6th DEPARTMENT OF PATHOLOGY & LABORATORY MEDICINE RESEARCH DAY

12 MAY 2026

PROGRAM BOOK

UNIVERSITY OF SASKATCHEWAN
College of Medicine
POSTGRADUATE MEDICAL EDUCATION
MEDICINE.USASK.CA

This event is an Accredited Group Learning Activity (Section 1) as defined by the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada and approved by the Canadian Association of Pathologists – Association canadienne des pathologistes. You may claim a maximum of 5.25 hours (credits are automatically calculated).

Through an agreement between the Royal College of Physicians and Surgeons of Canada and the American Medical Association, physicians may convert Royal College MOC credits to AMA PRA Category 1 Credits™.

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Overall Learning Objectives

Upon completion of this research day, participants will be able to:

- **Critically appraise** research methodologies, study design, and data interpretation presented during the sessions.
- **Identify** emerging research trends and advancements in pathology and laboratory medicine.
- **Integrate** relevant research findings into clinical and laboratory practice where applicable.
- **Collaborate** with peers and faculty through interdisciplinary discussion and scholarly exchange.
- **Evaluate** scientific presentations using structured assessment criteria.

Specific Session Learning Objectives

At the end of each session, participants will be able to:

- **Apply** principles of scientific communication when presenting research findings (presenters).
- **Present** research findings clearly and effectively to a multidisciplinary audience (presenters).
- **Analyze** study design, methodology, and statistical approaches used in the presented research.
- **Provide** constructive, evidence-based feedback to improve research design and interpretation.
- **Defend** research conclusions and respond to questions using scientific reasoning (presenters).

Program Overview and Educational Design

This Research Day has been designed as an accredited group learning activity, integrating both didactic teaching and interactive discussion to support meaningful learning and engagement. The program features a combination of faculty and trainee presentations, highlighting current research, innovation, and clinical applications in pathology and laboratory medicine.

All sessions include protected time for audience interaction to promote discussion, critical appraisal, and knowledge translation. Presentation formats have been standardized as follows:

- 10-minute presentations: 7-minute presentation and 3-minute Q&A
- 15-minute presentations: 10-minute presentation and 5-minute Q&A
- 50-minute keynote presentation: 40 minutes presentation and 10 minutes Q&A

This structured approach ensures consistency across sessions and aligns with Section 1 accreditation requirements by fostering active participation and reflective learning.

Welcome Message from the Provincial Head

It is my great pleasure to welcome you to the 6th Annual Research Day of the Department of Pathology and Laboratory Medicine at the University of Saskatchewan.

Our Department plays a central role in patient care across the province, supporting diagnostic services, clinical decision-making, and advancing precision medicine through innovation and research. Our strength lies in the integration of clinical service, education, and research, supported by a dedicated team of faculty, trainees, and staff.

Research is a cornerstone of our mission. It drives improvements in diagnostic accuracy, enhances patient outcomes, and enables the translation of emerging technologies, such as genomics, artificial intelligence, and digital pathology, into clinical practice. We remain committed to fostering a collaborative and supportive research environment that empowers our faculty and trainees to excel.

I would like to acknowledge the outstanding contributions of our faculty, residents, fellows, graduate students, and staff. Your dedication, curiosity, and perseverance continue to advance the impact of our department locally and globally.

This Research Day is a reflection of that commitment. It provides an opportunity to showcase the breadth and quality of research within our department, celebrate achievements, and strengthen collaborations across disciplines.

I would also like to extend my sincere gratitude to the Program Chair, Dr. Ahmed Mostafa, and the organizing committees for their leadership and efforts in delivering this excellent scientific program.

I look forward to an engaging and inspiring day.

Warmest Regard

Dr. Carol Cheung, MD, PhD, JD, FRCPC

Provincial Department Head and Professor, Pathology and Laboratory Medicine

Research Day Program Chair

Welcome to the 6th Annual Department of Pathology and Laboratory Medicine Research Day.

Today's program brings together faculty, residents, fellows, graduate students, and collaborators to highlight the innovative and impactful research being conducted across our department. Despite the demands of clinical service, our teams continue to push the boundaries of diagnostic medicine through high-quality research and interdisciplinary collaboration.

This year's program reflects the diversity of our field, spanning areas such as molecular diagnostics, genomics, artificial intelligence, transplant immunology, and quality improvement in laboratory medicine. These efforts underscore our department's commitment to advancing precision diagnostics and improving patient care across Saskatchewan and beyond.

We are also pleased to note that this program is accredited by the Canadian Association of Pathologists, recognizing its high educational and scientific standards.

Research Day provides an important opportunity to recognize the dedication of our trainees and to celebrate the mentorship provided by faculty. The strength of our program lies in this collaborative environment, where education and research are closely integrated.

I would like to thank all presenters, moderators, judges, and invited speakers for their valuable contributions. I also extend my sincere appreciation to the Planning Committee and Scientific Committee for their efforts in organizing this event, and to our administrative staff for their essential support behind the scenes.

Finally, congratulations to all presenters for their excellent work. Your contributions are the foundation of our department's academic success.

I hope you enjoy the program and find it both inspiring and engaging**.**

Dr. Ahmed Mostafa, MD, MSc, PhD, F (ACHI)

Associate Professor, Pathology and Laboratory Medicine

Planning Committee

Dr. Ahmed Mostafa (Resident Research Director)

Dr. Mark Milne (Department Research Facilitator)

Mr. Harold Shiffman (Department Manager)

Ms. Loreen Trautmann (Executive Assistant to the Provincial Head)

Scientific Committee

Dr. Ahmed Mostafa (Resident Research Director)

Dr. Alicia Andrews (Assistant Professor, Pathology and Laboratory Medicine)

Dr. Janine Benoit (Assistant Professor, Pathology and Laboratory Medicine)

Dr. C. Ron Geyer (Professor, Pathology and Laboratory Medicine)

Dr. Bryan Johnston (PGY2, Pathology and Laboratory Medicine)

Dr. Areej Khatib (Assistant Professor, Pathology and Laboratory Medicine)

Judges

Dr. Alicia Andrews (Assistant Professor, Pathology and Laboratory Medicine)

Dr. Roland N. Auer (Professor, Pathology and Laboratory Medicine

Dr. Janine Benoit (Assistant Professor, Pathology and Laboratory Medicine)

Dr. C. Ron Geyer (Professor, Pathology and Laboratory Medicine)

Dr. Jay Kalra (Professor, Pathology and Laboratory Medicine)

Dr. Areej Khatib (Assistant Professor, Pathology and Laboratory Medicine)

Awards

PGME Presentation Awards

Dr. Harry E. Emson Award – Best Senior (PGY4/5) Pathology Resident research presentation ($400)

Jack Adolph Award – Best Junior Pathology (PGY2/3) Resident research presentation ($300)

Dr. Lorne Massey Award – Best interdisciplinary research presentation ($400)

Graduate Student & UGME Presentation Awards

The Best Presentation Award ($500)

Plenary Speakers

Dr. Linda Chelico, PhD

Vice-Dean of Research, Biomedical Sciences
College of Medicine, University of Saskatchewan

Biography

Dr. Linda Chelico, PhD, began her five-year term as Vice-Dean Research, Biomedical Sciences in March 2026. A current professor and former Department Head in the Department of Microbiology, Immunology and Biochemistry, she is internationally recognized for her research on host antiviral defence mechanisms, particularly the APOBEC3 family of enzymes and their roles in restricting HIV-1 replication and contributing to mutagenesis in cancer. Through innovative biochemical and cellular studies, her lab has advanced understanding of the molecular “arms race” between HIV-1 Vif and APOBEC3 proteins, generating insights that inform novel therapeutic strategies and deepen knowledge of genomic stability and tumorigenesis. As Vice-Dean Research, Biomedical Sciences, she provides strategic leadership for biomedical research within the College of Medicine, serving on the Dean’s executive team and working in close partnership with the Vice-Dean Research, Clinical, Health Sciences, and Population Health to advance a coordinated, integrated research strategy across the College.

Dr. Janet Tootoosis BSc, MD, CCFP, FCFP

Vice-Dean Indigenous Health
College of Medicine, University of Saskatchewan

Biography

Dr. Janet Tootoosis is a Cree physician from Poundmaker Cree Nation and a long-standing leader in primary health care, medical education, and Indigenous health advancement in Saskatchewan. A practicing family physician in North Battleford since 2001, she is the owner and operator of the North Battleford Medical Clinic Inc., where she has built a career grounded in community service, clinical excellence, and culturally informed care.

