oncology Specialty Committee (Dr. Barbara-Ann Millar); CPQR Chair (Dr. Michael Milosevic); NCIC-CTG (now CCTG) Chairs or Co-Chairs of various committees (e.g. Lung,

Sarcoma, Symptom Control, Esophageal, Head and Neck, QoL, Testis); Co-Chairs of UICC TNM Staging Committee (Drs. Mary Gospodarowicz and Jim Brierley); and UICC Board of Directors (Dr. Danielle Rodin).

Additional faculty achievements and program highlights are described in our Annual Reports.

Continuing Education Programs

The Radiation Medicine Program at the Princess Margaret offers a wide range of interdisciplinary opportunities and programs that cater to practicing radiation medicine professionals, who seek to gain informal or structured learning experiences within our clinical environment at the Princess Margaret. RMP's continuing medical education (CME) program provides offerings in various formats designed to reach our peers locally, nationally, and internationally.

The award-winning Accelerated Education Program (AEP) is an educational platform within RMP that is endorsed and supported by UTDRO and its faculty. Its mandate is to deliver timely and accessible educational content to improve the quality of radiation therapy locally and across the globe. AEP delivers multiprofessional courses, typically 1-3 days in duration, focused on ahead-of-the-curve practice topics (e.g. lung image guidance (IG)/SBRT, liver IG/SBRT, head and neck IG/IMRT, paraspinal SBRT, CNS IGRT, SABR for oligometastases, intracranial fSRS). AEP also offers an annual Accelerator Technology Education Course (ATec), which was launched in 2012. The course has been identified by the Canadian Nuclear Safety Commission as a mandatory training element for its new employees in the Accelerator Regulation Division. Since 2016, a total of 17 on-site and "on the road" education courses have been held (total of 71 courses since AEP's inception in 2006). These 17 courses were attended by 504 radiation medicine professionals locally, nationally, and internationally.

In addition to AEP, there are numerous rounds held weekly at the Princess Margaret. Members of the department also participate in UTDRO Rounds and conferences, as well as CME events locally, nationally, and internationally, both as faculty and as participants.

Performance Indicators

In fiscal year 2020-2021, RMP delivered 8,312 patient consultations and 11,016 courses of radiation therapy. There were 4,401 visits to the Radiation Nursing Clinic for symptom control during radiotherapy. Wait times are tracked and reported to OH-CCO. RMP continued to meet the majority of the OH-CCO Performance Measures, and provincial averages for wait times, and peer review in 2020. Compliance with the Referral to Consult 14-day target was stable at a monthly average of 82% (exceeding OH-CCO target of 80%). Compliance with the Ready to Treat to Treatment Start 14-day target was stable at a monthly average of 89% (exceeding OH-CCO target of 85%). The peer review rate for curative courses for the calendar year was 93% (exceeding OH-CCO target of 75%).

RMP builds upon a strong foundation of scientific discovery that has enhanced cancer care in Toronto and beyond. The program is internationally recognized as a "powerhouse of innovation" and is unique in its engagement of varied disciplines in research, including radiation oncologists, medical physicists, radiation therapists, and trainees. The breadth and depth of research continues to be exemplary, spanning biological studies, translational biology and physics, clinical trials, to health services and education research. The average over the past 3 years has been approximately $46M in peer-reviewed funding annually, 269 peer-reviewed publications per year, and 151 active prospective clinical studies annually.

On average, RMP held 136 peer-reviewed grants per year and approximately 9% of new patients have been accrued to prospective clinical research studies annually.

RMP continues to recruit highly qualified new Clinical Investigators and Clinician Scientists to build capacity in priority research areas, including radiogenomics, radiomics, adaptive MR-guided radiotherapy, proton therapy, theranostics, data science/machine learning, and global health. Dr. Scott Bratman, who started on faculty at the Princess Margaret in 2016 as a Clinician Scientist, has just launched his start-up company focused on circulating methylation biomarkers (Adela), which captured $60M in investor funding; a first in the history of radiation oncology.

The program has also established strong collaborations locally within UHN and the Toronto biomedical community, as well as nationally and internationally, increasing the program's research capacity, innovation, and competitive advantage.

Odette Cancer Centre – Sunnybrook Health Sciences Centre

Program Overview

Sunnybrook Health Sciences Centre (SHSC) is fully affiliated with the University of Toronto. The Odette Cancer Centre (OCC) is the comprehensive cancer program of SHSC and houses one of North America's largest and dynamic radiation oncology programs (OCC DRO). SHSC provides an exciting and innovative research environment for radiation oncologists to work alongside a diverse team of healthcare professionals, which include 30 radiation oncologists. In 2019, over 8500 new radiation oncology patients were seen at OCC, which is currently equipped with 13 linear accelerators, a Gamma Knife unit, two MR planning centres, and Canada's first Elekta MR-LINAC. The OCC offers advanced clinical and research programs in IMRT, IGRT, brachytherapy, SRS, and SBRT and has a Medical Physics Department comprised of over 40 members and a Radiation Therapy Department with 135 staff. Infrastructure enhancements in place, as summarized below, include a MR brachytherapy suite, Gamma Knife Icon unit, and the world's only combined focused ultrasound MR-LINAC unit.

Program Leadership

OCC DRO Program Leadership:

- Dr. Gregory Czarnota (Chief)
- Dr. Arjun Sahgal (Deputy Chief, Technology, Infrastructure and Physics)
- Dr. Danny Vesprini (Deputy Chief, Clinical Care)
- Program Directors: Drs. Alex Louie (SBRT), Hans Chung (Brachytherapy), Hany Soliman (Education)

DRO Site Group Leads:

- Drs. Irene Karam (Breast), Zain Hussain (Head and Neck), Arjun Sahgal (CNS), Hans Chung (GI), Andrew Loblaw (GU), Eric Leung (GYN), Larry Paszat (Haem), Patrick Cheung (Lung), Toni Barnes (Skin)

Medical Physics Leads:

- Dr. Stephen Breen (Head of Medical Physics)
- Dr. Annie Hsui (Deputy Head)

Radiation Therapy Leads:

- Steve Russell (Manager and Head)
- Donna Lewis (Supervisor)
- Linda Easton (Supervisor)
- Francois Gallant (Supervisor)
- Darby Ehrler (Professional Practice Lead)

Innovations

The following are significant infrastructure innovations at OCC in the last 5 years:

- A major program for advanced image guided-radiotherapy has been in development, centred on Gamma Knife Icon technology, combined focused ultrasound MR-LINAC technology, and an integrated MR brachytherapy suite. This program represents a $25M investment within OCC for research and development.

- The Gamma Knife Icon represents the 14th unit at the OCC, expanding the complement by one radiation delivery unit. Two high-throughput AI planning-driven Varian Halycon units have recently been acquired in addition to a second MRI-guided focused ultrasound device.

In addition, the following significant program innovations occurred at OCC in the last 5 years:

- One of the primary clinical and academic foci over the past 5 years has been stereotactic body radiotherapy (SBRT). The SBRT Program has clinical and research programs within each major discipline (e.g. Prostate, Pancreas, Liver, CNS). OCC also has an active Oligometastases Program. Several clinical trials and academic partnerships have been developed for outcome studies.
- The Cancer Ablation Therapy (CAT) Program led by Dr. Arjun Sahgal has been instrumental in identifying the OCC DRO as an emerging leader in advanced radiation. The program has active research programs related to the Gamma Knife Icon, MR brachytherapy suite, and MR-LINAC.
- In conjunction with the MR-focused Ultrasound Program, radiation oncology has developed several new programs aimed at integration of radiation with this novel technology. World firsts in brain tumours, rectal cancers, and head and neck cancer have resulted in active research programs.
- The Brachytherapy Program continues to expand. With the addition of Dr. Eric Leung, an Interstitial GYN Brachytherapy Program is continuing to grow with provincial leadership in helping to develop similar programs in other regional centres.
- Ultrasound-mediated therapy response detection continues to be a hallmark of the cancer research program with first-in-human testing commencing in 2017. Collaborative studies continue with the Princess Margaret and MD Anderson Cancer Center (MDACC) to test this novel technology. These approaches have been expanded to a Radiomics Program focused on innovations in ultrasound, CT and MR imaging for therapy response prediction and monitoring.

Collaborations

The OCC DRO has continued to provide regional leadership in cancer care, which is a major strategic goal of the department. Our previous administrative and clinical leadership of the Durham Regional Cancer Centre (for which there were evening clinics at the OCC) and the Simcoe Muskoka Regional Cancer Program (for which Dr. Kathy Mah, our then Head of Medical Physics was appointed Head of Physics, and Dr. Gerard Morton was Head of Radiation Treatment from 2013-2015) has continued as a strong clinical partnership through cooperation in multiple MCCs. Access to multidisciplinary care has continued to improve over the past 5 years with radiation clinics at Toronto East General Hospital (Lung, GU), Scarborough General Hospital (GI, GU, Breast), Scarborough Rouge Centenary (GU, Breast, GI), and North York General Hospital (GU, Breast). Radiation Oncologists also provide MCC support to cancer care teams at many community hospitals, including Humber River Hospital, York Central Hospital, Markham Stouffville Hospital, Mackenzie Richmond Hill Hospital, Royal Victoria Hospital, St. Michaels Hospital, and all those mentioned previously where radiation clinics are established.

Academic partnerships over the past 5 years have also continued to expand, including collaborations with Elekta as a founding member of the MR-LINAC Consortium. Clinical testing of this technology has begun. Specifically, collaborations with the MR-LINAC Consortium have been successful in promoting academic productivity. The other founding members in this consortium include MDACC, University Medical Center Utrecht, Netherlands Cancer Institute, University of Wisconsin-Madison, the Royal Marsden NHS Foundation Trust, and the Christie NHS Foundation Trust. Other collaborations with various Elekta-based research consortiums continue with the Spine Consortium, Oligometastases

Consortium, and LINAC-based SRS Brain Consortium. In addition, our connection with Ryerson University has led to a partnership to develop a shared program to train medical physics residents.

Faculty

Members of the OCC DRO Program, including faculty members from physics, radiation therapy, and radiation oncology have continued to support numerous undergraduate, postgraduate, interprofessional, continuing medical educational, and administrative activities, which are outlined in the Academic Programs section of the 2021 UTDRO Self-Study Report. Notably, faculty either chair or co-chair multiple international and national oncology committees, demonstrating continued leadership at all levels (Appendix 8.1). Our members have also continued in the strong tradition and dedication to pre- and postgraduate education, as evidenced by the many teaching awards received (Appendix 3.2).

Continuing Education Programs

A number of CE programs are offered at OCC, including in-house oncology rounds, cancer research rounds, various scientific seminars, and symposia that are offered annually.

Performance Indicators

The OCC DRO has continued to excel in clinical performance over the past 5 years. The number of new radiation oncology patients seen at OCC has increased from 6584 in 2011-2012 to 8500 in 2019-2020. This number is projected to continue to increase at a rate of 3% per year with over 9000 new consults expected by 2023-2024. Treatment complexities and number of treatment courses have likewise increased over the past 5 years. In 2010, there were 7089 courses of treatment (plus 680 brachytherapy fractions). This has increased to 8132 courses in 2015 (14.7% increase within 5 years). Treated cases number over 6,700 per annum. Our Brachytherapy Program continues to be the most active in the country.

