

# Princess Margaret Cancer Centre

## annual report 2012





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# a message from our leadership

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We are pleased to provide the 2012 annual report of the Princess Margaret Cancer Centre at University Health Network (UHN). This report highlights activities of our cancer disease groups and departments, aligned with the themes of our strategic plan: transforming patient care, correlative cancer biology, guided therapeutics, novel therapeutics, outreach and partnerships. Our focus has been on program integration, enabling a culture of innovation and engaging staff.

We have had several exciting developments at the Princess Margaret. Her Majesty the Queen approved our request to formally change the name of the Princess Margaret Hospital to the Princess Margaret Cancer Centre. Our new name

more accurately reflects the scope of the cancer program, which provides treatment and services to patients across UHN hospitals. “Centre” is the terminology used internationally in association with academic health sciences institutions that integrate research with clinical services and conduct clinical drug trials.

In 2012, we made significant progress in delivering patient-centred, personalized cancer medicine. Our innovative interprofessional team continues to collaborate to translate the science of cancer into practice and deliver top quality care to cancer patients. We launched a new strategic plan for 2013-2018 – World Class Personalized Cancer Medicine – which articulates key strategic

directions across clinical care, research, education and outreach. The Princess Margaret Cancer Foundation kicked off the \$1billion BELIEVE IT! campaign to raise additional funds to support personalized cancer medicine.

We continued to strengthen support for patients across the continuum of care by establishing the evidence base for earlier palliative intervention and implementing psychosocial intervention for patients with advanced disease. We published leading research linking the molecular characterization of tumours with response to therapy, and established our first guided therapeutics operating room. We reached out to

the broader community to provide more patients with access to molecular profiling, and we continued to have global impact by collaborating and sharing knowledge across borders.

We want to thank all staff and volunteers in the Cancer Centre for their continuing efforts to provide the best care to our patients and to develop novel approaches to cancer treatment. We are especially grateful to our patients, partners, and donors for their ongoing support. For further details about our many successes in 2012, please visit our website at: [www.theprincessmargaret.ca](http://www.theprincessmargaret.ca)



**Marnie Escaf,**

MHA, HBBA  
Senior Vice President  
Executive Lead  
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**Mary Gospodarowicz,**

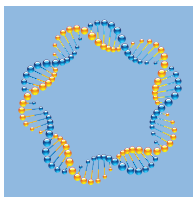
MD, FRCPC, FRCR (Hon)  
Medical Director  
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# our new strategic plan: world class personalized cancer medicine

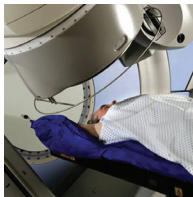
At the Princess Margaret Cancer Centre, our vision is: “To achieve global impact as one of the top five comprehensive cancer programs in the world”. In 2012, we launched a five-year strategic plan – World Class Personalized Cancer Medicine – that sets out an ambitious and transformative agenda to realize our vision. The plan articulates goals aligned with the five strategic themes below:



**transform patient care:** We will transform patient care by developing new models of inter-professional care, offering support through all the aspects of cancer care, personalizing cancer care and serving unique vulnerable populations, as well as empowering patients to become partners in their care.



**augment correlative cancer biology:** We will accelerate implementation of personalized cancer care based on a novel understanding of patient and tumour molecular characteristics, as well as their impact on treatment outcomes, through expanded correlative cancer biology programs.



**accelerate guided therapeutics:** We will continue to innovate in guided therapeutics and lead implementation of new and powerful cancer diagnostics and treatments supported by a robust foundation of new informatics including pattern recognition and automation

## “achieve global impact as one of the top five comprehensive cancer programs in the world”



**expand novel therapeutics:** We will provide patients with access to leading-edge treatment methods through research and implementation of novel systemic therapeutics, incorporating molecular imaging and genomic signatures and improving outcomes for cancer patients globally.



**drive outreach and education:** We will strengthen our impact and reputation, contribute to our communities, improve care and research, and exchange knowledge through global and local collaborations and partnerships, as well as education.

Our new plan takes into account emerging trends in care, research, and cancer control and is aligned with the strategic plans of UHN, Cancer Care Ontario and the University of Toronto, as well as with the Princess Margaret Cancer Foundation’s Personalized Medicine Campaign. Our plan supports patient-centred care, empowers patients as partners in their care and promises to provide well-documented, best possible outcomes. Delivering these themes will require focus, attention and integration across our core areas. To achieve these goals, we will continue to focus on developing and renewing infrastructure to support the delivery of excellent care, education and research.

[http://intranet.uhn.ca/departments/pmh\\_cancer\\_program/about/PrincessMargaretCancerCentreStrategicPlanLaunch.asp](http://intranet.uhn.ca/departments/pmh_cancer_program/about/PrincessMargaretCancerCentreStrategicPlanLaunch.asp)

# our program

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The Princess Margaret Cancer Centre at the University Health Network (UHN) in Toronto, Ontario, is the largest cancer program in Canada. It consists of over 2,900 employees, 218 inpatient beds, and approximately 398,000 square feet of research space based in the Princess Margaret Hospital site on University Avenue. The neuro-oncology program is at the UHN's Toronto Western Hospital, and surgical oncology is based primarily at the Toronto General Hospital.

Together with its research arm, the Ontario Cancer Institute (OCI), the Princess Margaret has a team of more than 1,000 researchers, trainees and staff creating new frontiers in advanced cancer diagnostics, breast cancer research, stem cell and developmental biology, medical imaging and image-guided surgery, and radiation and photodynamic therapies. In 2012, our teams produced over 930 publications and secured approximately \$150,000,000 in external funding to support cancer research.

The Princess Margaret has the largest radiation treatment centre in Canada and one of the largest treatment facilities in the world. It ranks among the top centres in the world for bone marrow transplantation, and has established a solid international reputation for having

some of the longest surviving bone marrow transplant recipients in the world. We offer comprehensive, multidisciplinary cancer care and have expertise across the spectrum of cancer services. The clinical program is organized as a matrix of modality-based departments and disease site-specific interprofessional groups.

Many clinical departments and professions are engaged in the delivery of services across all major disease sites; key achievements in 2012 from each of our service areas are summarized in this report.

Among the services provided this past year, we delivered 4,047 cancer surgeries<sup>1</sup>, as well as 31,022 outpatient chemotherapy treatments, 10,150 courses of radiation treatment, and 319 stem cell transplants<sup>2</sup>.



<sup>1</sup> Source: UHN Scorecard, Fiscal Year April 1, 2010 – March 31, 2011

<sup>2</sup> Source: UHN Statistical General Ledger – Funded Volume Report, Fiscal Year April 1, 2010 – March 31, 2011



## new patients in 2012

Disease Group		2012 <sup>3</sup>
Malignant	Gastrointestinal	1,706
	Genitourinary	1,654
	Breast	1,525
	Gynaecology	931
	Lung	877
	Head and Neck	729
	Leukemia	666
	Lymphoma	527
	Thyroid	454
	Melanoma	403
	Sarcoma	321
	Central Nervous System	243
	Eye	145*
	Other	812
	Benign neoplasms <sup>4</sup>	
Total Neoplasms		12,818 <sup>5</sup>
Non-Neoplastic <sup>6</sup>		4,339
Other		842
<b>Total</b>		17,999

\*Eye includes melanoma in eye and sarcoma in eye

Our research institute, the OCI, conducts research in genomics, proteomics, structural biology, molecular biology, biophysics, stem cell biology and behavioural sciences. OCI researchers employ state-of-the-art tools to analyze cancerous cells at the molecular level, test gene and cellular therapies for cancer and other diseases, develop new technologies for diagnosing and treating cancer, determine the effects of diet and behaviour on cancer risks, and to develop and test informatics tools for the large-scale analysis of patient populations.

