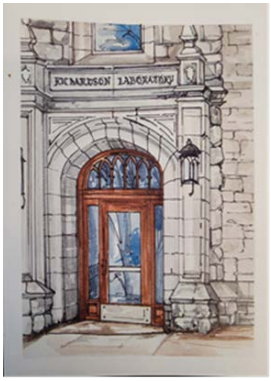
PATHOLOGY AND MOLECULAR MEDICINE

Queen's University

Kingston Health Sciences Centre
Centre des sciences de la santé de Kingston

PMM – 2024 in Review



Department of Pathology and Molecular Medicine

Working with and learning from this exemplary group for another wonderful year has been a pleasure. Please enjoy this annual report featuring highlights from 2024. This year marked advances in clinical practice, groundbreaking discoveries, impactful research, and a commitment to education—all contributing to our mission to improve human health and train the next generation of clinicians and scientists.

Thank you for all your contributions.

David Berman, Department Head

Clinical Advancements and Innovations

Anatomic Pathology (Dr. Grin)

The AP Division demonstrated outstanding teamwork in 2024. Despite staffing challenges, the team prioritized effectively, stayed organized, and maintained exceptional turnaround times. Our *Cancer Care Ontario* turnaround time remained above target, well above the provincial average, and among the best in Ontario—an especially impressive feat given that 2024 marked the highest case volume in the department's history. Maintaining this level of service and quality is a testament to the team's dedication and hard work.

The Division continues to expand and modernize. We welcomed two fellowship-trained pathologists into new *SEAMO-funded* positions and successfully recruited two skilled pathology assistants, despite national shortages. To further improve efficiency and time to treatment, we expanded the *immunohistochemistry* testing menu. Additionally, we continue to maximize the lab's limited footprint through creative solutions.

This year was also one of preparation for the new *Regional LIS* system, launched on December 6th. Many Division members dedicated countless hours to planning, collaborating, and meticulously reviewing system details. Implementing a project of this scale is no small feat, and while not everything was perfect at *Go-live*, the launch was a success—better than most! The team remains focused on refining the system, demonstrating impressive leadership and attention to detail throughout the process.

Hematopathology, Coagulation, and Transfusion Medicine (Dr. Good)

A significant focus for the hematology laboratories in the past year has been the preparation for the LUMEO implementation, including support for regional hospitals aimed at standardizing laboratory practices across the region. With the introduction of LUMEO, another regional site, LACGH, has successfully implemented CellaVision digital imaging for peripheral blood film review, further enhancing regional capabilities. In recognition of the leadership shown in this project, the hematology laboratories at KHSC and Brockville won the KHSC Team Award for Leadership. KHSC also became the first hospital in Canada to implement Nanopore NGS technology for tissue typing and acquired a spectral cytometer, which will significantly improve diagnostic flow cytometry for hematological disorders. Additionally, introducing low-volume sample tubes for blood collection reduced red cell transfusions by 1,400 units per year. The National Inherited Bleeding Disorder Genotyping Laboratory (NIBDGL), which has been in operation for 24 years, continues to provide reference diagnostic services for hemophilia and rare bleeding disorders, is transitioning to whole genome sequencing for routine screening in the coming months. 2024 was also a highly productive year for blood-related research. Please see the research section below.

Clinical Biochemistry (Dr. Huang)

The Biochemistry Lab remains committed to continuous quality improvement. Key achievements in 2024 include:

Selection of New Chemistry and Immunoassay Analyzers

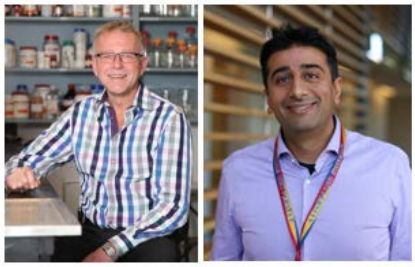
With current instruments nearing contract expiry, Dr. Oleschuk and Donnah Pocius led the development of an RFP to guide selection and procurement. The process incorporated detailed specifications for functionality, quality management, and operational suitability alongside a standardized scoring system for manufacturer evaluations. The new instruments are expected to uphold high-quality lab services.

Enhanced Emergency Department Testing

- **Volatile Testing Now Available 24/7**
  Previously limited to four trained technologists during work hours, gas chromatography-based volatile testing required after-hours approvals and call-backs, delaying turnaround times. In 2024, instruments were relocated to the Core Lab, and all 18 technologists were trained, enabling 24/7 testing with results in under an hour. This improvement reduced staff burden and lowered costs.