Since 2008, Dr. Tootoosis has served as a Clinical Associate Professor in the University of Saskatchewan's College of Medicine. She has played a pivotal role in training future physicians through her work as an instructor and site director for the North Battleford Family Medicine Residency Training Program, contributing to the development of a strong rural and Indigenous medical workforce.

Her leadership extends across provincial health initiatives, with an extensive history of involvement in health care delivery, system improvement, and educational program development. She is recognized for her commitment to strengthening relationships between Indigenous communities and the health care system, and for championing approaches that integrate Indigenous knowledge, equity, and self-determination.

Dr. Tootoosis currently serves as the Vice Dean of Indigenous Health in the College of Medicine at the University of Saskatchewan, where she leads strategic efforts to advance Indigenous health education, research, and partnerships across the province. She will receive her Master of Health Professions Education from the University of Saskatchewan in June 2026, further enhancing her capacity to shape health professional training and system transformation.

Dr. Shamini Selvarajah, PhD, DABMGG, FACMG, FCCMG

Director, Solid Tumour Genomics, Division of Genome Diagnostics
Laboratory Medicine Program | University Health Network – A Healthier World
Assistant Professor | University of Toronto
Department of Laboratory Medicine & Pathobiology

Biography

Dr. Shamini Selvarajah is an ABMGG and CCMG dual-boarded diagnostic laboratory scientist in the Division of Clinical Laboratory Genetics at the University Health Network in Toronto, Ontario. She is also an Assistant Professor in the University of Toronto's Department of Laboratory Medicine and Pathobiology. She earned her PhD at the University of Toronto and completed fellowship training in clinical cytogenetics at the Harvard Medical School Genetics Training Program and in clinical molecular genetics at McMaster University. Her role as a clinical lab scientist includes oversight of genetic testing for oncology, including companion diagnostics, genomic test development for clinical laboratory use, and applications of next-generation sequencing in clinical care. Her translational research interests focus on genitourinary cancer genomics and the development and implementation of non-invasive genomic tests for acquired cancers through the application of high-throughput technologies. Dr. Selvarajah is internationally engaged in guideline and standards development, serving on the Clinical Laboratory Standards Institute Document Development Committee for liquid biopsy methods in oncology, the Association for Molecular Pathology Clinical Validation of cfDNA/ctDNA Assays Working Group, and as an assessor for the European Molecular Quality Network's external quality assessment schemes. As an educator, Dr. Selvarajah has co-developed and leads competency-based curricula in clinical genetics and molecular pathology for Royal College pathology residents, CCMG Genetic and Genomic Diagnostics fellows, and practicing pathologists through initiatives at UHN, the Canadian College of Medical Geneticists, and the Ontario Molecular Pathology Research Network.

The 6th Annual Research Day Program
College of Medicine, U of S
12 MAY 2026

Time: 08:00 – 16:00
Location: Glenn Hall at Crossmount

Registration & Breakfast
08:00 – 08:30

Opening Session (Dr. Ahmed Mostafa Chair)

Time	Speaker	Details
08:30 – 08:35	Opening Remarks – Dr. Carol Cheung, Provincial Head	***Administrative –*** *Not accredited*
08:35 – 08:50	Vice-Dean Research – Dr. Linda Chelico, PhD	**OVDR Outlook - 2026** *(10+5)* **Learning Objectives:** Describe research priorities; Identify opportunities; Apply institutional resources **CanMEDS:** Leader, Scholar **COI:** No COI
08:50 – 09:05	Vice-Dean Indigenous Health – Dr. Janet Tootoosis	**Indigenous Health and Wellness Grounded in Relationship** *(10+5)* **Learning Objectives:** Describe principles; Recognize relationship-based care; Apply culturally appropriate approaches **CanMEDS:** Professional, Communicator, Health Advocate **COI:** No COI
09:05 – 09:55	Guest Speaker – Dr. Shamini Selvarajah	**Optimizing ctDNA Testing for Precision Cancer Care—Opportunities and Pitfalls** *(40+10)* **Learning Objectives:** Describe ctDNA applications; Evaluate limitations; Apply findings clinically

Time	Speaker	Details
		CanMEDS: Medical Expert, Scholar **COI:** Member on advisory board (Pfizer)
10:00 – 10:15	**Break**	*Not accredited*

Faculty Research Presentations (Dr. Alicia Andrews, Chair)

Time	Speaker	Details
10:15 – 10:30	Dr. Areej Khatib, Assistant Professor, Pathology and Laboratory Medicine	**Does the Diagnostic Laboratory Matter? Rural Lab Diagnosis and Systemic Therapy Delays in Metastatic Colorectal Cancer** *(10+5)* **Learning Objectives:** Analyze lab impact; Evaluate delays; Identify improvements **CanMEDS:** Medical Expert, Leader, Health Advocate **COI:** Funded grants or clinical trials (Pfizer)
10:30 – 10:45	Dr. Roland N. Auer, Professor, Pathology and Laboratory Medicine	**Detour Hemorrhages Around Non-Perfused Brain to Retina and Dura After Brain Death in Children** *(10+5)* **Learning Objectives:** Describe mechanisms; Interpret findings; Apply clinically **CanMEDS:** Medical Expert, Scholar **COI:** No COI
10:45 – 11:00	Dr. C. Ron Geyer, Professor, Pathology and Laboratory Medicine	**Next Generation Antibody Engineering: High-Valent, Multi-Specific Antibodies** *(10+5)* **Learning Objectives:** Describe advances; Compare platforms; Evaluate applications **CanMEDS:** Medical Expert, Scholar **COI:** No COI
11:00 – 11:15	Dr. Cody Lewis, Assistant Professor, Pathology and Laboratory Medicine	**Evaluating Discrepancies in Transcutaneous Bilirubin Screening** *(10+5)* **Learning Objectives:** Identify discrepancies; Evaluate accuracy; Improve protocols

Time	Speaker	Details
		CanMEDS: Medical Expert, Leader **COI:** No COI

11:15 – 11:30	Dr. Mary Kinloch, Associate Professor, Pathology and Laboratory Medicine	**Ovarian Cancer Research** *(10+5)* **Learning Objectives:** Describe research trends; Evaluate challenges; Apply findings **CanMEDS:** Medical Expert, Scholar **COI:** FroggaBio (speaker travel support), AbbVie; Merck; Ovarian Cancer Advisory Board, Genome Canada (grant funding)
11:30 – 11:45	Dr. Josie Rybchuk, Associate Scientist, Pathology and Laboratory Medicine	**Seegene Stool Study** *(10+5)* **Learning Objectives:** Describe methods; Evaluate assays; Interpret results **CanMEDS:** Medical Expert, Scholar **COI:** No COI
11:45 – 12:00	Dr. Phillipe Price, Assistant Professor, Pathology and Laboratory Medicine	**Progress Audit of the Massive Hemorrhage Protocol *(10+5)*** **Learning Objectives:** Describe protocol; Evaluate audit; Apply improvements **CanMEDS: Leader,** Medical Expert **COI:** No COI

Trainee Research Presentations – Session I (Dr. Areej Khatib, Chair)

Time	Speaker	Details
12:00 – 12:10	Dr. Daniel J Markewich (PGY5)	**An Assessment of Margin Positivity in Lumpectomy Specimens Comparing Conventional Wire-Localization to Magnetic Seed Localization** *(7+3)* **Learning Objectives:** Compare techniques; Evaluate outcomes; Apply findings **CanMEDS:** Scholar, Medical Expert **COI:** No COI
12:10 – 12:20	Dr. Bryan Johnston (PGY2)	**Assessing Digital Readiness in AI-Enabled Diagnostic Medicine: A Human Factors Framework** *(7+3)* **Learning Objectives:** Describe frameworks; Evaluate AI integration; Apply principles **CanMEDS:** Scholar, Leader **COI:** No COI

12:20 – 12:30	Dr. Dan Zhang (PGY3)	**Computational Pathology of Kidney Transplant Biopsies: Machine Learning-Based Risk Models Using PIRCHE-B and PIRCHE-T2** *(7+3)* **Learning Objectives:** Describe ML models; Evaluate prediction; Apply clinically **CanMEDS:** Scholar, Medical Expert **COI:** No COI
12:30 – 12:40	Dr. Richard Zhu (PGY3)	**Comparative Study on Androgen Receptor, STAT6 and PMS2 Immunohistochemistry in Sebaceous Neoplasms** *(7+3)* **Learning Objectives:** Compare markers; Evaluate utility; Apply diagnostics **CanMEDS:** Scholar, Medical Expert **COI:** No COI