The Campbell Family Institute for Breast Cancer Research in the OCI focuses on developing the next generation of treatments for breast cancer patients. Led by internationally recognized scientist Tak Mak, the institute joins basic, translational

and clinical research and focuses on developing new drugs and therapies that are more effective, less toxic and can increase a patient's quality and length of life.

The newest addition to OCI, the Campbell Family Cancer Research Institute, will accelerate the pace of breakthrough cancer research, facilitating the translation of cancer discoveries into new life-saving therapies and more personalized cancer treatments for each patient. This institute is headed by Benjamin Neel, a leading authority on cancer cell research.

The Cancer Clinical Research Unit (CCRU) at the Princess Margaret is aimed at enhancing the quality and productivity of cancer clinical trials and promoting a culture of responsibility and accountability in

## ambulatory clinic visit activity

Ambulatory Clinics	Clinic Visits 2011-12 <sup>7</sup>
Haematologic Malignancies	35,027
Genitourinary	27,876
Head and Neck	20,407
Breast	18,538
Gynaecology	18,535
Gastrointestinal	17,288
Central Nervous System and Eye	12,448
Lung	8,368
Skin	5,276
Other <sup>8</sup>	11,187
Radiation Treatment	158,076
Chemotherapy	30,881
Palliative/Symptom Management	4,333
<b>Total</b>	368,240

clinical trials. The CCRU includes a Clinical Trials Support Unit, Quality Assurance and Metrics, Cancer Registry, and Biostatistics. The CCRU is the backbone of our clinical research enterprise and enables more patients to access new treatments through clinical trials by continuing to attract and develop exciting and innovative trials to the Princess Margaret. In 2012, we secured space in the Ontario Power Generation building at 700 University Avenue for our clinical research administration offices. This move to the building next door to the Princess Margaret Hospital site enables us to enhance physical capacity for clinical research in the hospital.

In this report, we would like to highlight our 2012 accomplishments in clinical, research, educational and other activities.

<sup>3</sup> Source: Princess Margaret Cancer Registry

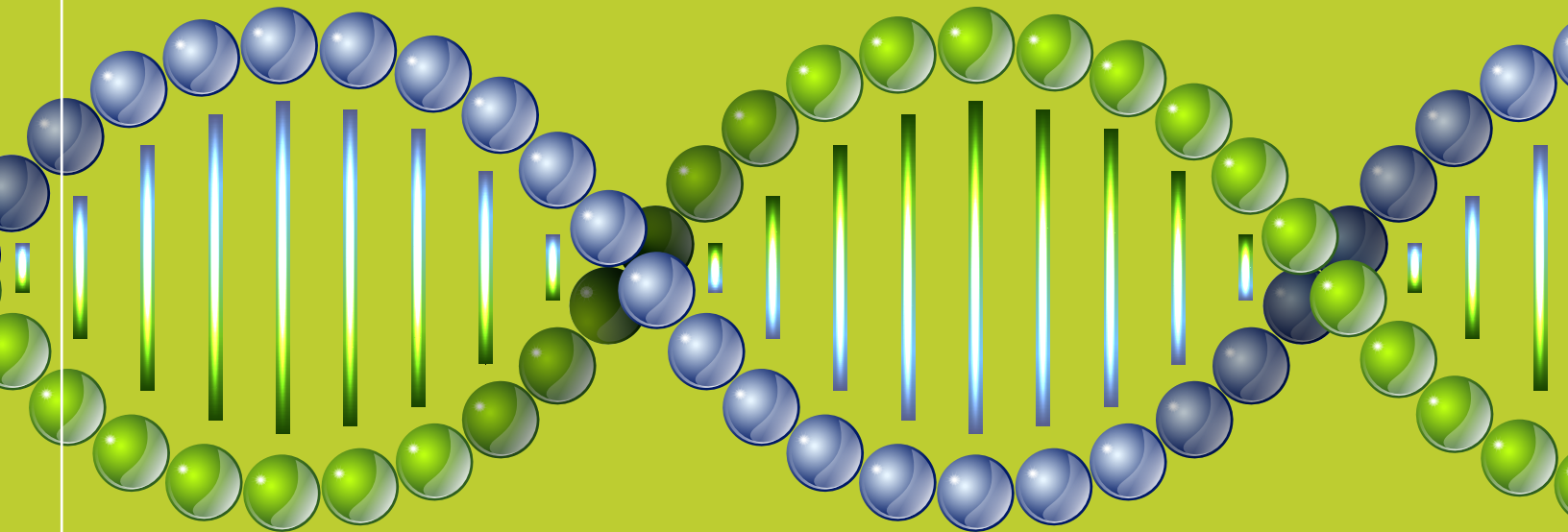
<sup>4</sup> Non-malignant tumours

<sup>5</sup> Total adjusted to account for cases shared between Site Groups and reflected the total of new cancer patients across Site Groups

<sup>6</sup> No suspicion of cancer; primarily benign haematology (e.g. aplastic anaemia) – for full breakdown, please see Appendix A

<sup>7</sup> Source: UHN Statistical General Ledger and Chemo Daycare Statistics

<sup>8</sup> Surgical Oncology Dental Clinic



# Believe It.

WE WILL CONQUER CANCER  
IN OUR LIFETIME



The Princess Margaret

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# personalized cancer medicine

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The theme of personalized cancer medicine is evident in all of our work at the Princess Margaret Cancer Centre. In April 2012, The Princess Margaret Cancer Foundation (PMCF) launched the BELIEVE IT! campaign. Foundation President and CEO Paul Alofs announced the Billion Dollar Challenge for Personalized Cancer Medicine (PCM), which will run over five years. The campaign aims to raise \$500 million through philanthropy, while the remaining \$500 million will be secured through grants and awards to researchers at the Princess Margaret.

Funds raised during this campaign will enable the Princess Margaret to attract, retain and train world-class researchers, physicians and other key staff so that we can continue to lead the way in PCM, as well as secure the equipment and technology that will allow us to improve the lives of our patients, and share the new, more effective treatments we develop with other organizations.

PCM is defined as “finding the right treatment for the right patient at the right time”. Each person’s cancer and response to treatment is unique and as such, the Princess Margaret Cancer Centre is committed to a future of individualized treatments. Our concept of PCM encompasses detection of cancer, diagnosis, targeted therapies, and tailored supportive care.

The focus on detection is intended to find cancer earlier, to provide better outcomes for our patients. We are working on new molecular imaging technology that can identify cancers when they are microscopic and enable enhanced monitoring of treatment. We are also discovering new biomarkers – indicators of cancer that can be detected through blood and serum tests.

Diagnosing and analyzing cancers more precisely will lead to a better understanding of each patient’s disease and support more customized and effective treatment. Defining the genetics of every tumour will be a large part of delivering tailored treatments.

Providing targeted surgery, radiation and drug treatments focuses on getting rid of cancer while leaving healthy tissue intact. We are developing new targeted therapies based on our growing understanding of the role of cancer stem cells, immune therapy and, epigenetics in disease development, and we are accelerating advances in surgical and radiation therapy techniques like imaged-guided and minimally invasive treatments.

Our many services to help patients and their families cope with both the physical and emotional side effects of cancer include patient education programs and psychosocial and survivorship support.

With the support of the BELIEVE IT! campaign, we will continue to drive excellence in PCM and provide our patients and their families with the highest quality care and support.