- **New Acetaminophen Reagent Reduces Hemolysis Interference**
  Acetaminophen testing, crucial for overdose management, was previously hampered by hemolysis interference, requiring sample recollection. A new reagent, validated and implemented in 2024, allows testing on samples with hemolysis indices up to 4+ (previously 1+). This reduced unreportable results from 14.7% to 0.4%, significantly improving service efficiency and patient care.

Microbiology (Drs. Tomalty and Sheth)



2024 saw transformative upgrades in Microbiology, including new semi-automated specimen processing systems and cutting-edge blood culture and bacterial identification technologies. These innovations improve diagnostic capabilities, particularly in detecting multi-antibiotic-resistant bacteria. The Infectious Disease Sequencing Lab continued to lead genomic surveillance efforts, completing over 35,000 SARS-CoV-2 genomes and introducing assays for RSV and influenza monitoring.

Clinical Genetics (Dr. Crocker)

The clinical genetics lab made significant strides in 2024, enhancing capabilities, streamlining workflows, and improving turnaround times despite staffing challenges. A major development underway is the transition to large-scale whole genome sequencing, positioning our team as provincial leaders in rare disease testing and clinical innovation.

Key achievements include validating new assays, such as the standalone BRAF test for rapid melanoma and Lynch syndrome diagnosis and a Molecular PML-RARA PCR test replacing FISH. Equipment upgrades— a biological safety cabinet, liquid handling system (under validation), and a NextSEQ sequencer—will enhance efficiency and sequencing capacity in 2025. Digital workflow innovations further optimized operations by automating pending case lists, extractions prep, and billing/result tracking for Medical Genetics.

We also submitted a highly competitive application to Ontario Health to become a provincial sequencing and variant interpretation hub. If awarded, this designation will create exciting opportunities for innovation and impact, allowing our scientists to leverage cutting-edge technology and research to advance precision medicine across the province and beyond.

Digital Pathology (Dr. Sonal Varma)

After two years of persistent lobbying and numerous strategic meetings, I am thrilled to announce that the hospital has approved our budget request to transition KHSC's surgical pathology service into a fully digital practice for primary diagnoses. This transformative milestone positions us at the forefront of innovation in pathology. Additionally, we have initiated efforts to establish regional partnerships aimed at case-sharing, consultations, collaborative research, and enhancing trainee education. These alliances will not only optimize diagnostic workflows but also foster knowledge exchange and elevate the quality of pathology services in our region.

2024 Research Highlights – Department of Pathology & Molecular Medicine (Dr. Davey)

This year, department members continued to lead innovative research programs spanning cancer biology, immunology, genomics, genetics, epigenetics, cell signaling, and coagulation science, making significant contributions to both fundamental discoveries and clinical advances.

We began the year by celebrating Dr. Lois Mulligan's distinguished career and her *Bracken Chair in Genetics* award. Dr. Mulligan delivered a terrific lecture, where she presented and reflected on her pioneering work in oncogenic RET signaling and its impact on precision oncology.

In other news, department members played a key role in securing two major team grants from the *Terry Fox Research Institute*: *Tumour Host Immunodynamics of Bacillus Calmette Guérin Refractory Bladder Cancer* (Drs. Berman, Greer, Tyryshkin, and Cottrell) and *Neuroendocrine Tumours of the Lung, Prostate, and Pancreas* (Drs. Renwick and Tyryshkin). A defining milestone this year was the $25 million gift that renamed QCRI as the *Cara & Murray Sinclair Cancer Research Institute*, strengthening our capacity for transformative cancer research. The department also marked the *100th anniversary of Richardson Labs*, celebrating its rich legacy and continued contributions to the future of pathology and molecular medicine.

Faculty and trainees received significant honors. Dr. Peter Greer was awarded the *Joseph S. Stauffer Chair in Cancer Research*, and Dr. Prameet Sheth became the inaugural *KHSC Genomics Chair*. Dr. David Lillicrap's internationally recognized research in hemophilia A and von Willebrand disease continued with strong support from CIHR, NIH, and the Canadian Hemophilia Society. In transfusion medicine, Dr. Jeannie Callum led the *FARES-2* randomized controlled trial (CIHR-funded), enrolling 600 cardiac surgery patients to compare frozen plasma with prothrombin complex concentrate, with results expected next year.

Dr. Anna Panchenko and her trainees mapped nucleosome positioning (*Nucleic Acids Research*), evaluated pathogenicity predictors in cancer (*Journal of Molecular Biology*), and identified pioneer transcription factors in chromatin remodeling (*eLife*). She also renewed her five-year *OICR Investigator Award*, securing continued support for her cancer genomics research. Working with Drs. Nicol, Tyryshkin, and Varma, Dr. Xiaolong Yang secured a *Canadian Cancer Society Challenge Grant* ($525,000 over three years) to investigate the role of pyroptosis effector *GSDMD* in breast cancer therapy. His group also developed advanced biosensors for cancer drug discovery (*Biosensors*), created a novel bioluminescent sensor to quantify *GSDMD* activity (*Cells*), and identified *PTPN12* as a key regulator of the Hippo pathway in breast cancer (*International Journal of Molecular Sciences*).