Lunch
12:40–13:30 (*Not accredited*)

Trainee Research Presentations – Session II (Dr. C. Ron Geyer and Dr. Janine Benoit, Chairs)

Time	Speaker	Details
13:30 – 13:40	Dr. Pramath Kakodkar (PGY5)	**Comparative Analysis of Optical Genome Mapping and Targeted Next-Generation Sequencing in Matched Bone Marrow and Peripheral Blood Samples for Acute Myeloid Leukemia** *(7+3)* **Learning Objectives:** Compare technologies; Evaluate performance; Apply findings **CanMEDS:** Scholar, Medical Expert **COI:** No COI
13:40 – 13:50	Dr. Bryan Johnston (PGY2)	**Reflex BAP1 Testing in Serous Effusion Cytology as a Trigger for Germline Risk Assessment in Mesothelioma** *(7+3)* **Learning Objectives:** Describe testing; Evaluate triggers; Apply clinically **CanMEDS:** Scholar, Medical Expert **COI:** No COI

Time	Speaker	Details
13:50 – 14:00	Dr. Peter Xu (PGY2) Biochemistry Fellow	**Assessment of Anti-Cyclic Citrullinated Peptide Antibody Assay on the BioPlex 2200 system *(7+3)*** **Learning Objectives:** Describe assay; Evaluate performance; Apply diagnostics **CanMEDS:** Scholar, Medical Expert **COI:** No COI
14:00 – 14:10	Dr. Sridevi Koduru (PGY1)	**Placental Chorangiomas: A Five-Year Clinicopathological Review** *(7+3)* **Learning Objectives:** Describe findings; Evaluate significance; Apply clinically **CanMEDS:** Scholar, Medical Expert **COI:** No COI
14:10 – 14:20	Dr. Pramath Kakodkar (PGY5)	**Decoding Brain Tumors with AI: Large Language Models as Copilots for Multimodal Diagnosis of CNS Malignancies** *(7+3)* **Learning Objectives:** Describe AI tools; Evaluate models; Apply to diagnostics **CanMEDS:** Scholar, Leader **COI:** No COI
14:20 – 14:30	Dr. Zoher Rafid-Hamed (PGY1) Internal Medicine	**Integrating Artificial Intelligence Competencies into Existing CanMEDS Frameworks** *(7+3)* **Learning Objectives:** Describe competencies; Evaluate integration; Apply to training **CanMEDS:** Scholar, Leader, Professional **COI:** No COI
14:30 – 14:40	Dr. Pramath Kakodkar (PGY5)	**Microbeam Radiation Therapy (MBRT) Bypasses Vascular Sequestration to Facilitate Lymphocyte Extravasation** *(7+3)* **Learning Objectives:** Describe mechanisms; Evaluate effects; Apply research **CanMEDS:** Scholar, Medical Expert **COI:** No COI

14:40 – 14:50	Anjali Saxena (Medical Student)	**From Ethical Obligations to Clinical Standards: A National Framework for Medical Error Disclosure in Canada** *(7+3)* **Learning Objectives:** Describe frameworks; Evaluate ethics; Apply to practice **CanMEDS:** Professional, Health Advocate **COI:** No COI
14:50 – 15:00	Heather Cole (Genomic Lab Supervisor)	**Mysteries Solved: Interesting Cases in Genetics** *(7+3)* **Learning Objectives:** Describe cases; Evaluate diagnostics; Apply to lab practice **CanMEDS:** Medical Expert, Scholar **COI:** No COI
15:00-15:10	Mark Mokhtar (PGY1)	**Atypical CD99 Expression in Stage II Clear Cell Sarcoma of the Kidney: A Diagnostic Pitfall** **Learning Objectives:** Describe key features of clear cell sarcoma of the kidney, recognize atypical CD99 expression as a diagnostic pitfall, and apply appropriate differential diagnosis **CanMEDS:** Medical Expert, Scholar **COI:** No COI

Break & Judges Deliberation
15:10 – 15:30

Awards Ceremony
15:30 – 15:45

Celebration & Group Photo | Closing Ceremony.
15:45 – 16:00

Plenary Presentation Abstract

Indigenous Health and Wellness Grounded in Relationship

Janet Tootoosis, MD, CCFP

Vice Dean, Indigenous Health, College of Medicine, University of Saskatchewan

Abstract
Overview of the Office of the Vice Dean, Indigenous Health, and the new Department of Indigenous Health and Wellness in the USASK College of Medicine. Connect the office's and department's goals with authentic community engagement. Share the rationale for the community engagement strategy and practices of OVDIH and DIHW.

Optimizing ctDNA Testing for Precision Cancer Care—Opportunities and Pitfalls

Shamini Selvarajah, PhD, DABMGG, FACMG, FCCMG

Director, Solid Tumour Genomics, Division of Genome Diagnostics
Laboratory Medicine Program | University Health Network – A Healthier World
Assistant Professor | University of Toronto
Department of Laboratory Medicine & Pathobiology

Abstract

Liquid biopsy has rapidly transitioned from an investigational concept to an increasingly routine tool in precision oncology. Among liquid biopsy modalities, plasma circulating tumor DNA (ctDNA) has emerged as a powerful approach for non-invasive genomic profiling, treatment selection, and longitudinal disease monitoring. This presentation will explore the evolving clinical role of ctDNA testing across multiple cancer types, beginning with non–small cell lung cancer, where ctDNA assays helped establish liquid biopsy as a practical tool for guiding targeted therapy in patients progressing on tyrosine kinase inhibitors. It will then expand to applications beyond lung cancer, including NGS-based ctDNA testing in metastatic prostate cancer to identify DNA repair gene alterations that inform PARP inhibitor use, and a pan-cancer ctDNA initiative at Princess Margaret for patients without available tumor tissue, demonstrating how blood-based testing can enable timely access to targeted therapy without repeat invasive biopsy. Additional examples will include targeted ctDNA assays in breast cancer for detecting emerging resistance mutations while on endocrine therapy. Throughout, the presentation will balance clinical advantages—such as minimally invasive sampling, faster turnaround times, and feasibility of serial monitoring—with key technical and interpretive challenges, including low tumor burden, variable ctDNA shedding, clonal hematopoiesis, and tumor fraction assessment. The session will underscore that ctDNA testing, while increasingly integrated into clinical care, remains a rapidly advancing field with ongoing efforts to refine assay performance, harmonize workflows, and more fully embed ctDNA metrics into precision oncology practice.

FACULTY ABSTRACTS

Does the Diagnostic Laboratory Matter? Rural Lab Diagnosis and Systemic Therapy Delays in Metastatic Colorectal Cancer

Adam Ismail[1], Amandri Dahanayake[2], Shahid Ahmed[3], Yagan Pillay[4], Areej Khatib[5]

[1]College of Arts and Sciences, University of Saskatchewan, Saskatoon, SK, Canada
[2]College of Arts and Sciences, University of Saskatchewan, Saskatoon, SK, Canada
[3]Department of Medical Oncology, College of Medicine, University of Saskatchewan, Saskatoon, SK, Canada
[4]Division of General Surgery, College of Medicine, University of Saskatchewan, Prince Albert, SK, Canada
[5]Department of Pathology and Laboratory Medicine, College of Medicine, University of Saskatchewan, Prince Albert, SK, Canada

Background: In metastatic colorectal cancer (mCRC), timely biomarker testing and treatment initiation are critical in the era of precision oncology. In Saskatchewan, diagnostic pathology services are delivered through both rural and urban laboratories, with biomarker testing centralized in urban centers. We examined whether the location of the diagnosing laboratory influences treatment timelines and outcomes.

Methods: We conducted a population-based retrospective cohort study of 818 patients diagnosed with stage IV CRC (2017–2022). Patients were analyzed by both residency and the diagnosing laboratory location (rural vs urban). Outcomes included biomarker distribution, time from diagnosis to systemic therapy, and overall survival.

Results: While patient residency alone was not associated with treatment delays or survival, diagnostic laboratory location revealed important differences. Patients diagnosed in rural laboratories experienced longer median time to chemotherapy initiation (66.5 vs 55 days; p=0.011) and clinically meaningful delays in immunotherapy initiation (77.5 vs 65 days; p=0.114). Surgical timing and overall survival did not differ significantly. RAS mutations were more frequently observed among rural residents (11.2% vs 1.6%), although overall mutation prevalence was lower than expected for mCRC.