Over the past 5 years, the OCC DRO has continued to be a major academic radiation oncology enterprise. The department has 8 Clinician Scientists (Drs. Lisa Barbera, Edward Chow, Stanley Liu, Andrew Loblaw, Lawrence Paszat, Eileen Rakovitch, Argun Sahgal, and Shun Wong). The number of peer-reviewed papers per year continues to increase, from just over 100 in 2011, to over 350 in 2015 (155 as primary or senior author), and 426 in 2020. Many of these papers appear in high impact journals (e.g. *JCO, Lancet, JAMA, NEJM*). The department continues to be successful in securing multi-year external grant funding with over $20M in external peer-reviewed and industry-supported grants held in 2020. In 2020 alone, the collective members of the department secured over $5M in additional grant funding. Notable publications, grants, and awards are detailed in the Research & Scholarship section of the 2021 UTDRO Self-Study Report. Our diverse group of academic radiation oncologists spans a wide range of research foci. Examples of world-leading academic innovations include:

- MR-guided focused ultrasound for recurrent rectal cancer (Dr. William Chu; first-in-man)
- World's largest and most mature active surveillance cohort for prostate cancer (Dr. Andrew Loblaw)
- Biomarkers of radiation resistance (Dr. Stanley Liu)
- MRI-guided prostate biopsy in unselected BRCA mutation carriers (Dr. Danny Vesprini; first-in-man)
- Ultrasound activated microbubble enhancement of cancer therapy (Dr. Gregory Czarnota)
- Ultrasound-guided focused ultrasound for palliation of bone metastasis (Dr. Edward Chow)

- SBRT with Radium 223 for oligometastatic prostate cancer (Dr. Patrick Cheung)
- Whole gland salvage HDR for recurrent prostate cancer (Dr. Hans Chung)
- Epidemiological and biomarker studies in DCIS (Dr. Eileen Rakovitch)
- Advancing cancer prevention in low-income neighborhoods (Dr. Lawrence Paszat)
- Stereotactic radiosurgery for spine and brain metastasis (Dr. Arjun Sahgal)
- Mechanisms of radiation-induced inhibition of neuronal development (Dr. Shun Wong)
- MR-LINAC treatment for primary brain tumours (Dr. Arjun Sahgal)

Carlo Fidani Cancer Centre – Credit Valley Hospital (Trillium Health Partners)

Program Overview

The Carlo Fidani Cancer Centre at Credit Valley Hospital, Trillium Health Partners (THP) is a regional cancer program located in Mississauga providing cancer care to the Mississauga-Halton and Central-West (MHCW) LHINs, a population of ~2.1 million people. The radiation program opened fully in 2005. Pre-COVID, the program was assessing ~4,200 new patients for radiotherapy (fiscal year 2019-2020), but assessed ~3600 in fiscal year 2020-2021. Prior to the pandemic, the program was growing in terms of patients seen and radiotherapy courses delivered at >4% per year over the last 5 years. The program has expanded from 3 radiation oncologists at inception in 2005 to its present size of 13 (12 at 1.0 FTE and 1 at 0.6 FTE). The department runs 6 linear accelerators, 2 CT Simulators, and an HDR brachytherapy unit (currently used for skin and vaginal vaultbrachytherapy). The program provides full-service radiation oncology with the exception of sarcoma, head and neck, and interstitial brachytherapy. Up until 2012, an active oncology clinical trial program was present at the cancer centre, but this was suspended in 2012 to be reevaluated. In May 2016, a new oncology clinical trial program was launched and continues to expand successfully.

Program Leadership

- Division Head, Radiation Oncology; Regional Lead, Radiation, CCO: Dr. Anthony Brade MD, PhD
- Manager, Radiotherapy: Sandi Sodhi
- Head, Physics: Dr. Raxa Sankreacha
- Director, Oncology Program, THP: Jennifer Speziale
- Medical Lead, Oncology Program: Sameena Uddin (on LOA, temporary coverage Joan Murphy)
- Regional Director, MHCW Regional Cancer Program: Roxanne MacAskil
- Senior Vice President, Cancer Services: Leslie Starr

Innovations

The following is a list of significant program innovations that have taken place in the last five years:

2017 Prostate HDR Brachy
2018 Implemented 7-day treatment model during replacement of single linear accelerator
2019 Varian cone clinical release on TB HDMLC LINAC (decomm Brainlan cones in prep for LINAC replacement)
2020 Implemented 7-day treatment model during replacement of two linear accelerators
2020 Institution-wide launch of Epic EMR and program integration with Aria
2020 Prostate SBRT 5F protocol with spacer gel
2020 DIBH implementation for Breast
2020 26/5 hypofractionation for Breast
2020 MA39 Breast trial activation & enrolment
2020 2x LINAC replacement

2020 6FFF and 10FFF clinically released for HDMLC LINACs utilizing high dose-rate delivery for SBRT lung, soft tissue, and bony SBRT
2021 DIBH for lymphoma in progress
2021 Aria/Eclipse upgrade to v15.6 (infrastructure overall) slated for June
2021 Varian Hyperarc for multiple brain metastases (slated for implementation)

Collaborations

The following is a list of collaborations and partnerships involving THP UTDRO faculty in the last five years:

- Since 2011, THP's Medical Physics Residency Program has been affiliated with the UTDRO CAMPEP-accredited program; 1-2 residents per year accepted. Current successes include residency completion for 6 candidates, who have been employed full-time into Medical Physicists positions.
- Since 2013, THP has accepted between 3-5 Radiation Therapy Students (Michener) per year for their final year didactic teaching.
- Collaboration between faculty Medical Physicist, Dr. Grace Zeng-Harpell and Dr. Monique van Prooijen (Princess Margaret) on their project entitled "Comparison of Treatment of Brain Metastases with VMAT or Leksell Gamma Knife".
- Participation and collaboration with faculty in the CCO CQA Program since 2013.
- Partnership with the Princess Margaret to provide brachytherapy service for patients with gynecological malignancies (cervix).

Faculty

Table 39 lists activities involving THP UTDRO faculty in the last five years.

Table 39: Faculty Activities at Trillium Health Partners

Faculty Member	Activities
Anthony Brade	*Internal* • Division Head, Radiation Oncology • Radiation Oncology Representative, Scientific Review and Oversight Committee • Member, Integrated Cancer Program Committee, THP • Member, Radiation Safety Committee, THP. • Member, Radiation Clinical Operations Committee, THP • Member, Treatment Delivery Review Committee, THP • Member, Outpatient Oncology Clinic Redesign Team, THP • Member, Grand Rounds Planning Committee, THP *External* • Regional Lead, Radiation Oncology, THP-Mississauga Halton Central West Regional Cancer Program • Member, Radiation Oncology Provincial Advisory Committee (Ontario Health-Cancer Care Ontario) • Member, Provincial Radiation Treatment Program Committee (Ontario Health-Cancer Care Ontario) • Radiation Quality Lead, PROCLAIM Trial • Member, Steering Committee, Ontario Thoracic Cancer Conference • Member, Radiation Oncology Specialty Committee Executive Board, Royal College of Physicians

	• Examiner, Radiation Oncology Specialty Committee, Royal College of Physicians • Portfolio Scholar, University of Toronto Temerty Faculty of Medicine
Jonathan Wan	• Chair, Radiation Oncology Partners • Lead, SBRT site group • Lead, Lung site group
Senti Senthelal	• Lead, Breast site group
Yongjin Wang	• Lead, GU site group (non-prostate)
Jasper Yuen	• Lead, GU site group (prostate)
Andrew Chiang	• Lead, GI site group
Jidong Lian	• Lead, Heme site group
Luluel Khan	• Lead, CNS site group
Marisa Finlay	• Lead, Skin site group
Sarah Rauth	• Lead, Gyne site group • Chair, Board of Examiners, Medical Radiation Sciences, Temerty Faculty of Medicine, University of Toronto • Examiner, Radiation Oncology Specialty Committee, Royal College of Physicians
John Radwan	• Lead, Palliative site group
Grace Zeng-Harpell	*Internal* • VMAT implementation, planning standardization andquality/efficiency monitoring • SBRT *External* • 2011 CCO RapidArc Physics Coaching • 2015 CPQR VMAT technique quality guidelines • 2015 JACMP Associate Editor

Continuing Education Programs

The Physics Residency Program has been offered since 2011. THP also offers Annual Radiation Safety Training to its members.

Performance Indicators

Since 2011, the program has consistently been the top performer or near the top for key clinical performance metrics measured and published by OH-CCO (Referral to Consult and Ready to Treat to Treatment times) in the face of sustained (4-5% PA) growth in referrals and capped treatment capacity. Fiscal year 2020-2021 saw significant volume pressures due to the COVID-19 pandemic (Table 40).

Table 40: Annual Treatment Volumes at Trillium Health Partners

Fiscal Year	C1R
2016-2017	3835
2017-2018	3924
2018-2019	4139
2019-2020	4241
2020-2021	3563

Stronach Regional Cancer Centre – Southlake Regional Health Centre

Program Overview

Stronach Regional Cancer Centre (SRCC) is part of Southlake Regional Health Centre, a community hospital serving the Central LHIN with a population of 1.5 million. The Cancer Centre and the Radiation Medicine Program (RMP) opened formally in March 2010. The Southlake RMP assesses about 1700 new patients per year in most common tumour sites. The program operates 4 Medical Accelerators and has one CT Simulator. There are 7.1 radiation oncology FTEs (8 physicians), 4.8 FTE medical physicists (6 staff), and 28 FTE radiation therapists (36 staff).

Program Leadership

- Regional Lead, Radiation Oncology: Dr. Woodrow Wells, MD
- Division Head, Radiation Oncology, SRCC: Dr. Charles Cho
- Head, Medical Physics, SRCC: Dr. Ivan Yeung
- Manager, Radiation Therapy, SRCC: James Loudon
- Director, Central Regional Cancer Program and SRCC: Lorrie Reynolds
- Executive Vice President, Clinical Services and Regional Vice President, Cancer Services, Central Cancer Program, Ontario Health-Cancer Care Ontario: Barbara Steed

Innovations

The following is a list of infrastructure innovations in the last 5 years:

- Voluntary breath hold for breast cancer patients to minimize the use of ABC snorkels during the COVID-19 pandemic.
- Ventricular Ablation with Radiation therapy Pilot Project:
  Khaykin, Y., Taremi, M., Conrad, T., Terricabras, M., Comsa, D., Le, K., Aziz, Z. & Ryan, M. Stereotactic Ablative Radiotherapy for Refractory Ventricular Tachycardia. REB approved. Southlake approval to proceed with 6 patients. First patient successfully treated October 21, 2020. Two patients have been treated to date.
- Full deployment of MOSAIQ Care Plans. This project allowed for automated workflow for patients undergoing radiation planning and therapy. It also facilitated the capture of all required data to comply with Ontario Health-Cancer Care Ontario submissions for the RT-QBP funding reform.

Collaborations

The following is a list of collaborations and partnerships involving SRCC UTDRO faculty in the last five years:

- Southlake RMP accepts learners in radiation oncology (2 to 6 per year), medical physics (one per year), and in radiation therapy (two per year beginning in 2016).
- Southlake RMP participates annually in the Collaborative Research Seed Funding Grants for interprofessional, multi-centre research projects since its inception.

Faculty

All faculty participate in teaching learners in their respective fields. Selected Radiation Oncologists and Medical Physicists collaborate with Radiation Therapists in scholarly activities, as outlined in Appendix 9.1. Faculty members are also involved in various external initiatives:

- Southlake RMP faculty participate in OH-CCO Communities of Practice in the Lung site group, as well as Therapy, Physics and Radiation Safety Officer Communities of Practice.
- Central Region Education Day for Primary Care in February 2020.
- Canadian Partnership against Cancer (CPAC) Rectal Cancer Project.
- MAGIC (Multidisciplinary Annual Gastrointestinal Cancer) Annual Conference.
- Princess Margaret Cancer Centre Clinical Research Mentorship Program to build global health capacity in collaboration with the Princess Margaret, MD Anderson, and centres in Zimbabwe and Nigeria.

Continuing Education Programs

The following is a list of the Continuing Education Programs available to faculty at this site:

- Monthly Cancer Centre inter-disciplinary Grand Rounds
- Weekly Radiation Medicine Rounds by OTN from the Princess Margaret Cancer Centre; a virtual round since the spring of 2020
- Bi-weekly Peer Review for all patients of program. This Quality Program shifted to virtual as of April 2020
- Bi-monthly Quality Rounds

Performance Indicators

Southlake RMP meets all of Ontario Health-Cancer Care Ontario wait time metrics, and is consistently in the top two programs in the province for the parameters of Referral to Consult and Ready to Treat to Treatment. The Stronach Cancer Centre has been the number one ranked Regional Cancer Centre in the province in the last 3 years. Southlake RMP has seen 5 to 10% growth for the past 4 years, although since the March 2020 pandemic, overall growth has been negative in the past year by 25%.