Other key research advances included Dr. Michael Rauh's work on *clonal hematopoiesis (CH)*, which identified its role in neutrophil dysfunction and pneumonia risk (in collaboration with McMaster) and its link to kidney disease (in partnership with Vanderbilt), with findings published in *Nature Medicine* and *Nature Reviews Nephrology*.

Trainees also excelled, with Casey Wong securing a *Canadian Cancer Society PhD Fellowship*, Brian Laight receiving the *Bruce and Janet Elliott Graduate Award in Transdisciplinary Cancer Research*, and Madeleine Carew winning the *STC-Intertek Best PhD Research Award*.

These achievements highlight the department's leadership in pathology, laboratory medicine, and translational research, strengthening its role in advancing precision medicine and patient outcomes.

Research Genomics and QLMP, the Queen's Laboratory for Molecular Pathology (Dr. Nanan, Mr. Virk, Dr. Berman)

We welcomed Dr. Kyster Nanan as the new Scientific and Operational Lead, PMM Research Genomics this year. With his leadership, the Department made significant advances in research genomics through collaboration in 2024. Queen's, KHSC, and KGHRI worked together to secure funding for critical instrument service contracts, ensuring our sequencing capabilities remained strong. Queen's and the Hospital also joined the Ontario Joint Genomics Program (OJGP), a consortium with University Health Network (UHN) and the Ontario Institute for Cancer Research (OICR) that aims to offer high-quality sequencing services to academic and industry clients. Dr. Nanan and Dr. Susan Crocker serve on the OJGP Oversight Committee, where they will contribute to the program's governance and strategic direction.

QLMP and the Canadian Cancer Trials Group biobank (called the Tumour Tissue and Data Repository) began transformative renovations which include the biobank, -80°C freezer storage, and expanded laboratory space, while incorporating state-of-the-art equipment such as an automated stainer and cover slipper, as well as nucleic acid isolation and quality assurance tools.

In addition to these advancements, the team has significantly enhanced digital pathology services through an upgraded HALO image analysis platform, with more precise and efficient image analysis, supporting a wide range of research projects. In 2024, QLMP expanded its reach by providing services to 42 researchers at Queen's University and supporting 32 Canadian Cancer Trials Group (CCTG) clinical trials.

In addition, we were proud to provide specimen processing and top-quality whole genome and whole exome sequencing to Queen's researchers, empowering them to join the Marathon of Hope Cancer Centres Network (MOHCCN) in partnership with Princess Margaret Hospital and Queen's Centre for Health Innovation (CHI), joining the Marathon of Hope Cancer Centres Network, a massive cancer profiling effort that spans major centres in Canada and supports precision oncology efforts. We are also proud to collaborate with several additional external groups, including the Royal College, to provide cutting-edge digital pathology expertise and resources.

Looking ahead, the Department is committed to making advanced digital pathology and genome-scale sequencing technologies more accessible and affordable to researchers and fostering stronger collaborations between scientists and clinicians. Planned upgrades to our sequencing, computing, and imaging infrastructures and expanding partnerships across the University will further advance this vision by enhancing throughput and efficiency, enabling us to meet the growing demand for these services. By expanding and upgrading research services already available in the Department, we will further support local researchers and strengthen the local research ecosystem.

Celebrating 100 Years of Excellence: Richardson Laboratory Centennial Event

Richardson Lab 1924

Richardson Lab 2024

In 2024, the Department hosted a full-day celebration of Richardson Laboratory's remarkable legacy, bringing together current members, alumni, and friends to honor a century of groundbreaking research, education, and clinical innovation. The event highlighted what makes our department special—our talented and dedicated scientists and physicians, past and present, whose commitment to excellence continues to shape the future of pathology and molecular medicine.

Dr. Paul Manley reflected on Richardson Laboratory as a "Refuge, Incubator, Home," tracing its storied history and impact. Dr. Paul Kubes then took us into the future with a captivating keynote on real-time imaging in pathology. A series of research talks followed, showcasing the department's diverse expertise—from Dr. David Lillicrap's insights into hemophilia to Dr. Jeannie Callum's work in trauma resuscitation, Dr. Michael Rauh's innovations in cancer surveillance, and Dr. Neil Renwick's research on microRNA diagnostics. The Kaufman Lecture, delivered by Dr. Alanna Church, explored the role of molecular profiling in pediatric oncology, and provided outstanding examples of the power of genomics to advance cancer care.

The celebration was a true testament to the enduring strength and innovation of Richardson Laboratory, leaving attendees inspired and reconnected with the department's legacy and future.

Our keynote speaker of the day was Dr. Paul Kubes (Canada Excellence Research Chair, Queen's University) - Left

This year's Kaufman Lecturer was Dr. Alanna Church (Assistant Professor of Pathology, Harvard Medical School) – Right

Educational Contributions

Undergraduate Education

Once again, the department expanded its role in the Life Sciences and Health Sciences programs, introducing new courses on data visualization and human disease. Pathology-based research projects continued to grow, fostering engagement and inspiring students to pursue careers in medicine and research. The undergraduate team, led by Drs. Chris Nicol and Lois Mulligan, welcomed Micheline McDonald, whose contributions have been invaluable.

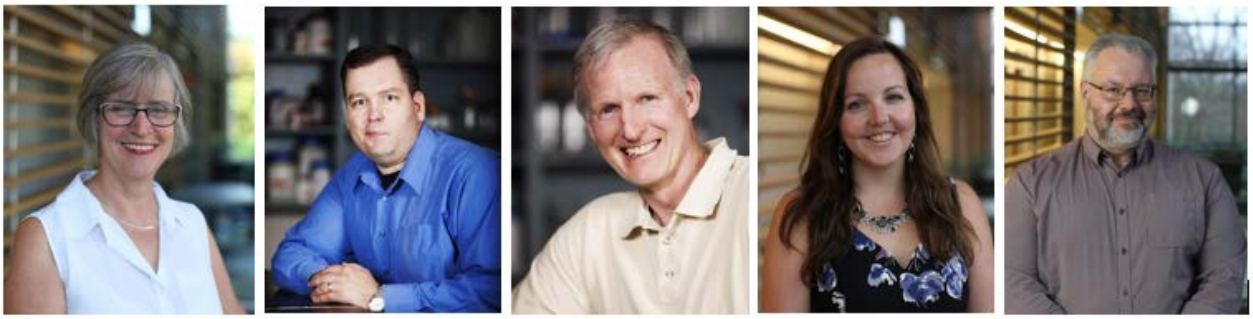
Residency and Graduate Programs

Our residency program in Diagnostic and Molecular Pathology celebrated significant milestones:

- All final-year residents passed their Royal College Examinations.
- A new elective program with the Office of the Chief Coroner was launched to provide hands-on experience in medical death investigation.

The graduate program saw exceptional growth, with 11 new students joining and 7 defending their theses. Trainees garnered prestigious awards, including CIHR Vanier Doctoral Fellowships and Canadian Cancer Society Fellowships. The program's productivity included 17 publications and numerous conference presentations.

Our education team leads (R – L): Drs. L. Mulligan, C. Nicol, P. Greer, C. Orr & K. Cunningham



Recognitions and Appointments

Faculty Achievements

This year saw renewed funding for several clinicians and senior scientists, including Drs. Tricia Cottrell and Anna Panchenko. These achievements highlight our faculty's commitment to advancing cutting-edge research and clinical practice.

Leadership transitions further enriched our department with new roles and responsibilities:

- Dr. Scott Davey as Associate Head of Research.
- Dr. Harriet Feilotter's departure and appointment as Division Head, Genome Diagnostics, at UHN.
- Dr. Susan Crocker appointed Service Chief, Clinical Genetics.
- Dr. Yun Huang appointed Interim Service Chief, Clinical Biochemistry.
- Dr. Sandip Sengupta appointed Chief of Pathology & Medical Director of Laboratory Medicine, North York General Hospital.
- Dr. David Good appointed Medical Director of Laboratories, KHSC.
- Dr. David Berman appointed Interim Medical Director of Laboratories, Brockville General Hospital.

We also honored the career and contributions of Dr. David Lebrun, who retired this year after a distinguished 30-year career as a clinician-scientist.

Service Milestones

We acknowledged decades of service by faculty and staff, including:

- Dr. Henry Wong (10 years), Joyce deVette-McPhail and Lis Andersen (20 years), and Drs. John Rossiter, David Hurlbut, and David LeBrun (30 years).

Looking Ahead

Our focus for 2025 includes:

- Expanding clinical, educational, and research capabilities and partnerships in genomics, diagnostics, and quality improvement.
- Continuing to enhance educational offerings across undergraduate and graduate levels.
- Addressing workforce challenges and optimizing clinical services.

Reflecting on 2024, the outstanding achievements of our faculty, staff, and trainees exemplify our commitment to advancing medical practice, fostering discovery, and preparing the next generation of healthcare leaders. Together, we are truly shaping the future of medicine.