Conclusions: In this contemporary mCRC cohort, survival was comparable across regions; however, diagnosis in a rural laboratory was associated with delayed systemic therapy initiation. These findings suggest that inefficiencies in centralized biomarker referral and diagnostic workflows—rather than patient geography alone—may represent a modifiable “weak link” in metastatic CRC care pathways.

Detour Hemorrhages Around Non-Perfused Brain to Retina and Dura After Brain Death in Children

Roland N. Auer[1] and Julie A. Mack[2]

[1]Department of Pathology and Laboratory Medicine, College of Medicine, University of Saskatchewan, Saskatoon
[2]Department of Radiology, Academic Practice Division, Penn State Milton S. Hershey, Pa, USA.

Background: Viral pneumonia causes out-of-hospital cardiorespiratory arrest in infants and toddlers. Brain capillary closure occurs after 10 minutes due to ischemic cerebral edema arising as an influx of CSF, closing capillaries by compression from perivascular edema, resulting in a brain that cannot be re-perfused.

Methods: We examined 40 cases with respect to clinical history, resuscitation history, brain histology, retinal hemorrhage, and dural hemorrhage, including the pituitary gland, when available.

Results: Clinical histories showed breathing stopped in the awake child. Emergency personnel used epinephrine to restart the heart. Disseminated Intravascular Coagulation (DIC) was seen in concert with inflammatory disease seated in the lungs, and reperfusion after cardiorespiratory arrest. All brains showed either uniform or patchy ischemia seen as pallor of neuropil that was perivascular and sharply demarcated. Cerebral microcirculatory closure was seen as augmented Virchow-Robin perivascular spaces, and compressed microvessel often devoid of red blood cells. Two pituitary glands were available and showed infarction. Retinae showed no microcirculatory closure, but hemorrhage of varying degrees.

Conclusion: The disproportionately large brains of infants and toddlers require high cerebral blood flow, re-routed around non-perfused brain on resuscitation. The pituitary gland is infarcted in the non-perfused brain due to its portal blood supply from the brain. Radionuclide evaluation in the literature on brain death shows the absence of cerebral blood flow, but flow to pericerebral structures. From the bleeding dura, spillover blood caused a subdural but not an epidural hematoma. Clinical brain death in global ischemia is caused by brain microvessel closure. Cerebral microvessels cannot transmit blood flow, even if the heart is restarted. Resuscitation then diverts the considerable brain blood flow of the infant or toddler into a detour of flow around the non-perfused brain to the retina and dura. Despite the hemodynamic origin of these bleeds, all cases were medico-legally charged with shaking or abusive head trauma.

Next Generation Antibody Engineering: High-Valent, Mult-Specific Antibodies

Ron Geyer[1]

[1]Department of Pathology and Laboratory Medicine, College of Medicine, University of Saskatchewan, Saskatoon

Abstract:

Exploiting the innate modularity of proteins has allowed advances across the fields of synthetic biology and biotechnology. By using standardized protein components as building blocks, complex, multiprotein assemblies with sophisticated functions can be generated; feats previously not possible with strictly genetic-engineering approaches. The development of strategies for protein assembly is accelerating, pushing the boundaries of protein architecture. Here, we describe genetic and post-translational engineering strategies to create complex antibody-like molecules with unique properties and describe their applications in problems that are not solvable using standard IgG molecules.

Evaluating Discrepancies in Transcutaneous Bilirubin Screening

Cody Lewis[1,2], Sukhbir Kaur[3]

[1]Saskatchewan Health Authority, Saskatchewan
[2]Department of Pathology and Laboratory Medicine, College of Medicine, University of Saskatchewan, Saskatoon
[3]LifeLabs, British Columbia

Background: The Dräger Jaundice JM-105 is used in Saskatoon, Saskatchewan, Canada, to screen neonates for jaundice using transcutaneous bilirubin (TcB). Elevated TcB results are confirmed with laboratory measurement of total serum bilirubin (TSB), and high TSB levels may prompt bilirubin fractionation. Failure to detect and treat neonatal jaundice can lead to severe complications, including kernicterus. Discrepancies between TcB and TSB results may lead to unnecessary blood draws from falsely elevated TcB readings or missed diagnoses from falsely low readings. This study aimed to identify potential sources of these discrepancies.

Methods: Between 2023 and 2025, TcB measurements were obtained from 235 neonates during post-calibration evaluation of a fleet of JM-105 meters used for routine screening in Saskatoon. Five replicate TcB readings were collected per patient, averaged, and compared with time-matched TSB measured using the Roche Cobas. Concordance was assessed by determining the proportion of TcB-TSB pairs exceeding total allowable error (TEa) thresholds of 15–20%. Replicate precision was evaluated against the manufacturer's specification that readings fall within 50 µmol/L. Neonates were categorized as having light, medium, or dark skin tone using color swatches.

Results: Among TcB-TSB pairs, 28.1% exceeded a 15% TEa, 16.6% exceeded 20%, and 6.3% exceeded 30%. Skin tone influenced accuracy: 90% of dark-skinned neonates showed TcB overreads, compared with 15.0% of light-skinned and 20.3% of medium-skinned neonates. Falsely low TcB readings occurred in 7.5% of light-skinned and 3.7% of medium-skinned neonates but were not observed in dark-skinned neonates. 60% of replicate readings exceeded manufacturer precision limits, with some differences exceeding 100 µmol/L.

Conclusion: TcB discrepancies appear partly related to skin tone, though device precision and user technique may also contribute. These findings highlight the need for stronger quality assurance processes and validated QC materials to improve the reliability of TcB screening.

Massive Hemorrhage Protocol Activation in a Tertiary Hospital Network: A 3-year Retrospective Quality Improvement Audit Using Quality Indicators

PHILLIPE PRICE 1,2, INGRID TAM 1,2, SHEILA ANTHONY 1, OKSANA PROKOPCHUK-GAUK 1,2

1 Saskatchewan Health Authority; 2 Department of Pathology and Laboratory Medicine, University of Saskatchewan

Introduction/Objective:

Massive bleeding (frequently defined as administration of 10 units of red blood cells (RBC) or more in 24 hours) has a high mortality rate. Use of a Massive Hemorrhage Protocol (MHP) has been demonstrated to improve patient outcomes. In 2019, a multidisciplinary expert committee from Ontario published criteria for a successful MHP, which proposed eight quality indicators (Q1-Q8). These guidelines were adopted in a Canadian tertiary-care hospital network in 2021. We undertook a quality improvement audit of our revised MHP to evaluate compliance rates with these quality indicators. Further, we sought to identify potential MHP under-activation rates based on patients receiving a massive transfusion of RBC, but an MHP was not activated, and see if there were differences in compliance rates compared to the MHP-activated group.

Methodology:

A retrospective chart review of patients from 3 urban hospital facilities between August 23, 2021, and August 23, 2024, was completed. Quality indicators included: Q1. Tranexamic acid administered within 1 hour of MHP activation; Q2. RBC transfusion initiated within 15 min of MHP activation; Q3. Call-for-transfer initiated within 60 min of MHP activation (if transferred from rural settings); Q4. Temperature 35°C or more achieved at MHP termination; Q5. Hemoglobin maintained between 60-110 g/L during MHP activation; Q6. Transition to group-specific RBC and plasma within 90 min of arrival/hemorrhage onset; Q7. Appropriate MHP activation (6 red cell units or more in the first 24 h, or more than 40 mL/kg RBC in 24 h in pediatric patients); Q8. Blood component wastage (including plasma that is thawed and not used before expiry). Two patient lists were generated: the first is all MHP activations within the study period, and the second is all patients who received 10 RBC units or more in 24 hrs. These lists will be cross-referenced to generate two patient groups: the “MHP Activation Group”, and the “Massive Hemorrhage, no MHP” group. The Student t-test will be used to compare quality indicator compliance rates between the two groups.

Results:

The two patient lists were generated, including 184 MHP activations, and 92 patients who received 10 units or more in 24 hours. To date, data assessing Q1-Q8 indicators have been collected on 28 patients with the following compliance rates: Q1=54%, Q2=57%, Q3=0%, Q4=36%, Q5=36%, Q6=57%, Q7=96%, Q7=95%. Quality metrics are not always collected at the time of an MHP, and the data collection failure rates ranged from 0% for Q8 to 57% for Q4.

Conclusion:

The results of this audit will help identify areas for improvement in the delivery of future MHPs.

