



## Radiation Medicine Program

# ANNUAL 2019 REPORT 2020



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# A MESSAGE FROM THE CHIEF



The Radiation Medicine Program (RMP) at the Princess Margaret Cancer Centre is committed to delivering the highest standard of patient care. Over the past year, our dynamic and cohesive multidisciplinary team of radiation oncologists, medical physicists, radiation therapists, administrators, researchers, educators, and support staff have continued to advance us towards our vision of “Precision Radiation Medicine. Personalized Care. Global Impact.” RMP remains the largest single-site radiation medicine program in the world, providing 9168 patient consultations and 11,286 courses of radiation treatment in fiscal year 2019-2020, recording the highest number of courses delivered in the recent decade.

We are approaching the culmination of our **Strategic Roadmap to 2020**, and a strategic refresh is due this year. I am immensely proud of the important progress and advances our program has contributed to radiation medicine over the last five years. First and foremost, we have launched our state-of-the-art MR-Linac facility. Together with our unique MRgRT facility, RMP now encompasses the largest MR-guided radiation therapy program in the country, which enables us to treat more patients with cutting-edge technology. I would also like to take this opportunity to acknowledge the outstanding efforts undertaken by Team RMP during UHN's Accreditation Survey in 2019. In particular, RMP's Accreditation Working Group went above and beyond in their efforts to ensure that we were all “best-in-class”, and abreast of all relevant standards, practices, and policies. Furthermore, several members of Team RMP received prestigious awards and appointments, including Laura Dawson, who was the first Canadian and fifth woman to become ASTRO's President-Elect; Jolie Ringash, who has been appointed as CARO's President-Elect; and Brian O'Sullivan, who received the ASTRO Gold Medal in honour of his impact and achievements in Radiation Oncology.

Our innovative education programs continue to attract attendees from around the world. In 2019, RMP welcomed 179 undergraduate and post-graduate trainees, and hosted 58 observers from 17 countries. Our award-winning Accelerated Education Program (AEP) offered two courses beyond Toronto for the very first time – one in Beijing, China and another in St. John's, Newfoundland. In training such a diverse group of radiation medicine professionals, we are achieving our goal of global impact, maximizing cancer outcomes for not just our own patients, but for those around the world.

RMP has continued to disrupt the radiation treatment landscape through new Adaptive Radiation Oncology research and knowledge dissemination to ensure the right treatment at the right time for every patient. This year, RMP has continued its upward trajectory on the number of peer-reviewed research publications and grants captured by RMP investigators. In particular, a multidisciplinary team led by RMP and UHN investigators received a \$6M Terry Fox New Frontiers Program Project Grant to explore vulnerabilities in the tumour microenvironment that can be exploited to personalize cancer treatment.

In summary, I am delighted to be able to share so many program accomplishments from 2019-2020. Even in unprecedented times, RMP remains unwavering in our mission to “advance exemplary radiation medicine through patient care, research and education in partnership with our patients and community”. As Chief, it is my pleasure to be working alongside such a diverse and talented team who share a common vision and passion for delivering world-class personalized radiation medicine. I look forward to all that we can achieve together in the coming year.

**Fei-Fei Liu, MD, FRCPC, FASTRO**  
 Chief, Radiation Medicine Program, Princess Margaret Cancer Centre  
 Head, Department of Radiation Oncology, University Health Network



## State of the Art Facility

- 16 Linear accelerators
- 2 Leksell Gamma Knife Perfexion units
- 3 CT simulators
- 1 MRI 3T simulator
- 1 PET CT simulator
- 1 Orthovoltage/Superficial X-ray unit
- 2 Brachytherapy high dose rate (HDR) remote afterloaders
- 1 Magnetic resonance-guided radiation therapy (MRgRT) facility
- 1 MR-Linac facility

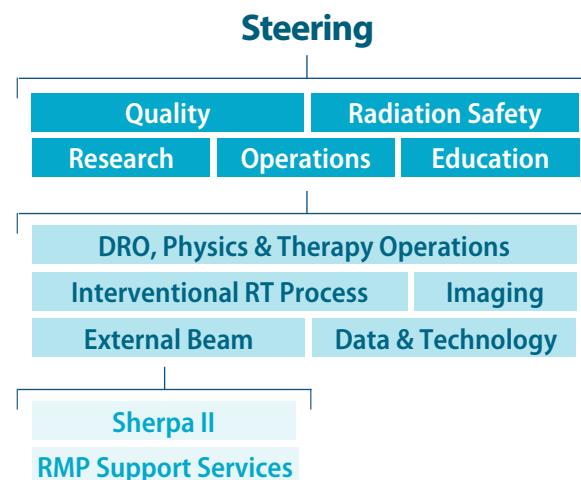
# PROGRAM OVERVIEW

The Radiation Medicine Program (RMP) at the Princess Margaret Cancer Centre is the largest radiation treatment centre in Canada, and one of international acclaim as amongst the top three such programs in the world. The program is organized into the three core disciplines of radiation oncology, medical physics and radiation therapy; each supported by robust clinical, research, administrative and technical teams. Together, this multi-professional group of over 400 staff work collectively to deliver high quality and safe radiation treatment to over 9000 cancer patients every year.

RMP has a diverse pool of talent, with many staff holding important leadership roles in patient-centred care, research and education at the local, national and international levels. Our research program, which spans from biological studies, translational biology and physics, clinical trials, to health services and education research, aims to innovate and advance radiation medicine practice, producing over 270 peer-reviewed publications annually.

Our interdisciplinary environment facilitates the delivery of innovative education programs covering the entire spectrum of professional learning in radiation medicine. RMP offers training at the undergraduate, graduate and postgraduate levels in collaboration with the University of Toronto and Michener Institute of Education at UHN, as well as continuing medical education through our Observership and Accelerated Education Program (AEP).

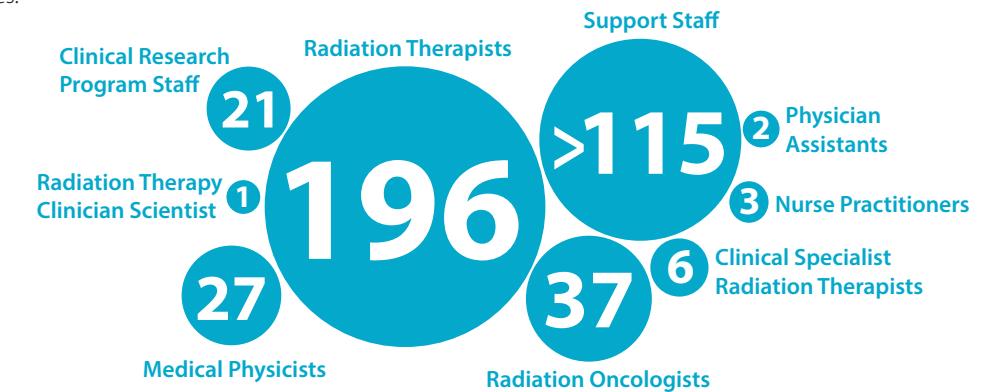
## Program Structure



\*As of 2019

## Team RMP

Our multi-talented, inter-professional staff enables all aspects of our program to succeed. Led by the Program Chief, 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.