Simcoe Muskoka Regional Cancer Program (SMRCP)

Program Overview

The Simcoe Muskoka Regional Cancer Program (SMRCP) is a community cancer program that provides a full spectrum of cancer care to patients from LHIN 12, and additional gynecological oncology care for patients from LHIN 13. The SMRCP serves a population of approximately 600,000 people. The program is community based with a focus on clinical care, along with a small, but active clinical trials program. The SMRCP is primarily based at the Simcoe Muskoka Cancer Centre (SMRCC) located at the Royal Victoria Regional Health Centre (RVH) in Barrie with two regional systemic therapy sites at the Orillia Soldier's Memorial Hospital and the Muskoka Algonquin Health Centre in Huntsville. Comprehensive radiation therapy services have been offered at the SMRCC since July 2012 when the SMRCC was opened. The radiation therapy program is one of the fastest growing programs in the province. In 2012-2013, the first full year the SMRCC was opened, the new patient volume was 1051, whereas in 2019-2020, the new patient volume was 2555; a rate of increase of 30% new patients per year over the last 8 years. The program has grown from 3 FTEs in radiation oncology in 2012 to 9 FTEs as of April 2021. The RVH/SMRCP is a teaching site for the U of T Departments of Family and Community Medicine and Radiation Oncology, as well as the Rural Ontario Medical Program.

Program Leadership

- Medical Director and Head, Radiation Oncology, SMRCP: Dr. Christiaan Stevens
- Chief, Oncology: Dr. Matthew Follwell
- RVP, OH-CCO: Nancy Savage
- Program Director, SMRCP: Martha Cope

Innovations

The SMRCC opened with 3 Varian Clinac IX LINACs in 2012. A fourth LINAC, a Varian TrueBeam, was added in 2019-2020. A HDR unit is imminently being installed with an anticipated go-live date in July 2021. The SMRCP has an active SBRT Program, including lung, bone, prostate, kidney, adrenal, and lymph nodes, as well as brain fSRT, with spinal SBRT planned to go live in the fall of 2021 and SRS in the 2021-2022 fiscal year. It is one of a few programs in Ontario that approaches 100% peer review for all treated cases.

We recently have developed a multidisciplinary Skin Cancer Program in collaboration with general surgery, plastic surgery, and dermatology, as well as the Family Medicine Teaching Unit; it is a potential model that OH-CCO intends on using to improve skin cancer care across Ontario. The SMRCP has endeavored to improve patient-centredness by implementing new models of care; within the radiation treatment program, we have created a CSRT-led palliative radiotherapy clinic to improve access to palliative radiotherapy. Additionally, we have established a satellite radiation oncology clinic at a regional partner hospital, and plan on creating similar clinics at other regional partner sites in order to bring care closer to home and to strengthen community connections throughout Simcoe-Muskoka.

Collaborations

The SMRCP has multiple partnerships within and beyond UTDRO. SMRCP radiation oncology staff routinely partner with other UTDRO faculty as part of the UTDRO Collaborative Research Seed Grant Program. There is a long and enduring relationship with the Odette Cancer Centre (OCC) to provide brachytherapy service for patients with genitourinary malignancies, as well spine SBRT and SRS. The program also collaborates with the OCC and Sunnybrook Health Sciences Centre for access to PSMA-PET as part of the PREP study for men with biochemically recurrent or metastatic prostate cancer.

The program also has a partnership with the Princess Margaret Cancer Centre (PM), such that radiation oncologists at the SMRCP who treat patients with gynecological malignancies are cross-appointed at the University Health Network/PM, and participate as part of the PM gynecology site group to provide brachytherapy services for this patient population.

The SMRCP has a relationship with the Unity Health (St. Michael's Hospital) Neurosurgery Program to provide neurosurgery support for SMRCP patients with primary and metastatic central nervous system malignances.

Faculty

Table 41 lists activities involving SMRCP UTDRO faculty in the last five years.

Table 41: Faculty Activities at SMRCP

Faculty Member	Activities
Christiaan Stevens	*Internal* • Medical Director and Head, Radiation Oncology, SMRCP • Member, SMRCP Breast, Lung & GU Disease Site Groups • Member, RVH Operations Committee • Clinical Trial Site PI, MAC.19, MAC.23, MA39, LUMINA, DUCHESS • Supervising PI, Peer review research project with PGY-3 Adrian Cozma et al. "A Retrospective Study of Plan Modifications Resulting from Peer Review of Palliative and Radical Radiation Treatment Plans" *External* • Member, Canadian Partnership for Quality Radiotherapy (CPQR) NSIR-RT Action Committee • Member, OH-CCO Radiation Oncology Human Resources Working Group • Member, OH-CCO Clinician Wellbeing Advisory Committee • Member, OH-CCO Radiation Oncology Provincial Action Committee • Founder and Co-clinical Director, Community Radiation Oncologists of Southern Ontario (COMRADS) Educational Group
Matthew Follwell	*Internal* • Chief, Department of Oncology • Co-Chair, Palliative Care and End-of-Life Working Group, RVH • Committee Member, Art @ RVH • Member, RVH Medical Advisory Committee • Physician Lead, SMRCP Gastrointestinal Disease Site Group • Member, SMRCP Breast and CNS Disease Site Group • Physician Representative, RVH Foundation

	External • Member, OH-CCO CNS Advisory Committee
Fred Yoon	*Internal* • Chair, SMRCP Lung Disease Site Group • Physician Lead, SMRCP Oligomets Committee • Member, SMRCP GU and Lymphoma Disease Site Groups. • Co-PI, Peer review research project with PGY-3 Adrian Cozma et al. “A Retrospective Study of Plan Modifications Resulting from Peer Review of Palliative and Radical Radiation Treatment Plans” • Co-PI, 2020 UTDRO Collaborative Seed Grant with Dr. Srinivas Raman et al. for "Integrated Use of Wearable Diagnostics in Lung Cancer” *External* • Founder and Co-Clinical Director, Community Radiation Oncologists of Southern Ontario (COMRADS) Educational Group
Juhu Kamra	*Internal* • Lead, SMRCP Lymphoma Disease Site Group • Member, SMRCP GI and Skin Disease Site Groups
Tiffany Tam	*Internal* • Chair, Radiation Oncology Academic Rounds • Physician Lead, SMRCP CNS and Spine SBRT Program Development Working Group • Member, SMRCP Lung and Breast Disease Site Groups • Member, SMRCP IGRT Committee • Member, Radiation Therapy Quality Assurance Committee • Designated Supervising Physician, SMRCP, Radiation Safety Committee • Co-PI, Peer review research project with PGY-3 Adrian Cozma et al. “A Retrospective Study of Plan Modifications Resulting from Peer Review of Palliative and Radical Radiation Treatment Plans” • Co-PI, 2019 UTDRO Collaborative Seed Grant for "Development of a Decision Aid for Patients with Extensive Brain Metastases – A Collaborative Study”
Adam Gladwish	*Internal* • Member, RVH Research Ethics Board • Physician Lead, SMRCP GU Disease Site Group • Member, SMRCP Breast and Gynecology Disease Site Groups • Member, SMRCP IGRT Committee • Member, SMRCP ARIA Change Committee • Member, UTDRO Resident Wellness Committee • Member, UTDRO Research Committee • Clinical Trial Site PI, PR-20 *External* • President, Radiation Oncology Associates, RVH • Member, Council of Ontario Association of Radiation Oncology
Jessica Conway	*Internal* • SMRCP Radiation Oncology Educational Lead/Residency Representative • Physician Lead, SMRCP Breast and Gynecological Disease Site Groups • Member, SMRCP GU Disease Site Group • Co-PI, 2019 UTDRO Collaborative Seed Grant for “Assessment of Sexual Health in Cervical Cancer Survivors Treated with Definitive Radiation” *External* • Member, CARO Membership Committee

Continuing Education Programs

The following is a list of the Continuing Education Programs available to faculty at this site:

- Physician Management Institute (PMI) Courses run by the Canadian Medical Association.
- The Centre for Faculty Development – Teaching for Learning in Collaboration (TLC) Program.
- Physician Dinner Series: A regular series of talks/lectures on topical medical or professional practice issues.
- Clinical Oncology Rounds: A monthly rounds for the entire oncology program on relevant topics in oncology.
- Radiation Oncology Academic Rounds: A monthly rounds for the radiation oncology division on relevant topics in radiation oncology.
- RVH Grand Rounds: A monthly rounds for the entire RVH staff on relevant medical topics.
- Community Radiation Oncologists of Southern Ontario (COMRADS) Lectures: A biannual educational series on topics relevant to radiation oncology.

Performance Indicators

The SMRCP Radiation Therapy Program has grown rapidly over the past 8 years and is predominantly a program constituted of radiation oncologists with less than 10 years staff experience (3 ROs have been at RVH for >10 years, 2 ROs between 5 and 10 years, and the other 4 ROs at <5 years). Patient-reported outcomes with respect to satisfaction with care are consistently >90%.

The program primarily focuses on cancers with high incidence and prevalence (breast, prostate, lung, rectum), and does not currently provide routine care for patients with primary head and neck malignancies, sarcoma, or pediatric malignancies. We provide state-of-the-art radiotherapy using Volumetric Arc Therapy and Cone Beam Computed Tomography, Stereotactic Body Radiotherapy (SBRT), and fractionated Stereotactic Radiotherapy for brain metastases. We are scheduled to start HDR intracavitary brachytherapy for gynecological malignancies, and the long-term goal is to develop a comprehensive Brachytherapy Program inclusive of MRI-guided interstitial brachytherapy, as well as prostate brachytherapy. We will be expanding our SBRT Program to include spine, followed by liver, in addition to stereotactic radiosurgery over the next 2 years.

Objective outcome measures, such as long-term toxicity, disease-free survival, and overall survival, which in part, are most reflective of clinical performance are available through OH-CCO provincial statistics. Given the rapid growth of the program, clinical performance metrics, such as Referral to Consult and Ready to Treat to Treatment times have been variable, ranging from being a high performer relative to other regional programs, to being one of the lowest performers approximately 3 years ago. This has been primarily influenced by the availability of manpower resources to accommodate the significant growth in referrals to radiation oncology, and the growth in radiation therapy utilization, which historically was very low in this region (radiation utilization was ranked 13th out of 14 LHINs in the province in 2010). This latter issue can be seen as a positive outcome measure, as our increased wait times in 2018-2019 reflected the success of the program in rendering radiation therapy more accessible and better utilized by the patients within LHIN 12 (the latest 2016-2017 data ranked the SMRCP 9th in the province). Since the addition of 2 radiation oncology FTEs in 2018-2019 and the 4th LINAC in 2019-2020, our Referral to Consult and Ready to Treat to Treatment times are consistently at or exceed the provincial average, and we anticipate our radiation utilization will continue to improve.

Prior to the SMRCP becoming a comprehensive cancer program, the preexisting Systemic Therapy Program had a well-established clinical trials program. Since 2012, a lot of work has been done to

integrate radiation therapy studies into the program and we currently have 7 academic/cooperative group radiation-specific clinical trials open and accruing. We have completed 5 studies; for 2 of these studies, we had the highest accrual of any community centre in Canada. Despite this early success, only 3% of patients who receive radiotherapy at the SMRCP participate in clinical studies. The goal is to increase this activity over the next 5 years. This will be achieved through both program-specific and RVH-wide initiatives. The RVH has established a centralized research program with a Chief Research Scientist and Research Manager. The SMRCP Clinical Trials Program is being folded into this larger RVH program with the goal to more efficiently utilize resources to improve capacity to support more academic studies, in addition to successfully supporting industry-sponsored studies. This may also help to facilitate becoming an affiliate NRG site through which many of the important and impactful radiation therapy trails are being run. We have also been part of multiple UTDRO Collaborative Seed Grant submissions, and several or our co-submissions have been successful over the past 7 years. Internally, we have a very effective Quality Assurance Program and multiple internal research projects have been selected as abstracts for presentation at symposia and conferences, including the COMP Winter School, CARO, and RTi3.