PGME ABSTRACTS

An Assessment of Margin Positivity in Lumpectomy Specimens Comparing Conventional Wire-Localization to Magnetic Seed Localization

Daniel J Markewich[1], Ray Deobald[2], Melissa Wood[2], Henrike Rees[1], Manv Pandher[1]
[1]Department of Pathology and Laboratory Medicine, College of Medicine, University of Saskatchewan

[2]Department of Surgery, College of Medicine, University of Saskatchewan

Background: Recently, the breast surgeons in Saskatoon implemented magnetic seed localization as an alternative to conventional wire-localized lumpectomies. Some surgeons had anecdotally noticed increased rates of margin positivity with the new technology. The breast pathology group undertook a quality improvement project to compare margin positivity rates between the new and old methodology.

Methods: This was a retrospective review of all lumpectomy specimens in Saskatoon from July 1, 2023, to April 30, 2025. Specimens were categorized as either wire-localized (WL), magnetic-seed localized (MSL), or non-localized excisions (NLE). The inclusion criteria included patients aged 18 or older with malignant or in situ neoplastic disease. Data collected included patient demographics, specimen characteristics, margin positivity, and re-excision status. Clinically significant cut-off points for offering re-excision were used for classification.

Results: There were 658 cases identified for evaluation, with 318 WL, 288 MSL, and 52 NLE. The average specimen weight and volume were 76.2 g and 176.0 cm^3, respectively, and there was no significant difference between the three groups. Of these cases, 518 cases (244 WL, 224 MSL, and 50 NLE) involved invasive breast carcinoma without neoadjuvant treatment. This group's overall margin positivity rate was 10.0% (52 cases) for invasive carcinoma on ink and 2.9% (15 cases) for DCIS on ink. There was no statistically significant difference in terms of margin status between the WL and MSL groups for positive invasive breast carcinoma cases (p=0.985) and positive DCIS cases (p=0.535). Additionally, there was no significant difference in terms of margin positivity between surgeons (p=0.388) when comparing WL and MSL cases.

Conclusions: These results suggest that there is no significant difference between WL and MSL cases in terms of margin positivity. This suggests that surgeons can feel comfortable choosing whichever option works best for them and the patient.

Comparative Analysis of Optical Genome Mapping and Targeted Next-Generation Sequencing in Matched Bone Marrow and Peripheral Blood Samples for Acute Myeloid Leukemia

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Background: Bone marrow (BM) sampling remains the gold standard for AML genomic characterization; however, peripheral blood (PB) offers a minimally invasive alternative. This study evaluates the concordance of Optical Genome Mapping (OGM) and targeted Next- Generation Sequencing (NGS) between matched BM and PB samples.

Methods: Thirty-seven AML patients with matched BM/PB samples underwent OGM and NGS (Oncomine Myeloid panel). Patients were stratified by PB absolute blast count: < 2×10^9/L (n=12), 2–15×10^9/L (n=12), and >15×10^9/L (n=12). Concordance was classified as complete (all BM variants detected in PB) or partial (majority of variants detected, with low-level subclones or specific mutations restricted to BM). Lastly, the impact on ELN 2022 risk classification was assessed.

Results: OGM demonstrated high concordance across all groups. In the < 2×10^9/L cohort, 83.3% were concordant and 16.7% partially concordant. The 2–15×10^9/L group showed 75.0% concordance and 25.0% partial concordance. Cases with PB blasts >15×10^9/L achieved 100% concordance. No OGM cases were discordant, and ELN 2022 risk classification remained unchanged using PB findings. NGS concordance was 66.7% in the < 2×10^9/L group and 75.0% in the 2–15×10^9/L group. Partial concordance reflected alterations detected only in BM, including *KMT2A* rearrangements, *CEBPA*, *FLT3-ITD*, *WT1*, and *NPM1*. Notably, *KMT2A* rearrangements missed by PB RNA-based fusion assays were captured by PB OGM, highlighting the utility of DNA-based structural variant detection. Complete concordance for both platforms was reached at PB blasts >15×10^9/L. ELN risk classification was stable in most cases, with only one escalation and one de-escalation noted.

Conclusions: PB shows high genomic concordance with BM for both OGM and NGS, and these were captured with fidelity even at low blast counts (< 2×10^9/L) without compromising risk stratification. These findings suggest PB-based testing can facilitate rapid, accessible diagnostic assessment, particularly for patients in geographically remote regions without onsite hemato-oncology services.

Assessing Digital Readiness in AI-Enabled Diagnostic Medicine: A Human Factors Framework

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Background: Digital diagnostic workflows have become commonplace in laboratories around the globe. However, the rapid growth of artificial intelligence (AI)-enabled tools for diagnostic support raises questions about how to assess an institution's readiness to adopt these technologies. Current readiness frameworks primarily focus on infrastructure and technological capacity without sufficient attention to the human factors that influence diagnostic workflows. Without a human factors framework, the implementation of AI-enabled diagnostic workflows risks fragmentation and inconsistent adoption, leading to health disparities that undermine quality care and patient safety.

Method: A review of existing digital readiness frameworks and digital health capability models was conducted to identify domains currently used to assess institutional readiness. These constructs were examined using a human factors perspective to determine their relevance to digital diagnostic workflows.

Results: Existing readiness tools predominantly assess institutional readiness through domains related to information technology infrastructure, workforce training, leadership and governance, and organizational strategy. Our analysis identified five domains of digital readiness relevant to diagnostic medicine: cognitive, ergonomic, workflow, organizational, and educational readiness. Comparison with existing frameworks suggests that ergonomic conditions and diagnostic workflow integration are underrepresented domains. These domains capture key aspects of the human-AI interface in diagnostic medicine, including the integration of digital systems across pre-analytic, analytic, and post-analytic diagnostic workflows.

Conclusion: Expanding digital readiness frameworks to incorporate human factors considerations, particularly ergonomic design and workflow integration, may provide a more balanced approach to evaluating institutional readiness for AI-enabled diagnostic systems. Future work will involve developing a readiness matrix based on these five domains and applying it to existing diagnostic workflows to support the safe adoption of AI-enabled diagnostic technologies. This framework provides a foundation for the development of structured readiness assessment tools and future validation studies linking digital readiness to diagnostic workflow performance, quality care, and patient safety.

Computational Pathology of Kidney Transplant Biopsies: Machine Learning-Based Risk Models Using PIRCHE-B and PIRCHE-T2

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Background: Conventional antigen-level HLA matching incompletely predicts kidney allograft rejection. Molecular epitope mismatch algorithms quantify B-cell- and T-cell-relevant disparities and may better reflect distinct alloimmune pathways. We evaluated whether PIRCHE-B and PIRCHE-T2 scores differentially associate with antibody-mediated rejection (AMR) and T cell-mediated rejection (TCMR) and assessed their prognostic value.

Methods: This retrospective single-center cohort included 594 kidney transplant recipients (1981-2021; follow-up to January 2024). For-cause biopsies were classified using Banff criteria 1997-2022. High-resolution HLA typing was used to calculate PIRCHE-B and PIRCHE-T2 scores. Associations with rejection phenotype and Banff lesions were analyzed using nonparametric tests. Receiver operating characteristic (ROC) analysis identified optimal thresholds, and Kaplan-Meier analysis assessed rejection-free survival.

Results: Among 375 recipients with biopsy data, 79 (21.1%) developed AMR, 104 (27.7%) TCMR, and 39 (10.4%) mixed rejection. Median PIRCHE-B and PIRCHE-T2 were significantly higher in rejection versus no-rejection (p<0.01). Elevated PIRCHE-B, particularly at HLA-B, -DR, and -DQ, is associated with AMR and microvascular inflammation (p<0.01). Higher PIRCHE-T2, especially at class I loci, is associated with TCMR, tubulitis, and arteritis (p<0.05). ROC thresholds showed modest discrimination: PIRCHE-B total ≥18, DR/DQ ≥9, PIRCHE-T2 total ≥65, and Class I ≥31. Patients above thresholds experienced earlier rejection (log-rank p<0.01). A combined model stratified low-, intermediate-, and high-risk groups with distinct rejection-free survival (p<0.001).

Conclusions: PIRCHE-B and PIRCHE-T2 capture complementary pathways of AMR and TCMR. Their integration improves prediction of rejection phenotype and timing, supporting the role of epitope-based mismatch algorithms in transplant pathology and clinical risk stratification.