# transforming care

## Supportive Care for Advanced Disease

Managing Cancer And Living Meaningfully (CALM) is an innovative intervention designed by our Department of Psychosocial Oncology and Palliative Care (POPC) to support patients facing advanced disease, as well as their primary caregivers. Delivered by psychosocial staff, CALM addresses symptom management and communication with healthcare providers, self-concept and personal relationships, sustaining hope, and facing mortality.

Pilot studies have shown an improvement in spiritual well-being and attachment security, and a reduction in death anxiety following the intervention. Participants reported that CALM gave them a safe place to process the experience of advanced cancer, the permission to talk

about death and dying, assistance in managing the illness and navigating the healthcare system, a reduction in the strain on family relationships, and the opportunity to “be seen as a whole person” within the healthcare system.

Randomized controlled trials are now underway at the Princess Margaret, funded by the Canadian Institutes of Health Research (CIHR) and, in Germany, by German Cancer Aid. Pilot studies are also now being developed in Italy, the United Kingdom and Taiwan. Expertise in the delivery of CALM has been disseminated internationally at annual workshops at the Princess Margaret for clinical and research groups from the United States, Europe, the Middle East and Asia.



## Early Palliative Care

A randomized controlled trial on palliative care in Canada, led by our POPC team, showed significant improvements in quality of life and patient satisfaction with early referral to palliative care. The study was selected for “Best of ASCO” and featured in ASCO’s Annual Report on Progress Against Cancer. The resulting publication was listed as the Canadian Cancer Society’s Top 10 research findings of 2012.

“Many studies have shown that palliative care still happens too late, in the last few months of life,” said Camilla Zimmermann from the POPC team. “(Palliative care) is basically team-based whole-person care. The take-home message for me is that the palliative care specialists and oncologists need to work more in collaboration.”

The findings were published in the *Journal of Clinical Oncology*.

## Robotic IV Automation (RIVA)

We are the first cancer centre in Canada to use a robot to produce chemotherapy doses for ambulatory and inpatients. On December 4th, 2012, the Chemo Daycare Pharmacy prepared its first chemotherapy dose using RIVA (Robotic IV Automation). “Robotic automation provides a solution that enhances medication safety for our cancer patients as well as occupational health and safety of pharmacy staff,” says Rita Kwong, Site Operations Manager, Princess Margaret Pharmacy, UHN. “RIVA is the future of drug delivery and Princess Margaret is proud to be at the forefront of this leading innovation.”

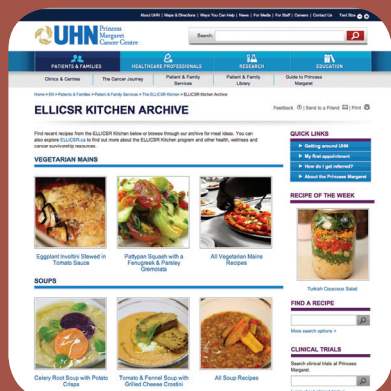
Pharmacy technicians manually prepare about 200 intravenous (IV) chemotherapy doses each day by drawing the drug from a vial in a vented safety cabinet. When the drug is transferred from a vial to a syringe or bag, staff can potentially be exposed to the toxic agents through tiny airborne liquid droplets or needle stick injuries. With RIVA, new safety measures are in place, including image and barcode recognition, dimensions

and weight verification to accurately select the right drug and diluent for preparation, and an electronic audit trail that documents dose preparation.

RIVA interfaces with the hospital pharmacy computer system, enabling the robot to prepare doses from prescription orders entered by pharmacists. This one-stop process reduces the risk of medical error by eliminating the need for technicians to read the printed labels to determine the dose needed. RIVA will be operated by technicians and will support the expanding scope of practice for pharmacy technicians.



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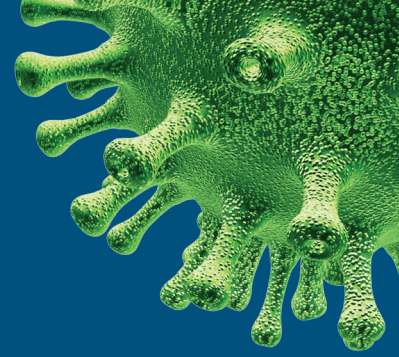
## Survivorship and Patient Education

In 2012, we expanded many components of our comprehensive breast and gynaecologic cancer survivorship program to all cancer patients. Nearly 1,000 patients met with our survivorship clinicians for a consult or follow up to assess their capacity for and engage them in self-management, link them to resources, and help them set their survivorship goals.

Over 2,000 participants took part in education classes offered at ELLCISR this year, covering a wide range of self-management topics. 390 took part in the Health Steps exercise class, and 900 in the “Cooking for Health” classes. We launched the “Living Well with Cancer” discussion group and “Getting Back on Track, Life After Head and Neck Cancer” education classes.

Our ELLCISR Kitchen program went online via [www.ellicsrkitchen.ca](http://www.ellicsrkitchen.ca). We have posted close to 60 recipes with complete content for patients, survivors and caregivers to access. In 2012, we had close to 8,000 page views and 2,383 video views.

# correlative cancer biology



## Tumorigenesis Post Chemotherapy

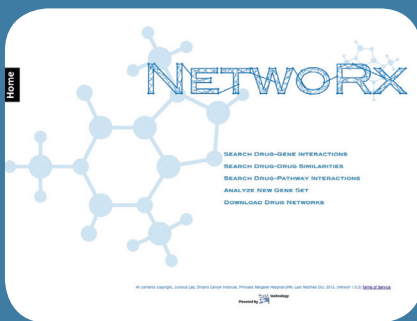
Our renowned stem cell scientist, John Dick, published research in the journal *Science* that has added more depth and complexity to why cancers come back. In a major breakthrough that will change the ways in which cancer is studied and treated in the future, Dr. Dick and his team have discovered a key reason why many tumours may return after chemotherapy. The new study shows that some of the cells that drive tumour growth hide from common chemotherapy drugs by going dormant, reigniting the disease when they awaken after treatments

end. The study shows that the newly discovered dormant cells have precisely the same genetic mutations as those active ones that drove the original tumour.

It was assumed that cancers returned after chemotherapy because of subsequent genetic mutations that made them resistant to the drugs being used against the original tumours, which is true in many cases; but the discovery of the genetically-identical dormant cells shows that other forces are at play in cancer recurrence and

that these non-genetic forces must now command the attention of the oncology community. Along with cancer cells, tumours contain a number of normal tissues, including blood vessels and immune system agents, "...and it appears that tumour cells can lie in proximity to these non-tumour cells and that can influence their behaviour," says Dr. Dick. "So that is one of the properties we should be looking for; we should be looking for where tumour cells are sitting, who they're close to and what kind of signals they are receiving."

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## NetwoRx

OCI scientists, led by Dr. Igor Jurisica, developed a new tool in 2012 to better understand the complex nature of drug mechanism of action. The researchers combined datasets from previously published experiments that studied how different yeast mutations responded to individual drugs.

Called 'NetwoRx', a database of 5,924 genes and 466 drugs was created, allowing for extensive data analysis to investigate drug effects at the system level. Users can search by drug name and see which specific genes are affected or, conversely, input a set of genes they want to study and retrieve every drug that targets them. The database has been published at:

<http://ophid.utoronto.ca/networx>

Scientists now need to look for ways to kill these dormant cells or to control the factors that can awaken them. “We need to understand the biological properties – not necessarily the genetic properties – that are driving dormancy,” says Dr. Dick. “An understanding of these non-genetic properties could lead to an entirely new generation of cancer medications”. Drugs that could interfere with the external signals that call the dormant cells out of sleep could also become a weapon in the oncology arsenal. “What our paper is saying is that on top of (targeting) the genetic properties of these cells you have to target the biological properties to be more effective. Everything doesn’t just rest on genetics.”