R.S. McLaughlin Durham Regional Cancer Centre – Lakeridge Health

Program Overview

The R.S. McLaughlin Durham Regional Cancer Centre (DRCC) at Lakeridge Health sees approximately 3000 new radiation patients per year and delivers approximately 3400 courses of radiation therapy. Our 11 Radiation Oncologists offer clinic services at the DRCC and at our 4 regional partner sites. Radiation treatment is delivered at DRCC in a 7-bunker facility with 6 clinical LINACs. An 8th bunker is located at the Peterborough Regional Health Centre (PRHC) and the installed LINAC is operated by DRCC as a satellite facility. All LINACs are Elekta units with full IGRT capabilities. In addition, 4 LINACs have a flattening filter free beam, and 2 have a 6-degree of freedom couch. Our planning system is Monaco and our radiation information system is MOSAIQ. An active Brachytherapy Program uses the Elekta Flexitron unit for delivery and Oncentra Brachy and Oncentra Prostate for brachy planning. A team of 8 Medical Physicists and 60 Radiation Therapists help provide treatment planning and delivery. At DRCC, we treat all palliative patients, along with primary breast, prostate, lung, gastrointestinal, gynecological, lymphoma and skin cancers. Head and neck, primary brain and sarcoma patients are referred elsewhere.

Program Leadership

- Radiation Oncology Lead: Dr. Medhat El-Mallah
- Radiation Therapy Manager: Christine Black, MA, MRT(T)
- Chief of Medical Physics: Dr. Katharina Sixel, PhD, FCCPM, FCOMP

Innovations

The past 5 years have seen significant quality improvement initiatives to ensure that DRCC continues to offer state-of-the-art radiation services to our patients. We have expanded our SBRT Program to additional sites, such as oligomets, prostate, liver, spine, kidney, and adrenals. DRCC now offers a full range of stereotactic treatments. We have introduced the use of flattening filter free beams for our small volume, hypofractionated treatments. We have implemented interstitial HDR treatments for cervix, under MRI image guidance. Furthermore, we have implemented the use of hydrogel tissue spacers for prostate SBRT.

Another notable project is the replacement of our LINAC at the PRHC satellite facility. The time interval from last patient treated on the old LINAC to first patient treated on the new machine was four months. This included equipment removal, room renovations, equipment installation, and commissioning. As a single LINAC facility, patients had to travel to Oshawa for their radiation treatment during the downtime. We are proud to have been able to compress a standard 6-month replacement timeline so significantly and to get patients back to treatment close to home as soon as possible.

Collaborations

The main partnership between DRCC and UTDRO revolves around the Medical Physics Residency Program. DRCC is an affiliated site for physics residence teaching. We have graduated 2 residents in

the past 5 years and have a current resident in year one of the two-year program. Both graduates are employed and enjoying successful careers in medical physics.

Faculty

Dr. Katharina Sixel is the only UTDRO faculty member at DRCC/Lakeridge Health. She is the Chief of Physics and as such, is involved in all clinical initiatives from an administrative and oversight perspective. Dr. Sixel is the Site Coordinator for Lakeridge Health within the Physics Residency Program. She is also a participant in the SIMAC Evaluation Project.

Continuing Education Programs

DRCC offers a variety of educational rounds to staff. These include Grand Rounds for the entire Cancer Program, Radiation Oncology Rounds with a target audience of radiation staff, and Quality Assurance Rounds for radiation staff. In addition, OTN provides access to academic rounds at both the Odette and Princess Margaret Cancer Centres.

Performance Indicators

DRCC has 7 LINACs, 2 CT simulators, and one HDR after loader. It also has an MRI scanner shared with the hospital. Over the past five years, the following treatments have been offered at DRCC:

- External beam
- High dose-rate (HDR) brachytherapy

Key performance metrics from fiscal year 2019-2020 include:

- New radiation consults: 3000
- Treated courses: 3400
- Treated cases: 2581

The staff breakdown includes 11 Radiation Oncologists, 8 Medical Physicists, and 60 Radiation Therapists at DRCC. The only UTDRO-appointed faculty member has participated in clinical trials and has published 3 abstracts over the last five years.

FACULTY REPORT

This faculty statement covers the period from June 2016 to March 2021. All UTDRO faculty were invited to offer their opinions that contribute to this report *via*:

- A confidential and anonymous online faculty survey (Appendix 10.1)
- Two virtual faculty town halls conducted *via* Zoom on February 16, 2021 and February 22, 2021 (Appendix 10.2)

This document was prepared by the UTDRO Faculty Statement Working Group, which was formed to have broad representation from the 3 core disciplines of radiation medicine: radiation oncology, medical physics, and radiation therapy at Odette, Princess Margaret, and the affiliated community cancer centres. The 4 domains comprising this report are as follows: (i) education, (ii) research and collaboration, (iii) mentorship and career, and (iv) administration. The statement was created to best reflect both confidential and public responses provided on the strengths and weaknesses of the department, as provided by faculty members in the online survey and town halls. All Faculty Statement Working Group representatives had the opportunity to review the final Statement in advance of its submission.

Faculty Statement Working Group:

- Dr. Alex Louie (Faculty Statement Working Group Chair; Radiation Oncology, OCC)
- Dr. Laura Dawson (Radiation Oncology, PM)
- Dr. Katharina Sixel (Medical Physics, DRCC)
- Dr. James Chow (Medical Physics, OCC)
- Dr. Mark Ruschin (Medical Physics, OCC)
- Merrylee McGuffin (Radiation Therapy, OCC)
- Grace Lee (Radiation Therapy, PM)
- Meghan Ward (Business Manager, UTDRO)

Background

The University of Toronto Department of Radiation Oncology was established in January 1991, and at present, Dr. Fei-Fei Liu is the Chair of the department. Dr. Liu is serving her second and final term, which will conclude in December 2022. Dr. Liu also serves as Chief of the Radiation Medicine Program (RMP) at the Princess Margaret Cancer Centre (PM), which is one of the two main academic institutions of UTDRO (96 UTDRO-appointed faculty). The other main academic UTDRO institution is the Odette Cancer Centre, which is affiliated with the Sunnybrook Health Sciences Centre (58 UTDRO-appointed faculty). Dr. Gregory Czarnota is the Chief of Radiation Oncology at Odette and is also serving his second and final term since his appointment in 2013.

Beyond the two primary academic centres, various community-based cancer centres within the Greater Toronto Area (GTA) with strong ties to UTDRO have opened since 2006. These include the Carlo Fidani Peel Regional Cancer Centre (CFPRCC; 11 UTDRO-appointed faculty) in Mississauga, the Simcoe Muskoka Regional Cancer Centre (SMRCC; 8 UTDRO-appointed faculty) in Barrie, the Stronach Regional Cancer Centre (SRCC; 8 UTDRO-appointed faculty) in Newmarket, and the Durham Regional Cancer Centre (DRCC; 1 UTDRO-appointed faculty) in Oshawa. Additional faculty at UTDRO include those at Michener (3) and other (3).

UTDRO is amongst the largest academic radiation medicine departments in the world, with 188 faculty members (Appendix 2.1), consisting of membership from radiation oncology (97; 52% of total), medical physics (54; 29%), radiation therapy (35; 19%), and other education/scientist faculty (2; 1%). The diversity and interprofessional nature of the faculty is summarized in Appendix 2.2. In the last 5 years, there has been successful academic career development with 25 academic promotions (7 non-physicians and 18 physicians): 5 to Full Professor and 20 to Associate Professor. The 2017 External Review had reported 14 academic promotions: 2 to Full Professor and 12 to Associate Professor. The academic development of radiation therapists and medical physics is a tremendous opportunity for UTDRO, and non-physician faculty members have made significant research and educational contributions to radiation medicine locally, nationally, and internationally.

Overview of Faculty Opinion

This report builds on the discussions of previously identified strengths and weaknesses generated by the two virtual town halls and the faculty survey. From the two town halls, there were a total of 89 participants, consisting of radiation oncologists, medical physicists, radiation therapists, scientists, and educators. The town hall format was developed by the Faculty Statement Working Group in consultation with an external facilitator. Town halls were facilitated and hosted by the external moderator and co-hosted by members of the Faculty Statement Working Group, with an open forum on each of the 4 domains (education, research and collaboration, mentorship and career, administration), followed by specialty-specific breakout room discussions. This provided an opportunity to capture thematic perspectives on culture and engagement within the UTDRO program. Questions and comments could also be submitted anonymously in real-time for broader discussion. The Faculty Survey was developed by the Faculty Statement Working Group and was distributed broadly by the UTDRO Office. Faculty were given 2.5 weeks to complete the survey with 2 email reminders. The survey was set up so that all responses were collected in an anonymous fashion. The response rate was approximately 35% (66 respondents).

The 2017 External Review identified several strengths of UTDRO. Broadly speaking, the current top 3 strengths of UTDRO were noted to be commitment to education, excellence across a diversity of research endeavours, and interprofessional expertise and leadership. Over the last 5 years, the majority of faculty indicated that UTDRO has become an even stronger leader in local, national, and international professional organizations, in clinical trials and clinical research, in peer-reviewed grant funding, and in peer-reviewed publications. In addition, the majority of faculty agreed that UTDRO continues to lead in undergraduate/postgraduate training in radiation medicine, translational physics research, and interprofessional expertise and collaboration. This is reflected in the diversity of academic interests and goals within the department.

The prior review also identified several challenges for future growth and development. In the last 5 years, it was noted that one of the biggest challenges for UTDRO remains collaboration between PM and Odette. It was also suggested that while there are some pathways for leadership training, gaps exist that highlight a need for formality across professions. In addition, it was felt that the department would benefit from continuing to build on opportunities for faculty development in teaching, adoption of mentorship for faculty, consolidating continuing education offerings, establishing clear opportunities for promotion, hiring strategically for academic programs, continuing to expand the UTDRO Collaborative Research Seed Grant Program, and mentoring trainees on employment opportunities. Finally, despite efforts from a very dedicated administrative team and creation of standard documents to clarify metrics required for promotion, navigation of processes was still felt to be cumbersome by some faculty.

As PM and Odette represent the only two academic institutions from which an internal UTDRO Chair can be selected, several comments from the survey indicated the perception that one institution was favoured over the other by the UTDRO Chair. Several survey respondents suggested that the next UTDRO Chair should not simultaneously hold a Head of Department status at either academic institution. Regardless, it will be a priority for the next UTDRO Chair to build on the commonalities of each academic institution, as well as the community-based centres in a manner that synthesizes an improved culture of trust and collaboration.

In 2014, UTDRO launched its strategic plan, *Roadmap to 2017: The Transformative Agenda*. Following the 2017 External Review, it was concluded that UTDRO is "nationally and internationally recognized as one of the top academic cancer programs", thus supporting the re-appointment of the Chair. Suggestions were put forward for improvement, and in August 2018, a strategic planning process was overseen by a 13-person Steering Committee, representative of all radiation medicine disciplines and demographics of the department. This led to the development of a refreshed strategic plan, *UTDRO 2022: Reflect. Transform. Lead*., which focused on 5 key themes: (i) heightening the culture of academic excellence, (ii) preparing the radiation medicine leaders of tomorrow, (iii) accelerating uptake of cutting-edge knowledge in radiation medicine, (iv) collaborating for transformative reach and impact, and (v) enhancing success through governance and operations.

The majority of faculty who responded to the survey were familiar with the contents of the refreshed strategic plan and where to access it; although only a minority had previously referenced it (e.g. in a grant application). In addition, many respondents felt that they identified with the stated goals and themes of the new strategic plan and were engaged to participate. Furthermore, many indicated that UTDRO has been successful in executing the refreshed plan thus far.

Majority of the survey respondents indicated that UTDRO faculty are engaged in many activities that contribute to the academic goals of the department, most notably with the annual UTDRO Research Day. This annual event serves as an opportunity for radiation medicine trainees across all disciplines to present their work in a collaborative and safe environment, in preparation for larger-scale external national and international settings. The Target Insight and RTi3 meetings are also highlighted for raising discourse, especially within the medical physics and radiation therapy disciplines. It was suggested that quantitative metrics of success and benchmarking of progress would be helpful to guide the future direction of these UTDRO-led meetings. This would inform areas that could be improved, prioritize what works well, and identify gaps for new initiatives.

Longitudinal activities, including weekly UTDRO Rounds and monthly Evening Journal Clubs, were recognized by most survey respondents as sustained efforts for continuing education across all disciplines within the faculty. The American Society for Radiation Oncology (ASTRO) Alumni Event was noted to be a valued annual event, in terms of networking, honouring award winners, and reconnecting with individuals worldwide, who have either trained or previously been affiliated with UTDRO.

Generally, respondents felt that UTDRO ranks highest nationally in relation to other academic radiation oncology departments, and above average to highest amongst departments internationally. Most agreed that UTDRO is a good place to develop and enhance one's academic career and would likely recommend an academic appointment with UTDRO to both friends and colleagues.

Below are some of the highlights from the faculty survey related to the perceived strengths and weaknesses of the department, as well as opportunities for improvement.

Details of Strengths, Achievements and Opportunities for Improvement

Education

A noted strength within UTDRO is its encompassing leadership and commitment to education across all radiation medicine disciplines. Many respondents felt that this was an area where the elements of collaboration between member institutions and identity of the University program really shine.

UTDRO has the largest Post-Graduate Radiation Oncology Residency Training Program in Canada. Residents consistently have a high pass rate in the Royal College of Physician and Surgeons of Canada (Royal College) specialty licensing examinations. The Residency Program teaching curriculum is highly structured, including interdisciplinary staff-led weekly didactic teaching and oral examination "drills". Radiobiology and physics courses are taught longitudinally and are commonly populated by residents from other Canadian radiation oncology training programs. Recently, Competency by Design (CBD) curricula was implemented in the Residency Program and was recognized by a significant proportion of survey respondents as an improvement for future growth and development for UTDRO.

UTDRO is also home to the largest Radiation Oncology Fellowship Program in the world, with an average enrollment of 29 fellows each year from Canada and across the globe, distributed between Odette and the Princess Margaret. In addition to obtaining subspecialized clinical, technical, and research training, the fellows host frequent journal clubs and hot topic seminars. Many of graduates of the Fellowship Program go on to implement what they have learned locally and/or mature into leadership roles in their own radiation oncology programs. Based on these strengths, UTDRO regularly hosts on average 200 visiting elective residents, fellows, and observers from across the world. One suggestion from the faculty survey was to consider having shared fellows between Odette and the Princess Margaret; although it was recognized that independent funding mechanisms at each institution add to the complexity and feasibility of this concept.

Graduate degree MSc and PhD programs in radiation sciences are active through the Institute of Medical Sciences (IMS). Various faculty members hold cross-appointments with IMS. To build collaborations and interdisciplinary learning amongst trainees, the Strategic Training in Transdisciplinary Radiation Sciences for the 21st Century (STARS21) Program for clinicians, graduate students, and post-doctoral fellows was initiated. This Terry Fox Foundation supported initiative builds on the foundation and legacy of the former Excellence in Radiation Research for the 21st Century (EIRR21) Program, with the intent to provide trainees with the leadership, management, and communication proficiencies necessary to define them as future leaders within radiation medicine in Canada.

The Michener Institute of Education provides an opportunity for both academic and educational endeavours for radiation therapists who are appointed to UTDRO. UTDRO and Michener offer a joint BSc Degree and Advanced Diploma in Medical Radiation Sciences, which is the first and largest professional undergraduate program of its kind in Medical Radiation Sciences. Previously, there was a professional master's degree program for radiation therapists (MScHSc in Medical Radiation Sciences), but this program has closed since the last external review. It was commented that the availability of other similar education, professional, and career-building opportunities are lacking for radiation therapists and would be of interest to develop within the department.

UTDRO has a Clinical Physics Residency Program, which allows medical physics trainees to learn from the breadth and depth of educational opportunities at the Odette Cancer Centre, Princess Margaret Cancer Centre, Carlo Fidani Peel Regional Cancer Centre, and Durham Regional Cancer Centre. Physics residents who have graduated from the program can participate in the Medical Physics Certification Exam conducted by the Canadian College of Physicists in Medicine and become certified medical physicists in North America.

UTDRO has also been actively involved in global education and outreach, primarily though the Princess Margaret Global Cancer Program launched in 2020. It has partnered with Cancer Education at the Princess Margaret to deliver various educational programs, led by Radiation Oncologist, Dr. Danielle Rodin. The Global Oncology Leadership Development (GOLD) Program is an interdisciplinary program for the over 200 clinical fellows at the Princess Margaret, of which 75% are trained outside of Canada. GOLD is delivered jointly by the PM Global Cancer and Education Programs. It blends training on intrapersonal, interpersonal, organizational, and systems leadership with training on health systems through a mix of didactic lectures, workshops, networking events, online learning, and a formal connection with a mentor.

The CARO-ARRO Collaborative Global Oncology Enrichment Program is a collaborative, multi-institutional program to network, receive mentorship, and explore the field of global oncology and cancer control, which is not currently included as part of core training. The program is free and runs online through the Princess Margaret Cancer Campus educational platform. In its inaugural year in 2020, there were 203 registered course participants from 14 different countries.

It was acknowledged that the current COVID-19 pandemic has increased the frequency of virtual events, and that this may present an opportunity for a refresh of collaborative education activities. Suggestions included virtual invited professorships; broadcasting invited in-person speakers virtually to partner hospitals; and creating a repository of lectures for trainees. Although it was recognized that considering different forums and methods for meetings would provide a natural path to innovation, some faculty felt that the department's culture was less open to change as it relates to departmental activities.

Research and Collaboration

UTDRO is active and leading in numerous areas of radiation medicine research, including basic sciences, translational biology, evaluation of the biologic response to radiotherapy, quality of life, quality assurance, quality improvement, imaging, radiobiology, survivorship, health services research, technological innovation, and clinical trials. Although peer-reviewed funding is extremely competitive, many investigators and radiation program initiatives have been successful in obtaining large-scale grant funding (Table 34). In the current funding environment, other sources of support, including philanthropic funds and other sponsorships have been leveraged.

The tremendous number of academic and research achievements is rooted in the broad engagement of UTDRO faculty as leaders in their respective areas, combined with the enthusiasm of trainees and team members. Many faculty hold provincial, national, and international professional organization leadership positions (Appendix 8.1) and have received major honours and awards, with notable examples provided in Appendix 2.4.

There was debate amongst faculty regarding the diversity of research within UTDRO, with some viewing it as a lack of a unified academic mission, while others indicated that this observation would be inherent in any department the size of UTDRO and should be viewed as a strength. Some faculty reported that

they identified their research to be more closely affiliated with their own institution rather than with UTDRO, which can in turn lead to another barrier for collaboration. It was also suggested that certain areas of academic excellence may reflect the efforts of individuals and/or small groups, and that these may be independent from overall departmental efforts. While some preferred having a unifying research vision, others acknowledged that the department may be too large to have an all-encompassing focus (e.g. specific technology), as is the case in some radiation oncology departments worldwide.

Initiatives such as the previously established UTDRO Collaborative Research Seed Grant Program has expanded from projects between the 2 major academic centres (PM and Odette), to now encourage involvement and collaborations with partner community radiation oncology centres. This was felt by some faculty to have improved academic growth and development in the last 5 years.

As identified by some UTDRO faculty, consistent and sustained collaborations between the Odette and Princess Margaret continue to be a challenge. Strategies such as the UTDRO Collaborative Research Seed Grant Program and other disease-specific projects have fostered some engagement. Investment in novel technologies at both centres, like the MR-LINAC, pose a natural opportunity for collaboration between the respective radiation medicine disciplines within disease sites. However, unique nuances in hospital governance and infrastructure, as well as investigator research agenda and philosophy, continue to impede larger scale research collaborations between the two sites. It is anticipated that this will continue to be a challenge for UTDRO. As such, focused strategies to incentivize and engage faculty in joint UTDRO academic activities needs to be prioritized. This matter should also be considered a priority for both the next UTDRO Chair and Departmental Site Chairs (PM, Odette, Southlake, Carlo Fidani, Durham, Barrie).

Joint continuing education events like Target Insight and RTi3 are recognized to foster pan-departmental representation of all radiation medicine disciplines. RTi3 is the premier national radiation therapy conference, with the commitment to inspire, inquire and innovate the practice of radiotherapy. As a growing event, the 2021 RTi3 event recently attracted 224 delegates from across Canada, as well as the United States and United Kingdom. The annual conference encompasses topics on technical advances in radiation therapy, education, treatment planning, quality, patient outcomes and supportive care.

One well-received suggestion from faculty was to have a combination of virtual (more convenient) and in-person (more engagement) joint UTDRO activities, with invitations to thought leaders, external speakers, and notable alumni to increase impact and participation. Refreshing these events can be a tool to further build the sense of community within UTDRO.

Mentorship and Career

Faculty respondents acknowledged the importance of mentorship, especially as it relates to one's career and academic promotion. Specific criteria and resources for initial appointment, as well as senior academic promotion are available and accessible on the UTDRO website. While some respondents indicated some improvement in the areas of adoption of mentorship for faculty, opportunity for faculty development in teaching, and a clear process for promotion, the majority felt that these items were unchanged over the last 5 years. Many participants at the town hall indicated that mentorship was often done informally rather than formally, and that gaps existed especially for new and mid-career staff across disciplines. Formal mentors are often more senior, full professors, but should also include experienced and established junior and mid-career faculty. It was suggested that beyond intra-departmental mentorship, representatives from medical physics and radiation therapy desire clearer pathways for career growth and promotion. They felt that opportunities for mentorship within their disciplines were

fewer than for physicians. Many respondents across the disciplines suggested that mentorship for junior and mid-career faculty should be prioritized both formally and informally, and in the context of specific tracks (e.g. education, clinical, discipline-specific). Furthermore, these recommendations on mentorship could be effective tools in fostering future collaborations instead of competition.

Administration

Respondents unanimously acknowledged the dedication and hard work of the UTDRO Administrative Team to support the department. A tremendous amount of effort has been invested with the aim to improve departmental structures and processes. Communication strategies, such as the UTDRO newsletters and social media are more routinely employed to improve UTDRO's visibility and brand. Administrators are also recognized for their key role in focused areas, such as education training programs and promotion processes.

Several administrative challenges experienced relate to the high turnover of staff, and as a result, awareness of what each departmental administrator can or cannot do. Faculty are often more familiar with their own institutional infrastructure. As such, it was felt by some that investment in a designated administrator tasked with simplifying and streamlining endeavours, such as the three-year review, academic promotion, onboarding of new staff, grant applications, and notice of relevant funding/award opportunities would be invaluable. Furthermore, it was noted that while resources on topics like academic promotion exist on the UTDRO website and administrators are highly committed to support faculty, many at the town hall expressed uncertainty regarding who best to contact for different processes. This highlights that additional steps to ameliorate communication and efficiency from an administrative standpoint are required.

Overall Summary

In summary, responses from the two virtual town halls and faculty-wide survey indicate that UTDRO continues to be a strong department with many strategic priorities achieved in the last 5 years. It remains as the preferred radiation medicine department to train, work, and develop an academic career both nationally and internationally. Strong foundations in education and leadership continue to translate in high academic productivity. Noted opportunities for growth persist, including the areas of large-scale collaborations between the two main academic institutions, innovations in annual departmental activities, openness to new ideas, as well as more efficient and transparent processes for academic promotion and success.

LEARNER REPORT

This Learner Report was prepared by the UTDRO Learner Statement Working Group, which had broad representation from UTDRO's Radiation Oncology Fellowship Program, Radiation Oncology Residency Program, Medical Physics Residency Program, and UME Program. Program leadership and trainees, specifically the Chiefs/Co-Chiefs, from the Princess Margaret, Odette, and Stronach Regional Cancer Centres participated in the working group. The Medical Radiation Sciences (MRS) Program did not participate in this working group as the program is currently undergoing a review through the University of Toronto Quality Assurance Process (UTQAP) in parallel with the 2021 UTDRO External Review. As such, the MRS Program has prepared its own Student Report (Appendix 11.1) as part of their 2013-2021 UTQAP MRS Self-Study Report (Appendix 3.3). All Learner Statement Working Group representatives had the opportunity to review the final Learner Report prior to its submission to the Office of the Dean.

Learner Statement Working Group:

- Dr. May Tsao (Vice Chair, Education, UTDRO)
- Dr. Jennifer Croke (Director, Fellowship Program)
- Dr. Gerard Morton (Director, Brachytherapy AFC Program)
- Dr. Andrea Bezjak (Director, Radiation Oncology Residency Program)
- Dr. Hany Soliman (Associate Director, Radiation Oncology Residency Program, OCC)
- Dr. Derek Tsang (Director, UME Program)
- Dr. Hedi Mohseni (Chief Medical Physics Resident, SRCC)
- Dr. Meredith Giuliani (Associate Director, Radiation Oncology Residency Program, PM)
- Dr. Andrea McNiven (Director, Medical Physics Residency Program)
- Dr. Michael Tjong (Chief Radiation Oncology Resident, PM)
- Dr. Rachel Glicksman (Co-Chief Radiation Oncology Fellow, OCC)
- Dr. Michael Wang (Co-Chief Radiation Oncology Fellow, OCC)
- Dr. Enrique Gutierrez (Co-Chief Radiation Oncology Fellow, PM)
- Dr. Mariana Petruccelli (Co-Chief Radiation Oncology Fellow, PM)
- Meghan Ward (Business Manager, UTDRO)

The Learner Report includes feedback collected from a confidential and anonymous online survey (Appendix 11.2) that was sent to all current radiation oncology fellows and residents, medical physics residents, and STARS21 scholars (total of 73). Students received a survey invitation email from the UTDRO Administrative Office on April 16, 2021. Multiple email reminders from the UTDRO Administrative Office and program directors were sent to the trainees. The survey, which was delivered online using the Qualtrics survey tool, was active until June 4, 2021.

The learner survey was designed to gather student feedback on their academic experiences, satisfaction with their programs, and student support resources and guidance. The survey consisted of a total of 16 questions; 6 questions and 10 statements that students rated using a Likert scale. Open-ended questions gave trainees the opportunity to comment on each of the following topics: departmental strengths and areas of improvement, program outcomes, professional development, as well as equity, inclusion, and professionalism. Demographic questions (e.g. gender, age, location) were not captured to protect the identity of the survey respondents. Participation in the online survey was voluntary and learner responses were kept anonymous. When the survey period closed, 21 responses were collected for an overall

response rate of approximately 29%. The relatively low response rate can be attributed to the fact that Ontario was experiencing its third COVID-19 wave during the survey period, reporting the highest number of cases in a single day since the onset of the pandemic. As such, staff and trainees were instructed by hospital leadership and academic program directors to halt all non-essential meetings and activities to increase the focus on hospitals' COVID-19 response.

An external consultant reviewed and collated the survey results. UTDRO program leadership were not involved in the collation or review of survey results. The Learner Report aimed to reflect the sentiments provided by the trainees in the online survey and covers 4 main domains: (i) general feedback and satisfaction, (ii) education, (iii) research, and (iv) equity, inclusion, and professionalism (EIP).

Distribution of Respondents

Majority of the survey respondents were radiation oncology fellows (43%; 9), followed by radiation oncology residents (38%; 8), and medical physics residents (14%; 3) (Figure 23). There were very few respondents, if any, from the other academic programs.

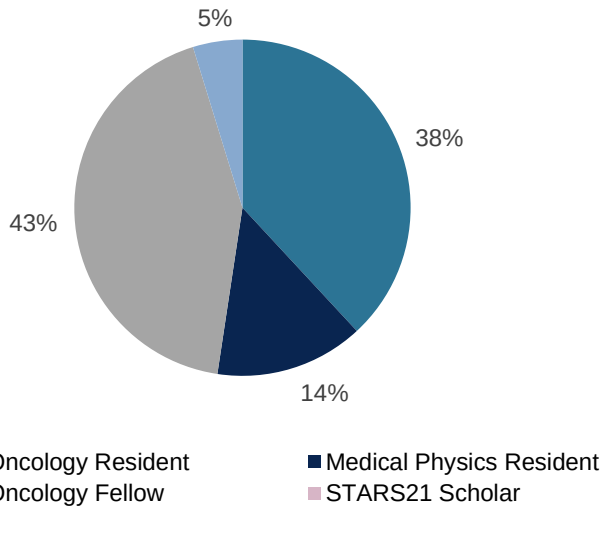

Figure 23: Program Type of Survey Respondents (n = 21)

Overview of Learner Opinion

General Feedback and Satisfaction

Responses from the learner survey indicated that trainees perceive UTDRO to be at the forefront of innovation and is the preferred training centre for radiation oncology. Students cited the top strength of UTDRO to be its size, which was associated with access to state-of-the-art facilities, high volume of patients, and exposure to rare cancer cases; all factors that enhanced their overall learning experience. Many felt that opportunities for research and exposure to world class experts and research programs were unparalleled at UTDRO. Engaged and supportive faculty/mentors and the collaborative nature of UTDRO were secondary strengths, followed by the department's strong reputation and name recognition on the global stage.

The top themes in the areas for improvement, in order of importance, included having more designated time for research; consistency in mentorship (e.g. managing time, work-life balance) and career counselling; streamlining communication, especially in the COVID-19 era where most means of communication have migrated online (e.g. less dependence on emails for communication, especially for urgent patient matters, combatting Zoom fatigue); and promoting intra- and inter-coherence and collegiality to enrich the work culture at each of the UTDRO sites.

Students were also asked to provide feedback on their general satisfaction with the department. Most respondents (95%) agreed that UTDRO is a good place to develop and enhance their careers (Figure 24). Eighty-five percent of respondents stated that they would recommend UTDRO to colleagues/friends who want to train in radiation medicine (Figure 25).

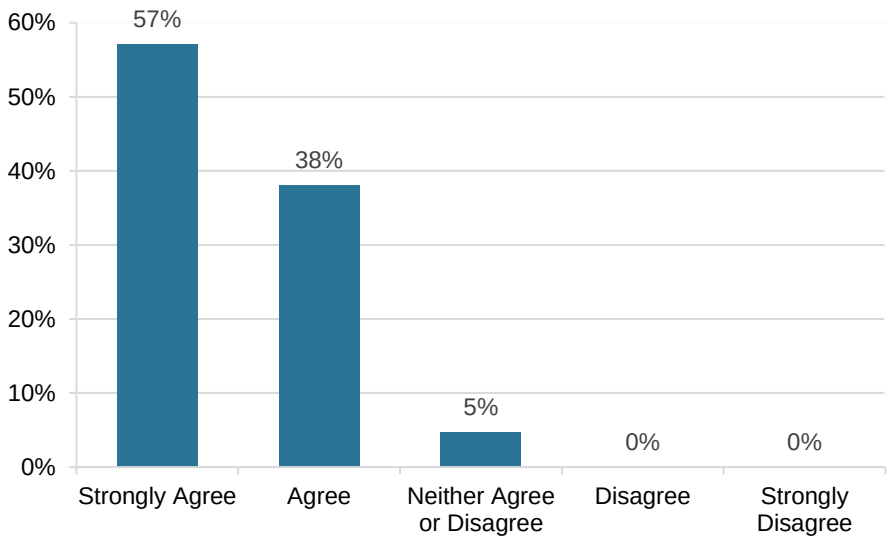

Figure 24: Agreement with "UTDRO is a Good Place to Develop and Enhance Your Career (n = 21)

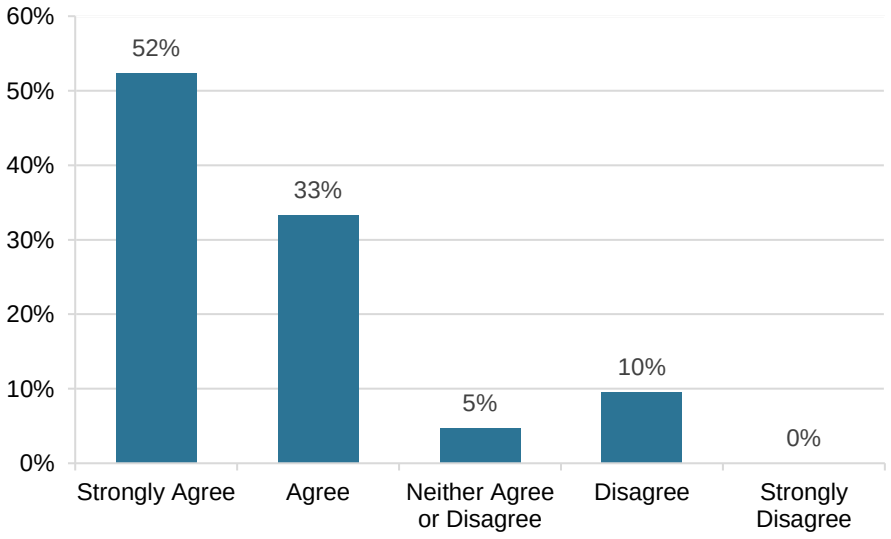

Figure 25: Agreement with "I Would Recommend UTDRO to Colleagues/Friends Who Want to Train in Radiation Medicine" (n = 21)

Education

UTDRO offers educational programs at the undergraduate and postgraduate levels, which are comprised of various formal (e.g. Resident Academic Half Day, Research Seminars, Journal Clubs) and informal (e.g. learning in clinic, feedback on contouring and RT plan review) learning opportunities. As such, students were asked to provide feedback on the quality of formal and informal education they have received at UTDRO. Interestingly, a greater proportion of students rated the informal education higher (very good to excellent) than the formal education (76% *vs*. 45%) (Figures 26 and 27).

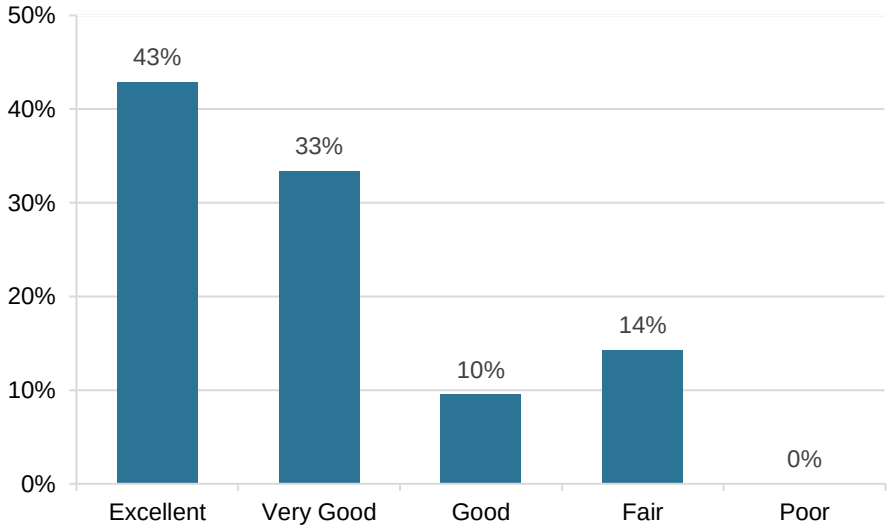

Figure 26: Satisfaction Level with Quality of Informal Education Received at UTDRO (n = 21)

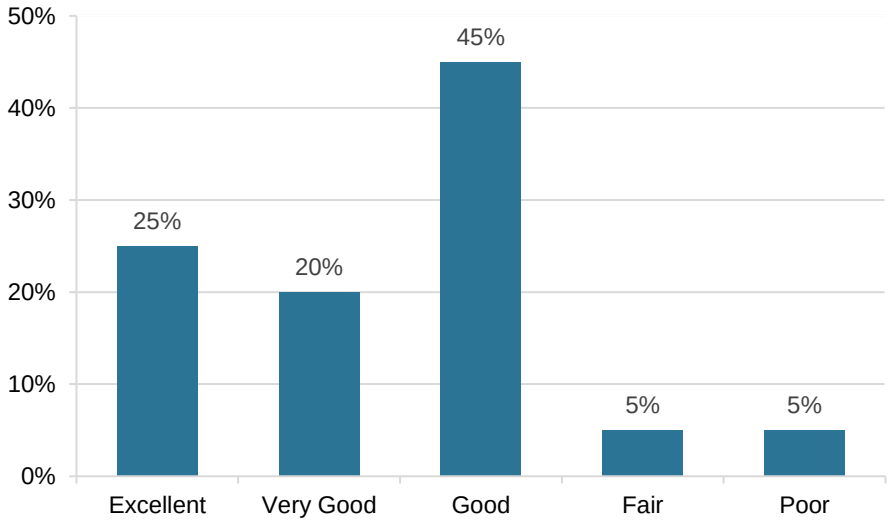

Figure 27: Satisfaction Level with Quality of Formal Education Received at UTDRO (n = 20)

UTDRO offers various Continuing Education (CE) opportunities to its students and faculty to promote the dissemination of new knowledge and foster the adoption of best practices generated by the department's academic programs. When asked whether the UTDRO Research Day, Evening Journal Club, Target Insight Conference, Clinical and Experimental Radiobiology Course, and hospital-based

rounds have contributed to trainees' academic learning and professional development, most survey respondents believed they had contributed a moderate amount (Figure 28). Respondents also noted other activities that have aided in their academic learning and growth, including AEP's Accelerator Technology (ATec) Course, Medical Physics Journal Club, protected teaching time with faculty, and QA Rounds, wherein trainees felt more engaged (which is not really the case for hospital-based rounds).

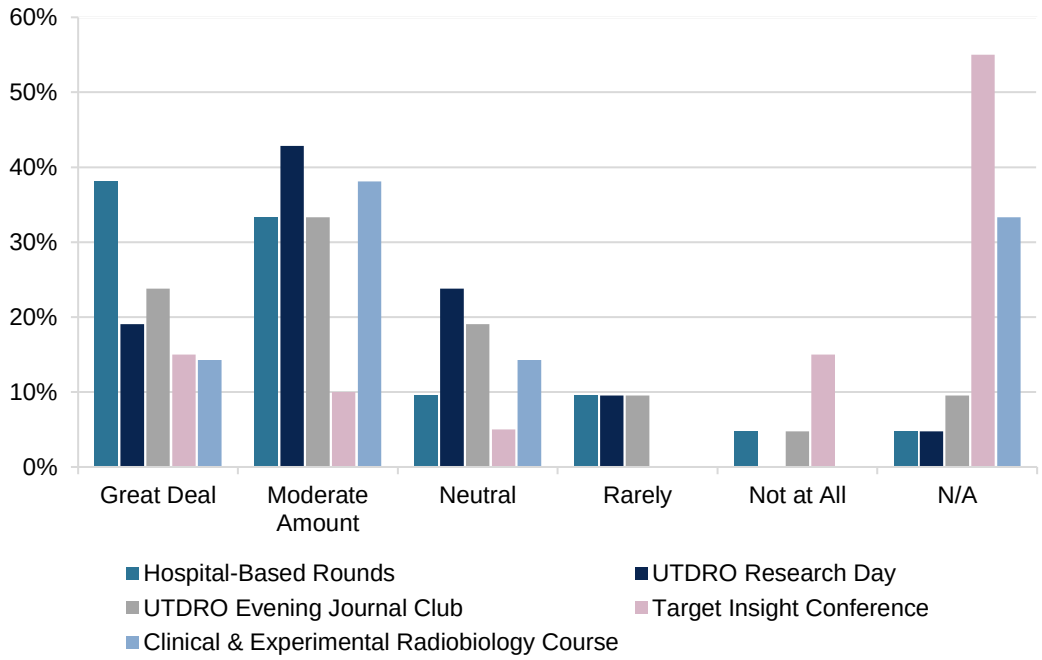

Figure 28: Level of Academic Learning and Growth from UTDRO CE Activities (n = 21)

The learner survey was also used to obtain a sense of how students felt about the opportunities they had for developing their teaching skills at UTDRO. The majority of survey respondents (57%) reported that the level of teaching opportunities available within their clinical settings was good or better (Figure 29).

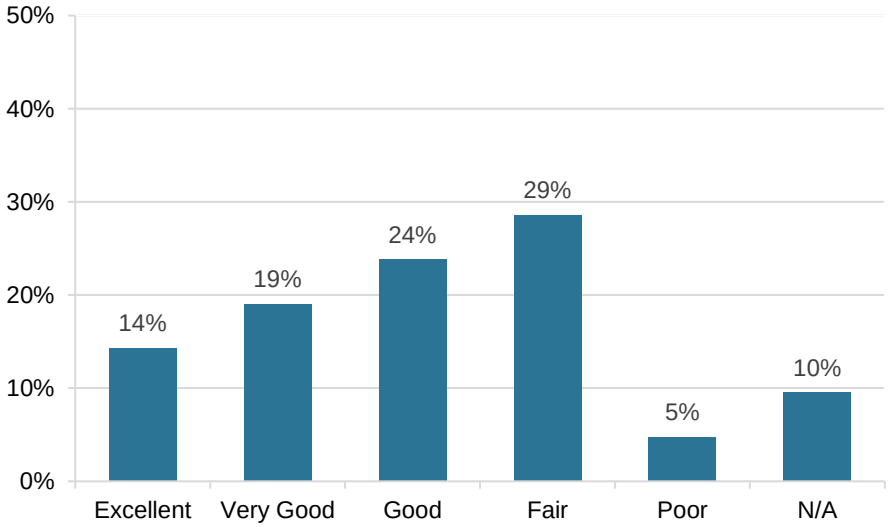

Figure 29: Satisfaction Level with Teaching Opportunities Available at UTDRO (n = 21)

From an administrative standpoint, feedback was also sought on whether students were provided sufficient information when being on-boarded. Most survey respondents (76%) indicated that the orientation they had received when they first joined UTDRO was good or better (Figure 30).

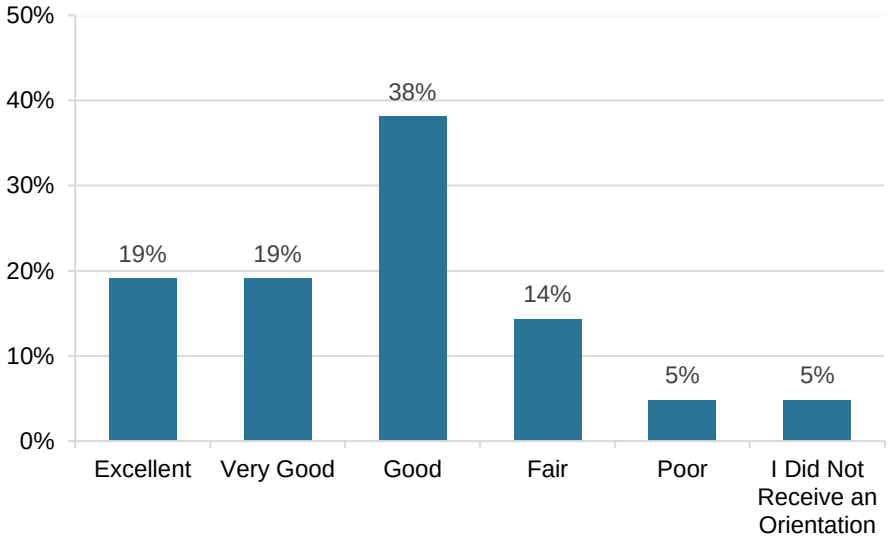

Figure 30: Satisfaction Level with Orientation Received When First Joined UTDRO (n = 21)

Research

UTDRO and its affiliated academic hospitals and research institutes prides itself as being one of the largest, most productive academic radiation medicine programs worldwide. Students in our various academic programs are actively engaged in research, driving innovation along the entire patient trajectory from diagnosis through treatment to end-of-life care and long-term survivorship. When asked about their level of satisfaction with research opportunities available during training, the majority indicated it was good or better (90%) (Figure 31). Similarly, most students (86%) felt that the amount of research support (e.g. funding, access to patient data, statistical support) provided during training was good or better (Figure 32).

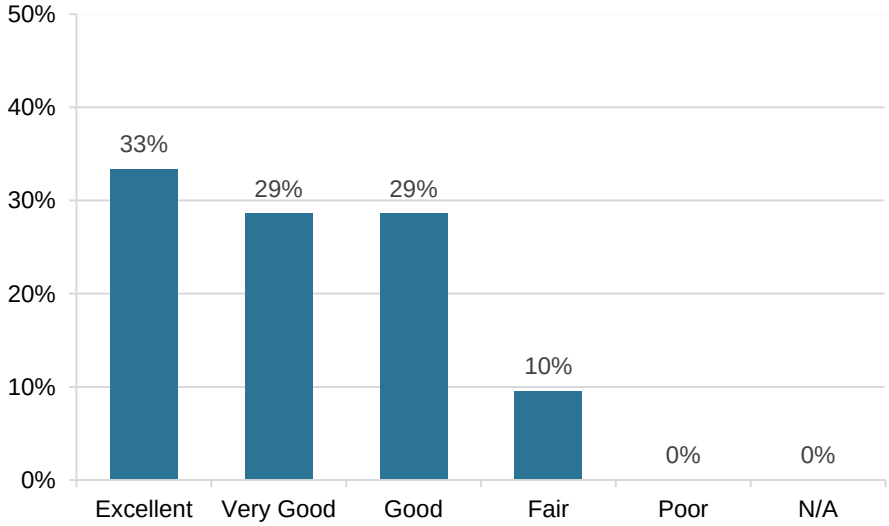

Figure 31: Satisfaction Level with Research Opportunities Available at UTDRO (n = 21)

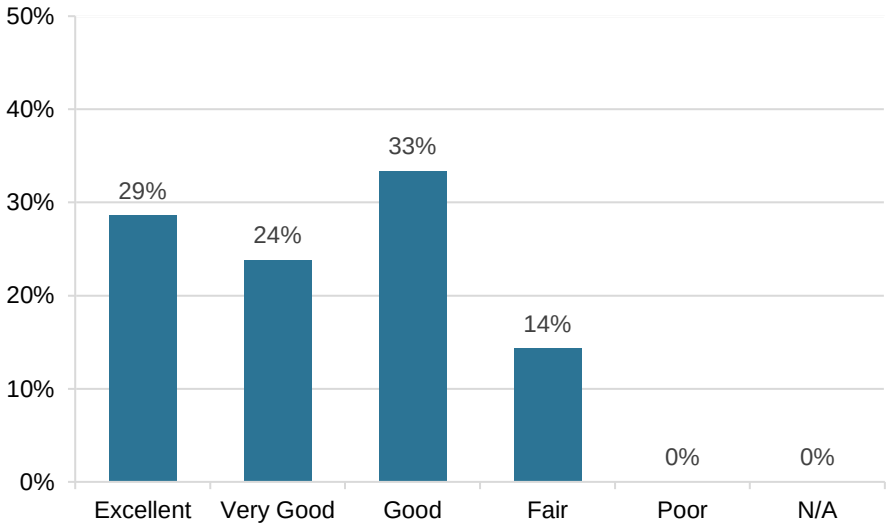

Figure 32: Satisfaction Level with Research Support Available at UTDRO (n = 21)

Despite the available research opportunities, a common sentiment amongst the respondents was the challenge to secure protected time for research, which they deemed as being a major impediment to being academically productive. In particular, it was noted that the perceived research expectations for radiation oncology residents were "high, up to 5 first-author manuscripts and a graduate degree in order to be considered a strong candidate" for academic positions. As such, residents felt quite stretched to meet these research expectations in addition to the residency curriculum and responsibilities of patient care. Furthermore, it was noted that due to the heterogeneity in research mentorship and quality of projects, some residents would not have many publications by the end of their residency and/or have publications with low journal impact factors. These pressures, which exist due to the residents' perceived job market concerns, has a negative impact on their overall training experience and quality of life.

Equity, Inclusion and Professionalism

UTDRO ensures its faculty, staff, and trainees have access to support to address and fulfill U of T's position on Equity, Inclusion, and Professionalism (EIP). The department also continues to align its culture, principles, and philosophies with that of the Temerty FoM Office of Inclusion and Diversity, as well as other external professional bodies, such as the CPSO. The learner survey was used to seek how students felt about the department's position on EIP. Most respondents (71%) agreed that UTDRO is committed to supporting a culture of EIP (Figure 33). When asked how the department could further improve its EIP efforts, several recommendations were made, including recruiting BIPOC (Black, Indigenous, people of colour) trainees and those from marginalized communities; increasing trainee and faculty awareness and engagement on social issues and inequities to access; deploring micro-aggressions and learner mistreatment (not just from the Chair, but also from the program directors); and acting on incident complaints (e.g. sexist and racist remarks from staff).

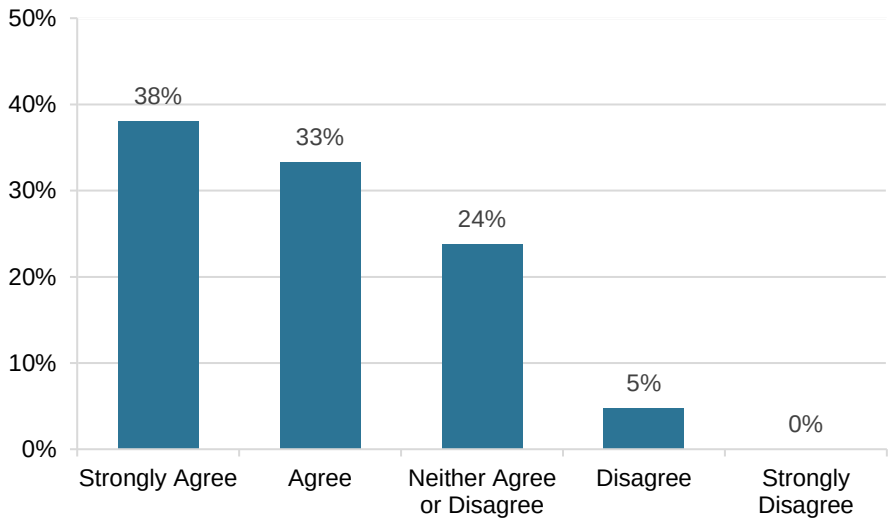

Figure 33: Agreement with "UTDRO is Committed to Supporting a Culture of Equity, Inclusion, and Professionalism" (n = 21)

Overall Impressions

In summary, responses from the learner survey indicated that trainees perceive UTDRO to be at the forefront of innovation and is the preferred training centre for radiation oncology. Students cited the top strength of UTDRO to be its size, which was associated with access to state-of-the-art facilities, high volume of patients, and exposure to rare cancer cases; all factors that further enhanced their overall learning experience. Noted opportunities for growth included having more dedicated time for research, consistency in mentorship and career counselling, and streamlining communication. Overall, the majority of students (95%) who responded to the survey believed that UTDRO is a good place to develop and enhance their careers, with many (85%) stating that they would recommend UTDRO to colleagues/friends who desired to train in radiation medicine.

FUTURE DIRECTIONS

In accordance with our strategic plan, *UTDRO 2022: Reflect. Transform. Lead*., UTDRO has the following aspirational priorities for the department:

1. Heighten the culture of academic excellence.
2. Prepare the radiation medicine leaders of tomorrow.
3. Accelerate uptake of cutting-edge knowledge in radiation medicine.
4. Collaborate for transformative reach and impact.
5. Enhance success through improved governance and operations.

These five strategic pillars of activities have guided the department since 2018. Over the last five years, UTDRO has made strides in advancing cancer care on a global scale through research, pushed the boundaries of innovation, and contributed to enhancing practice through our award-winning education programs. Our achievements and successes are a reflection of the hard work and deep commitment of our talented, multidisciplinary faculty, trainees, and staff.

In the years ahead, we will build upon these accomplishments and work collectively towards achieving our mission to "Prepare future radiation medicine leaders, contribute to our communities, and improve the health of individuals and populations through discovery, application, and communication of knowledge." By remaining true to our core values of proactive, transformative leadership, innovation, excellence, partnerships and collaboration, and respect, we will shape our department into one that delivers "Global leadership in radiation oncology by transforming practice through innovation and excellence in research and education."

The process of preparing the UTDRO Self-Study Report has highlighted many strengths of the department, as well as opportunities that exist for growth. The next five years present the opportunity for UTDRO to magnify its presence, both in terms of knowledge generation and knowledge dissemination. The key directions we plan to pursue over the next few years are described below.

Equity, Inclusion and Professionalism

Under the leadership of the new Director of Equity, Inclusion, and Professionalism (Dr. Danielle Rodin), UTDRO will continue to align its culture, principles, and philosophies with the Temerty FoM's Equity, Diversity and Inclusion Action Plan. Comprised of a multiprofessional team of radiation oncologists, medical physicists, radiation therapists, and scientists, diversity remains the department's greatest strength. Strategies to enhance equity and diversity in faculty hiring and student recruitment will be a top priority for UTDRO. A concerted department-wide effort towards awareness-building on the themes of discrimination, unconscious bias, micro-aggressions, mistreatment, and building a positive workplace culture will be undertaken. The importance of a positive culture that stresses the professionalism values of equity, diversity, and inclusion will also be promoted through public statements from leadership on issues that arise. Another major effort will focus on accountability. The EIP Director will now form part of the Hiring and Promotions Committees to ensure accountability for staff behaviour and to highlight positive professional behaviour. Any equity issues that are brought forward will be reported back to trainees and staff on an annual basis. Departmental surveys will be conducted to evaluate the perceived impact of these efforts within the department over time.

Collaboration

Across its programs, UTDRO values partnerships and collaborations with other University of Toronto departments, government groups, professional organizations, and other academic institutions across all constituencies. Over the next five years, UTDRO will continue to nurture and expand its local, national, and international partnerships. Internally, the department will push for an increase in collaborations across the six affiliated sites, and amongst its faculty through the development of databases, collaborative clinical trials, and additional research initiatives. Building a strong strategic relationship between the two main sites (PM and OCC) continues to be a work in progress. Focused strategies to incentivize and engage faculty in joint UTDRO academic activities will be prioritized. Building on the commonalities of each academic institution in a manner that synthesizes an improved culture of trust and collaboration will be a priority for the department.

Mentorship and Career Counselling

The importance of mentorship, especially as it relates to one's career or academic promotion, was a predominant theme in the 2021 Faculty Report and Learner Report. The adoption of mentorship for faculty and trainees, opportunities for faculty development in teaching, and clarity around the academic promotion process were areas where many felt needed improvement. UTDRO will continue to work with faculty and trainees to address these recommendations, with a focus on establishing mentorship for junior and mid-career faculty in the context of specific tracks (e.g. education, clinical, discipline-specific). Based on the success of the existing Resident Mentorship Program and Junior Faculty Mentorship Program, a department-wide roll out of similar programs across the various disciplines and sites will help alleviate many of these pain points. Additionally, UTDRO will seek additional funding to finance the administrative infrastructure required to support these department-wide faculty development, promotions, and mentoring activities.

Faculty Recruitment

The depth and breadth of talent within UTDRO is exceptional. The department has had great success in strategic recruitments with faculty that have brought expertise that complements existing talent. In recent years, many faculty have departed UTDRO for prominent leadership positions elsewhere, underscoring the fertile opportunities for our faculty members. While an abundance of knowledge and experience has been lost due to the departure of several senior faculty members, it has also provided an opportunity to introduce new faculty who bring fresh, creative ideas to the department. Key recruitments have been made to maintain the level of productivity, innovation, and overall academic excellence of the department. This also highlights the importance of continuing leadership development internally within UTDRO, particularly within the domains of research and education.

CAMPEP-Accredited Stream within Medical Biophysics

Enabling the medical physicists within UTDRO to develop their own independent research programs and access graduate students are top priorities for UTDRO. The Chair and physics leadership at UTDRO continue to have discussions with the Department of Medical Biophysics (MBP) Chair and MBP Executive Committee on how to develop a CAMPEP-accredited medical physics stream within MBP, which will provide a "home grown" pipeline of candidates for the Physics Residency Program. The academic appointment of several Princess Margaret physicists to MBP in 2020 marks an important milestone for the physics group. The access of medical physics clinical researchers to graduate students

will provide tremendous collaborative opportunities for research and education activities within the physics group and MBP, and bolster research activities related to radiotherapy medical physics.

Brand and Identity

At the time of the previous external review, it was noted that faculty and trainees identified themselves more closely with the hospital in which they worked or trained than with the University. This issue appears to be less prominent in the current Self-Study, reflecting an increase in the perceived value of UTDRO to each faculty member. This is likely a consequence of the improved communication strategies (e.g. e-newsletters, twitter), as well as a greater number of departmental activities which contribute to a sense of community for faculty. UTDRO will nonetheless continue to develop an internal branding strategy that will further engage faculty, trainees, and staff, and amplify the perceived value of the "UTDRO" brand. Although, UTDRO is top ranking in its reputation among Canadian Radiation Oncology Departments, its global presence still needs strengthening. The department continues to develop its external brand and enhance the department's visibility on the global stage. Proposed strategies include, but are not limited to ensuring all faculty have the UTDRO logo on their posters and slide decks when presenting at conferences or meetings.

Sustainable Funding Model

Strategies to maintain sustainable and stable funding is a key focus for UTDRO. The department continues to explore revenue-generating strategies, including industry alliances and monetizing educational offerings, such as the new MRgRT Training Program, as well as further expanding the Clinical and Experimental Radiobiology Course to a paying international audience. International trainees represent a significant opportunity for expansion of our global impact, as well as acquiring incremental funding for our educational programs. Additional options for revenue generation include international partnerships, CMEs, and of course, philanthropy. The establishment of an Endowed Chair in UTDRO would also assist in recruiting and retaining the highest-quality faculty and ensuring sustainable financial support for the department.

As part of MOHLTC's Health System Funding Reform strategy to drive consistent, equitable and high-quality care for patients treated with radiation therapy across Ontario, Ontario Health-Cancer Care Ontario will implement a new Radiation Treatment Quality Based Procedures (RT-QBP) funding model by 2022-2023. RT-QBP may impact specific programs within UTDRO (e.g. MRS Program) as hospital sites may no longer receive adequate funding to cover the cost of faculty involved in training and educational activities. UTDRO leadership will continue to liaise with hospital leads to assess the risks and financial and systems impact of the new funding model.

Alumni Engagement

Over the next five years, UTDRO will continue to promote an alumni engagement strategy with the U of T Advancement Office to strengthen the department's relationship with its graduates, and to encourage alumni to form partnerships/collaborations with each other. This will help UTDRO further strengthen its community of ambassadors around the world and build its global brand.

Enhancing Operational Excellence

UTDRO's operational activities have undergone significant changes and turnover over the recent five years. To maintain a smooth transition, standard operating procedures (SOPs) will be developed. In addition, staff will be provided improved clarity on their roles and responsibilities. Partnership with registrarial groups at the Temerty FoM will be enhanced. In addition, a culture of transparency and accountability will be further promoted. With these goals in mind, the UTDRO operational budget will be closely monitored. A system will also be created to declare and monitor COIs more efficiently amongst faculty.

Faculty and Student Wellness

Given the COVID-19 pandemic and the subsequent burnout and fatigue of frontline healthcare workers, UTDRO will continue to monitor the impact on faculty and trainee wellbeing, retention, and subsequent effect on enrolment to address health human resource demands post-COVID.

Research

UTDRO continues to enhance the scope and size of its radiation research, but the impact of research has the potential to reach farther and deeper. A priority for the department is to increase the impact of its research, striking the balance between clinical care delivery and innovations with clinical impact. The establishment of world-leading MR-guided radiotherapy programs at the Odette and Princess Margaret Cancer Centres catalyzed by the procurement of Elekta Unity MR-LINACs at both centres presents a unique opportunity for highly impactful collaborative research within the UTDRO community.

The UTDRO Collaborative Research Seed Grant Program will continue as it is a very important and successful initiative in promoting research collaboration across the affiliated sites. Efforts are ongoing to secure funding from industry or philanthropy that is independent of the five participating UTDRO clinical departments that currently fund the Seed Grant Program. The UTDRO Evening Journal Club is another mechanism to increase collaboration amongst faculty, and this forum for knowledge exchange will also continue.

Strategic Plan Refresh

With both the current strategic plan, *UTDRO 2022: Reflect. Transform. Lead*. and Dr. Fei-Fei Liu's final term as Chair concluding at the end of 2022, UTDRO will be embarking on its next strategic planning process to help set new directions and priorities that will support innovation and academic excellence across the department for the next five years. Over the course of the coming year, UTDRO will engage its faculty, trainees, staff, and key partners to better understand the progress the department has made on its current strategic priorities and determine how we can further enhance the department's reputation internationally and elevate it to new levels in leadership and contributions. UTDRO will ensure its renewed goals and directions are aligned with the strategic plans of U of T and the Temerty FoM, which is currently undergoing a refresh.

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