Comparative Study on Androgen Receptor, STAT6 and PMS2 Immunohistochemistry in Sebaceous Neoplasms

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Distinguishing sebaceous neoplasms from histologic mimics such as basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) can be challenging. While adipophilin and androgen receptor (AR) are described in the literature, neither is sufficiently discriminatory alone. We evaluated whether STAT6 and PMS2, chosen for their distinct staining patterns in pilot observations and because they are more available than other reported sebaceous markers, could improve diagnostic accuracy. One hundred cases were selected: 75 sebaceous neoplasms (20 sebaceous carcinoma, 39 sebaceous adenoma, 11 sebaceous hyperplasia, 5 sebaceoma) and 25 controls (16 BCC, 9 SCC). Tissue microarrays were stained with AR, STAT6, and PMS2. Positive staining was defined as >10% nuclear staining for AR and >10% cytoplasmic staining for STAT6. PMS2 showed two reproducible patterns: cytoplasmic with nuclear staining and purely cytoplasmic staining, each requiring >10% of tumor cells for positivity. Two blinded dermatopathologists independently scored all cases; discrepancies were resolved with a third dermatopathologist. Sensitivity/specificity: AR (90.0%/62.0%), STAT6 (91.3%/40.0%), PMS2 nuclear+/cytoplasmic (68.7%/86.0%), PMS2 cytoplasmic only (8.0%/100%). Combining stains improved specificity: AR+STAT6 (83.3%/70.0%), AR+PMS2 nuclear+/cytoplasmic (66.0%/96.0%). Subgroup analysis showed that most false positives for AR and STAT6 arose from BCC with adnexal differentiation, whereas PMS2 nuclear+/cytoplasmic staining was rare in BCC and SCC, and PMS2 cytoplasmic only staining was absent in all controls. AR with STAT6 provided the best balance of sensitivity and specificity, while AR with PMS2 nuclear+/cytoplasmic maximized specificity. These combinations may aid in diagnosing sebaceous neoplasms in challenging cases and have potential clinical implications for identifying patients with Muir-Torre syndrome.

Reflex BAP1 Testing in Serous Effusion Cytology as a Trigger for Germline Risk Assessment in Mesothelioma

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Background: BRCA1-associated protein 1 (BAP1) is a highly specific marker for diagnosing malignant mesothelioma in serous effusions. Loss of nuclear BAP1 expression reflects underlying BAP1 inactivation. While most BAP1 mutations are somatic and follow the two-hit hypothesis, a minority occur in autosomal dominant BAP1-related tumour predisposition syndrome (BAP1-TPDS). Routine inclusion of BAP1 immunohistochemistry (IHC) in mesothelioma work-up serves not only as a diagnostic discriminator, but also as a potential entry point for identifying patients at risk for BAP1-TPDS.

Methods: We designed a workflow in which pleural or peritoneal effusions evaluated for suspected mesothelioma include reflex BAP1 IHC as part of the routine diagnostic work-up. For BAP1-negative cases, we defined a structured review step including: 1) clinical history focused on BAP1-core tumours, 2) age at diagnosis, and 3) multiplicity of primary malignancies. These triggers could prompt referral to hereditary cancer genetics for germline BAP1 testing.

Results: Reflex BAP1 testing at the cytology level required no additional procedures beyond routine cell block processing, supporting feasibility and minimal incremental cost. The proposed algorithm preserved the diagnostic utility of BAP1 in distinguishing malignant from reactive mesothelial proliferations while also embedding a structured trigger for germline risk assessment. From a quality-improvement standpoint, retrospective review of a provincial mesothelioma case with a known germline BAP1 mutation showed that the cytology-based triage step would have led to a genetics referral, highlighting its potential to reduce missed BAP1-TPDS diagnoses.

Conclusion: Embedding reflex BAP1 immunohistochemistry into routine mesothelioma cytology, coupled with a standardized review step, transforms diagnostic cytology into a low-cost, biopsy-independent platform for systematic BAP1-TPDS case-finding. In a centralized provincial practice, this workflow is readily implementable and scalable. Given the autosomal dominant inheritance pattern and elevated lifetime cancer risk associated with BAP1-TPDS, integrating hereditary cancer genetics referral represents a practical workflow extension promoting patient safety within diagnostic pathology.

Assessment of Anti-Cyclic Cirtullinated Peptide Antibody assay on the BioPlex 2200 system

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Background: Anti–cyclic citrullinated peptide (ACCP) antibody is an important serological marker for diagnosing rheumatoid arthritis (RA) alongside clinical and radiological findings. ACCP levels offer higher specificity than rheumatoid factor, erythrocyte sedimentation rate, and C-reactive protein, and is correlate with RA severity. The BioPlex 2200 platform provides semi-quantitative ACCP measurement alongside other rheumatologic markers, enabling consolidated RA screening. This study assessed the analytical performance of the BioPlex 2200 ACCP assay and compared its qualitative agreement with an ELISA method.

Methods: Assay verification followed relevant CLSI guidelines for Health Canada–approved tests. Precision was evaluated using three QC levels measured in duplicate twice daily for five days. Linearity was assessed using a calibrator set, and dilution performance was examined using pooled patient samples diluted 1:4, 1:10, 1:20, 1:50, and 1:100. Accuracy was determined through comparison with a reference laboratory using the same methodology. The manufacturer's cutoff (3.0 U/mL) was verified using samples from 30 healthy individuals. Qualitative agreement with an ELISA method (QUANTA Lite, Werfen) was also examined. Total allowable error was ±30%, and analyses were performed using EP Evaluator(Data Innovations).

Results: Between-day and total imprecision were ≤5.8% and ≤8.6% across QC levels. Linearity was observed from 0.5–300 U/mL (slope 0.998; error 6.3%). With a 50-fold dilution, the clinical reportable range extended to 15,000 U/mL while maintaining linearity. Results were comparable with the reference laboratory (n=35; slope 0.998; intercept 7.72; R=1.000). All 30 healthy volunteer samples measured <3.0 U/mL. Compared with ELISA, BioPlex results agreed for negative and strongly positive samples, but showed variability for the moderate ELISA positives (40–59 U/mL) samples. Excluding this group, qualitative agreement was high (Cohen's κ=0.907).

Conclusion: Overall, the BioPlex 2200 ACCP assay met manufacturer claims for precision and linearity, demonstrated adequate clinical range, and showed strong agreement with ELISA except in moderately positive samples.

Placental Chorangiomas: A Five-Year Clinicopathological Review

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Background: Chorangiomas are benign vascular tumors of the placenta and are composed of fetal blood vessels. Incidental placental chorangiomas are found in approximately 1% of cases when the placenta is examined microscopically, whereas clinically or ultrasonographically detected lesions are much less frequent. Large chorangiomas are described as a tumor size of >4 cm and are frequently associated with fetal or maternal complications. The mechanisms underlying the development of a chorangioma are poorly understood; some studies suggest an environmental cause such as higher-altitudes and/or genetic factors, could be involved in the pathogenesis of chorangioma.

Methods: In this retrospective study, all cases of histologically confirmed placental chorioangiomas were retrieved from the pathology database over a five-year period (January 1, 2021 to December 31, 2025). Histopathological findings and corresponding clinical records were reviewed for each case.

Results: A total of 32 cases of placental chorioangioma were identified during the five-year study period, corresponding to an incidence of 1.4%. The mean maternal age was 30.2 years (range: 17–40 years). Prenatal ultrasonography detected chorioangiomas or vascular placental lesions in 10 cases (31%). The largest tumor measured 7.6 cm in greatest dimension, while most lesions ranged from 0.2 cm to 5 cm.
Among the cases, 25 were singleton placentas, and 7 were twin placentas. Small-for-gestational-age placentas (≤10th percentile for gestational age) were observed in 30% of cases. Maternal and fetal morbidities associated with these pregnancies included placental abruption, uterine rupture, premature rupture of membranes, maternal and fetal vascular malperfusion, and intrauterine growth restriction (IUGR).

Conclusion: Most chorangiomas are small and incidental and are generally not associated with other conditions such as maternal or fetal vascular malperfusion. However, large chorangiomas are linked to significant maternal and fetal morbidity. A high index of clinical suspicion and regular antenatal surveillance may potentially improve maternal and fetal outcomes.

Decoding Brain Tumors with AI: Large Language Models as Copilots for Multimodal Diagnosis of CNS Malignancies Across Supratentorial, Infratentorial, and Spinal Compartments

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Background: Large language models (LLMs) are increasingly integrated into clinical education, yet their reliability across multidisciplinary neuropathology workflows remains unexplored. This study evaluated generative AI performance using sequential clinicoradiopathologic inputs to assess diagnostic accuracy, confidence calibration, and reasoning quality.