11,286  
Radiation treatment courses\*



\$45.7M  
Peer-reviewed funding



21  
Radiation oncology residents

9,168  
Patient consultations\*

272  
Peer-reviewed publications

23  
Radiation oncology fellows

6,061  
Patients treated at  
Radiation Nursing Clinic\*

306  
Active clinical studies

6  
Medical physics residents

9.5%  
New patients accrued to  
prospective clinical studies

38  
Medical radiation sciences students

58  
Observers from 17 countries

# 2019 THE YEAR IN NUMBERS

\*fiscal year statistics

## A YEAR IN REVIEW

# STRATEGIC ROADMAP TO 2020

Since the launch of the **Strategic Roadmap to 2020** in 2015, RMP has focused on implementing several key initiatives and activities to help achieve its four strategic priorities to: 1) accelerate discovery to deliver precision medicine for best patient and population outcomes; 2) integrate research and education with clinical practice; 3) strengthen internal and external community linkages; and 4) extend high reliability with systems thinking. Key highlights from 2019-2020 are shown.

### Accelerate discovery to deliver precision medicine

- Launched Proton Therapy Consultation Service at PM
- Rolled out Radiation Therapist Case Expert practice model with RT Site Leaders training in CT Sim & Treatment Planning
- Developed harmonized process for overseeing MR-guided adaptive RT in RMP to ensure impact, including new technology implementation, protocol development approval & optimal clinical/academic utilization
- Implemented adaptive treatment with MR-Linac in 2 clinical sites
- Developed prospective REB-approved umbrella protocol to allow MRL data acquired in course of routine clinic to be used for research
- International leadership of MR-Linac Consortium Liver Tumour Site Group
- Participated in CCO's Relationship, Body Image & Intimacy Pilot Project in partnership with CCO Radiation Therapy Community of Practice & PM Psychosocial Oncology Program

### Extend high reliability with systems thinking

- Enhanced awareness & access of KPI metrics across RMP, including development of RT Planning Workload Database & Clinical Volume Predictive Modeling Dashboard
- Developed roll-out & training plan of EVOQ for all prostate-only cases in GU
- Harmonized communication & reporting of research performance in RMP through development of research dashboard with near real-time information on publications & funding
- Improved notification rate of RMP-related events by having UHN Incident Reporting System reconfigured to copy RT Practice Leaders on all reports filed indicating RMP locations
- RT Quality Practice Leader joined PM Quality Committee to improve communication & coordination with RMP

### Strengthen internal & external community linkages

- Hosted a continuing education event with referring physicians from St. Michael's, St. Joseph's, Humber River, & Michael Garron Hospitals
- Established & implemented UHN Employee Engagement Survey Action Plans for various disciplines within RMP
- Established UHN-RMP QBP Governance Advisory Committee to provide strategic oversight for CCO RT-QBP implementation at PM
- Established virtual clinics across site groups within RMP
- Completed SharePoint CMS upgrade in collaboration with UHN Digital to enhance communication & collaboration across RMP/UHN
- Piloted first capital project partnership with UHN & FM-PRO for 3T MR replacement project

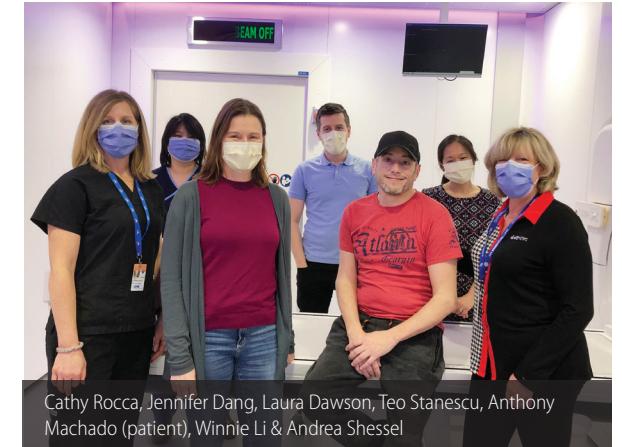
### Integrate research & education with clinical practice

- Launched "AEP on the Road" with on-site RT courses delivered in China & Atlantic Canada
- Formalized partnership with Hong Kong Hospital Health Authority for annual advanced training of HK radiation therapists
- Established "For RTs by RTs" Rounds to enhance capacity & professional development amongst therapists in RMP
- Initiated development of case bank workflow capable of converting clinical cases with unique teaching moments into an online resource suitable for self-directed learning/support teaching
- Launched *RMP Research Bites*, a quarterly e-newsletter highlighting RMP research activities & achievements
- Secured external funding to develop collaborative global capacity education initiative for radiation therapists & physicists in Ethiopia
- Completed external review of AEP by Ontario Hospital Association to guide strategic planning of program



## Launch of State-of-the-Art MRL Facility

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 (photo on left). This cutting-edge technology fully integrates an MR scanner with a linear accelerator to enable true real-time imaging during radiation treatment delivery. With construction beginning in January 2018, several significant milestones were attained in 2019. These included Health Canada approval in March, first volunteer imaging in May, completion of staff training, as well as CNSC and Elekta certification in July, and receiving the CNSC Operating license in August. 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. Furthermore, on March 27, 2020, RMP completed the first-ever MRL Liver SBRT treatment in Canada at the Princess Margaret. A second patient with liver cancer also completed his SBRT treatment on the MRL on March 31, 2020 (photo on right). Thanks to the immense collaborative efforts and dedication of our multidisciplinary teams, RMP has achieved a major milestone in advancing precision radiation medicine for our patients.



Cathy Rocca, Jennifer Dang, Laura Dawson, Teo Stanescu, Anthony Machado (patient), Winnie Li & Andrea Shessel

# CLINICAL CARE

Our clinical practice encompasses all aspects of cancer care – from diagnosis to survivorship. In 2019-2020, RMP provided 9,168 patient consultations and delivered 11,286 courses of radiation treatment, with 82% of new patient consultations being conducted within the 14-day target established by Cancer Care Ontario (CCO). There were 6,061 visits to the Radiation Nursing Clinic (RNC) for symptom and side effect management.

Our clinical practice is integrated into four multidisciplinary Super Teams comprised of anatomically related tumour site groups. Standardized treatment protocols that relate to evidence-based disease management guidelines are used by each site group to plan and treat patients.

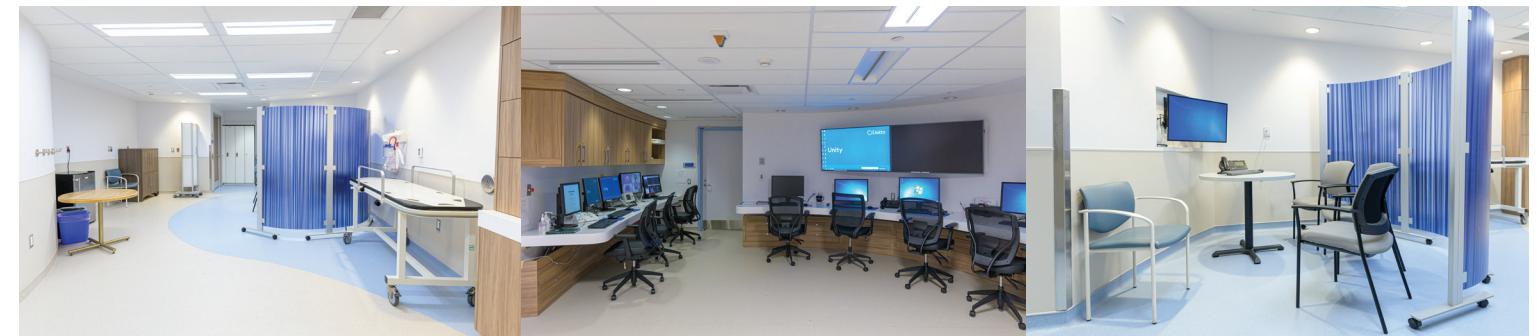
In addition to site groups, a number of specialized programs exist to further support individualized care in a subset of patients. Together, our inter-professional team works collaboratively to assess, plan and deliver personalized care to our patients.

### CLINICAL TEAMS

Superteams	Tumour Site Groups
Team 1	Endocrine, eye, head & neck, skin
Team 2	Breast, lung, upper gastrointestinal (GI)
Team 3	Genitourinary (GU), gynecological (GYN), lower GI
Team 4	Central nervous system (CNS), leukemia, lymphoma, palliative, pediatrics, sarcoma

### SPECIALIZED PROGRAMS

Brachytherapy	Palliative Radiation Oncology
Gamma Knife Radiosurgery	Pediatric Radiation Therapy
Oligometastases	Stereotactic Radiation Therapy



## Expansion of the Multidisciplinary Princess Margaret Brain Metastasis Clinic

The multidisciplinary Princess Margaret Brain Metastasis Clinic offers personalized brain metastases treatment within 1 week of referral. In February 2019, the Brain Metastasis Clinic relocated from its previous 2B clinic to the "Endocrine/Lung/Skin/Sarcoma" space on the second floor of the Princess Margaret. This new space provides more patient rooms and workstations, accommodating the increase in patient volumes and growing team. The Program Co-Directors, **David Shultz** and Gelareh Zadeh, are grateful to many people, in particular Iryna Tymoshyk, for orchestrating this seamless move. The brain metastasis team continues to expand its services across Ontario with the establishment of cross-appointed radiation oncologists, and a collaborative, multidisciplinary oligo-metastases brain clinic between the Princess Margaret and Stronach Regional Cancer Centre at Southlake. This partnership identifies patients who would benefit from stereotactic radiation treatment vs. surgery. Appropriate patients are then fast-tracked to the Princess Margaret for stereotactic radiation. Patients who are suitable for surgery will be assessed and treated by a specialized surgical team at the Toronto Western Hospital. A similar partnership has commenced with our colleagues from the Carlo Fidani Cancer Centre in Mississauga. An additional outcome of these initiatives has been the opportunity to build awareness and understanding of the treatment options for brain metastasis with our referring partners.

## Excellence in Patient Care



Fei-Fei Liu, Alexander Sun, Pat Merante, Kevin Smith, Paula Kirsh, David Shultz, Andrew Bayley

2019 marked the 20<sup>th</sup> anniversary of the Gerald Kirsh Humanitarian Awards, which recognizes extraordinarily compassionate care provided by staff and volunteers at the Princess Margaret. Amongst the 13 nominees, 5 were from RMP: **Andrew Bayley, Pat Merante, Alexander Sun, David Shultz, and Rebecca Wong**. As stated by Joel Kirsh, son of the late Gerald Kirsh, "Great representation from [RMP] is very fitting; 20 years ago it was the compassionate care of Dr. **Padraig Warde** and his team that gave birth to the Gerald Kirsh Awards."

Congratulations to **David Shultz** and Shelley Westergard on being the 2019 winners of the Gerald Kirsh Awards! Previous winners from RMP include **Wilfred Levin** in 2008, **Sandra Scott** in 2015 and **Alejandro Berlin** in 2017.

“**[Dr. Shultz] has eased our fears while keeping us grounded in reality and encouraged us to spend time together and remember to laugh; the best medicine of all. He never makes me feel as though I am wasting his time, or that he has somewhere else to be. He is warm, friendly, and human. In some ways, I am sad that I met him this way, but I'm glad that he has been there for us; we have needed him.**”

**Patient** ”

## Award Winning Case Expert Radiation Therapy Practice Model

The Person-Centred Radiation Therapy Team, led by **Elen Moyo**, received the 2019 Ontario Association of Medical Radiation Sciences (OAMRS) Team Award for the development and implementation of an innovative Case Expert Radiation Therapist (CERT) practice model that newly-defines the role of radiation therapists in delivering personalized, precision radiation treatments for improved patient experience and potentially benefiting treatment outcomes.

The 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. Feasibility and pilot studies demonstrated that this innovative model of care led to broad improvements in radiation therapy service delivery for patients, as well as greater engagement of the health care providers.



Elen Moyo, Erin Velec, Grace Lee, Andrea Shessel, Annette Sperduti, Neena Sharma, Suyeon Kim, Michael Velec; (front) Jennifer Dang, Jasmine Chen (OAMRS Awardees)



**Alejandro Berlin** was appointed as the inaugural Medical Director of Data Science, Outcomes, and Smart Cancer Care at the Princess Margaret for a 2-year term, effective November 2019



**John Kim** was re-appointed as the Ontario Head & Neck Cancer Lead for Ontario Health - CCO for another 2 years until 2022



**Daniel Letourneau** was appointed as the Interim Head of Medical Physics, effective July 2019



**Maitry Patel** was elected as Ontario's Alternate Provincial Director on the Canadian Association of Physician Assistants Board of Directors for a 2-year term starting October 2019



**Danielle Rodin** was appointed as the inaugural Director of the Global Cancer Program at the Princess Margaret for a 2-year term, effective November 2019

## Leadership Appointments

**Joelle Helou:** DRO Breast Site Group Leader (May 2020); succeeding Anne Koch, who held this position since 2014

**Tim Craig:** Interim Associate Head of Medical Physics, Clinical Affairs (September 2019)

**Carina Feuz:** Interim Radiation Treatment Delivery Practice Leader (April 2019); succeeding Winnie Li, who held this position since 2018

**Robert Heaton:** Physics Sarcoma Site Lead (September 2019)

**Ali Hosni:** DRO GI Site Group Leader (July 2019); succeeding Jolie Ringash, who held this position since 2015

**Harald Keller:** Lead - 1B CT Imaging (September 2019)

**Patricia Lindsay:** Lead - Delivery (September 2019)

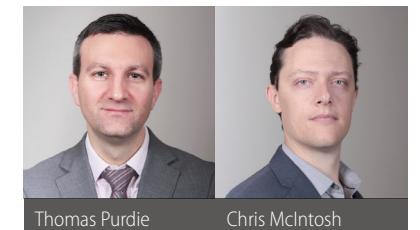
**Teo Stanesco:** Physics Team 2 Lead (September 2019)

**Tony Tadic:** Physics Team 3 Lead (September 2019)

**Jeff Winter:** Lead - 2B CBCT Imaging; Physics GU Site Lead (September 2019)

## First Patients Treated with RayStation Machine Learning Plans

In 2019, RMP treated its first patients with radiation treatment plans generated using machine learning features in RayStation. Developed by **Thomas Purdie** and **Chris McIntosh**, in collaboration with RaySearch, this groundbreaking technology marks the first application of machine learning in a radiation treatment planning system. Since May 2019, every patient with localized prostate cancer treated at the Princess Margaret has been participants of an evaluation study led by **Alejandro Berlin**. Patients will have both a manually generated plan and a machine-learning plan, and are treated with the superior plan following physician and peer review. This initiative builds upon our previous study, which demonstrated that AI-generated plans were equivalent, or even superior to human-generated plans in 94% of prostate cancer cases.

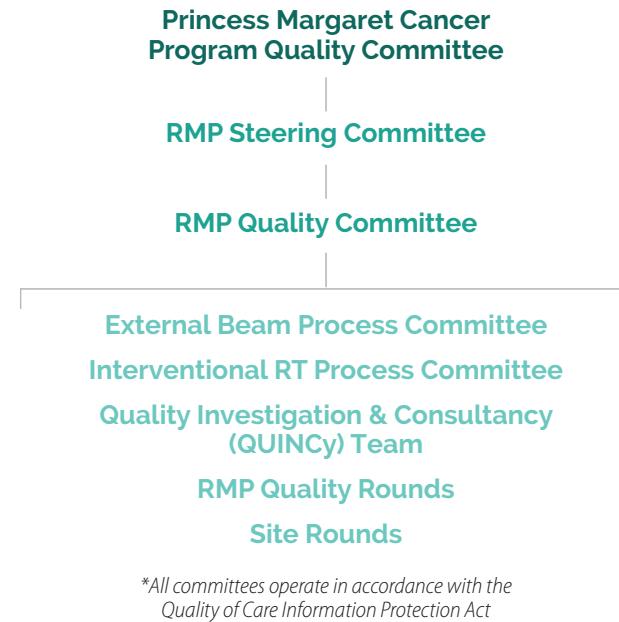


Thomas Purdie Chris McIntosh

# QUALITY & SAFETY

The RMP Quality Committee (RMP QC) functions to monitor, analyze reports, and make recommendations on all aspects of radiation treatment quality and safety within RMP. Reporting to the RMP Steering Committee and Princess Margaret Quality Committee, the RMP QC aims to exceed national and international safety standards, and oversees a quality-monitoring program for the department covering the following four domains:

1. **Performance Indicators**, aimed at evaluating compliance with relevant standards
2. **Quality Assurance**, aimed at monitoring radiation treatment quality control processes
3. **Quality Education**, aimed at contributing to quality and safety competence through education
4. **Incident Learning**, aimed at managing an incident learning system



## Excellence in Performance

The RMP QC uses the standards established by Cancer Care Ontario, Canadian Partnership for Quality Radiotherapy (CPQR), and Accreditation Canada to guide the development and maintenance of quality in the program.

### CCO Performance Measures

CCO monitors three key performance areas: i) referral-to-consult wait times; ii) ready to treat-to-treatment start wait times; and iii) peer review rates. RMP continues to meet the majority of the CCO Performance Measures, and provincial averages for wait times, and peer review in 2019.

### CPQR Program Compliance

CPQR has published a series of 19 guidelines in three categories: technical quality control, quality assurance and patient engagement. Compliance has been assessed against all of the CPQR guidelines; three have been deemed not applicable to RMP practice. In 2019, RMP had an overall compliance rate of ~91%.

**82%**  
of cases within referral-to-consult wait time target

**89%**  
of cases within ready to treat-to-treatment wait time target

**90%**  
of radical cases peer reviewed

## Successful RMP/UHN Accreditation

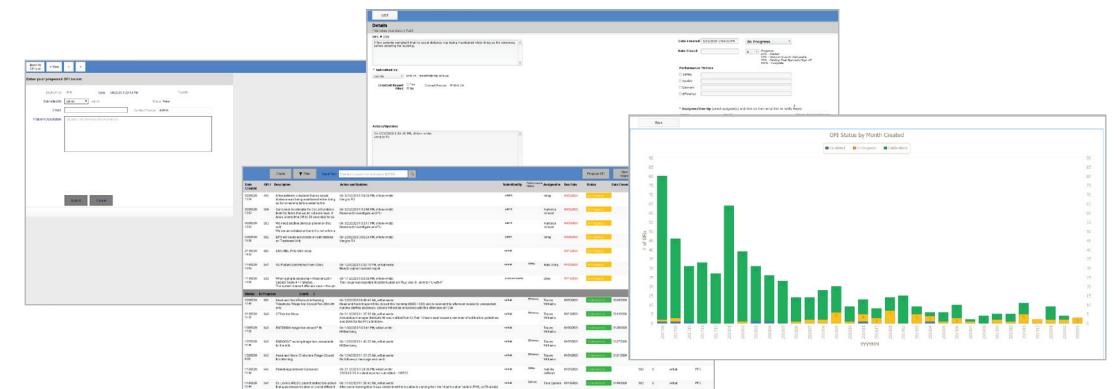
In September 2019, UHN underwent its rigorous Accreditation Canada review and maintained its exemplary accreditation status thanks to the collective efforts of all staff. In particular, the auditors were highly laudatory of RMP and the Princess Margaret on our commitment to providing safe and quality care for our patients. Thanks to the RMP Accreditation Team (**Julie Wenz, Andrew Bayley, Marcia Bowen, Angela Cashell, Jennifer Croke, Carina Feuz, Robert Heaton, Christine Hill, Catarina Lam, Lyndon Morley, Bern Norrlinger, Elizabeth Ng**), who critically reviewed the Cancer Care Standards, Required Organizational Practices (ROPs), and Priority Processes, as well as proactively responded to any deficiencies identified, gathered evidence on how we comply to key standards, and prepared the extremely useful Staff Awareness Campaign. In total, UHN met 100% of the ROPs – which must be in place to maximize patient safety, and 99.5% of all the standards.

“Canada lags the rest of the developed world in not having a proton facility. Having seen almost every comprehensive cancer program in Canada, I personally am of the view that the RMP at PM is the only radiation medicine program capable of implementing such a facility.”

**2019 Accreditation Canada Surveyor**

## Opportunities for Improvement within RMP

The Sensitivity to Operations Project (StOP) project was established by Radiation Therapy management in 2016 to overcome the challenge of recording/tracking operational issues that arise during the day. The team consisting of **Veng Chhin, Lorella Divanbeigi, Jerry Roussos, Andrea Shessel, Steven Tran** and **Bob Partridge** set out to develop a program similar to RMP Helpdesk’s issue tracking system. In August 2017, UHN implemented Safety Huddles as a part of its Caring Safely initiative. **Elizabeth Ng** led the development and implementation of Safety Huddle Boards for radiation therapy, and StOP transformed into the Safety Huddle Database incorporating issues captured by the safety huddles. All staff are encouraged to submit Opportunities for Improvement (OFI) to the Safety Huddle Database. Users will be notified regarding whom the issue has been assigned to, any progress updates and case closures. All OFIs that affect safety, delivery, efficiency and quality are addressed at the daily Directors’ Safety Huddle. Since its implementation, 688 OFIs have been recorded, with 510 completed, 171 in progress, and 7 currently escalated. In recognition of the positive impact of the Safety Huddle Database on operational/clinical activities, the team recently received the 2019 RMP Clinical Award – Distinction in Quality & Process Improvement.



# EDUCATION

As the largest radiation medicine programs in North America, RMP provides one of the most comprehensive clinical settings for the formal training of radiation oncologists, physicists and therapists. RMP's education portfolio is closely aligned with that of the University of Toronto's Department of Radiation Oncology as a fully affiliated teaching hospital of the University. This strategic alignment enables the optimal utilization of educational expertise and infrastructure, and facilitates the achievement of the central education mandate of RMP and UTDRO.

The formal professional training programs include undergraduate training for radiation therapy (BSc Medical Radiation Sciences) and medical education; post-graduate training programs for radiation oncology residency, radiation oncology fellowship, and medical physics residency; as well as the Strategic Training in Transdisciplinary Radiation Science for the 21<sup>st</sup> Century (STARS21) Training Program. RMP staff also teach residents and fellows from other training programs, as well graduate students from University of Toronto Departments, such as the Institute of Health Policy, Management and Evaluation, Dalla Lana School of Public Health, Nursing, Institute of Medical Science, Institute of Biomaterials & Biomedical Engineering, and Medical Biophysics.

RMP offers interdisciplinary continuing education catered to practicing radiation medicine professionals, who seek to gain informal or structured learning experiences at the Princess Margaret, including the RMP Observership Program; the Accelerated Education Program, which delivers in-depth structured 2-3 day courses; and the Personalized Learning Program™ (PLP™) in Radiation Medicine, which offers 3-6 months of on-site and online learning opportunities.



## UNDERGRADUATE

- 38 BSc Medical Radiation Sciences students
- 55 Undergraduate Medical Education students
- 1 CARO-CROF student
- 25 Summer students

## POST-GRADUATE

- 21 Radiation oncology residents
- 23 Radiation oncology fellows
- 6 Medical physics residents
- 4 Strategic Training in Transdisciplinary Radiation Science for the 21<sup>st</sup> Century scholars

## CONTINUING EDUCATION

- 58 Observers from 17 countries
- 158 AEP external participants (4 on-site & 2 on-the-road AEP Courses)
- 1 Personalized Learning Program participant

# DIVERSE LEARNERS

*\*Academic year statistics*

## Building Global Capacity in Radiation Medicine

As global leaders in clinical practice, research and education, RMP actively disseminates its knowledge and best practices so that quality care can be available to all patients within our community and globally. In 2019-2020, RMP hosted 58 observers from 17 countries. Observers spent a median of 10 days (range: 1-40) at RMP, and included health professionals from radiation oncology (21%), medical physics (10%), radiation therapy (10%), trainees (52%), as well as other participants (7%). RMP continued discussions with our global partners in Africa, Jamaica, United Kingdom, Hong Kong and China on strategies to leverage radiation and educational expertise to enhance global capacity within radiation medicine.



“My overall experience was fulfilling as the staff members always make me feel welcome and encouraged me to continue with further training such as fellowship program in the future. I had a great learning experience. Thank you!”

Observer

## Creating a Sustainable Radiation Medicine Workforce in Ethiopia

As part of RMP's efforts to build global capacity in radiation medicine, **Rebecca Wong** received funding from the Celgene Cancer Care Links™ grant program to implement and evaluate an undergraduate degree program for radiation therapists and a Master's program for medical physics in Ethiopia. This 4-year pilot project aims to create a sustainable, locally trained workforce to overcome the ever-increasing demands for radiotherapy in Ethiopia, and serve its national training needs through the TAAAC (Toronto Addis Ababa Academic Collaboration). RMP faculty will engage in month-long immersive teaching trips, three times a year to deliver a curriculum in collaboration with a low/middle income centre that is founded on the concepts of the “training the trainers” model, and building a world-class education program.



## AEP On-the-Road: First Education Courses in Atlantic Canada and China

The Accelerated Education Program (AEP)'s joint Chinese Academy of Medical Sciences (CAMS)-Princess Margaret Lung IG/SBRT Education Course took place on June 14-15, 2019 in Beijing, China. Sponsored by Elekta China, this 2-day course marks PM-RMP's very first foray into "AEP on the Road". The course was attended by 30 radiation oncologists, medical physicists and radiation therapists from 10 cancer centres across China. With a curriculum developed in partnership with CAMS faculty and RMP's **Jasmine Chen, Nicole Harnett, Alex Sun, Rebecca Wong** and **BeiBei Zhang**, this unique and engaging experience earned many laudatory comments from the attendees. RMP is grateful for the opportunity to build upon the quality and capacity for radiation therapy in China.

In September 2019, **Meredith Giuliani, Andrea McNiven, Andrea Shessel** and **Rebecca Wong** were joined by local faculty to deliver a 2-day Lung and Liver IG/SBRT "On-the-Road" course to teams of radiation medicine professionals at the H. Bliss Murphy Cancer Centre in St. John's, Newfoundland. This course was part of a partnership with the Harrison-McCain Foundation and Atlantic Canada Cancer Centres to facilitate the implementation of the latest radiation therapy techniques and approaches.



Lung IG/SBRT course in Beijing, China



Lung and Liver IG/SBRT course in St. John's, Newfoundland

## Leadership Appointments

**James Chow:** Promoted to rank of Associate Professor at UTDRO (July 2019)

**Peter Chung:** Promoted to rank of Associate Professor at UTDRO (July 2019)

**Meredith Giuliani:** Promoted to rank of Associate Professor at UTDRO (July 2019); Associate Director of the UTDRO Residency Program (renewed July 2019)

**Shane Harding:** Co-Director of the STARS21 Program (November 2019), succeeding Marianne Koritzinsky who held this position since 2012

**Nicole Harnett:** Director of Curriculum at U of T IMS (May 2019)

**Andrea McNiven:** Director of the UTDRO Medical Physics Residency Program (renewed July 2019)

**Barbara-Ann Millar:** Promoted to rank of Associate Professor at UTDRO (July 2019)

**Derek Tsang:** Director of the UTDRO Undergraduate Medical Education Program (January 2020); succeeding Meredith Giuliani, who held this role since 2014

## RMP Welcomes Summer Students



The 2019 RMP Summer Student Program was a great success, welcoming 25 students to work and learn alongside our RMP faculty and staff, and help to advance a wide range of departmental research projects. Students were invited to partake in a number of professional development and social activities throughout the summer including a Welcome Breakfast, Mid-Summer Research Day, Final Presentation Day, and End of Summer Social at The Rec Room arcade. Students also had the opportunity to participate in the Medical Biophysics Summer Seminar Series and the PM Cancer Program Summer Seminar Series. The RMP Summer Student Program was well received with many of the students expressing great appreciation for the positive and impactful experiences offered throughout the summer.

“My summer RMP project was quite interesting and taught very applicable skills for my future profession within the healthcare industry... Overall, I would describe my summer at RMP as being a diverse mosaic filled with educational, practical, and fun experiences.”

Summer Student

## Excellence in Teaching

**Jennifer Croke** received the PARO Excellence in Clinical Teaching Award (May 2019)

**Meredith Giuliani** received the U of T Wightman-Berris Academy Anderson Award (May 2019) and the Association of Faculties of Medicine of Canada (AFMC) Young Educators Award (April 2020)

**Fei-Fei Liu** was awarded the Mel Silverman Mentorship Award from the U of T Institute of Medical Science (IMS) (May 2019)

**Andrea McNiven** received the American Association of Physicists in Medicine (AAPM) Innovation in Medical Physics Education Award (July 2019)



Jennifer Croke, Glen Bandiera Susan J. Lief, Meredith Giuliani Mel Silverman, Fei-Fei Liu, Mingyao Liu



Andrea McNiven receiving her award at AAPM annual meeting

Andrea McNiven

# RESEARCH

RMP is a world-leader in radiation research aimed at developing more precise, personalized solutions that will cure more patients with fewer side effects. Its research program spans the breadth of the four professional disciplines of radiation oncology, medical physics, radiation therapy and radiation nursing, and is led by nationally and internationally recognized experts. The program encompasses the full spectrum of radiation research from laboratory-based biology and physics discovery to clinical trials in patients, including survivorship, health services, and education research.

RMP is disrupting the radiation treatment landscape through new Adaptive Radiation Oncology research and knowledge dissemination to assure the right treatment at the right time for every patient. The program is accomplishing this through innovative approaches that integrate clinical care and research, learning from all of our patients while focusing on the outcomes that matter most to patients along their cancer journey.

RMP research activities are strategically focused on six key domains to accelerate the availability of adaptive radiation oncology for every patient:

1. Radiogenomics
2. Radiomics
3. MR-guided radiotherapy
4. Oligoprogression
5. Regenerative radiation medicine
6. Patient-reported outcomes

These research themes are highly integrated and closely aligned with the research objectives of the Princess Margaret, UHN and University of Toronto's Department of Radiation Oncology. There is strong collaboration with other academic and industry-based research groups within UHN, as well as external groups locally, nationally and internationally.



# NOVEL DISCOVERIES

\*calendar year statistics

## Radiotherapy Crucial to Curing Millions of Women with Cervical Cancer in Low-and Middle-Income Countries



**Danielle Rodin, Michael Milosevic** and colleagues reported that investment in radiotherapy for cervical cancer in low- and middle-income countries (LMICs) can save over 9 million women and produce \$151B of economic growth in the next 20 years. Published in *Lancet Oncology*, these findings underscore the need and benefit of radiotherapy for patients with cervical cancer patients in LMICs.<sup>i</sup>

## Safety and Efficacy of 5-Fraction Stereotactic Body Radiotherapy (SBRT) for Non-Small-Cell Lung Cancer



**Andrea Bezjak** and colleagues reported on a Phase I/II dose-escalation trial for patients with inoperable, centrally located non-small cell lung cancer. Published in the *Journal of Clinical Oncology*, these findings demonstrate that 5-fraction SBRT was associated with relatively low rates of toxicity and high rates of tumour control.<sup>ii</sup>

## Prophylactic Cranial Irradiation Decreases Incidence of Brain Metastasis in Non-Small Cell Lung Cancer

**Alexander Sun** and colleagues provided a long-term update on a prospective randomized Phase III trial for patients with locally advanced non-small cell lung cancer. Published in *JAMA Oncology*, these findings showed that prophylactic cranial irradiation decreased rates of brain metastases and improved disease-free survival.<sup>iii</sup>



## Promising Prognostic Feature May Guide Treatment Decision-Making in HPV+ Oropharyngeal Carcinoma



**Sophie Huang** and colleagues confirmed the prognostic value of radiologic extranodal extension (rENE) for HPV-positive oropharyngeal carcinoma patients. Published in *Radiotherapy Oncology*, these authors propose to refine the new TNM-8 cN-classification by incorporating rENE, which could improve staging performance, and facilitate future clinical trial design and treatment decision-making.<sup>iv</sup>

## Prevalence and Determinants of Return to Work in Nasopharyngeal Carcinoma Survivors

**Nathaniel So, Jolie Ringash** and colleagues examined factors that may facilitate or impede successful return to work (RTW) in nasopharyngeal carcinoma survivors. Published in *Int J Radiat Oncol Biol Phys*, authors reported that most survivors RTW, and successful RTW was associated with younger age, better performance status, higher quality of life, lower symptom burden, smaller decline in frontal functioning, and having health benefits.<sup>v</sup>



## Treatment Planning with Novel Imaging System Can Reduce Prostate Radiotherapy Treatment Margins



**Young-Bin Cho** and colleagues reported on the use of high-dose volumetric CT (HDVCT) for treatment planning in volumetric modulated arc therapy (VMAT) prostate radiotherapy. Published in *Phys Med Biol*, findings show that compared to conventional CT, HDVCT generates enhanced images, which can reduce uncertainty arising from inter-observer variability and planning target volume (PTV) margin.<sup>vi</sup>

## Powerful Tool for Genome-Wide Discovery of DNA Methylation Biomarkers

**Scott Bratman, Daniel De Carvalho** and colleagues presented a protocol for cfMeDIP-seq, a powerful liquid biopsy tool that can be used for early cancer detection and classification, treatment and disease monitoring, and more. Published in *Nature Protocols*, this work formed the basis of DNAMx Inc., a UHN spin-off company that will bring non-invasive cancer detection one step closer to patients on a global scale.<sup>vii</sup>



## RMP/UHN Investigators Awarded \$6M Terry Fox New Frontiers Program Project Grant

**Michael Milosevic, Marianne Koritzinsky** (program co-leads), **Alejandro Berlin**, David Brooks, Hansen He, Tracy McGaha, Brad Wouters, and Gelareh Zadeh (project leads) received a Terry Fox New Frontiers Program Project Grant for their project entitled “Triggers and Targets in the Tumour Microenvironment: Hypoxia and Beyond”. The multidisciplinary team will explore how hypoxia interacts with immune cells and other elements of the tumour microenvironment, leading to more aggressive cancer behaviour, spread to other parts of the body, and becoming treatment-resistant. The program includes four highly integrated projects focused on four aggressive types of cancer: glioblastoma multiforme, pancreatic cancer, castrate-resistant prostate cancer, and cervical cancer. While each project is slightly different, the overarching goals remain the same: to identify vulnerabilities within the tumour microenvironment that can be exploited to personalize therapies. All four projects integrate basic, translational, and clinical components to accelerate discoveries that can benefit patients.



Michael Milosevic & Marianne Koritzinsky

## Notable Peer-Reviewed Funding

**Alejandro Berlin:** Establishing a Patient-Derived Xenograft Engraftment Method from Tumor-Targeted MR-Guided Biopsies in Curable Prostate Cancer. AbbVie-CARO ACURA Award

**Scott Bratman:** Lung Cancer Early Detection and Classification Using Methylome Analysis of Plasma Cell Free DNA. CIHR Project Grant

**Scott Bratman:** Genomics-Based Radiosensitization for HPV-Negative Squamous Cell Carcinoma of the Aerodigestive Tract. CIHR Project Grant

**John Kim:** Developing Advanced Radiomics-Based Prognostic Models for Tumour Recurrence Following Chemo Radiation Therapy in Anal Cancer. Cancer Research Society Operating Grant

**Fei-Fei Liu:** Developing an Anti-Fibrosis Treatment to Improve Cancer Survivorship. Canadian Cancer Society Innovation to Impact Grant

**Benjamin Lok:** Developing New Interventions for Breast and Lung Cancer. Canada Foundation for Innovation, John R. Evans Leaders Fund

**Benjamin Lok:** Investigating a Resistance Mechanism Mediated by a Skp, Cullin, F-box Containing E3 Ubiquitin Ligase Complex in Small Cell Lung Cancer. CRS Operating Grant and Lung Cancer Research Foundation Pilot Grant

**Alexandra Rink:** A Universal Self-Calibrating in Vivo Real-Time Optical Radiation Dosimeter for Quality Assurance and Quality Control of Radiotherapy Treatment. CIHR Project Grant

**David Shultz:** Measuring Hypoxia-Specific Epigenetic Profiles in High-Risk Sarcoma. American Radium Society Multidisciplinary Seed Grant

**David Shultz:** Characterizing the Genetic Landscape of Radiation Associated Cutaneous Angiosarcomas. Sarcoma Foundation of America, Race to Cure Sarcoma Research Award

**Tony Tadic:** A Framework for Fast Online Adaptive Treatment Planning for Prostate Radiotherapy. Sanofi-CARO Award

**Derek Tsang:** Prospective Quality-of-Life Study of Children Treated with Repeat Radiotherapy for Brain Tumours. Brain Tumour Foundation of Canada Feature Grant

**Robert Weersink:** Registration of Endoscopic Optical Information to Volumetric Imaging. NSERC Discovery Grant

## Notable Awards and Distinctions

**Scott Bratman:** CIHR OICR Early Career Investigator Program Award

**Carina Feuz:** Journal of Medical Imaging and Radiation Sciences Editor-in-Chief Top Paper 2019 Award for her publication entitled “Implementing workshops to improve radiation therapists’ knowledge and attitudes about sexual health issues in cancer patients”

**Benjamin Haibe-Kains:** Canadian Cancer Society Bernard and Francine Dorval Prize

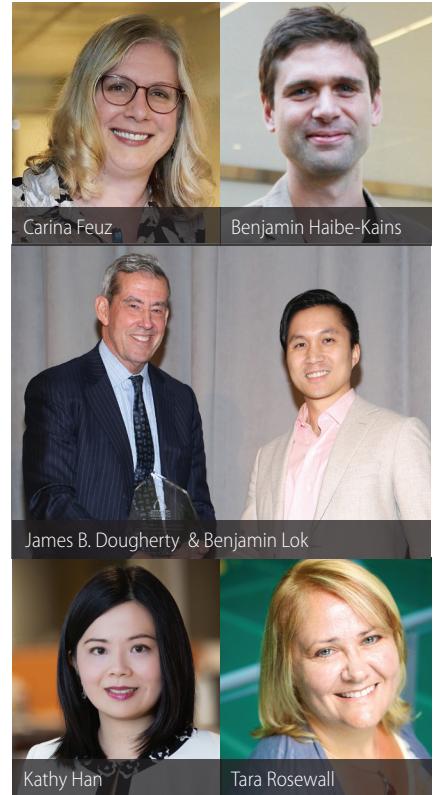
**Kathy Han:** Gynecologic Oncology Group Foundation New Investigator Award

**Benjamin Lok:** Lung Cancer Research Foundation William C. Rippe Award for Distinguished Research in Lung Cancer; CIHR OICR Early Career Investigator Program Award

Christine Papadakos, Tylar Meeks Stringer, Janet Papadakos, **Jennifer Croke**, Anne Embleton, **Caitlin Gillan**, Kim Miller, Andrea Weiss, Kirsten Wendtlandt, **Meredith Giuliani:** American Association for Cancer Education R. Davilene Carter Presidential Prize - Best Manuscript Award

**Danielle Rodin and Michael Milosevic:** Princess Margaret Till and McCulloch Clinical Paper of the Year Award for their publication entitled “Scale-up of radiotherapy for cervical cancer in the era of human papillomavirus vaccination in low-income and middle-income countries: a model-based analysis of need and economic impact”

**Tara Rosewall:** Appointed as Clinician Investigator. Princess Margaret Cancer Centre Research Institute, UHN



Carina Feuz

Benjamin Haibe-Kains

James B. Dougherty & Benjamin Lok

Kathy Han

Tara Rosewall

## Innovation in Radiation Therapist-led Research



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**#ESTRO38**

Andrea Shessel, Vickie Kong, Winnie Li, Grace Lee, Michael Velec

Radiation therapists play a critical role in RMP’s research endeavors, with many conducting practice-changing research with profound impact on patient care. In 2019, our radiation therapists reached significant research milestones with their 200<sup>th</sup> publication with a therapist as senior author and exceeded \$500,000 in successful research grant funding. Their strong presence at the 38<sup>th</sup> Annual Congress of the European Society for Radiotherapy and Oncology (ESTRO) held in Milan, Italy from April 26-30, 2019 was a further testament to their achievements. **Colleen Dickie, Vickie Kong, Grace Lee, Winnie Li, Andrea Shessel, Michael Velec** and **Tara Rosewall** shared their expertise and experiences on radiation therapy with a global audience of over 7000, in topics regarding considerations for younger patients; development of personalized therapy for bladder cancer; the impact of advanced practice radiation therapists on breast cancer therapy; a new patient-focused model of care; factors that limit clinical implementation of adaptive radiotherapy; as well as clinical safety of implanting an image-guidance tool for prostate radiotherapy.

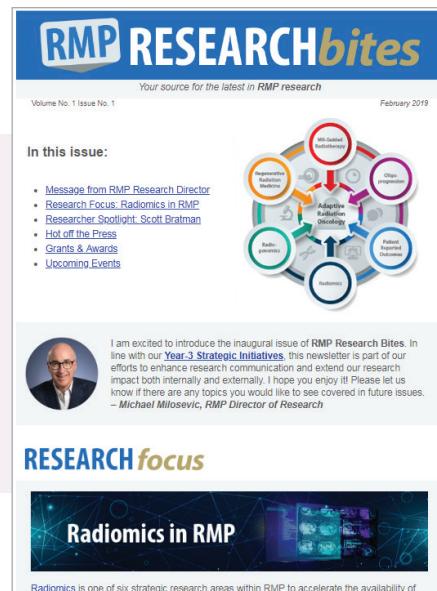
## Excellence in Cancer Research



**Alexander Sun** was appointed as the Addie MacNaughton Chair in Thoracic Radiation Oncology for a 5-year term, effective July 1, 2019. Alex has led RMP's Lung Site Group since 2013, and has made substantial contributions in clinical research; holding several national and international leadership positions in thoracic oncology clinical trials. In this role, he will build upon the strong foundations established by Andrea Bezjak, the inaugural Chair, and will continue to provide strong leadership in lung radiation oncology, in collaboration with colleagues across Surgical, Medical, Psychosocial Oncology, the allied health care team, as well as translational and basic scientists at the Research Institute. Alex was also appointed as Co-Chair for the CCTG Lung Disease Site Committee, effective June 18, 2019.



**Mary Gospodarowicz** was awarded the prestigious 2020 Gray Medal from the International Commission on Radiation Units and Measurements (ICRU). The Gray Medal was established by ICRU in 1967 and honours individuals who have made outstanding research contributions to different areas of nuclear medicine, including diagnostic radiology, radiation therapy and radiation protection.



## Launch of RMP Research Bites e-Newsletter

The inaugural issue of the RMP Research Bites e-Newsletter was launched in February 2019; an initiative led by **Michael Milosevic, Emma Ito, Lisa Chong,** and **Matthew Ramotar.** This newsletter is part of our efforts to enhance research communication and extend our research impact both internally and externally; aligned with RMP's strategic priority to strengthen internal and external community linkages. To date, our issues have had over 5700 views, and continues to grow.



# TEAM RMP

With a team of over 400 radiation specialists, the Radiation Medicine Program is fortunate to have a diverse pool of talent to increase RMP's capacity to deliver on its vision to achieve **Precision Radiation Medicine. Personalized Care. Global Impact.** In 2019, 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.



**Laura Dawson** was appointed as President-Elect of the American Society for Radiation Oncology (ASTRO). ASTRO is the world's largest and one of the most influential societies of radiation oncologists. Laura is the first Canadian, and only one of five women, to be elected to this prestigious position in ASTRO's 62-year history.

**Jolie Ringash** was appointed as CARO's President-Elect, and will become the President of CARO for a 2-year term from 2021-2023. Since the establishment of CARO, five RMP radiation oncologists have held the position of CARO President, including Bernard Cummings, David Payne, Mary Gospodarowicz, Michael Milosevic and Andrea Bezjak.



**Fei-Fei Liu** was inducted as a Fellow of ASTRO, joining the ranks of other highly distinguished radiation oncologists within RMP, including Bernard Cummings, Laura Dawson, Mary Gospodarowicz and Brian O'Sullivan.

**Andrea Bezjak** was appointed as a new member of the International Association for the Study of Lung Cancer (IASLC) Board of Directors for a 4-year term starting September 2019.



**Brian O'Sullivan** was awarded the prestigious 2020 ASTRO Gold Medal. This award recognizes Brian as a revered member of the global radiation oncology community, acknowledging his outstanding contributions to the advancement of radiation medicine worldwide in the domains of research, clinical care, teaching and service.

**Catherine Coolens** was inducted as a Fellow of the Institute of Physics and Engineering in Medicine. This distinction recognizes role models in the field of medical physics or engineering with outstanding contributions in research and development, as well as professional practice nationally or internationally.



## NEW TALENT

- Radiation Oncology** Ezra Hahn, Srinivas Raman, Philip Wong
- Medical Physics** Leigh Conroy, Edward Taylor
- Radiation Therapy** Payin Baidoe-Ansah, Andrew Belanger, Samantha Bulger, Emily Kennedy, Maureen Lee, Amanda Ly, Lynn Nguyen, Sajjad Rassool, Ankur Sharma, Sandra Tea, Yangchen Ukyab
- Physician Assistant** Samantha Parmelee
- Administration/ Research/Operations** Samina Akhtar, Rachel Bell, Amy Liu, Reza Reiazi, Fayaza (Fia) Syed, Jessica Weiss
- Clinical Research Program** Renise Ayearst, Heidi Chan, Nicole Gumapac, Luke Heaphy

\*Permanent new staff hires listed

## SUSTAINED SERVICE

Congratulations and thank you to our dedicated RMP members who have reached their  $\geq 25$  year service milestone in 2019.

- 25 Years** Anne Di Tomasso, James Joseph, Alex Vitkin
- 30 Years** Elizabeth De Ocampo, F. Connie Martins, Stephen Pizzale
- 35 Years** Mary Stewart
- 40 Years** Anney Hirji
- 45 Years** Bernard Cummings, George Parsons

## Notable Awards and Distinctions

- Marcia Bowen:** Triovest 700 University International Women's Day #EachForEqual Champion (March 2020)
- James Chow:** Reviewer of the Year Award for Physics in Medicine & Biology Journal (March 2019)
- Jennifer Dang:** OAMRS Recent Graduate Award (March 2019)
- David Hodgson:** Honorary Fellow, Royal College of Surgeons of Ireland (September 2019)
- Grace Lee:** OAMRS Practitioner of the Year Award (March 2019)



### RMP Clinical Awards

- Exceptional Program Service: **Michelle Chan**
- Distinction in Quality & Process Improvement: RMP Safety Huddle Database and Electronic Safety Huddle Board Team (**Lorella Divanbeigi, Elizabeth Ng, Bob Partridge, Steven Tran**)
- Distinction in Technical Improvement: RMP Data Analyst Team (**Lucy Lu, Wei Zhou**)
- Excellence in Patient Experience: **Devin Hindle**

### RMP Education Awards

- Best RMP Rounds: **Rebecca Wong**
- Trainee Excellence in Education: **Jeff Winter**
- Excellence in Education Support: **Cheryl Marcelo**
- Distinction in Teaching: **Alana Pellizzari**
- Distinction in Professional Mentorship: **Catherine Coolens**

### Accelerated Education Program Awards

- Highest Overall Teaching Effectiveness Score: **Andrea Bezjak**
- Putting Innovation to Work: **Stuart Rose**

### RMP Research Awards

- Research Productivity – Radiation Oncology: **Scott Bratman**
- Research Productivity – Medical Physics: **Jean-Pierre Bissonnette, Catherine Coolens**
- Research Productivity – Radiation Therapy: **Sophie Huang**
- Most Influential Research Publication: **Normand Laperriere**
- Exceptional Research Support: **Sameera Ahmed, Jasmine Chen, Lisa Chong, Bernadeth Lao, Tirth Patel**
- Research Leadership: **Laura Dawson**
- Top Clinical Trial Accrual Investigator: **MRgRT Facility Radiation Therapists\***

## Honouring a Lifetime of Achievement



**Annette "Nettie" Sperduti** retired on July 31 after devoting 40 years to radiation therapy. Nettie graduated from the College of Radiographers in 1979 and spent the last 30 years working as a radiation therapist at the Princess Margaret. In 2018, Nettie was selected a winner of a UHN Local Impact Award, as part of the Radiation Therapy Workplace Violence Implementation Group. RMP thanks Nettie for her commitment to delivering top-notch, patient-centred care for the last few decades.



RMP also celebrated **John Jezioranski's** well-deserved retirement at a farewell event on September 27. John was a physics associate at RMP, and was one of the recipients of the inaugural RMP Clinical Award for Exceptional Program Service in 2018. We are deeply grateful for his passion and dedication over the past 34 years.



## Share Your Smile: Photo Buttons Initiative

To help cancer patients connect better with Team RMP during the COVID-19 pandemic, the program launched a Photo Buttons initiative spearheaded by **Derek Tsang**. Inspired by the “Share Your Smile” movement at Scripps Mercy Hospital, large 3.5” buttons of photos submitted by staff were created, so patients could see staffs’ smiles under the layers of PPE. This impactful initiative has been very well received by both patients and staff, reinforcing RMP’s commitment to providing our patients with the most compassionate care.



## Tribute: Honouring the Career and Legacy of a Leader in Oncology



**Mary Gospodarowicz** stepped down from her position as Medical Director of the Princess Margaret on May 29, 2020. Mary joined the Princess Margaret as a radiation oncologist in 1978 and was appointed Chief of RMP, as well as Professor and Chair of UTDRO from 2001-2012. Her exemplary leadership led her to become both the Medical Director of the Princess Margaret and regional Vice-President of Cancer Care Ontario in 2005. During her time as RMP Chief, Mary built a strong multidisciplinary program, which tightly integrated radiation oncology, physics and therapy, establishing RMP as one of the top comprehensive radiation programs in the world.

Mary is a world-renowned clinician and researcher in lymphoma and genitourinary cancers, and has authored over 365 publications. Her visionary approach towards giving patients the best treatment and not just the best radiation therapy, has changed paradigms in the treatment of these cancers. More recently, Mary has focused her efforts on global health. During her term as the Union for International Cancer Control's first female and first Canadian President (2012-2014), she positioned Canada at the centre of global efforts to combat cancer, and still continues to advocate for equitable access to RT globally. In recognition of her impact and leadership in advancing cancer care around the world, Mary was awarded the ASTRO Gold Medal in 2014, and was invested into the Officer of the Order of Canada – the country’s highest civilian honour – in 2016.

As a further testament to her invaluable contributions to medicine, Mary was the first radiation oncologist to be appointed as University Professor at the University of Toronto in 2017. This is the highest academic rank bestowed at the University, recognizing exceptional scholarly achievement and pre-eminence in a particular field of knowledge; comprising no more than 2% of all tenured faculty. RMP held a virtual toast for Mary on May 28<sup>th</sup>, where many great stories were shared. A sincere thank you to Mary for all her invaluable contributions to RMP, the PM and cancer patients around the world.

“My job as a medical director, and our job as a comprehensive cancer program, is that no patients get lost and fall between the cracks. And no area of cancer is abandoned. Our ambition is to learn something from every patient who is treated here.”

Mary Gospodarowicz



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RMP Quality Committee

RMP Research Committee

RMP Steering Committee

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## Publication References (DOI)

- i. 10.1016/S1470-2045(19)30308-0
- ii. 10.1200/JCO.18.00622
- iii. 10.1001/jamaoncol.2018.7220
- iv. 10.1016/j.radonc.2019.10.011
- v. 10.1016/j.ijrobp.2019.09.008
- vi. 10.1088/1361-6560/ab050f
- vii. 10.1038/nprot.201.012

## \*MRgRT Facility Radiation Therapists

Jessy Abed, Samuel Appiah, Heather Ballantyne, Khenan Carmichael, Carla Cerase, Bruce Chan, Heidi Chan, Claudia Chan, Grace Cheng, Stephanie Chu, Anne Di Tomasso, Rachel Dick, Erin Dowie, Carina Feuz, Elena Fong, Adrian Fung, Amanda Hogan, Wilson Hong, Heather Jang, Fatima Khalfan, Yasietha Krishnakulasingham, Michelle Lara, Chrison Lee, Diana Lee, Ivy Lee, Alice Leung, Andrew Lieu, Min Lin, Zabin Mawji, Kirsten McCabe, Michelle Mendoza, Blanche Messham, Natassia Naccarato, Grace Naraine, Elizabeth Ng, Lian Pablo, Anisha Patel, Susan Patterson, Erin Prisciak, Peter Rakaric, Colin Robertson, Alexandra Sarra, Nathaniel So, Winnie So, Annette Sperduti, Mary Stewart, Steven Tran, Michelle Truong, Grace Tsui, Louise Wei, Millie Wong, Simon Xie, Kathy Yip

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# Radiation Medicine Program

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