## POP-CURE

A team of researchers from OCI and the Ontario Institute for Cancer Research (OICR) have been conducting a program to discover and validate new targets for the diagnosis, prognosis and treatment of colorectal cancer. The program, entitled POP-CURE (an acronym for PMH-OICR-Pfizer-CURE), is led by Dr. Bradley Wouters, OCI Senior Scientist.

POP-CURE used genomic and molecular pathology to develop a large clinical bio-bank to identify

molecular signatures in colorectal cancer. The Princess Margaret/UHN provided approximately 500 cases to the study, which ran from 2009-2012. The molecular signatures identified through POP-CURE helped the researchers identify biomarkers that can now be used to classify colorectal cancer by molecular sub-type. This knowledge could provide clinicians with powerful new tools to predict patient prognosis and response to treatment and also advance the quest for new targeted treatments.

## The Cancer Genome Atlas (TCGA)

The Cancer Genome Atlas (TCGA) is a project supervised by the National Cancer Institute (NCI) and the National Human Genome Research Institute that catalogues genetic mutations responsible for cancer, using genome sequencing and bioinformatics. TCGA applies high-throughput genome analysis techniques to improve our ability to diagnose, treat, and prevent cancer through a better understanding of the genetic basis of disease. The TCGA is sequencing the entire genomes of some tumors, including at least 6,000 candidate genes and microRNA sequences.

The Princess Margaret/UHN has contributed significantly to the TCGA initiative, across disease sites including lung, head and neck, endometrial, adrenal cortex, thyroid and other cancers. A report on the comprehensive TCGA genomic characterization of squamous cell lung cancers was published in the journal *Nature* in 2012 and included key contributions from the Princess Margaret’s Dr. Ming-Sound Tsao. We are continuing to engage with TCGA on the international scale to identify and characterize the molecular profiles of cancer to support our personalized cancer medicine agenda.



# guided therapeutics

## Guided Therapeutics Operating Room (GTx OR)

In 2012, we established our first guided therapeutics operating room (GTx OR) at the Toronto General Hospital. At approximately 160 m<sup>2</sup>, the GTx OR is more than three times larger than a standard operating room in most modern hospitals and incorporates complex imaging equipment. Its CT scanners are capable of capturing even small (early) tumours with unmatched precision, directing physicians to them via the safest and most optimal routes using GPS-like guidance through the patient's body. The room is also equipped with an Artis Zeego robotic Cone Beam CT scanner, which can be rotated around the patient to create a three-dimensional image of the surgical site as the operation progresses. "This gives us real time,

on-the-table imaging, allowing us to update the (pictures) whenever we want," says Jon Irish, Head of Surgical Oncology at the Princess Margaret.

Combined with some computer graphics programming, these images can be presented in multiple formats, including one in which healthy tissues, nerves and vessels surrounding target tumours will be sheathed in computer-generated protective fencing. If the fencing is approached, an "early approach warning" signal can be activated and if the boundary is breached, the electronic scalpel will shut down. "Let's say we now can detect a very, very small lung cancer; often the standard of care is to repeat a CT scan in a few months to see if it's grown," says Dr. Irish. With the GTx's real-time guidance capacity, surgeons have the capability of operating immediately, with increased confidence of finding and removing the earliest cancers.

The GTx OR is the world's first research-based operating room. "It's a research operating room; you can't actually be a patient in this operating room unless you're part of a research trial," says Dr. Irish. "The first in-human technologies will be used and evaluated here." The facility will also be used to evaluate multi-disciplinary models of care, exploring alternative nursing roles and new concepts in surgical team configurations.





## Guided Therapeutics (GTx) Laboratory

Our GTx Laboratory program has created new navigation tools by developing augmented and virtual reality technologies that can overlay an “avatar” onto a real image being visualized by the surgical team. The application of these techniques has improved the accuracy of resections, improved targeting of cancers and minimized impact on surrounding tissue. The GTx team has tested the value of its new tools in a clinical trial called “LIVE-IGS” (Localized Intraoperative Virtual Endoscopy-Image Guided Surgery). The group’s novel “surgical dashboard” has been positioned on digital imaging screens in the GTx OR and we are developing a prototype of a new technique that projects this dashboard directly onto the patient.

Our GTx physicists led work that combines surgery and radiation therapy information. Using augmented reality technology, the team developed aids for contouring tumours for radiation therapy and for displaying radiation dose on an endoscopic image during surgery. Our group demonstrated the clinical feasibility of intra-operative cone-beam CT for head and neck surgery using our prototype mobile C-arm. This study examined the impact on procedure time and workflow, and offered several important improvements that have been incorporated into the new GTx OR.

## Robotic Surgery

We continued to expand our capacity in robotic surgery, an area in which we have achieved several important milestones, including Canada’s only minimally invasive pelvic exenteration (extreme surgery for cure) for cervical cancer recurrence and the treatment of a patient with recurrent melanoma, which would not have been possible without the da Vinci robotic surgical system.

This past year, our robotic surgical system was used to perform minimally invasive surgery on rectal tumours, which can be particularly challenging to target as a result of the complexity of the anatomy. Traditional rectal cancer surgery can be associated with side effects such as incontinence and erectile dysfunction due to nerve injury. The precision of the da Vinci robotic surgical system enables surgeons to better identify nerves and other structures during surgery, thereby reducing the risk of negative side effects. Patients with rectal cancer often require chemotherapy and/or radiotherapy before and/or after surgery; however, with the use of the robotic surgical system, patients recover more quickly with fewer complications, and are therefore better able to tolerate additional cancer treatments that may be required.

“Our Princess Margaret Cancer Centre thoracic surgeons have been the first in Canada to adopt robot-assisted surgery for lung cancer,” says Dr. Irish. Our lung surgeons have noted a correlation between the use of the robotic surgical system and shorter hospital stays, less pain, easier recoveries, less blood loss and scarring compared to open-incision surgery. “We anticipate that robotic technology will provide a further improvement over video-thoracoscopic minimally invasive techniques that are our current standard at the University Health Network for early stage lung cancers,” notes Kazuhiro Yasufuku, Director of the Interventional Thoracic Surgical Program.

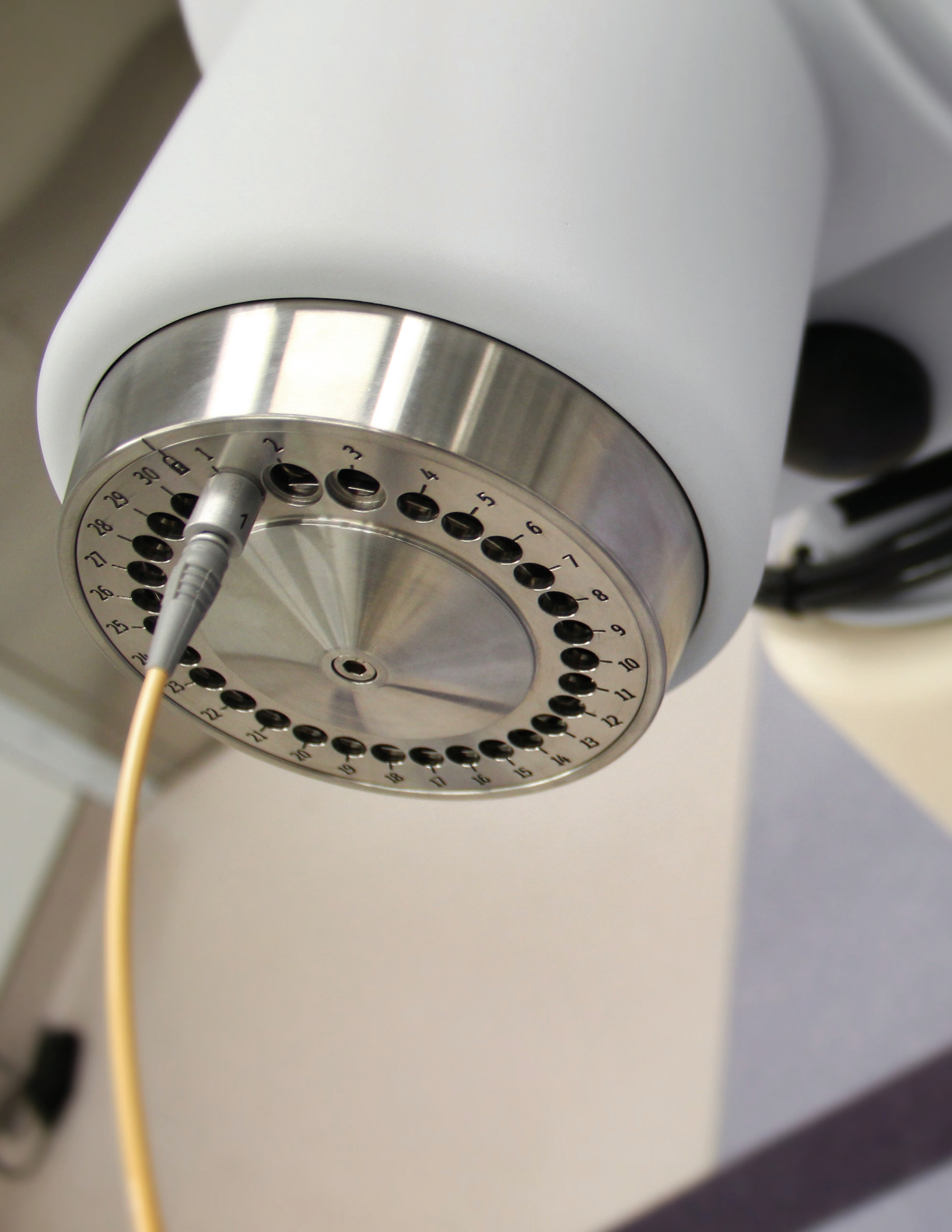


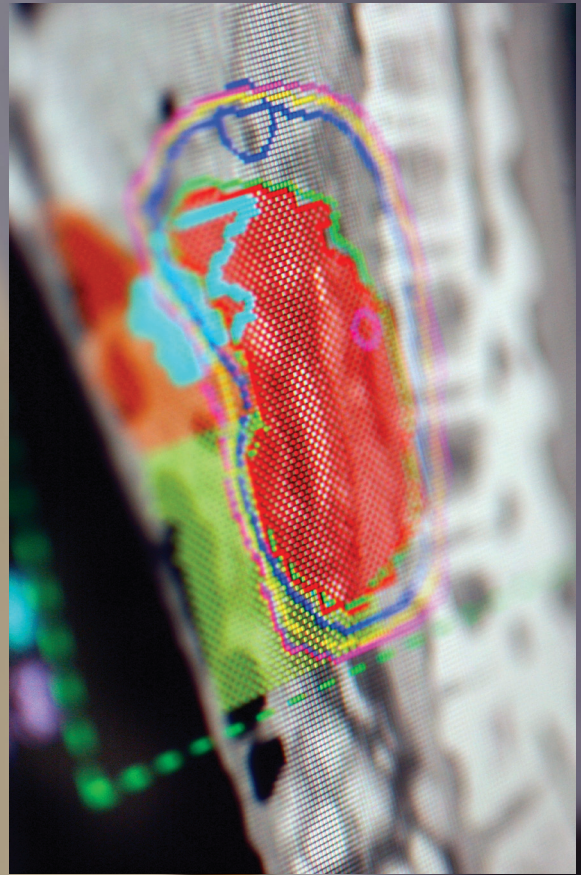
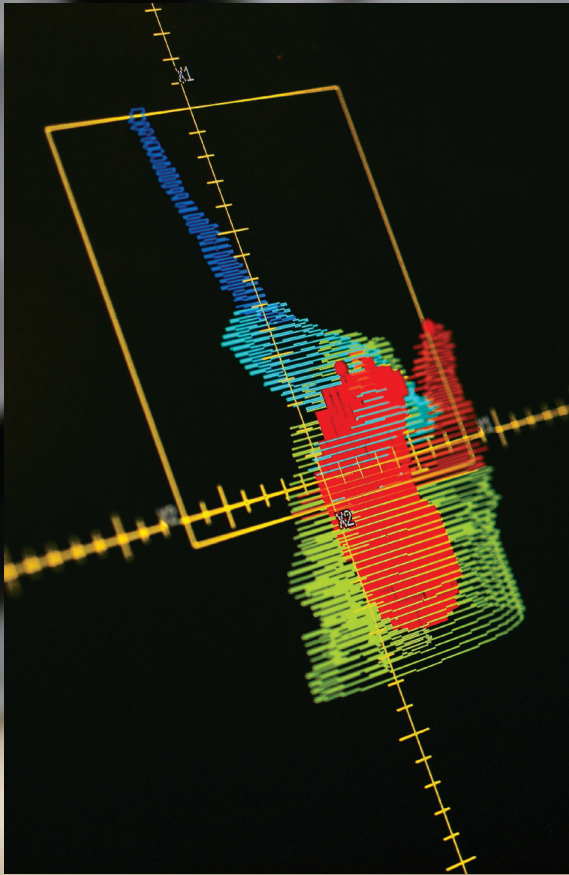
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## Breast Imaging

The Princess Margaret Cancer Centre is one of the first centres in Ontario to offer 3D breast mammography scans, or “tomosynthesis”. Acquired in the same way as regular mammograms, this technology creates sliced, computerized images of the breast, allowing radiologists to have more detailed information for evaluation, especially with dense breast tissues. We recently acquired three Hologic Selenia Dimensions units, the first commercially available tool to provide breast tomosynthesis. While research is underway to fully assess the value and limitations of this technology, this promising innovation offers an additional, highly sensitive tool for breast cancer detection.





# novel therapeutics

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## Integrated Molecular Profiling in Advanced Cancers Trial (IMPACT)

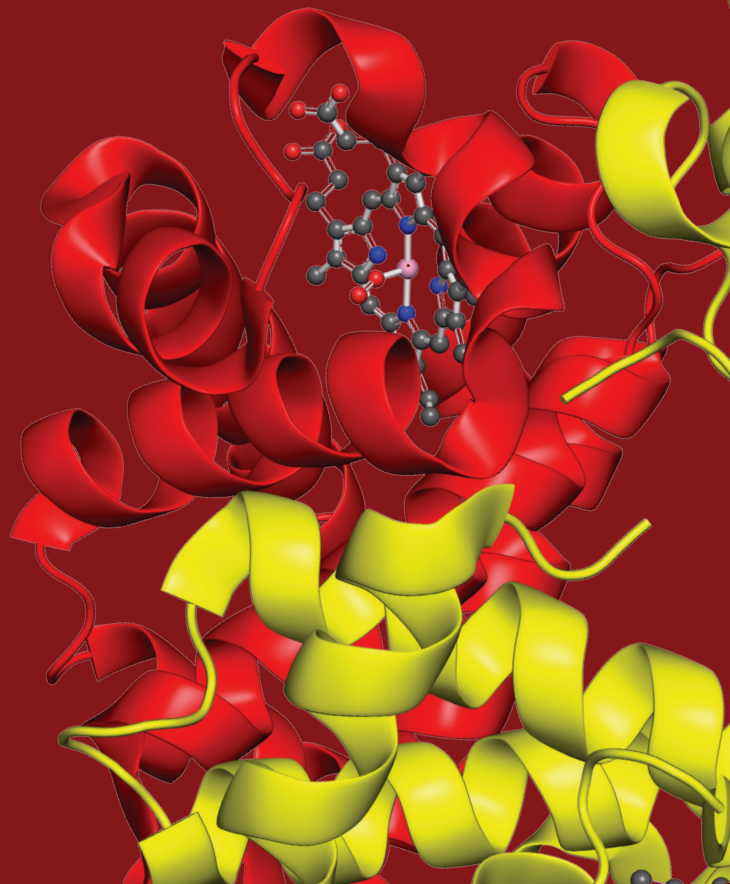
We reported in our 2011 annual report the implementation of our Integrated Molecular Profiling in Advanced Cancers Trial (IMPACT). IMPACT is an ongoing collaboration between the Princess Margaret and the UHN Laboratory Medicine Program, to provide molecular profiling information for advanced solid tumours.

We have expanded our internal capacity for IMPACT up to 1,000 patients, including breast, colorectal, non-small cell lung, gynaecologic, upper aerodigestive, pancreatobiliary and genitourinary cancer patients. With respect to the technologies used, we have transitioned IMPACT testing to Next Generation Sequencing with the Illumina MiSeq TruSeq Amplicon Cancer Panel (48 genes, 212 amplicons) and are developing a customized MiSeq panel that will include full exome coverage of additional cancer relevant genes. Collaboration is underway with medical genetics teams to develop a clinical care pathway for germline testing, as well.

To support the tracking of changes over time in individual patients, the MATCH protocol is being implemented. MATCH is open to patients enrolled in IMPACT with melanoma, breast, colorectal and gynaecologic cancers. It involves core needle biopsy and fine needle biopsy

of the same metastatic lesion for targeted sequencing, with the option to repeat the biopsy at key time points in a patient's disease course, including progression under systemic therapy.

We have now broadened the IMPACT approach with COMPACT (Community Oncology Molecular Profiling in Advanced Cancers Trial), to provide access to molecular profiling for more patients with selected advanced solid tumors and to identify patients with genomic alterations who may be candidates for clinical trials with new drug treatments.



## EGFR Mutations and Non-Small Cell Lung Cancer (NSCLC)

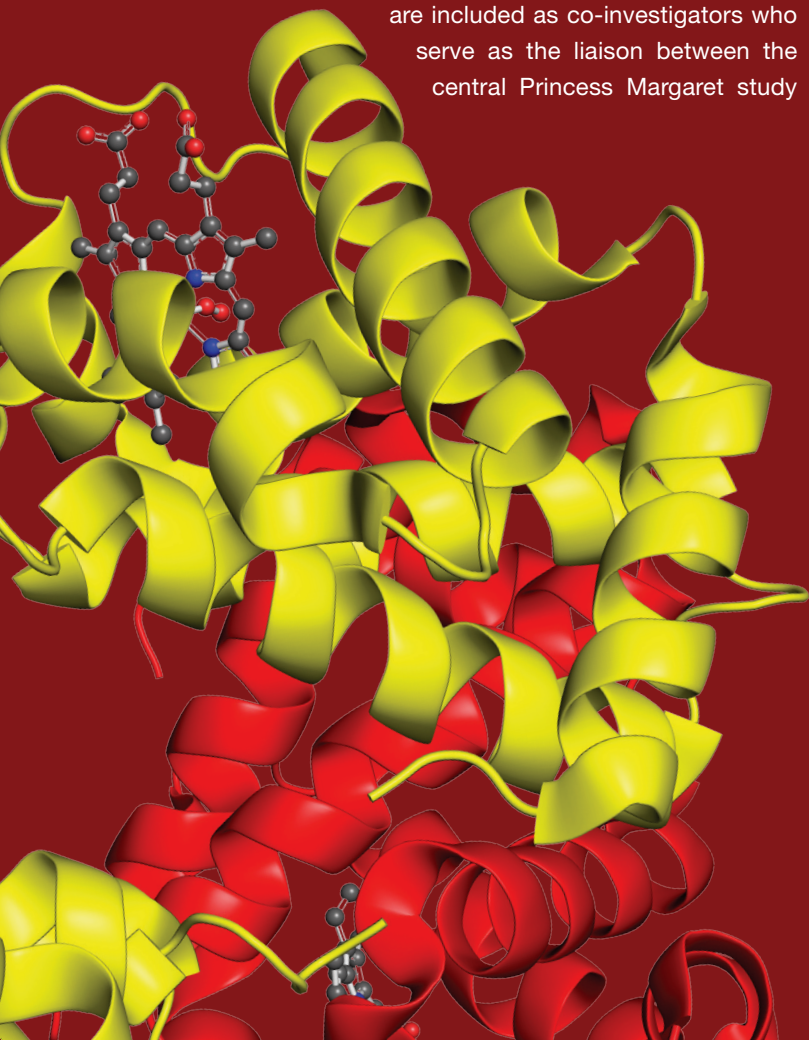
We are leading an investigation into the impact of mutation fraction, tumour sample cellularity, and diagnostic specimen type on EGFR TKI response, time to treatment failure (TTF) and overall survival (OS) in advanced EGFR mutation positive NSCLC patients in a collaboration of 10 cancer centres across Ontario. Patients with EGFR mutation positive samples were identified, tumour cellularity, mutation fraction (percent tumour cells mutated) and clinical outcome data collected. Interim analysis from six centres demonstrates increasing mutation fraction was associated with EGFR TKI response, but not TTF or OS in multivariate analysis. Exon 19 deletions are associated with a higher risk of death and a lower probability of response than L858R. Final analysis from all 10 centres will be completed in June 2013.

COMPACT is designed for up to 500 patients per year with advanced breast, colorectal, non-small cell lung and gynaecologic cancers. These patients can be referred by their treating medical oncologists to a specialized weekly COMPACT clinic staffed by our medical oncologists in the Drug Development Program

Medical oncologists at 14 GTA hospitals are included as co-investigators who serve as the liaison between the central Princess Margaret study

team and their respective medical oncology divisions. Referring medical oncologists receive summary reports of their patients' molecular profiling results, as well as information about any clinical trials that the patient may be eligible for based upon his/her genotype. Patients are given an opportunity to return to the COMPACT ambulatory clinic to discuss their molecular profiling results with a Princess Margaret medical oncologist.

COMPACT is a key step in our ongoing efforts to deliver increasingly personalized cancer medicine for patients at the Princess Margaret and in our community, particularly with respect to the early identification of patients with infrequent somatic mutations who may be candidates for experimental clinical trials with matched targeted therapies when standard therapy is no longer effective. COMPACT will also support our continued expansion of a clinically annotated, genomically characterized human tumour repository with stored blood samples for future studies led by Princess Margaret clinician-scientists, including next generation sequencing of selected samples.



## Pancreatic Cancer Genetics

Pancreatic cancer remains the most lethal tissue malignancy, with minimal progress in understanding and managing this disease for decades; however, recent advances in targeted drugs and genomic sequencing are providing new insights into tumour genetics which are beginning to have an impact on patient care. The Princess Margaret's Malcolm Moore and Steven Gallinger continued to make progress on the study of pancreatic cancer patients' gene mutations in Ontario.

In 2012, these oncologists increased the number of patients tested for BRCA1 and BRCA2 mutations, a known hereditary factor that can predispose people to pancreatic cancer. As well, 120 patients with advanced pancreatic cancer were tested and it was shown that a proportion of these patients carried the mutations), but that 50% of these patients had no family history of cancer. This finding demonstrates that we cannot rely solely on a patient's family history to identify BRCA1 and BRCA2 mutations. We have satisfying results treating these patients with targeted drugs, Gemcitabine and Cisplatin, as compared to an earlier approach of administering Gemcitabine only. In the upcoming year,

the team plans to test 300 advanced pancreatic cancer patients to identify similar findings.

We recently established collaboration with Memorial Sloan-Kettering Cancer Centre on a second generation, targeted poly ADP ribose polymerase (PARP) inhibitor administered to advanced pancreatic cancer patients with BRCA1 and BRCA 2 mutations. We expect this targeted drug to be more effective than the first generation PARP inhibitors.

Our team is now sequencing all pancreatic cancer patients with all stages of the disease who seek treatment at the Princess Margaret. We enroll each patient in our extensive pancreas cancer database, while recording their family history for the disease. Our team continues to work on the sequencing of these patients within a rapid two-week timeframe. We are also in collaboration with John Hopkins Hospital to sequence high-risk pancreas cancer patients who do not have the BRCA gene mutations, otherwise known as familial pancreas cancer. These patients have at least two relatives with pancreas cancer on the same side of the family.

## Immunotherapy Program

We reported in our 2011 report the establishment of a comprehensive immunotherapy program and our personalized medicine approach to growing immune cells from melanoma patients in the lab and reintroducing these cells into patients as a way to kill cancer cells. In 2012, our immunotherapy team conducted in-house tumour infiltrating lymphocyte studies for melanoma and is establishing an immune monitoring laboratory. The team also examined factors that inhibit immune responses to tumours, and joined a world-wide initiative to standardize scoring for immune infiltration in colon cancer pathology reportst.





# education and outreach

## Fighting Gynaecologic Cancers in Kenya

The Princess Margaret is helping Kenyan physicians develop a fellowship training program to advance prevention and treatment of gynaecologic cancers in Western Kenya. This relationship began in 2008, when Barry Rosen, Head of the Familial Breast and Ovarian Cancer Clinic at the Princess Margaret, travelled to Kenya. “It was shocking. I had never seen so many cases of advanced cervical cancer affecting young women – these women were often in their 30s and 40s with young children at home,” says Dr. Rosen. “But I was so impressed with the resiliency of the doctors, women, children and people working in the centre. The physicians were fantastic – what they lacked were resources.”

In September, 2012, a team from the Princess Margaret dedicated time to training two Kenyan doctors for six weeks in the areas of palliative care, radiation oncology and pathology. The training is part of the first subspecialty fellowship program in gynaecologic oncology at Moi University School of Medicine and Moi Teaching and Referral Hospital (MTRH) in Eldoret, Kenya, in partnership with the University of Toronto’s Department of Obstetrics and Gynaecology.

In sub-Saharan Africa, cervical cancer is the leading cause of cancer-related death in women; once diagnosed, the mortality rate is 80%, compared to 20% in Canada. Dr. Rosen believes training and support to Kenyan physicians

will improve patient outcomes. The Kenyan doctors, Elkanah Omenge and Peter Itsura, were the first Kenyans trained in a gynaecologic oncology subspecialty.

In collaboration with the University of Toronto, AMPATH and Moi University, Drs. Omenge, Itsura and Rosen have helped implement a cervix cancer screening program in Kenya. In its first year, the cervix cancer screening program saw 150 women; by the second year, 1,000 women were treated. This year, Dr. Omenge, who leads the program, anticipates over 14,000 women will be treated. In 2010, Dr. Rosen returned to Kenya and trained Drs. Omenge and Itsura to perform radical hysterectomies and pelvic lymphadenectomies to treat early cervical cancer. To date, close to 60 lives have been saved because of these procedures.







## Techna 2012 Symposium

The Techna 2012 Symposium brought together a diverse group of leaders and experts, including researchers, industry leaders, representatives from non-profits, government officials, policy experts, patient advocates, and members of the media, to discuss the challenges and opportunities that Information and Communications Technologies (ICT) pose for healthcare. The central question for the day was: "We could be doing much more, why aren't we?" Challenges outlined included privacy, institutional policies, and technical regulations. Potential solutions and examples of successes and failures for ICT in healthcare were also discussed.

Though there are some scientific and engineering problems to solve, there was no doubt that Canadians have the expertise to overcome those technical challenges. Entrepreneurs were advised to focus on technologies and business models that could avoid the complexity problem, and that government and socialized medicine stakeholders needed to be involved in the process of finding practical solutions.



## Summer Rounds Series: Reducing the Global Cancer Burden – Inquire and Inspire

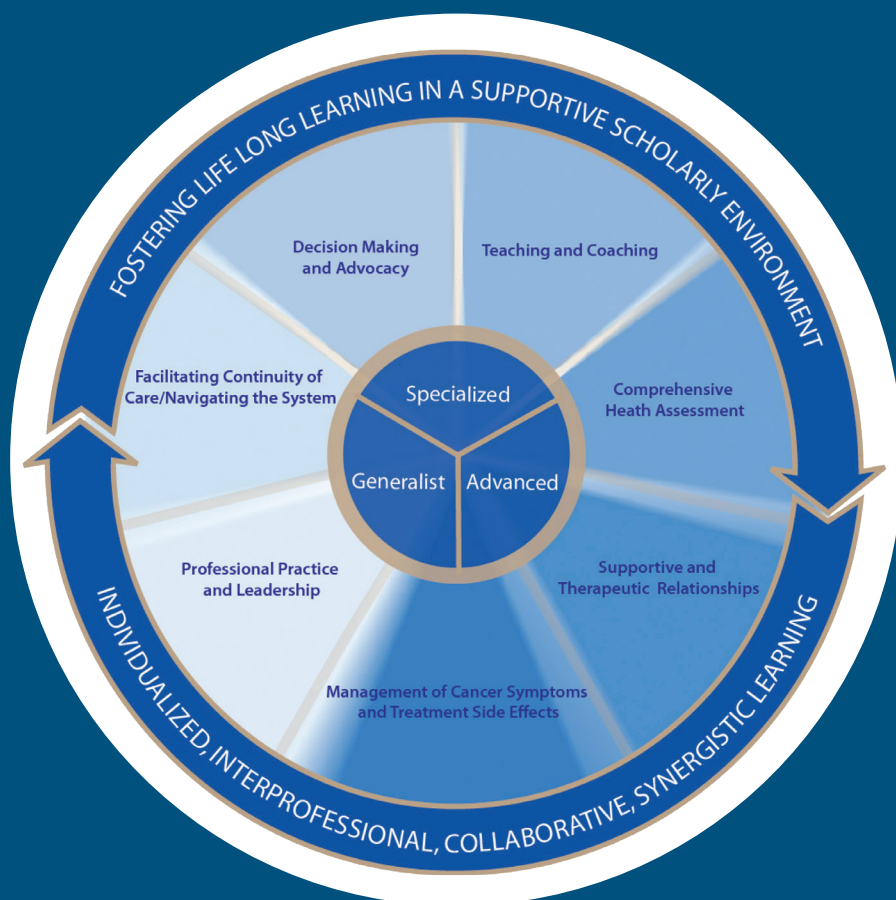
In 2012, the Princess Margaret launched a summer rounds series, Reducing the Global Cancer Burden – Inquire and Inspire. The rounds featured international speakers and explored the University of Toronto's Faculty of Medicine's A Road Map for Global Health (2011-2016). Global health is emerging as a major focus in all leading cancer centres. In addition to the roadmap, the U.S. National Cancer Institute launched a new Center for Global Health, and Canada hosted the UICC World Cancer Congress in Montreal in August. The summer rounds series provided exposure to global health and cancer issues, and sparked dialogue as to how the Princess Margaret might engage as a top five cancer centre in the global cancer arena.

The International Agency for Research on Cancer (IARC) World Cancer report states that cancer is a major public

health burden and accounts for one in eight deaths worldwide – more than AIDS, tuberculosis and malaria combined. By the year 2030, the cancer burden is projected to more than double, with 26.4 million new cases, 17 million deaths, and 75 million people living with the disease. More than 50% of cases and 60% of cancer deaths now occur in less developed countries and this proportion is expected to grow.

Our series included discussions on cancer mortality in India, opportunities for expanding cancer care and control in lower and middle income countries, and funding innovation in global research. We look forward to continuing the discussion on global cancer care and leading through knowledge sharing and collaboration around the world.

## Oncology Nursing Education Model



## Specialized Oncology Nursing Education

With over 500 nurses, the Oncology Nursing department at the Princess Margaret is the largest in Canada. The expansion of knowledge, new research findings, and potential breakthroughs in treatment and care emphasize the need for specialty education to support nurses in practice and prepare new nurses in this area. Specialized Oncology Nurses use their oncology knowledge and skills to manage symptoms, side-effects of treatment, counsel patients in coping strategies, teach self-care behaviours, monitor responses to treatment and nursing interventions, and advocate for and navigate patients/family through the system. This is the standard of care throughout the cancer program, across all disease site groups. Nurses acquire specialty education through a variety of ways. In 2012, a comprehensive oncology nursing education (CONE) program

was initiated based on current knowledge, successful continuing education programs and professional practice guidelines in oncology.

The pathway is designed to improve the understanding of patient experience across the continuum of care, streamline educational opportunities for nurses, and ensure that nurses are prepared to respond to patient and family needs. Using the customized pathway, nurses have the opportunity to shadow a patient at any point along the continuum starting from the disease screening process through to end-of-life care. The pathway also provides nurses with diverse course offerings that embed Princess Margaret disease site rounds and conferences, workshops offered by the de Souza Institute and professional development opportunities through the Canadian

Association of Nurses in Oncology, the Oncology Nursing Society and the International Society of Nurses in Cancer Care. After completing the foundational course offerings, nurses are expected to complete the Canadian Nurses Association (CNA) specialty certification exam in oncology or palliative care. This has resulted in more nurses engaging in continuing education and sitting for their national certification exam.

“The credentialing for oncology nursing indicates to patients, employers, the public and professional-licensing bodies that you are qualified, competent and current in a nursing specialty/area of nursing practice. As a leader in the largest cancer program in Canada, it distinguishes the nurses at the Princess Margaret as registered nurses who want to be the best,” says Barbara Fitzgerald, Director of Nursing.

## Kuwait Partnership

In 2012, we completed our second year of partnership with the Kuwait Cancer Control Centre (KCCC). During this time, more than 200 staff and clinicians from UHN-Princess Margaret have shared their expertise and knowledge in cancer services. The UHN-Kuwait team has grown from eight to 14 people and has been critical in guiding and assisting KCCC preparations for Canadian Accreditation and in furthering ongoing quality improvement efforts. The UHN Kuwait team worked with the KCCC to complete 112 partnership contracted deliverables for 2012.

Through the partnership, the Princess Margaret has been able to invest back into the cancer centre. We have secured additional space in an adjacent building for clinical research support, and have provided our departments with funding to support the development of priorities within their areas. We will also use resources from the partnership to fund four categories of activity aligned to the Princess Margaret's organizational values. We will invest in: a social responsibility agenda to pursue philanthropic projects; staff wellness to provide new resources for our employee health and satisfaction; international health to provide resourcing for new international opportunities; and special projects to improve our physical infrastructure.

The non-monetary benefits of the partnership are even more important. Those engaged have learned as much as they have taught, as the partnership has provided an opportunity for us to improve our skills in distance communication and telehealth. Our clinical teams, as ambassadors for Canadian healthcare, help to enhance the reputation of our health system globally. The partnership also contributes to our vision of achieving global impact.





# appendix A

breakdown of non-neoplastic cases 2012

Non-Neoplastic Condition	Cases	Non-Neoplastic Condition	Cases
Aplastic Anemia	30	Keloid	5
Appendicitis	55	Lymphadenopathy	26
Arteriovenous malformation	48	Lymphedema Clinic	5
Barrett's Esophagus	5	Monoclonal B-Cell Lymphocytosis	6
Bone Marrow Transplant Donor and Donor NOS*	121	Pancreatitis	52
Benign Prostatic Hyperplasia	65	Pigmented Villonodular Synovitis	3
Breast	314	Prostatic Intraepithelial Neoplasia	31
Cholelithiasis/Cholecystitis	106	Psychosocial visit – family member	53
Cervical Intraepithelial Neoplasia	24	Screening, NOS*	44
Central Nervous System	6	Thoracic, NOS*	86
Colposcopy	28	Thyroid	115
Elevated PSA	134	Trauma	12
Endometriosis	30	Trigeminal neuralgia	89
Eye	350	Urinary System	40
Fibromatosis	12	Vaginal Intraepithelial Neoplasia	2
Genetic Counseling	49	Vertigo	29
Hematology, Blood Disorder, etc.	752	Vulvar Intraepithelial Neoplasia	21
Hernia	42	Other	1,535
High grade dysplasia	14		
		<b>TOTAL CASES</b>	<b>4,339</b>

# appendix B

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princess margaret cancer centre leadership

Marnie Escaf, Senior Vice President and Executive Lead

Mary Gospodarowicz, Medical Director

## Clinical Program Leaders

- Sylvia Asa, Head, Pathology and Laboratory Medicine
- Pamela Catton, Director, Survivorship and Patient Education
- Barbara Fitzgerald, Director, Oncology Nursing
- Jonathan Irish, Department Head, Surgical Oncology
- Fei-Fei Liu, Head, Radiation Medicine Program
- Malcolm Moore, Department Head, Medical Oncology and Haematology
- Martin O'Malley, Medical Imaging Site Lead
- Amit Oza, Medical Director, Cancer Clinical Research Unit
- Gary Rodin, Department Head, Psychosocial Oncology and Palliative Care

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## Disease Group Leaders

- Breast – David McCreedy
- Central Nervous System/Eye – Normand Laperriere
- Endocrine – Shereen Ezzat
- Gastrointestinal – Jennifer Knox
- Genitourinary – Charles Catton
- Gynaecology – Stephane Laframboise
- Head and Neck – Brian O'Sullivan
- Leukemia – Andre Schuh
- Lung – Andrea Bezzak
- Lymphoma – Michael Crump
- Melanoma – Danny Ghazarian
- Sarcoma – Peter Ferguson

## Administration

- Judy Costello, Senior Clinical Director, Haematologic Oncology
- Rudy Dahdal, Director, Facilities and Redevelopment
- Jane Finlayson, Senior Public Affairs Advisor
- Zsolt Hering, Senior Business Manager, Finance
- Jin-Hyeun Huh, Director, Pharmacy Operations
- Faye Montgomery, Senior Director of Operations, Radiation Medicine Program
- MaryAnn Neary, Senior Clinical Director, Surgical Services
- Nimira Remtulla, Shared Information Management Services (SIMS) Site Manager
- Terri Stuart-McEwan, Executive Director, Solid Tumour Oncology and Gattuso Rapid Diagnostic Centre
- Roxana Sultan, Director, Strategic Planning and Implementation
- John Vespa, Senior Manager, Human Resources
- Martha Wyatt, Director, Regional Cancer Program Planning