Design: Fourteen cases (supratentorial, infratentorial, and spinal) were presented to four models (ChatGPT-5.3, Gemini-3, Perplexity Pro, SuperGrok). A multidisciplinary workflow was simulated by sequentially providing: clinical presentation, MRI images, radiology reports, histology images, and pathology reports. Models generated differential diagnoses and confidence percentages at each stage. Reasoning was evaluated using a 10-domain rubric (0–2 scale) assessing clinical reasoning, prioritization, radiopathological integration, and accuracy.

Results: Across 53 model-case evaluations, the correct diagnosis appeared in 58% of differentials using clinical presentation alone, increasing to 70% with MRI images, 81% with radiology reports, and 83% after histology, reaching 100% upon histology description integration. Mean diagnostic confidence rose from 30% to 97% across stages. Notably, the largest accuracy gain followed radiology report incorporation rather than raw imaging. Anatomical stratification showed supratentorial tumors had the highest early recognition (n=20, 64.5%), while spinal tumors more frequently required histology description for correct diagnosis. Rubric analysis demonstrated strong explainability and reasoning (mean ≥1.7/2) but lower pathology integration scores (0.8–1.5/2). Model specialization emerged: Gemini led in clinical reasoning, SuperGrok in radiologic interpretation, and Perplexity in pathology integration.

Conclusions: LLMs demonstrate progressive diagnostic refinement mirroring multidisciplinary workflows. Radiologist interpretation provided the strongest diagnostic signal, while histology primarily refined rather than introduced new diagnoses. Despite strong reasoning, limitations in histologic image interpretation underscore the ongoing necessity of specialist pathology expertise. This study highlights the potential for AI as a clinical knowledge adjunct while emphasizing the need for expert oversight in complex neuropathological cases. Expansion with larger cohorts and additional tumor types is underway.

Integrating Artificial Intelligence Competencies into Existing CanMEDS Frameworks

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Background: As artificial intelligence (AI) increasingly impacts clinical decision-making, existing educational frameworks, developed before the widespread adoption of AI, may not fully address the necessary competencies for evaluating AI tools safely. Rather than creating entirely new structures, there are opportunities to enhance existing subspecialty-specific frameworks. This study examined potential opportunities for integrating AI-related competencies within current Royal College Competency-Based Medical Education (CBME) frameworks.

Methods: The most recent Royal College Competence by Design (CBD) Entrustable Professional Activities (EPA) documents from ten residency programs were reviewed. Generative AI was used as a document analysis tool to examine EPA descriptions and associated milestones and to recommend potential candidates for AI augmentation. Prompts were designed to identify competencies across a wide variety of clinical decision-making elements shared across subspecialties. Candidates were then reviewed and categorized according to CanMEDS roles and CBME stages of training.

Results: Across ten residency programs, 79 EPAs were identified as potential candidates for AI augmentation. Opportunities were most frequently observed during the Core stage of training (40 EPAs, 51%), followed by Transition to Discipline (22%), Foundations (18%), and Transition to Practice (9%). A total of 119 milestones across the CanMEDS roles were identified as potential sites for AI competency integration, with the largest proportion associated with the Medical Expert role. While several specialties demonstrated multiple opportunities to incorporate AI-related competencies, others contained comparatively fewer explicit opportunities within their current EPA structures.

Conclusion: Existing CBME frameworks contain numerous opportunities to integrate AI-related competencies within current EPAs and milestones. Variability across specialties suggests that some programs may require further development to better reflect emerging AI-enabled clinical environments. As medical education evolves alongside AI-enabled healthcare systems, expanding how AI-augmented EPAs and milestones are defined represents an important next step in preparing residents for safe and effective clinical practice.

Microbeam Radiation Therapy (MBRT) Bypasses Vascular Sequestration to Facilitate Lymphocyte Extravasation Across Diverse Canine CNS Malignancies

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Background: Microbeam radiation therapy (MBRT) is a spatially fractionated radiation modality that has a wider therapeutic window than stereotactic radiotherapy (SRT). Current literature suggests that radiation-induced immunomodulation may contribute to treatment efficacy. The spatial dynamics of lymphocyte trafficking within the CNS tumour microenvironment after MBRT are yet to be discerned.

Methods: Seven pet dogs with spontaneously occurring CNS malignancies were enrolled in this study (MBRT, n = 3; SRT, n = 4). Whole-mount brain sections were stained for CD3 (T cells) and CD20 (B cells), digitized, and analyzed using a machine learning digital pathology computational tool. Lymphocyte densities were quantified across key anatomical compartments: tumor, non-tumor parenchyma, intraparenchymal vessels, and subarachnoid space (SAS). Tumor-to-non-tumor (T:NT) and parenchyma-to-vessel (P:V) ratios were calculated to assess immune infiltration and extravasation efficiency.

Results: Compared to SRT, the MBRT cohort had a substantially higher tumor-infiltrating lymphocyte (TIL) density with mean CD3 densities of (22.7 ± 12.6 cells/mm^2 *vs.* 4.8 ± 1.5 cells/mm^2) and mean CD20 densities of (49.4 ± 47.9 cells/mm^2 *vs.* 1.6 ± 1.9 cells/mm^2). The MBRT cohort also showed the highest P:V ratios, indicating efficient lymphocyte extravasation into the brain parenchyma. Contrastingly, the SRT cohort showed limited TIL with consistently high SAS and intraparenchymal vascular lymphocyte sequestration. At 48-hour post-MBRT, there was strong TIL, whereas SRT showed marked SAS lymphocyte sequestration. Notably, one long-standing SRT case of third ventricular choroid plexus carcinoma demonstrated a TIL rich microenvironment, suggesting that tumor location and CSF interface biology may influence immune trafficking.

Conclusions: This study shows that MBRT promoted efficient and sustained redistribution of lymphocytes from vascular reservoirs to tumor parenchyma, whereas SRT frequently results in lymphocyte sequestration at the SAS and intraparenchymal vascular compartments. The data support a MBRT model facilitates localized lymphocyte entry into the tumor microenvironment, underscoring a potential immunomodulatory mechanism for its superior therapeutic efficacy.

Atypical CD99 Expression in Stage II Clear Cell Sarcoma of the Kidney: A Diagnostic Pitfall

Mark Mokhtar, Sridevi Koduru, Alysa Poulin, Kathleen Felton

Abstract

Clear cell sarcoma of the kidney (CCSK) is a rare pediatric renal malignancy, typically occurring in children under five years of age. While its histologic appearance is notoriously variable, its immunohistochemical (IHC) profile is often non-specific. We report a case of Stage II CCSK in a 2-year-old male that demonstrated unusually strong, diffuse membranous CD99 expression. This finding initially raised diagnostic confusion with other small round blue cell tumors, particularly Ewing sarcoma. This case highlights the necessity of broad IHC panels and molecular evaluation to ensure accurate classification of pediatric renal neoplasms.

Introduction

Clear cell sarcoma of the kidney (CCSK) represents approximately 3% of all pediatric renal neoplasms. Historically known for its high propensity for bone metastasis, it remains a challenging diagnosis due to its morphological diversity and lack of specific IHC markers. Standard features include a myxoid background and a delicate, arborizing "chicken-wire" vascular network. CD99 expression is typically absent in CCSK; its presence often suggests alternative diagnoses such as Ewing sarcoma or primitive neuroectodermal tumors (PNET). This report discusses a case where intense CD99 positivity served as a significant diagnostic pitfall

Case Presentation

A 2-year-old male presented with a large left-sided renal mass, initially suspected to be a Wilms tumor. Clinical symptoms included abdominal protuberance, recurrent fevers (38.5°C), irritability, and decreased energy. Following the European (SIOP) protocol, the patient received neoadjuvant chemotherapy. Despite therapy, the mass showed minimal size reduction, and a radical left nephrectomy was performed. Microscopic examination demonstrated sheets of round-to-spindle cells with regular nuclei and minimal-to-clear cytoplasm. The tumor cells showed unexpectedly strong and diffuse membranous positivity for CD99. Other positive markers included Cyclin D1and Vimentin, while INI-1 expression was retained. Molecular studies confirmed the absence of EWSR1 rearrangement, ruling out Ewing sarcoma. The diagnostic workup for pediatric small round blue cell tumors requires a rigorous differential diagnosis. In this case, the unusual intensity of CD99 expression initially favored a neuroectodermal origin. However, the retention of INI-1 excluded rhabdoid tumor, and the lack of EWSR1 rearrangement and NKX2.2 expression effectively ruled out Ewing sarcoma. Support for CCSK was provided by Cyclin D1 and BCOR positivity, along with compatible morphology. Stage II CCSK carries an intermediate prognosis and necessitates multimodal therapy to prevent recurrence.

Student Abstracts

From Ethical Obligations to Clinical Standards: A National Framework for Medical Error Disclosure in Canada

Anjali Saxena[1] and Jay Kalra[1]

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Background: Medical errors remain a leading contributor to preventable harm in healthcare systems worldwide. Transparent disclosure of adverse events to patients and their families is widely recognized as an ethical obligation and a cornerstone of patient-centred care. We have previously described Canadian provincial regulatory initiatives promoting open disclosure and advocated for their integration into a no-fault framework. However, disclosure policies across Canada remain fragmented, inconsistently implemented, and insufficiently supported by organizational infrastructure to guide healthcare professionals. The objective of this study is to conduct a systematic comparative analysis of medical error disclosure policies across Canadian provincial and territorial healthcare authorities and to propose a best-practice model.

Methods: A structured comparative policy review was conducted examining medical error disclosure policies across Canadian provincial and territorial healthcare authorities. Policies were evaluated using five key indicators essential to effective disclosure: timeliness and accuracy of communication, presence of a supportive non-punitive culture, availability of formal education and training, team-based involvement in disclosure, and organizational infrastructure supporting implementation and accountability.

Results: While most jurisdictions endorse transparent disclosure in principle, substantial variability exists in operational guidance and implementation. Timely communication and team-based disclosure are commonly recognized; however, formal training in disclosure communication represents the most consistent national gap. Organizational infrastructure supporting disclosure, including defined procedures, accountability mechanisms, and psychological support for providers, also varies significantly. These inconsistencies contribute to provider uncertainty, fear of medicolegal consequences, and inconsistent patient experiences following adverse events.

Conclusion: Medical error disclosure is a complex, system-level process that requires alignment between ethical principles, communication practices, and institutional culture. Establishing a unified national framework grounded in non-punitive culture, structured education, and coordinated team-based disclosure could reduce variability, support clinicians, and strengthen transparency and trust in healthcare. We suggest the development of a patient-centered, non-punitive disclosure policy embedded within the standard of care.

Staff Abstracts

Mysteries Solved: Interesting Cases in Genetics

Heather Cole, Zafar Nawaz, Brenda Murphy

Department of Pathology and Lab Medicine, Genomics, University of Saskatchewan and Saskatchewan Health Authority, Saskatoon, Canada

Genetic testing includes many platforms, and straightforward results may, in fact, be more complicated. Coordination of platforms and interdisciplinary consultation helps to solve these complicated cases.

Presentation Evaluation Form

Presenter Name: _____

Title of Presentation: _____

Presenter Category:

☐ Resident → Year: ☐ PGY1 ☐ PGY2 ☐ PGY3 ☐ PGY4 ☐ PGY5

☐ Medical Student

☐ Graduate Student → ☐ Master's ☐ PhD

☐ Faculty

☐ Other: _____

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1. Presentation Evaluation

Criteria	Excellent (5)	Very Good (4)	Good (3)	Fair (2)	Poor (1)
Clarity and organization	☐	☐	☐	☐	☐
Delivery and communication skills	☐	☐	☐	☐	☐
Knowledge of the subject	☐	☐	☐	☐	☐
Quality of slides/visuals	☐	☐	☐	☐	☐
Ability to answer questions	☐	☐	☐	☐	☐
Abstract Evaluation	☐	☐	☐	☐	☐

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2. Conflict of Interest

Are you aware of any conflict of interest related to this presentation?

☐ No

☐ Yes → Please specify: _____

3. Final Score

Total Score (out of 35): _____ / 35

7. Comments

Criteria	5 – Excellent	4 – Very Good	3 – Good	2 – Fair	1 – Poor
Clarity & Organization	Exceptionally well-organized; logical flow; clear objectives; very easy to follow	Well-organized with minor gaps; clear overall	Generally organized but some unclear parts	Poor organization; difficult to follow	Disorganized; lacks structure
Delivery & Communication	Confident, engaging, clear articulation; excellent pacing	Clear delivery; minor pacing/engagement issues	Understandable but limited engagement	Difficult to follow; low engagement	Poor delivery; unclear or not understandable
Knowledge of Subject	Deep understanding; insightful, advanced explanations	Strong understanding; answers most questions well	Adequate understanding; covers main points	Limited understanding; superficial	Poor understanding; significant inaccuracies
Slides / Visual Quality	Professional, clear, visually appealing; enhances understanding	Good design; mostly clear; minor issues	Acceptable; somewhat cluttered or basic	Poor design; distracting; hard to read	Very poor visuals: they interfere with understanding
Q&A Ability	Confident, accurate answers; demonstrates critical thinking	Answers most questions well; minor gaps	Adequate but limited depth	Struggles to answer; unclear responses	Unable to answer appropriately
Abstract Evaluation	Clear, well-structured, scientifically rigorous; strong rationale, methods, conclusions	Well-written; minor gaps in clarity or detail	Adequate; lacks depth in some areas	Weak structure; unclear or incomplete	Poorly written; lacks clarity and merit

Scoring Guidance

- **Total Score (out of 30)**
- **26–30:** Outstanding
- **21–25:** Strong
- **16–20:** Acceptable
- **≤15:** Needs Improvement

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1. Overall Event Evaluation

1. How would you rate the overall quality of the Research Day?
   ☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor
2. How well did the event meet your expectations?
   ☐ Exceeded ☐ Met ☐ Partially Met ☐ Did Not Meet
3. How relevant was the content to your professional development or research interests?
   ☐ Highly Relevant ☐ Relevant ☐ Somewhat Relevant ☐ Not Relevant

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2. Achievement of Learning Objectives

To what extent did this activity enable you to achieve the following objectives?

Learning Objective	Fully Achieved	Mostly Achieved	Partially Achieved	Not Achieved
Critically appraise research methodologies, study design, and data interpretation	☐	☐	☐	☐
Identify emerging research trends in pathology and laboratory medicine	☐	☐	☐	☐
Integrate relevant research findings into clinical or laboratory practice	☐	☐	☐	☐
Collaborate through interdisciplinary discussion and knowledge exchange	☐	☐	☐	☐
Evaluate scientific presentations using structured criteria	☐	☐	☐	☐

3. Session-Level Learning Evaluation

4. Which sessions did you attend? _____

5. For the sessions attended, to what extent were you able to:

Session-Specific Objective	Fully Achieved	Mostly Achieved	Partially Achieved	Not Achieved
Analyze study design, methodology, and statistical approaches	☐	☐	☐	☐
Provide constructive, evidence-based feedback	☐	☐	☐	☐
Discuss emerging trends and innovations in the field	☐	☐	☐	☐

(Optional for presenters)

Presenter Objective	Fully Achieved	Mostly Achieved	Partially Achieved	Not Achieved
Apply principles of scientific communication in presenting research	☐	☐	☐	☐
Defend research conclusions using scientific reasoning	☐	☐	☐	☐

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4. Interactivity and Engagement

- Did the sessions include sufficient opportunities for interaction (e.g., Q&A, discussion, feedback)?
  ☐ Yes, significantly ☐ Yes, adequately ☐ Limited ☐ None
- How would you rate the level of audience engagement?
  ☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor

5. Commitment to Change (Required for CPD)

- As a result of attending this activity, do you intend to change any aspect of your practice, teaching, or research?
  ☐ Yes ☐ No

If yes, please describe one specific change you plan to implement:

What barriers might prevent you from implementing this change?

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6. Practice Impact (Optional but Recommended)

- Do you anticipate this activity will have an impact on your:
  - Clinical practice: ☐ Yes ☐ No ☐ Not applicable
  - Laboratory practice: ☐ Yes ☐ No ☐ Not applicable
  - Research activities: ☐ Yes ☐ No ☐ Not applicable

Please briefly explain:

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7. Event Organization

Aspect	Excellent	Very Good	Good	Fair	Poor
Communication and registration	☐	☐	☐	☐	☐
Program schedule and timing	☐	☐	☐	☐	☐
Abstract booklet/materials	☐	☐	☐	☐	☐
Venue / virtual platform	☐	☐	☐	☐	☐

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8. Open Feedback

- What did you find most valuable about this Research Day?

- How could the event be improved?

- Additional comments:
