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SPECIAL REPORT

Insights and Opportunities into the State of Precision Oncology in Atlantic Canada Report

Nova Scotia Health

ABSTRACT

This report, prepared by Nova Scotia Health's Implementation Science Team in partnership with the Atlantic Precision Medicine Initiative, examines the landscape of precision oncology across Atlantic Canada, focusing on foundational aspects that underpin this approach to cancer care. It highlights significant advancements in personalized cancer care, but also highlights regional disparities in testing infrastructure, governance, funding, and workforce capacity, among others. Drawing on findings from national and international literature and local key informant survey and interviews, the report outlines key insights and opportunities for improvement such as potential of unified governance, sustainable funding, and enhanced education and training for clinicians and patients.

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Abbreviations Table

Acronym	Definition
ACRI	Atlantic Cancer Research Institute
APMI	Atlantic Precision Medicine Initiative
AWMGS	All Wales Medical Genomics Service
BHCRI	Beatrice Hunter Cancer Research Institute
CLIA	Clinical Laboratory Improvement Amendments Act of 1988
EMRs	Electronic Medical Records
IWK	Izaak Walton Killam Hospital for Children
MGB	McCain GU BioBank
MHCCN	Marathon of Hope Cancer Centres Network
MTBP	Molecular Tumor Board Pipeline
MTBs	Molecular Tumor Boards
NB	New Brunswick
NGS	Next Generation Sequencing
NL	Newfoundland and Labrador
NS	Nova Scotia
NSH	Nova Scotia Health
PEI	Prince Edward Island
TFF	Terry Fox Foundation
UK	United Kingdom

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About Nova Scotia Health

Nova Scotia Health is the largest provider of health services in Nova Scotia. The over 24,000 person workforce provides healthcare and support services in hospitals, health centres, and community-based programs across the province.

About the Nova Scotia Health Innovation Hub

As the front door for innovation, the Nova Scotia Health Innovation Hub works closely with patients, clinicians, academic partners, government, and industry to test and scale new approaches that improve care and health outcomes for Nova Scotians. The Health Innovation Hub was pleased to partner with pharmaceutical companies on the development of this report, reflecting a shared commitment to advancing health innovation in Nova Scotia.

About the Nova Scotia Health Implementation Science Team

The Nova Scotia Health Implementation Science Team works closely with health system leaders, researchers, and clinical teams to evaluate and support the implementation of priority initiatives across the province. By generating practical insights and enabling rapid-cycle evaluation, this team helps strengthen health system planning and improve care for Nova Scotians. The Implementation Science team led the methodology and writing of this report, including the design and completion of the rapid evidence review, the design and analysis of the survey and interviews, and integration of data from those sources into the writing of the report.

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Structure of the Report

The report begins with an Executive Summary designed to provide decision-makers with a snapshot of the key findings and recommendations. This section highlights the challenges facing precision oncology in Atlantic Canada, including regional disparities, funding shortfalls, and governance complexities. It also outlines opportunities for advancement, offering a high-level roadmap for improvement.

The introduction lays the groundwork for understanding precision oncology, emphasizing its transformative potential in cancer care. It defines the core concept and its relevance to personalized medicine, specifically within the context of Atlantic Canada. The section introduces the Atlantic Precision Medicine Initiative and explains why this region was selected as the focus, highlighting its unique combination of challenges (such as smaller populations and geographic dispersion) and opportunities (like collaborative provincial initiatives).

The Methods section outlines the data collection and analyses processes. This section is critical in establishing the credibility of the findings. It outlines three key approaches:

- **Literature Review:** A rapid evidence synthesis explored existing research and best practices in precision oncology across Atlantic Canada.
- **Survey:** A targeted survey of key informants across Atlantic Canada's precision oncology community focused on capturing the perspectives related to gaps and strengths in the current system.
- **Interviews:** In-depth interviews with key informants from Atlantic Canada's precision oncology community provided insights into systemic barriers, enabling an in-depth understanding of the challenges and potential solutions.

The Organizing Framework introduces the five domains used to structure the report: Awareness, Testing, Treatment, Funding, and Governance. Each domain is briefly defined, emphasizing its role in evaluating the state of precision oncology. This framework ensures consistency across the report, linking findings and recommendations back to these core

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areas. It also provides a clear roadmap for readers, making it easier to navigate the document.

The Key Findings section serves as the report's centerpiece, presenting a comprehensive analysis of the state of precision oncology across Atlantic Canada. This section is divided into several subsections:

Regional Overview:

- Provides an assessment of cross-provincial efforts, such as the Atlantic Cancer Consortium, and highlights collaborative opportunities.
- Identifies disparities in precision oncology access and infrastructure among provinces.

Provincial-Specific Analyses:

- Provides an assessment of provincial specific efforts.
- Identifies disparities in precision oncology access and infrastructure within provinces.

The Opportunities and Insights section synthesizes the findings into actionable strategies aimed at advancing precision oncology in Atlantic Canada. Key proposals include:

- Establishing unified governance structures to enhance collaboration and oversight.
- Developing sustainable funding models to address resource gaps.
- Investing in workforce development to build expertise in precision medicine.
- Expanding testing and treatment infrastructure to improve access and equity.

This section provides a clear and practical roadmap for decision-makers to address the identified challenges.

Executive Summary

This report, prepared by Nova Scotia Health's Implementation Science Team in partnership with the Atlantic Precision Medicine Initiative, examines the landscape of precision oncology across Atlantic Canada, focusing on foundational aspects that underpin this approach to cancer care. It highlights significant advancements in personalized cancer care, but also highlights regional disparities in testing infrastructure, governance, funding, and workforce capacity, among others. Drawing on findings from national and international literature and local key informant survey and interviews, the report outlines key insights and opportunities for improvement such as potential of unified governance, sustainable funding, and enhanced education and training for clinicians and patients.

What is Precision Oncology?

Precision oncology is a personalized approach to cancer treatment that tailors therapies based on the genetic, molecular, and environmental profiles of individual patients(1). By using advanced diagnostics such as next-generation sequencing and biomarker analysis, precision oncology enables clinicians to select the most effective treatments, improving patient outcomes while minimizing unnecessary side effects. This approach represents a shift from traditional one-size-fits-all cancer treatments toward highly targeted interventions that consider the unique characteristics of each tumor.

Impact of the Current State of Precision Oncology

While precision oncology has the potential to revolutionize cancer care, **its implementation in Atlantic Canada is hindered by infrastructure gaps, workforce shortages, fragmented governance, and funding constraints**. Many provinces rely on external labs for molecular diagnostics, causing delays in treatment. Inconsistent clinician awareness, disparities in access, and temporary funding models further limit the widespread adoption of precision oncology. These challenges create inequities, where access to cutting-edge treatments depends on geographic location and available resources, delaying potentially lifesaving therapies.

Key Takeaways from the Report

This report **synthesizes insights from leading oncologists, pathologists, geneticists, and healthcare administrators** across Atlantic Canada to assess the current landscape of precision oncology and identify opportunities for transformation. The findings underscore both **progressive initiatives** and **structural barriers** impeding the widespread adoption of precision oncology. The perspectives captured in this report reflect the **real-world challenges faced by healthcare professionals**, as well as their collective vision for a more equitable and effective cancer care system. For example, a pathologist highlighted a critical issue:

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"We have some of the most innovative genetic research happening here, but when it comes to clinical application, we are struggling to provide even the most basic biomarker testing in-house. This creates unacceptable delays in patient care."

Such challenges, coupled with fragmented governance and inconsistent funding models, mean that *access to cutting-edge treatments depends heavily on geographic location and available resources*. These disparities are not just theoretical concerns; they *directly impact patients waiting for life-saving therapies*.

Key Informant Perspective on the Current State of Precision Oncology in Atlantic Canada

While Atlantic Canada boasts strong research collaborations, clinical implementation remains fragmented. Healthcare professionals across the region agree that precision oncology is a priority, but *systemic obstacles slow adoption of precision oncology*.

Infrastructure Gaps: Delays in Diagnostic Testing, Reliance on External Labs

Across Atlantic Canada, the lack of in-house molecular diagnostic facilities forces provinces to rely on external laboratories in Nova Scotia, Québec, or even the United States, creating significant delays in patient care.

"We wait weeks—sometimes over a month—for test results to come back from external labs. That's an eternity for a patient waiting to start targeted therapy. ***We need solutions now."*** *Oncologist*

"We basically are forced to send many of these things (test samples) out." – Pathologist

Testing delays result in postponed treatment decisions, particularly for patients needing biomarker-driven therapies. This reliance on external labs not only extends turnaround times but also *increases costs and administrative burdens*.

Fragmented Governance: Siloed Decision-Making

The absence of a coordinated, regional precision oncology strategy leads to inconsistencies in how precision medicine is implemented across provinces. There are no standardized protocols for biomarker testing, funding allocation, or treatment pathways.

"We lack provincial guidelines for reflex testing, leading to variability depending on the cancer type." – Pathology leader

"Each province is making independent decisions, so there's no consistency across the region." – Oncology administrator

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Without a unified governance structure, policies and protocols remain fragmented, making it difficult to implement large-scale initiatives effectively.

Funding Constraints: Short-Term and Unreliable Support

Precision oncology programs rely heavily on short-term grants, pharmaceutical partnerships, or provincial research funds, making sustained implementation challenging.

> *"We have funding for the drug, but we don't have funding for the test that we need to determine whether we would use the drug." – Oncologist*
>
> *"It [funding] only lasts a year, and then they cut it off." – Healthcare administrator*

Without long-term investment from provincial and federal governments, many initiatives struggle to expand beyond pilot projects, limiting their impact on patient care.

Workforce Shortages: Limited Expertise Slows Progress

A severe shortage of genetic counselors, molecular pathologists, and bioinformatics specialists across the region has created bottlenecks in precision oncology implementation.

> *"Specialized people in oncology are aware, but other disciplines need more awareness about the available tests." – Medical oncologist*
>
> *"Some oncologists are eager to adopt new genetic testing responsibilities, but others feel overwhelmed by additional training requirements and time pressures." – Specialist*

These workforce gaps delay testing, reduce the availability of genetic counseling, and limit the ability of healthcare providers to integrate precision medicine into standard practice.

Access Disparities: Geographic and Economic Barriers

Patients in rural and remote areas experience longer wait times for diagnostic testing and have fewer treatment options compared to those in urban centers.

> *"Biomarker tests for lung cancer are reflexed to Halifax or Miami, adding weeks to turnaround times due to batching and transit inefficiencies." – Precision oncology coordinator*
>
> *"Many patients don't even know these treatments exist, and by the time they are referred, options may be limited." – Oncologist*

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These access disparities highlight the need for regionally coordinated solutions to ensure that all patients, regardless of location, receive timely and equitable precision oncology care.

Provincial Highlights

Each Atlantic province demonstrates unique opportunities for advancing precision oncology. The report provides an in-depth provincial analysis based on literature and interviews:

Nova Scotia

- **Strengths**: Nova Scotia has adopted several cutting-edge technologies for AI-driven radiotherapy. Collaborative meetings between pathology, genomics, and oncology teams occur monthly to streamline care pathways.
- **Insights**: Although not Nova Scotia specific, physician awareness of available resources remains inconsistent, leading to underutilization of local diagnostic capabilities. Additionally, the province still relies on external labs for rare biomarker analyses.
- **Opportunities**:
    - Expand local diagnostic capabilities to improve testing efficiency.
    - Increase clinician education and awareness to ensure precision oncology is fully integrated into standard care.
    - Enhance collaborations between research and healthcare providers to translate discoveries into patient-centered applications.

A NS participant pointed out:

> *"We have the technology to do more testing locally, but many physicians are still sending samples elsewhere simply because they don't realize what we can do in-house."*

New Brunswick

- **Strengths**: The "mainstreaming" initiative enables oncologists to directly order genetic tests, bypassing overloaded genetics clinics and reducing wait times. Collaborations, such as Horizon Health Network's partnership with Amgen, expedite access to new therapies.
- **Insights**: Severe shortages of genetic counselors and pathologists slow progress, while inequities between health networks exacerbate access disparities.

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- **Opportunities**:
    - Expand workforce development initiatives to recruit and train genetic counselors and pathologists.
    - Centralize molecular testing across the province to improve efficiency and eliminate redundancy.
    - Increase public-private partnerships to secure funding for diagnostic and treatment innovations.

A New Brunswick-based cancer researcher explained:

> *"We have researchers developing new genetic tests, but we lack the human resources to integrate them into clinical workflows effectively."*

Newfoundland and Labrador 

- **Strengths**: The Newfoundland Genome Project and participation in the Marathon of Hope Network position the province as a leader in genetic research. These initiatives focus on understanding the unique genetic makeup of the local population to improve targeted therapies.
- **Insights**: Staffing shortages (e.g., a 30-40% deficit in pathologists) and heavy reliance on external labs delay diagnostics and treatment planning.
- **Opportunities**:
    - Develop a regional molecular diagnostics hub to reduce reliance on out-of-province testing.
    - Translate genomic research into real-time clinical applications to enhance patient care.
    - Expand training programs to address shortages in pathology and genetic counseling.

A Newfoundland and Labrador participant shared their frustration:

> *"Our research teams are doing groundbreaking work in genomics, but our healthcare system isn't equipped to implement these advances in real-time."*

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Prince Edward Island 

- **Strengths**: Efficient outsourcing of testing ensures acceptable turnaround times, and there are minimal funding constraints for approved diagnostics.
- **Insights**: Local testing infrastructure remains underdeveloped, and clinicians often lack a centralized repository for up-to-date diagnostic and therapeutic options.
- **Opportunities**:
    - Develop shared testing facilities with neighboring provinces to improve access to molecular diagnostics.
    - Create a centralized knowledge hub for clinicians to stay informed about the latest advancements in precision medicine.
    - Strengthen partnerships with research institutions to enhance capacity.

A Prince Edward Island participant observed:

> *"Our biggest challenge isn't the science—it's the infrastructure. We need a regional approach to testing."*

Strategic Considerations of the Findings for the Provinces

There is a transformative potential for Atlantic Canada to position itself as a national leader in precision oncology. Some opportunities to advance include:

- **Address infrastructure gaps** by investing in regional testing hubs and reducing reliance on external laboratories.
- **Develop sustainable funding** models to integrate precision oncology into standard healthcare practices.
- **Target recruitment and training programs** to build expertise.
- **Enhance governance** through a unified regional framework could streamline policies, ensuring equitable access to precision medicine.
- **Increase awareness and education** among both healthcare providers and patients is crucial for fully leveraging precision oncology's potential to improve cancer outcomes.
- **Collaborative Networks** through Regional hubs for molecular diagnostics and centralized data sharing could eliminate redundancies and improve efficiency.

Atlantic Canada has the tools and collaborative spirit to overcome its current limitations, but realizing this potential will require bold investments, policy reforms, and a commitment to equity across the healthcare system.

Introduction

The Atlantic Precision Medicine Initiative (APMI) seeks to transform cancer care in Atlantic Canada through precision oncology, an approach that tailor treatments to the genetic, molecular, and environmental profiles of patients. Despite notable advancements in diagnostics and personalized therapies, significant disparities in access, infrastructure, and integration persist across the region. This report, which was independently completed by Nova Scotia Health's (NSH) Implementation Science Team (IST) synthesizes findings from key informant interviews, a survey, literature reviews, and international comparisons to outline the state of precision oncology in Atlantic Canada and propose actionable opportunities for improvement.

Background

The future of health care lies in precision medicine (PM) (2). PM is the use of genetic, demographic, and environmental characteristics of people into consideration allowing doctors to provide personalized solutions to prevent, diagnose, and treat various areas, including cancer care(3). Being able to tailor therapies relies on biomarkers and objectively measured biological traits of individuals of different types (i.e. genetic, substances in the blood). Biomarkers are identified using modern diagnostic tools, often in tandem with companion tests and next generation sequencing (NGS), to identify and tailor treatments for each patient(4). PM aims to improve survival and quality of life by allowing clinicians to provide treatments that best work for the individual patient. In Atlantic Canada, provincial disparities, funding limitations, and fragmented governance hinder equitable access to PM.

There are many new pharmacological solutions that use, or are dependent on, PM technologies, that are soon going to become the standard of care globally. Although internationally, the integration of precision oncology varies widely, with countries like the United Kingdom (UK) and the European Union leading in standardized genomic services and funding structures, while nations such as Italy and the United States struggle with fragmented policies and disparities in access(5). The UK's Genomics Education Programme and centralized testing frameworks ensure equitable service delivery, while the EU prioritizes bioinformatics-driven initiatives to enhance clinical decision-making(6). Australia has successfully integrated multiomics data with AI-driven drug efficacy models, advancing treatment personalization(7). However, Italy's decentralized laboratory system and reimbursement gaps pose challenges to implementation, whereas the US faces systemic inequities in precision oncology education and test accessibility(8). Globally, precision oncology benefits from multidisciplinary tumor boards, public-private partnerships, and emerging real-world data integration. Countries aiming to expand precision oncology should leverage best practices, including streamlined governance models, value-based funding, and interoperable genomic databases to ensure broader and more equitable access to personalized cancer care. Additional information on the state of precision oncology internationally can be found in Appendix C.

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In Canada, there is a large variability in implementation and access to PM for patients, primarily due to structural policy limitations(9) and lack of clinician access to, or awareness of, health system PM capabilities(10–12). A growing number of pharmacological solutions are beginning to require a diagnostic test for appropriate diagnoses and/or disbursement, which is a limitation if testing infrastructure is not in place provincially(13). Technological advancements are rapidly evolving and have been transforming patient care in many areas including oncology, genetic disease management and chronic disease management, among others(14). These transformations, if well integrated into the health system, have the potential to predict disease risk, design custom treatments, and improve patient safety and care efficiency(15). It is imperative to leverage new testing pathways with existing genomic sequencing and bioinformatics capabilities to create a united path forward for PM in Atlantic Canada.

Currently, in Canada, there are many initiatives to bring PM to the forefront of cancer care and other areas. A recent report from Ontario evaluated the provinces PM infrastructure(16). The authors recommend that there should be a stronger focus on the social determinants of health and that there should be a PM ecosystem with a data platform that can capture, store, and analyze large volumes of data. The report suggests that the implementation of PM initiatives must be holistic in that the system must capture clinical, molecular, genetic, and lifestyle data. The sources of these data are multifactorial and therefore engaging all potential regional stakeholders in the design and implementation of a PM pathway in Atlantic Canada is important and necessary. Additionally, a ‘State of Readiness’ for genomic testing was completed in select Canadian provinces, including NS. The assessment found that each province was far from ready to provide optimal genomic testing that addresses patient needs, improves experiences and efficiency, and builds on scientific and economic growth(17).

At present, federal-provincial-territorial funding decisions regarding PM are piecemeal, with few jurisdictions having dedicated strategic direction or plans for interjurisdictional collaboration(18). While there are initiatives to improve PM access and delivery, these are still in the early stages. Provincial-territorial health systems, once working in relative isolation, are beginning to move to more collaborative and intentional approaches to structural PM upgrades.

Precision oncology in Canada is progressing but remains uneven across provinces due to disparities in awareness, testing infrastructure, funding, and governance(1,19,20). While some provinces, such as Alberta and British Columbia, have established centralized genomic testing frameworks, others lack a streamlined point of entry for PM services. Challenges include physician knowledge gaps, limited informatics integration, and inconsistent funding models that prioritize drug-based treatments over diagnostic innovations(19,21,22). Data management remains a concern, with calls for improved electronic medical records (EMRs) and biobank connectivity to enhance research and clinical decision-making. To address these gaps, recommendations include regulatory standardization, increased interdisciplinary collaboration, and sustainable funding

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mechanisms. Additionally, fostering partnerships between public and private sectors, integrating real-world data collection, and enhancing patient engagement in the precision oncology landscape can drive equitable access and efficiency in cancer care across Canada(23). Additional information on the state of precision oncology in Canada can be found in Appendix D.

There is a high volume of expertise in Atlantic Canada and with the number of collaborative initiatives in Atlantic Canada, there is an opportunity for the region to become a nationwide leader in the field of PM. To increase access, efficiency, and to improve health outcomes, it is imperative that all involved stakeholders work together to create a testing infrastructure that supports the growing needs for PM in the region. Personalized solutions and optimized therapies can only be accessible to patients with the right testing infrastructure that includes screening, diagnoses, prevention/early detection, and treatment.

The APMI is a group of stakeholders that are interested in assessing the current capabilities and gaps in diagnostic testing in the Atlantic region. Their goal is to build on the findings from the 'state of readiness'(17) and explore the various testing pathways to ensure that these are aligned to the needs of clinicians and patients to maximize access to innovative therapies by focusing on each Atlantic Province. Through a partnership with the NSH Innovation Hub and independently led by NSH's IST, this project explores the current precision oncology landscape with intentions to educate healthcare stakeholders and decision-makers on the current state of PM and can help guide system integrations that are needed to modernize patient care.

Research Objectives

The primary objective of this work is to summarize how PM is being administered and delivered in the four Atlantic provinces, with a focus on PM in oncology. Secondary outcomes of this work stem from the initial findings and will include a summary of opportunities for each health system to better their PM testing and treatment pathways: The main questions we aim to answer are:

1. What is the current state of PM care delivery in the four Atlantic provinces?
2. How does the current state of oncology-focused PM compare across Atlantic Canada's Health Systems?
3. What are the insights and opportunities currently available to improve the state of precision oncology in Atlantic Canada?
4. What evidence from global efforts to advance precision oncology hold promise for Atlantic Canada?

Methods

Organizing Framework for Precision Oncology in the Report

To best present the findings, an organizing framework was developed for this report to provide an independent and structured approach to presenting complex findings by breaking them down into interconnected domains, thereby providing clarity of the state of precision oncology in Atlantic Canada. This framework is built around five critical domains: **awareness, testing, treatment, funding/financing, and governance.** Each domain represents an essential pillar for assessing current capabilities, identifying gaps, and recommending improvements to create a cohesive and effective precision oncology ecosystem.

- **Awareness:** Awareness encompasses the knowledge and understanding of precision oncology among key stakeholders, including healthcare providers, policymakers, and the public.
- **Testing:** Testing refers to the availability, accessibility, and quality of molecular diagnostics and biomarker assessments that underpin personalized cancer care.
- **Treatment:** Treatment encompasses the application of precision oncology interventions, including targeted therapies, immunotherapies, and tailored treatment regimens informed by molecular diagnostics.
- **Funding and Financing:** This domain examines the financial mechanisms that support the integration of precision oncology, including funding for diagnostics, treatments, and supporting infrastructure.
- **Governance:** Governance encompasses the policies, structures, and oversight mechanisms that guide the implementation of precision oncology across healthcare systems.

Application of the Framework

The organizing framework serves as a structured lens for assessing the current state of precision oncology and identifying actionable opportunities for improvement. By addressing the domains, the report provides a holistic approach to understanding the state of precision oncology. These interconnected elements ensure that progress in one area is complemented by aligned advancements in others, creating a sustainable and equitable precision oncology ecosystem across Atlantic Canada.

This report applies a multi-methods approach, combining a rapid evidence synthesis, a survey of Atlantic Canadian key informants, and in-depth interviews with regional stakeholders. Together, these methods provide a comprehensive understanding of the current state of precision oncology in Atlantic Canada, as well as actionable insights for its integration into regional health systems.

Rapid Evidence Synthesis

A rapid evidence synthesis was conducted to identify insights and opportunities in the integration of precision oncology into health systems at the local, national, and international levels. Peer-reviewed journal articles, gray literature, policy documents, and organizational reports were reviewed to provide a contextual understanding of precision oncology (see Appendix A). Key sources were identified through targeted database searches (e.g., PubMed, Scopus, and Google Scholar) and included studies from comparable jurisdictions in terms of healthcare structure and resource constraints. The synthesis focused on awareness, testing, treatment, funding/financing, and governance.

Survey of Atlantic Canada Key Informants

Through collaboration among NSH, APMI and several experts, a survey was designed and distributed to a diverse group of stakeholders across Atlantic Canada, including clinicians, researchers, policymakers, and healthcare administrators. The survey aimed to capture anonymous perceptions of the current state of precision oncology in the region, barriers to its integration, and opportunities for improvement. Questions included both closed-ended items (e.g., Likert scale ratings on key issues) and open-ended prompts to elicit qualitative insights. Anonymity encouraged candid responses. Survey responses were analyzed using descriptive statistics to provide a broad overview of regional challenges and opportunities.

In-depth Interviews with Key Informants

In-depth, semi-structured interviews were conducted with key informants across Newfoundland and Labrador (NL), Nova Scotia (NS), New Brunswick (NB), and Prince Edward Island (PEI). Participants were selected using purposive sampling to ensure representation from various professional backgrounds, including oncology, pathology, genomics, healthcare administration, and policy. An interview guide was designed to explore themes such as testing infrastructure, funding models, governance, patient access, and strategic priorities for precision oncology. Interviews were audio-recorded, transcribed verbatim, and analyzed using thematic analysis to identify recurring patterns and nuanced insights(24).

Data Integration and Analysis

Findings from the rapid evidence synthesis, survey, and interviews were triangulated to ensure a comprehensive analysis. Survey results provided a macro-level understanding of stakeholder perspectives, while interviews offered in-depth context and detail. The evidence synthesis grounded regional findings in a broader context, identifying alignment with or deviations from international best practices. Themes were developed iteratively, guided by the data, and refined through regular team discussions to ensure validity and relevance.

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This multi-pronged approach ensures that the findings and recommendations of this report are robust, evidence-based, and actionable, reflecting the diverse perspectives of key stakeholders while aligning with global trends in precision oncology.

Key Findings

State of Precision Oncology in Atlantic Canada

This section uses publicly available information searched between June and Aug. 2023, to describe the current state of precision oncology across the four Atlantic provinces, examining the infrastructure, funding models, and collaborative efforts shaping diagnostic and treatment capabilities.

Atlantic Canada: Cross-Provincial Initiatives

Terry Fox Foundation

The Terry Fox Foundation (TFF) focuses on the adoption of PM through the establishment of a set of pan-Canadian centres. The TFF's goal is to facilitate "the adoption of PM for cancer through the creation of a pan-Canadian network of designated cancer centres"(25). Within the TCC, the Marathon of Hope Cancer Centres Network (MHCCN) was established to bring together researchers across Canada to advance PM for cancer treatments. Since its inception MHCCN has united leading researchers from these esteemed cancer centers to standardize their research practices and develop the protocols, procedures, and technological infrastructure required for seamless sharing, storage, and analysis of large-scale genomic data. The network is actively engaged in collaborative research endeavors across four key domains of cancer research, including genomic profiling of colorectal tumors, immunotherapy for ovarian cancer, molecular imaging for prostate cancers, and establishment of robust IT infrastructure and data governance frameworks for secure data sharing and analysis.

Withing the MHCCN, the Atlantic Canada Consortium represents a network of partners across Atlantic Canada, including institutions (i.e., University of New Brunswick, Memorial University, Dalhousie University, and the University of Prince Edward Island), health science centers (i.e., the Atlantic Cancer Research Institute [ACRI], Beatrice Hunter Cancer Research Institute [BHCRI]), and health authorities (i.e., NSH, Horizon Health Network, Vitalité Health Network, and Eastern Regional Health Authority) to build capacity and expertise for PM through the region. The network embeds research in the cancer clinic, uniting the top-tier cancer researchers and clinicians in Canada and allowing them to share their data and apply exciting new technologies such as artificial intelligence to deliver improved outcomes for each cancer patient in Canada.

The ACC's most current example of collaboration between major stakeholders aims is to improve the integration of PO into health systems. Although no evaluation of its efforts has been produced to date, it is a promising example. The main goal is to close the gap between research and care(26). Specifically, the ACC's projects focus on the collection and storage

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of patient specimens and data for colorectal and lung cancer patients. In the long-term, the project aims to expand the biobank to include various biological materials and retrospective data to facilitate collaborations in research and the conduction of clinical trials. Another project entails building capabilities through analytical methodologies to find new predictive markers along with examining the role the immune system and the gut microbiome play in patients with colorectal cancer. This project is also interested in integrating blood sample use as liquid biopsy for colorectal cancer diagnosis and monitoring to enhance access to care in rural areas. As an additional measure to enhance access to PM in rural areas, the ACC is working on next-generation sequencing-based molecular profiling for lung cancer patients. They aim to quantify and evaluate the barriers in Atlantic Canadian provinces that limit access to high-quality care. They mention that their goal is to enhance the current biomarker profiling and supporting liquid biopsy research to reduce the need for diagnostic imaging and tumor biopsies.

The ACC has multiple funding channels at different levels and jurisdictions. These include Terry Fox Research institute, MITACS Canada, Astra Zeneca, Pfizer, Hoffman-LaRoche Limited at the national level, and the BHCRI, the QEII foundation and Research Nova Scotia in NS; the New Brunswick Health Research Foundation and New Brunswick Innovation Foundation in NB; and Memorial University and the Newfoundland Department of Industry, Energy and Technology in NL at the provincial level.

Nova Scotia

Awareness

The ACC works with the BHCRI on increasing awareness among clinicians through training and educational sessions training in biobanking, bioinformatics, and fundamental science to research trainees and clinical residents in various aspects of cancer care. Their goal is to establish a curriculum for training in PM that's expandable countrywide. The collaboration is also partially supported by Dalhousie Medical school and NSH/IWK. Additional efforts to raise awareness include, the IWK Maritime Centre for Precision Medicine's work with the community, and the BMO Ride community and QEII Foundation were donors who, together, contributed $1.1 million to fully fund new, cancer-fighting genetic sequencing technology(27).

Testing and Treatment

NS has recently introduced an innovative cancer imaging and treatments designed to advance precision oncology in the province. Developed through a collaborative effort between NSH and Varian Medical Systems over the course of two decades, this technology integrates artificial intelligence to deliver faster and more precise therapy for cancer patients. The chief of medical physics with NSH emphasized the transformative potential of the technology, highlighting its ability to target specific tumors with unparalleled accuracy while minimizing damage to surrounding tissues. By leveraging advanced imaging capabilities and adaptive treatment clinicians can dynamically adjust treatment strategies in response to changes in tumor size and patient conditions. This approach may enhance

treatment precision while reducing the duration of therapy, offering patients a more efficient and effective care experience(28). While this approach has demonstrated promising results in early trials, it is currently undergoing clinical evaluation to ensure its safety and efficacy(29). There is a need for further clinical trials to validate the technology's advantages and refine treatment protocols. The first clinical trial, focusing on breast, liver, and lung cancers, will commence shortly, followed by a subsequent trial targeting head and neck cancers. These trials will provide valuable insights into the real-world impact of the Ethos machine and pave the way for its widespread adoption as a standard of care.

Funding

BHCRI is a research institute focusing on cancer research and training. With multiple funding partners, one of the areas funded is PM (through the Terry Fox Research Institute). Research NS supports, organizes, and coordinates research in NS. Their four areas of strategy include sustainable bioeconomy, climate change adaptation & resilience, Healthy people and healthcare systems, improved quality of life for Nova Scotians. Each of the areas contains 4 focuses that include reduce harm, improve systems and resources, build resilience, innovate for the future. The provided description of these focuses for each area is high-level. One of the mission statements under healthy people and healthcare systems involves advancing disease detection, diagnosis, treatment, and prevention. One interpretation of the provided statement would conclude areas covered under precision oncology. Upon screening the project titles of recipients of Scotia Scholar awards from 2020-2023, the projects did not seem to be directly involving precision oncology medicine. NS's acquisition of a next generation radiotherapy technology was made possible through a collaborative effort involving provincial funding, donations from the QEII Foundation's We Are campaign and the BMO Ride for Cancer event, as well as in-kind contributions from Varian.

New Brunswick

Insufficient information was found in the public domain on NB initiatives addressing awareness or funding. Therefore, this section focuses on testing and treatment.

Testing and Treatment

The New Brunswick Precision Medicine Centre brings together experts in fundamental and translational biomedical research, in clinical research, in genetic sequencing, in proteomic analysis and in public health. The goal of their research is to find possibilities and solutions that will transform patient care by administering the right treatments to the right patients at the right moment, as well as to provide a cutting-edge research and training environment for future healthcare professionals. The Centre for Precision Medicine is an innovative research project among the Université, the Vitalité Health Network and the ACRI. With this agreement, the partners will be able to work together and make the Centre into a beacon of healthcare research in NB.

Horizon Health Network advances cancer treatment in NB through an innovative partnership aimed at expediting access to therapies(30). This initiative establishes a new pathway for

delivering clinically validated cancer treatments to patients faster bypassing traditional processes to provide timely care and alleviate strain on hospital resources. This approach has potential to significantly enhance patient outcomes and experiences. By streamlining the treatment delivery process lengthy wait times that often hinder patients' access to innovative therapies are avoided(31). Through this partnership, Horizon Health Network will gain direct access to advanced cancer treatments, offering patients a faster route to potentially life-saving care. This approach marks a milestone in NB's healthcare landscape, underscoring the province's dedication to advancing patient-centered care and fostering a culture of research and innovation(32). With Research NB's support, this initiative promises to not only transform cancer treatment but also pave the way for future breakthroughs in healthcare delivery(33). Additionally, in partnership with the Université de Moncton, the Vitalité Health Network, and the ACRI aims to improve research on PM in NB by increasing funding for testing treatments and labs(34).

Newfoundland

Insufficient information was found in the public domain that relates to the state of awareness or funding in NL. Therefore, this section focuses on testing and treatment.

Testing and Treatment

The NL Genome Project and Center for Translational Genomics were the only initiatives found in NL. Very little information was found on the Center after its announcement in 2021. Its aim is to “become a one-stop-shop for genetic research in NL by offering clinical and research services”(35). The NL Genome Project is a local research study that aims to learn more about NL’s unique genetic makeup. In this pilot phase, the NL Genome Project will study the DNA, medical records, and health information of 10,000 volunteering, consenting participants(36). Current goals of the project include:

- Understand the genetic makeup of NL
- Develop better, safer and more targeted medicines
- Improve how we treat and prevent diseases
- Inform better healthcare choices by returning findings to participants
- Integrate PM into our local healthcare system
- Design a larger research project in NL

Prince Edward Island

Insufficient information was found in the public domain on PEI initiatives addressing awareness or funding. Therefore, this section focuses on testing and treatment.

Testing and Treatment

Within PEI there exists some programs that provides certain services for patients receiving certain medications. Little information was found that describes exactly the services delivered but there are studies that mentions specific projects that focus on patient flow processes and provide data driven solutions to improve quality of care and good health

outcomes, and claims that efforts of the partnership have the capacity to advance knowledge in PM and person-centered, evidence-based care in the province(37,38).

Key Takeaways from Atlantic Canada

- **Collaborative Frameworks and Initiatives:** Precision oncology in Atlantic Canada is anchored by robust collaborations such as the ACC, part of the MHCCN led by the TFF. Launched in 2021, the ACC unites regional academic institutions (e.g., Dalhousie University, Memorial University of Newfoundland), health research bodies (e.g., ACRI), and health authorities to bridge research and clinical applications. The consortium's mission is to improve diagnostics, predict treatment responses, and deliver personalized therapies. This initiative highlights regional efforts to integrate precision oncology into healthcare systems by advancing testing methodologies and biomarker profiling and incorporating innovative technologies such as liquid biopsies.

- **Research and Biobanking Developments:** The ACC focuses on data and specimen collection for colorectal and lung cancer, expanding the regional capacity for collaborative research and clinical trials. This approach facilitates data sharing, which is pivotal for tracking patient outcomes and fostering multi-institutional research. Additionally, ACC projects aim to utilize analytical methodologies to identify new predictive markers and explore the immune system's role in cancer, advancing both research and clinical practices.

- **Funding and Sustainability Challenges:** Precision oncology initiatives in Atlantic Canada rely on diverse funding sources, including the Terry Fox Research Institute, provincial research foundations (e.g., Research NS, NB Health Research Foundation), and private sector partnerships (e.g., Pfizer, AstraZeneca). However, funding models often involve non-recurring grants or pharmaceutical contributions, which may not sustain long-term operational needs.

Opportunities for Integration and Sustainability

- **Enhanced Governance Structures:** Establish formal governance frameworks to align multi-provincial efforts and standardize practices across institutions.
- **Comprehensive Education Programs:** Increase physician and clinician training on the capabilities and application of PM to ensure widespread, informed utilization.
- **Sustainable Funding Models:** Advocate for stable, government-backed funding that extends beyond pilot projects, ensuring the continuity of precision oncology services.
- **Infrastructure Development:** Invest in local testing capabilities to reduce dependency on external labs and streamline patient care.
- **Public and Patient Education:** Implement patient-centric outreach to improve awareness and engagement in PM options.

Summary
Atlantic Canada's precision oncology landscape reflects a commitment to advancing cancer care mostly through collaborative research. While progress has been made, addressing challenges in funding, education, and governance will be key to integrating PM fully into regional health systems and enhancing patient outcomes across the provinces.

Precision Medicine Survey in Atlantic Canada Findings and Analysis

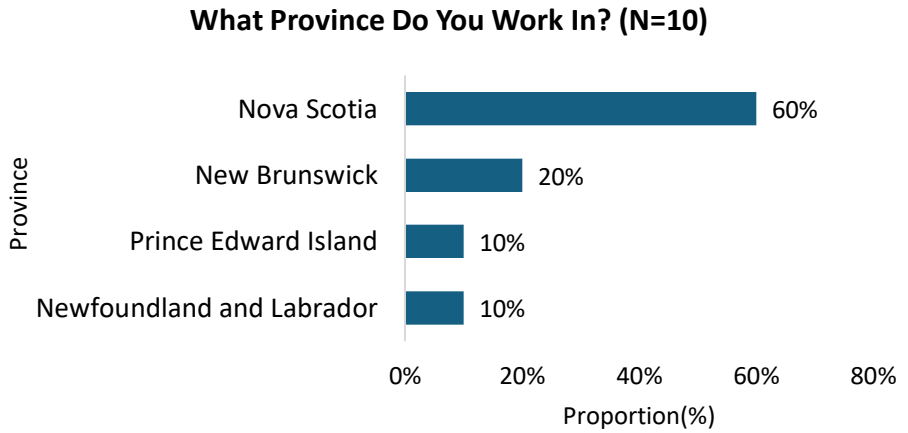
Overview

This section presents the key findings from the survey conducted in July and Aug. 2024 with 11 respondents from various stakeholders in the precision oncology landscape across Atlantic Canada. The objective was to anonymously assess their awareness, satisfaction, and experiences related to the current governance structures and processes in precision oncology.

Demographic Information

Most respondents work in NS, accounting for **60%** of the total responses (6 out of 10). NB follows with **20%** (two respondents), while both NL and PEI contribute **10%** each (one respondent each) (Figure 1).

Figure 1. Province of employment



There is a diverse range of roles within the healthcare system, with pathologists comprising the largest group at **30%** (three respondents). Medical oncologists represent **20%** (two respondents), while other roles, including medical oncologist/director of systemic therapy, staff pathologist, director/research, drug budget manager, and research/leadership, each account for **10%** (one respondent each) (Figure 2).

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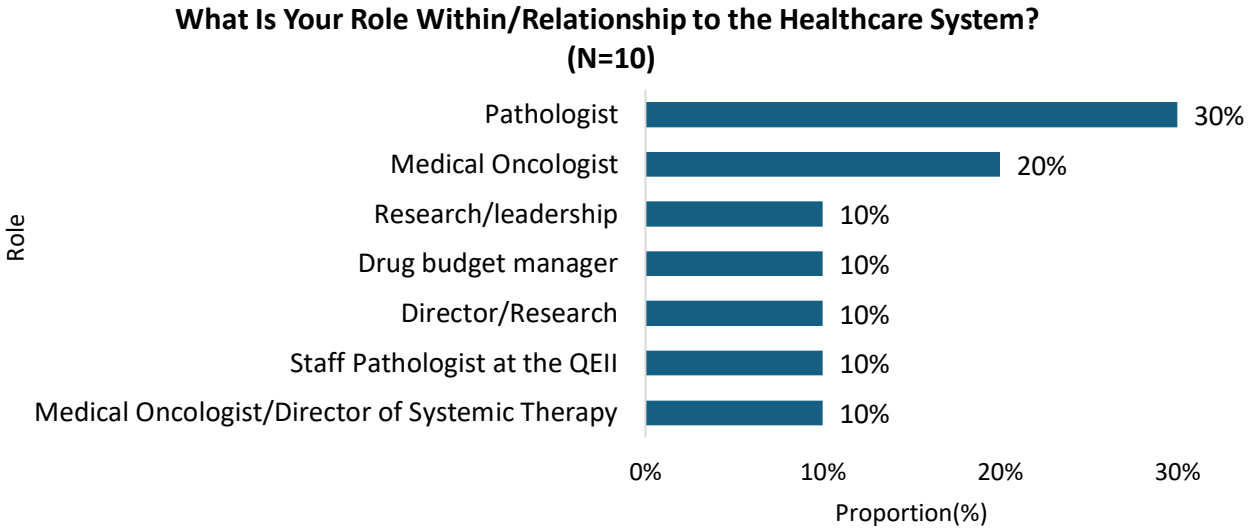
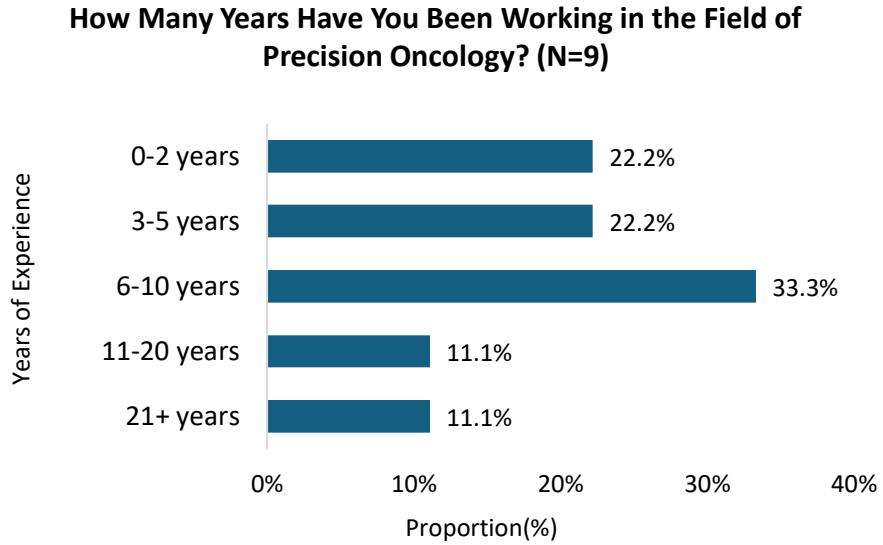
Figure 2. Role in healthcare system



A range of experience levels in precision oncology is reflected in the responses, with the largest group (33.3%, or three respondents) having worked in the field for six to 10 years. Both the 0-2 years and 3-5 years categories account for **22.2%** each (two respondents each), while those with 11-20 years and 21+ years of experience each represent **11.1%** (one respondent each) (Figure 3).

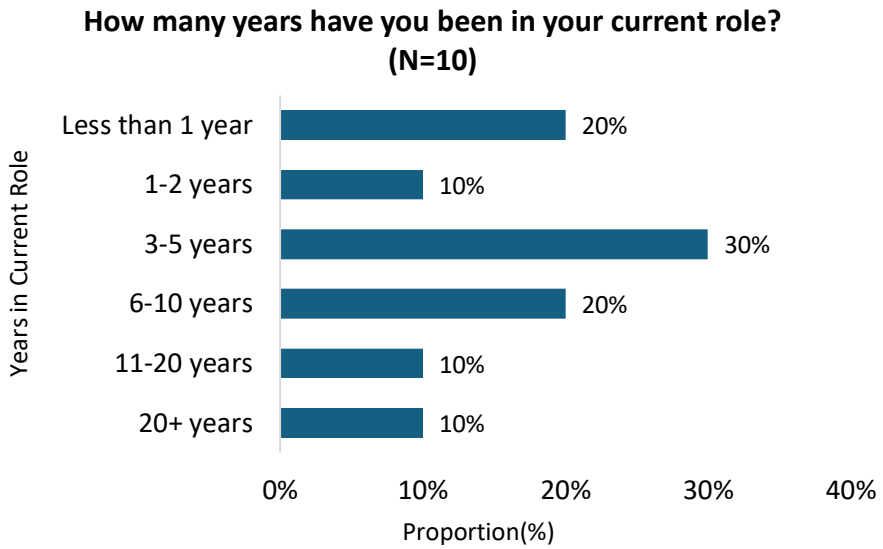
Figure 3. Years working in precision oncology



Respondents have different lengths of time in their current roles, with the highest proportion (30%, or three respondents) having been in their positions for three to five years. Those in their roles for less than one year represent **20%** (two respondents), as do those

with six to 10 years of experience. The 1-2 years, 11-20 years, and 20+ years categories each account for **10%** (one respondent each) (Figure 4).

Figure 4. Years in current role

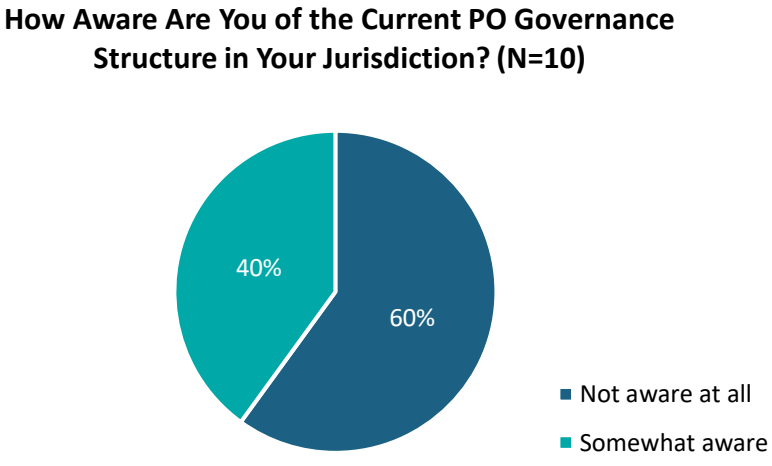


Findings

Awareness of Precision Oncology Governance

A substantial **60%** (six respondents) reported being not aware at all, while **40%** (four respondents) indicated they are somewhat aware of the current precision oncology governance structure (Figure 5).

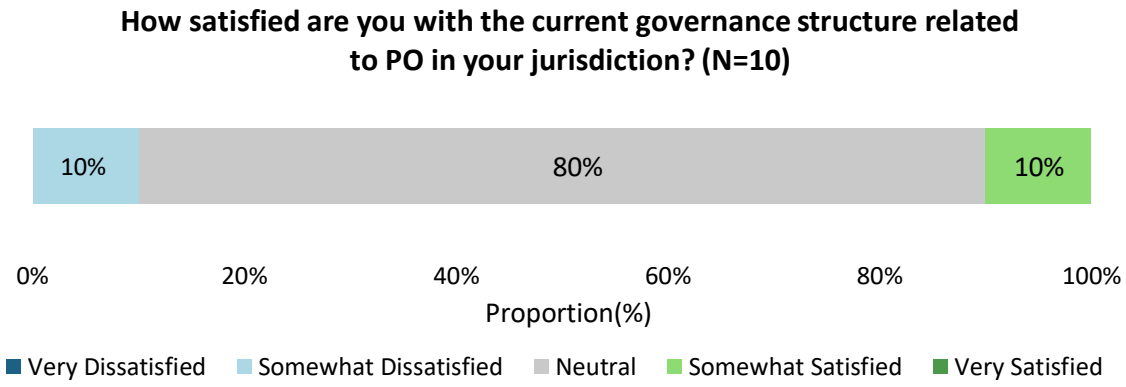
Figure 5. Awareness of current precision oncology governance structure



Satisfaction with Governance Structure

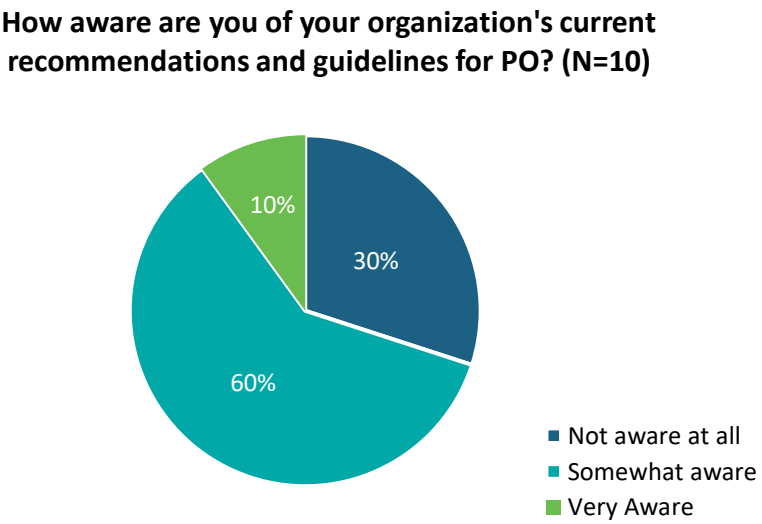
80% (eight respondents) expressed a neutral stance, while **10%** (one respondent each) reported being somewhat dissatisfied and somewhat satisfied with the current governance structure related to precision oncology. This distribution shows that many respondents feel indifferent about the governance structure, suggesting a need for more engagement and evaluation to identify the reasons for these neutral feelings and to enhance overall satisfaction (Figure 6).

Figure 6. Distribution of satisfaction with current precision oncology governance structure



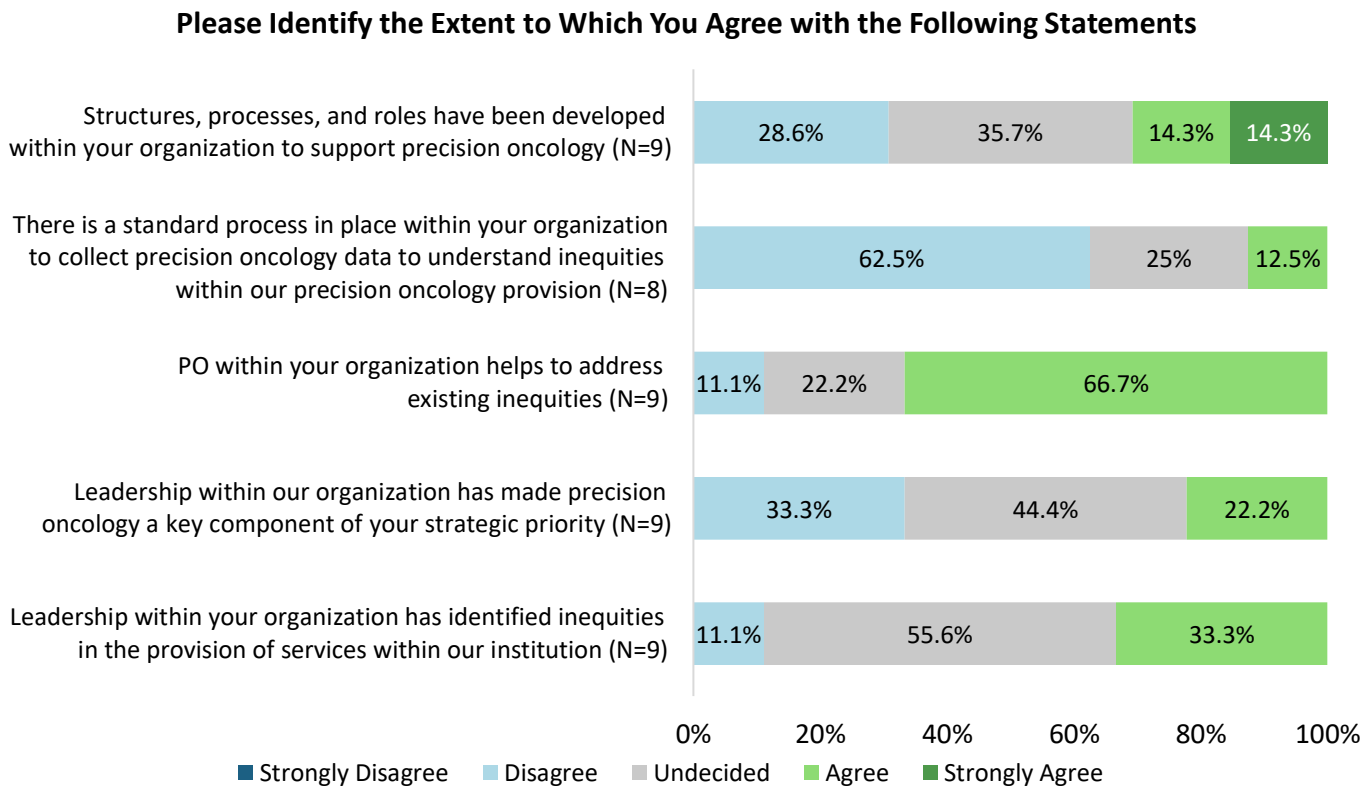
While **60%** indicated they are somewhat aware of the organization's current recommendations and guidelines for precision oncology, **30%** reported being not aware at all, and only **10%** expressed that they are very aware of these guidelines (Figure 7).

Figure 7. Awareness of current recommendations and guidelines for precision oncology



Responses indicate varying levels of agreement regarding the structures, processes, and leadership support for precision oncology within organizations. For the statement about developing structures, processes, and roles to support precision oncology, **28.6%** of respondents disagreed, while **14.3%** agreed and **14.3%** strongly agreed. The standard process for collecting precision oncology data shows a large **62.5%** disagreement, with only **12.5%** in agreement. Notably, the statement regarding precision oncology addressing existing inequities received the highest agreement at **66.7%**, while **11.1%** of respondents disagreed. When it comes to leadership's role in prioritizing precision oncology, **33.3%** agreed that it is a strategic priority, with **44.4%** undecided and **11.1%** disagreeing. In contrast, **55.6%** were undecided regarding whether leadership has identified inequities in service provision, while **33.3%** agreed. This distribution suggests a need for clearer communication and stronger initiatives to enhance support for precision oncology and address perceived inequities within the organization (Figure 8).

Figure 8. Agreement with various statements regarding the structures, processes, and leadership support for precision oncology within organizations



Awareness of Testing and Treatment

Awareness of current testing processes for precision oncology initiatives varies among respondents. **60%** (six respondents) reported being somewhat aware, while **20%** (two respondents) indicated they were not aware at all, and **20%** (two respondents) expressed

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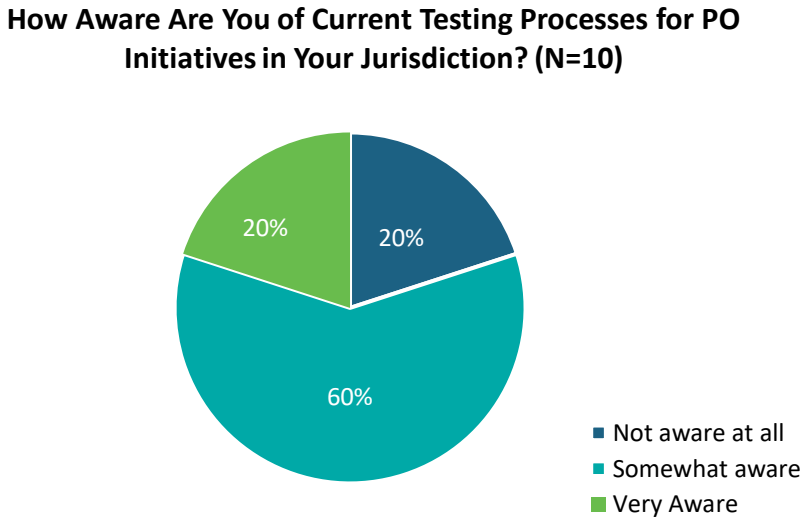
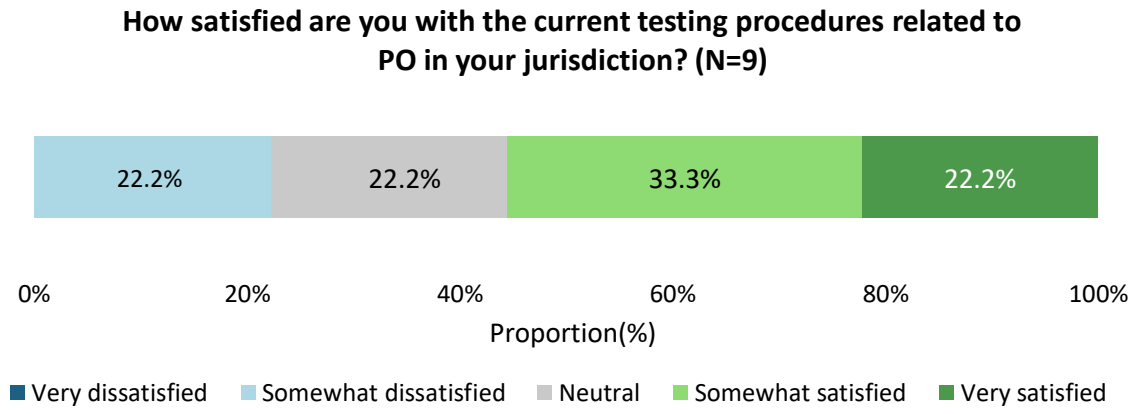
that they were very aware. This distribution suggests that while a majority of respondents have some awareness of testing processes, there is still a significant portion who are not fully informed (Figure 9).

Figure 9. Awareness of current testing processes for precision oncology initiatives



33.3% (three respondents) reported being somewhat satisfied, while **22.2%** (two respondents each) expressed somewhat dissatisfied, neutral, and very satisfied sentiments. This distribution indicates a mixed level of satisfaction, with a notable portion of respondents feeling positive about the testing procedures. However, the presence of dissatisfaction suggests that there may be areas for improvement (Figure 10).

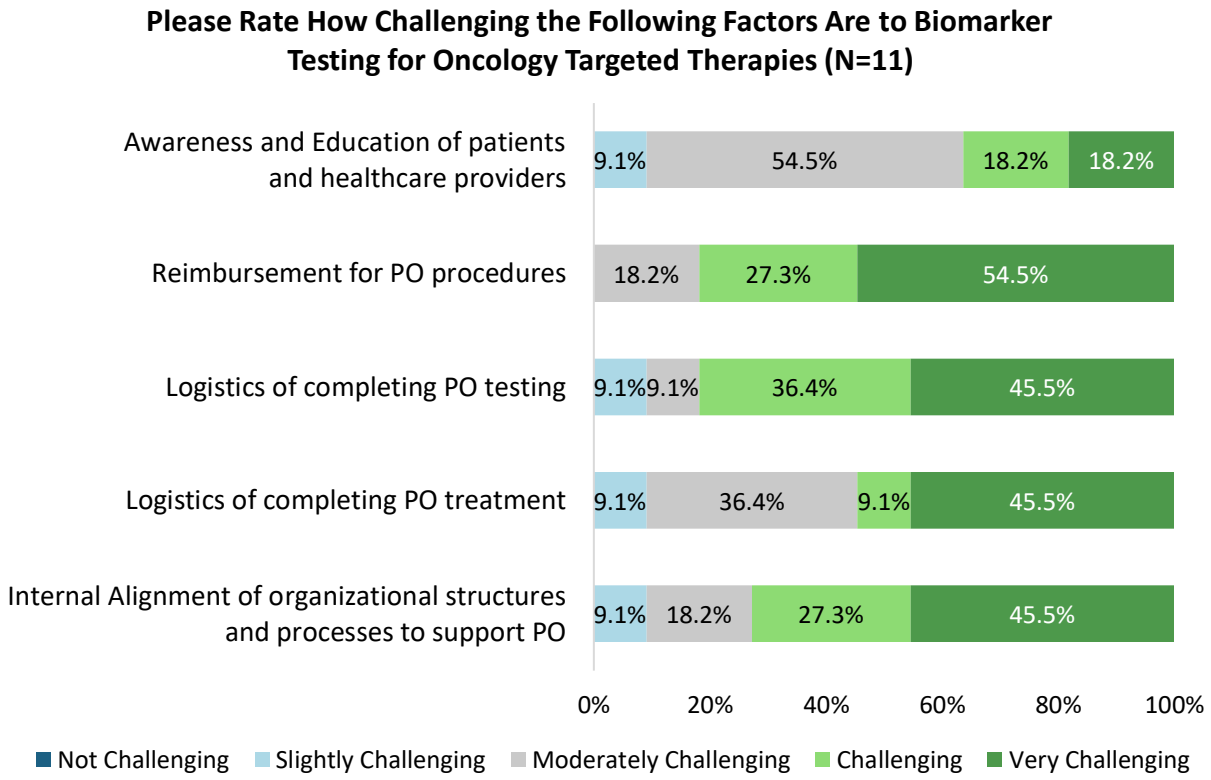
Figure 10. Satisfaction with current testing procedures related to precision oncology



Challenging Factors Affecting Biomarker Testing for Oncology Targeted Therapies

Respondents reported varying levels of challenges across factors impacting biomarker testing for oncology targeted therapies. Awareness and education of patients and healthcare providers emerged as moderately to very challenging, with **54.5%** rating it as moderately challenging **18.2%** as challenging and **18.2%** as very challenging. Reimbursement for PO procedures was particularly difficult, with **54.5%** rating it as very challenging and **27.3%** as challenging. Logistics of completing PO testing and treatment also posed significant obstacles, with **45.5%** finding both very challenging, while **36.4%** reported completing testing as moderately challenging. For internal alignment of organizational structures and processes, **45.5%** considered it very challenging **27.3%** as challenging and **18.2%** as slightly challenging. These results emphasize the need for targeted support in funding, logistical coordination, and organizational alignment to facilitate smoother PO implementation (Figure 11).

Figure 11. Ratings of how challenging various factors are to biomarker testing for oncology-targeted therapies



Awareness of Funding Mechanisms

60% (six respondents) reported being not aware at all of funding options, while **40%** (four respondents) indicated they are somewhat aware (Figure 12).

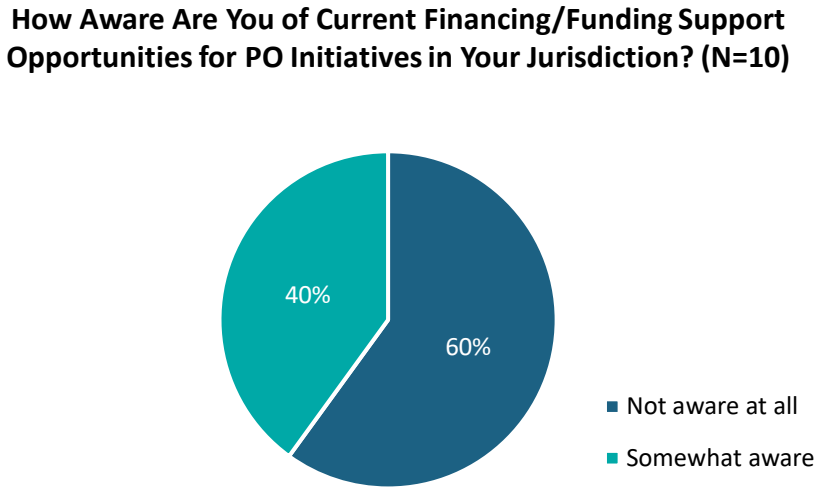
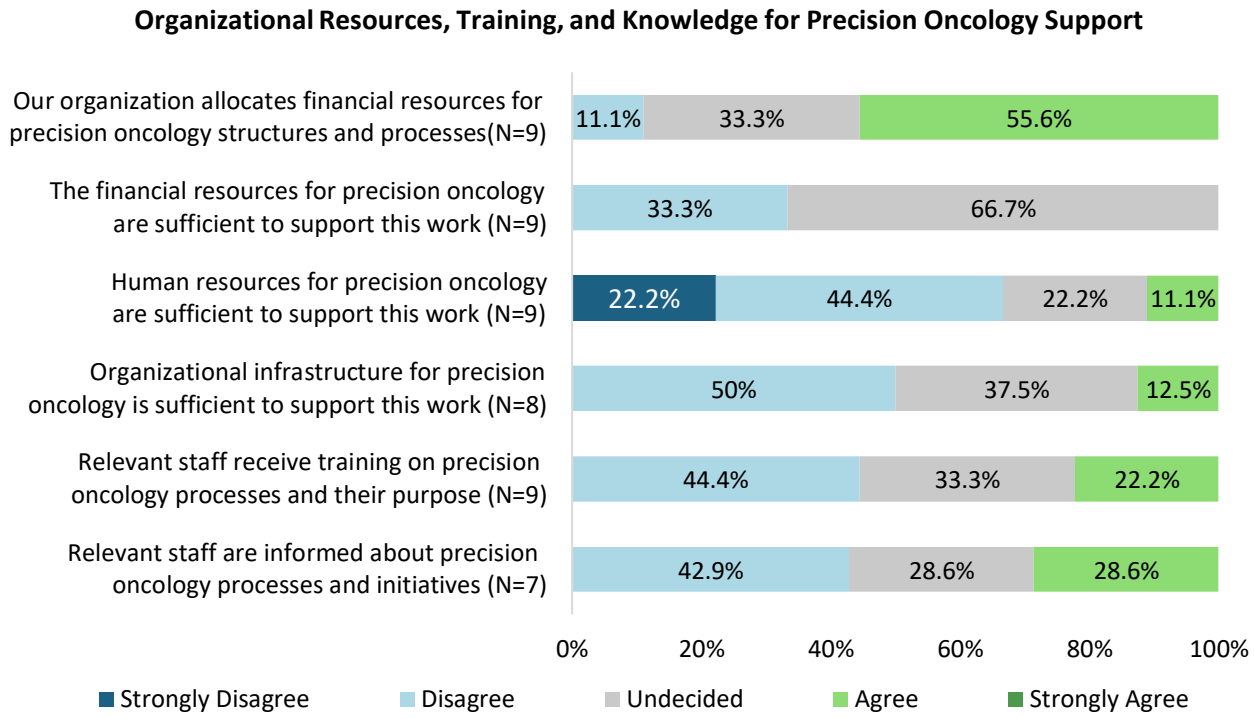


Figure 12. Awareness of current financing/funding support opportunities for precision oncology initiatives

Respondents expressed mixed perceptions regarding the sufficiency of financial, human, and training resources dedicated to precision oncology. **55.6%** agreed that their organization allocates financial resources for precision oncology, but **33.3%** were undecided about sufficiency, **33.3%** disagreed that current funding is adequate and **66.7%** were undecided. Regarding human resources, **44.4%** felt they were insufficient, with only **11.1%** in agreement. Similarly, **50%** felt that organizational infrastructure was insufficient to support precision oncology, with **37.5%** undecided. For staff training on PO processes, **44.4%** of respondents disagreed that training is adequately provided, while **33.3%** were undecided, and **22.2%** agreed. Similarly, regarding staff being informed about PO processes and initiatives, **42.9%** disagreed that staff are well-informed, **28.6%** were undecided, and **28.6%** agreed (Figure 13).

Figure 13. Agreement with various statements regarding organizational resources, training, and knowledge for precision oncology support

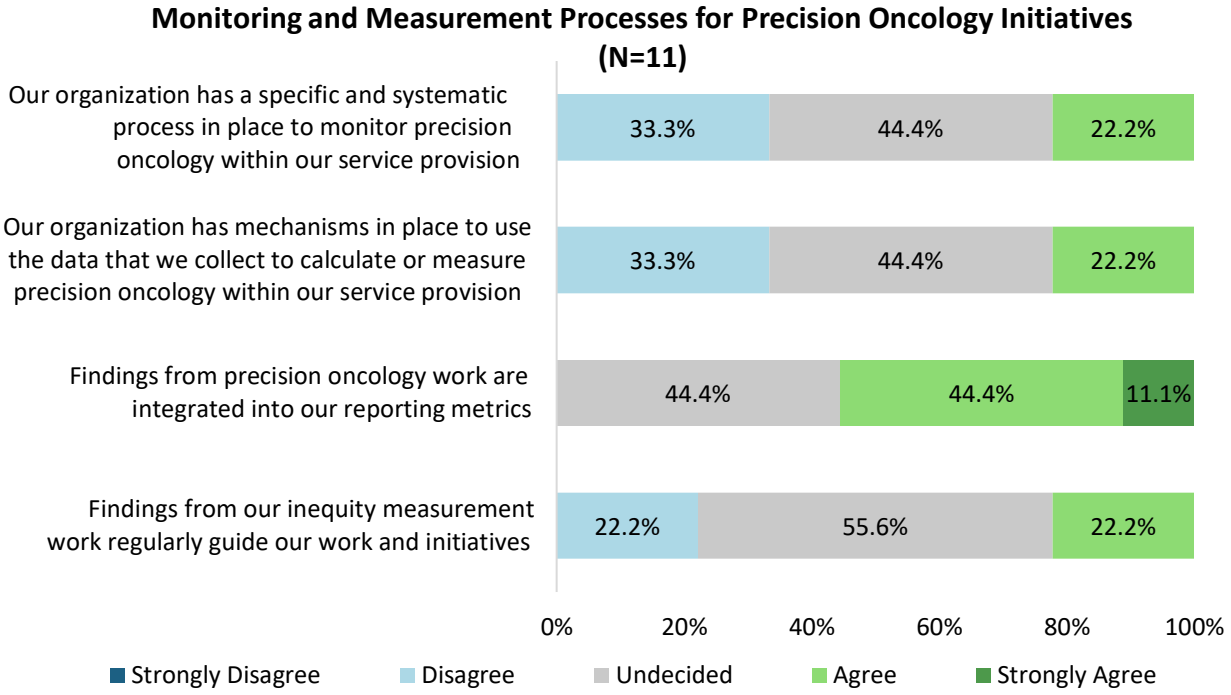


Monitoring and Integration

For the statement on having a systematic process to monitor PO, **33.3%** disagreed, while **44.4%** were undecided, and only **22.2%** agreed. Similarly, regarding mechanisms for using collected data to measure PO, **33.3%** disagreed, with **44.4%** undecided and **22.2%** agreeing.

In terms of integrating findings into reporting metrics, **44.4%** were undecided, **22.2%** agreed, and **11.1%** strongly agreed. For the statement about using findings from inequity measurements to guide work and initiatives **22.2%** agreed, with a significant **55.6%** undecided and 22.2% disagreed (Figure 14).

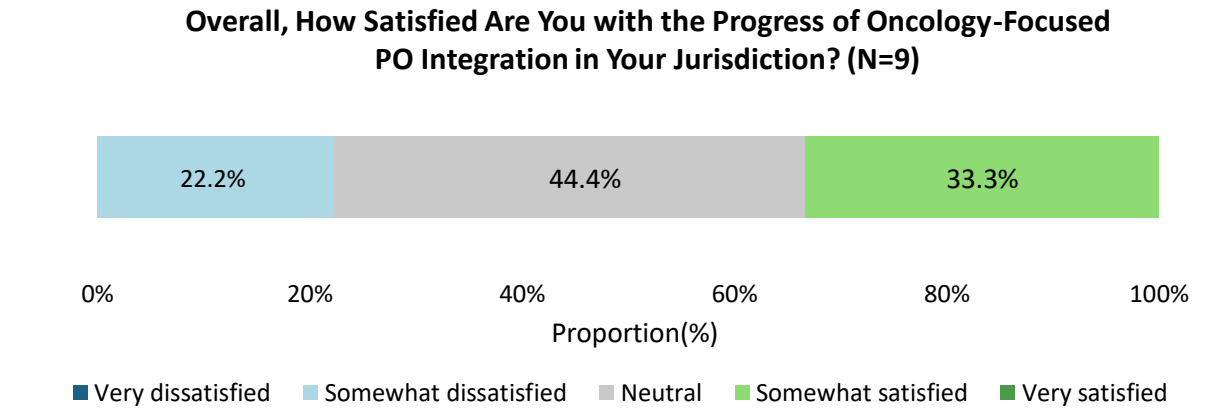
Figure 14. Agreement with various statements regarding monitoring and measurement processes for precision oncology initiatives



Overall Feedback

Regarding the progress of oncology-focused precision oncology integration in the jurisdiction. **44.4%** of respondents reported being neutral, suggesting uncertainty about the integration's effectiveness. **33.3%** expressed some satisfaction, while **22.2%** felt somewhat dissatisfied. This distribution highlights the need for enhanced communication and initiatives to improve satisfaction and ensure that stakeholders are informed and engaged in the integration process (Figure 15).

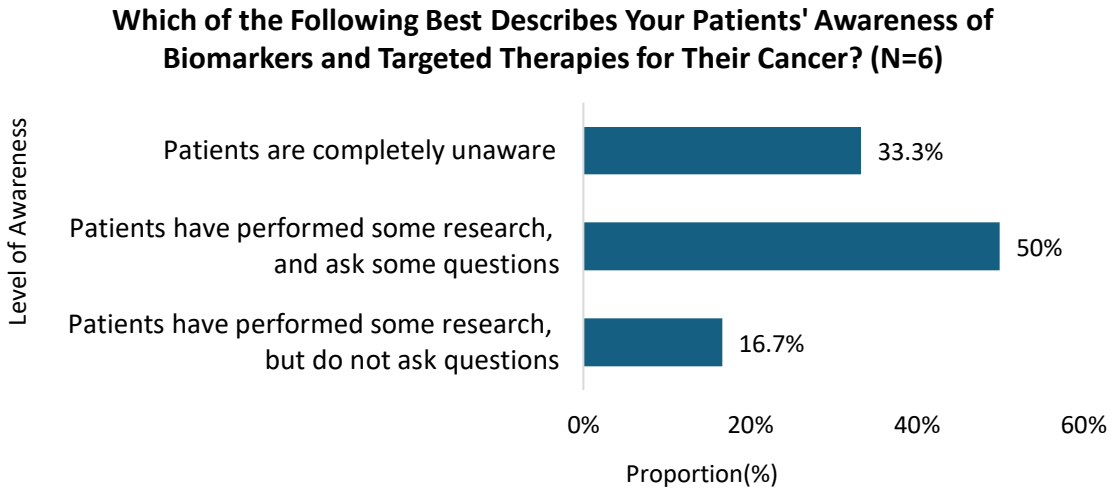
Figure 15. Overall satisfaction with progress of precision oncology integration



Awareness and Navigation

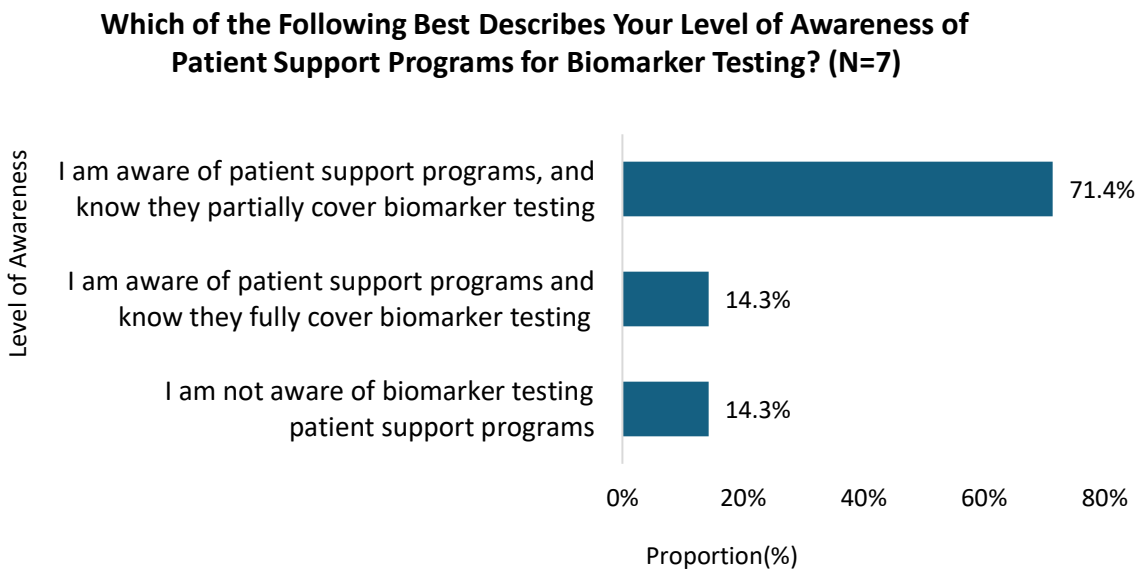
Regarding biomarkers and targeted therapies for cancer, **50%** of respondents indicated that patients have conducted some research and ask questions, demonstrating a proactive approach to understanding their treatment options. However, **33.3%** noted that patients are completely unaware of these therapies, highlighting a significant knowledge gap. Additionally, **16.7%** of patients have researched but do not ask questions, suggesting a need for improved communication and education to empower patients in their treatment journey (Figure 16).

Figure 16. Patient awareness of oncology biomarkers and targeted therapies



When it comes to awareness of patient support programs for biomarker testing, **71.4%** of respondents reported being aware of programs that partially cover biomarker testing, indicating a reasonable level of familiarity with available resources. **14.3%** stated they are aware of programs that fully cover biomarker testing, while another **14.3%** are not aware of any patient support programs for biomarker testing (Figure 17).

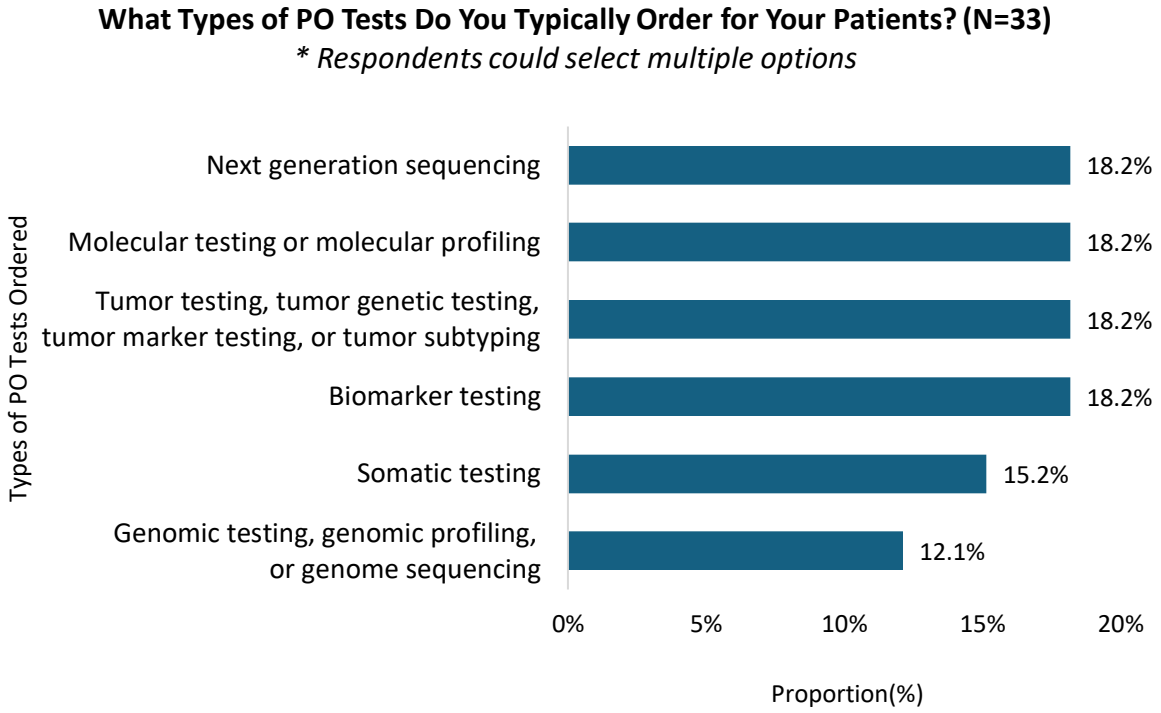
Figure 17. Respondent/provider awareness of oncology biomarkers and targeted therapies



Testing Process

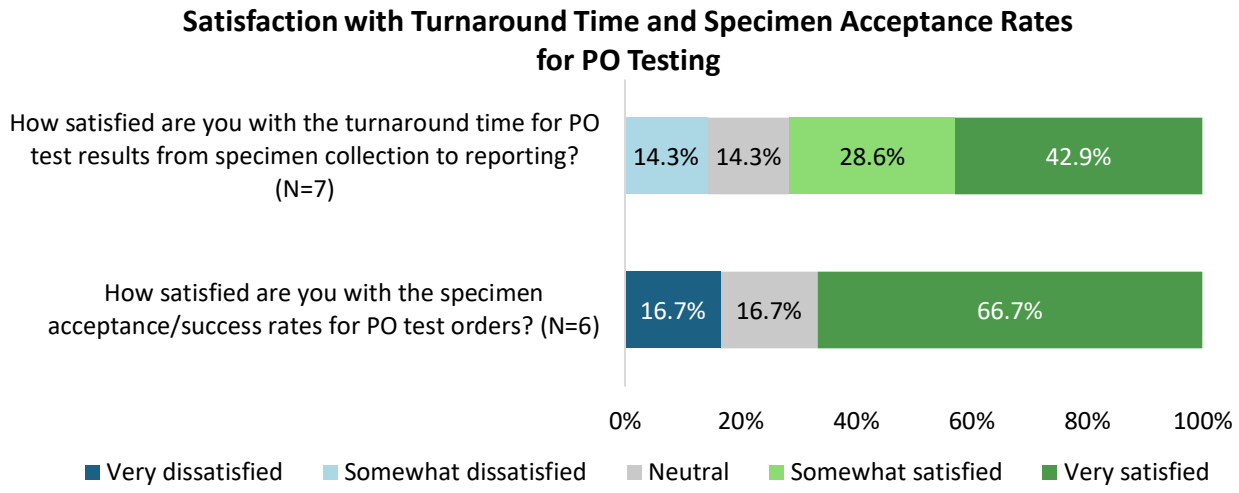
Regarding the types of precision oncology tests ordered for patients, biomarker testing and various forms of tumor testing, including tumor genetic testing, tumor marker testing, and tumor subtyping, each received **18.2%** of the responses, indicating a strong preference for these testing methods. Additionally, molecular testing or molecular profiling and NGS also had **18.2%** each, reflecting their importance in clinical practice. Somatic testing received **15.2%**, while genomic testing, genomic profiling, or genome sequencing was selected by **12.1%** of respondents (Figure 18).

Figure 18. Types of precision oncology tests ordered for patients



Satisfaction levels regarding the turnaround time for precision oncology test results show that **42.9%** of respondents are very satisfied, and **28.6%** are somewhat satisfied. This indicates a generally positive perception of the time taken from specimen collection to reporting. However, **14.3%** of respondents reported being somewhat dissatisfied, while **14.3%** remained neutral, highlighting areas where improvements could be made. In contrast, satisfaction with the specimen acceptance and success rates for PO test orders is notably higher, with **66.7%** of respondents indicating they are very satisfied. Only **16.7%** reported being somewhat dissatisfied, and **16.7%** were neutral (Figure 19).

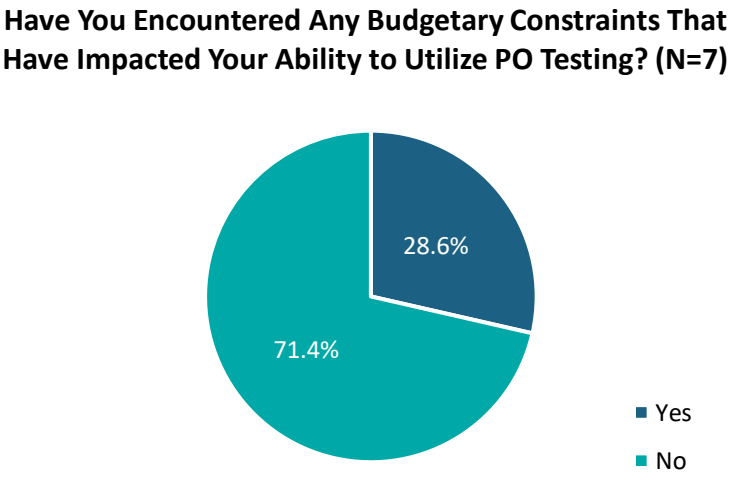
Figure 19. Satisfaction with turnaround times and specimen acceptance rates for precision oncology testing



Funding and Resources

Most respondents, **71.4%**, indicated that they have not encountered any budgetary constraints affecting their ability to utilize precision oncology testing. In contrast, **28.6%** reported experiencing such constraints, suggesting that while most professionals have access to necessary financial resources, there is a notable minority facing challenges (Figure 20).

Figure 20. Proportion of respondents who encountered budgetary constraints that have impacted the ability to use precision oncology testing



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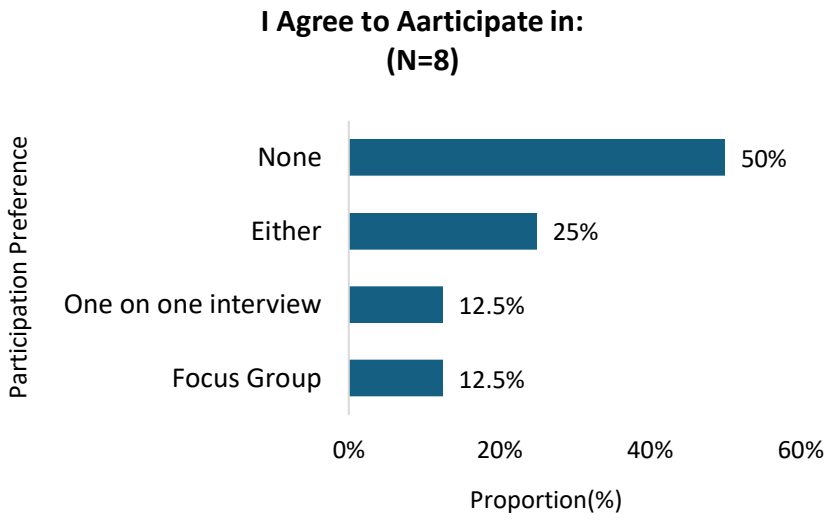
Interview Opt-in

The data shows the preference among respondents regarding participation in research activities. **50%** indicated that they do not wish to participate in either a focus group or a one-on-one interview. Meanwhile, **12.5%** expressed willingness to participate in a focus group, and another **12.5%** in a one-on-one interview. Additionally, **25%** of respondents are open to either option (Figure 21).

Figure 21. Decision to participate in other research activities



Interviews with Atlantic Canadian Key Informants on Precision Oncology

This section of the reports on the findings from key informant interviews that explored the region's precision oncology landscape by highlighting insights into current conditions and provides actionable opportunities for advancing personalized cancer care across Atlantic Canada. Interviews were conducted from Sept. through Nov. 2024 with oncologists, pathologists, geneticists, cancer directors, cancer researchers, and other key informants who work in precision oncology. In total, 24 key informants were interviewed. The distribution in provinces represented is shown in Table 1. The distribution among professions is shown in Table 2.

Table *1*. Distribution of participants across provinces

NS	NB	NL	PEI
13	6	4	2

Table *2*. Distribution of participants across professions

Oncologists	Pathologists	Geneticists	Other
6	6	4	8

Key Findings from Key Informant Perspectives

Awareness and Education Gaps

Awareness about precision oncology remains uneven among healthcare professionals and patients, with significant gaps in understanding of available technologies and resources. For example, a clinical genomic specialist expressed frustration:

"Physicians are not aware of what we can do. They often rely on drug company presentations or conferences for updates, overlooking what local labs can provide."

This reliance on external sources for information reflects a missed opportunity to capitalize on local expertise. Similarly, a radiation oncologist observed that:

"[while] awareness is improving…patients are more aware of genetic sequencing but less so about molecular targeted therapies."

The trend of increased patient awareness, likely driven by media and online resources, contrasts with clinician knowledge gaps noted across provinces. A medical oncologist explained,

"Specialized people in oncology are aware, but other disciplines need more awareness about the available tests."

A lack of comprehensive education and training for healthcare providers is slowing the implementation of precision oncology initiatives in Atlantic Canada. As one interviewee noted,

"Some oncologists are eager to adopt new genetic testing responsibilities, but others feel overwhelmed by additional training requirements and time pressures."

This mixed readiness among professionals creates uneven adoption, potentially delaying patient access to precision treatments. The issue extends to patients as well, many of whom are unaware of how genetic testing can influence their treatment plans.

"Most patients see genetic testing as something for their family's benefit," shared one provider, adding, "They don't realize it could directly change their treatment strategy—like switching to a more effective drug or altering a surgical plan."

Efforts to bridge these gaps are ongoing but unevenly distributed. A specialist explained,

"Our mainstream testing initiative is designed to make oncologists more independent in ordering and interpreting genetic tests, but it's been slow to launch and faces resistance in some areas."

Education modules and structured training programs are critical components of these initiatives, yet they often encounter delays due to logistical and resource constraints. To address these issues, stakeholders called for targeted education programs and a more robust integration of genetic counseling teams into cancer care workflows.

These findings suggests that while precision oncology is well understood within oncology subfields, broader dissemination of knowledge across healthcare roles remains lacking. These disparities highlight a need for interdisciplinary education programs. NB professionals appear more focused on the need to train general clinicians, reflecting a more integrated healthcare structure in the province. Improving awareness would require tailored approaches for different audiences, such as general practitioners, specialists, and patients.

Opportunities for Action

- **Implement Targeted Education Campaigns:** Develop workshops and e-learning modules for general clinicians and community healthcare workers to improve their understanding of precision oncology tools and capabilities.
- **Patient Education Initiatives:** Collaborate with patient advocacy groups to create resources that explain genetic testing and targeted therapies, enhancing informed decision-making.
- **Cross-Disciplinary Engagement:** Conduct regular interdisciplinary meetings between oncology, pathology, and general practice teams to align understanding and foster collaboration.

Testing Infrastructure and Reliance on External Laboratories

A foundational challenge in precision oncology across Atlantic Canada is the limited local infrastructure for advanced molecular diagnostics. The absence of fully equipped facilities has led to a heavy reliance on external laboratories in NS, Quebec, or even the United States for NGS and other biomarker testing. This outsourcing causes delays that disrupt timely diagnosis and treatment planning, leaving clinicians feeling frustrated and constrained. One pathologist described the situation starkly:

"We basically are forced to send many of these things [test samples] out."

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This reliance is not merely inconvenient—it directly impacts patient care. When samples are sent out of province, logistical inefficiencies compound the problem. For instance, the inflexibility of transport schedules creates additional delays. Another pathologist explained:

> *"If it's a Thursday, we don't ship on Fridays... by the time it's received and accessioned, there's that lag time."*

Even in provinces like NL, where testing infrastructure is developing, critical gaps remain. As one clinician remarked:

> *"When it comes to NGS or any of the newer technologies, we're currently still outsourcing... which slows down the process."*

These delays affect the entire care pathway, from diagnosis to treatment. Providers must wait weeks for results that determine eligibility for targeted therapies, leaving patients in limbo. Moreover, this dependency highlights the need for robust local infrastructure to reduce turnaround times and improve patient outcomes.

The reliance on out-of-province and international testing facilities creates bottlenecks and delays across Atlantic Canada, impeding timely care. A pathologist described the logistical challenges:

> *"Biomarker tests for lung cancer are reflexed to Halifax or Miami, adding weeks to turnaround times due to batching and transit inefficiencies."*

Similarly, a precision oncology coordinator explained,

> *"We batch RNA sequencing to 85 to 90 cases for economic reasons, delaying results".*

These delays are compounded by inconsistent testing guidelines. For example, a pathology leader noted,

> *"We lack provincial guidelines for reflex testing, leading to variability depending on the cancer type."*

In contrast, Alberta's harmonized oncology protocols provide an example of standardized testing that Atlantic provinces could emulate. NL's reliance on batching reflects a capacity issue that disproportionately impacts rural and smaller provinces. NS, on the other hand, benefits from a more centralized system in Halifax, though this creates regional dependencies that leave NL and PEI vulnerable to capacity constraints. A unified Atlantic Canadian testing framework could reduce duplication and enable economies of scale, but provincial differences in volume and capacity would need careful consideration.

Opportunities for Action:

- **Streamline Regional Testing:** Establish a centralized Atlantic Canada testing facility to reduce duplication and improve turnaround times.
- **Invest in Local Capacity:** Equip provincial labs with necessary technology and staff to handle high-priority tests locally.
- **Develop Standardized Protocols:** Create uniform reflex testing guidelines across the region to eliminate inconsistencies.
- **Develop Regional Testing Hubs:** Establish centralized facilities to serve multiple provinces, reducing dependence on external laboratories.
- **Upgrade Local Labs for High-Demand Tests:** Prioritize investments in molecular diagnostics for cancers like lung and gastrointestinal.

Financial and Resource Constraints

Financial barriers were a recurring theme among participants, who highlighted the disconnect between funding for advanced therapies and the diagnostics needed to determine patient eligibility. As one oncologist noted:

> *"We have funding for the drug, but we don't have funding for the test that we need to determine whether we would use the drug."*

Short-term partnerships with pharmaceutical companies often provide initial funding for testing, but these arrangements are temporary and unreliable. One participant observed,

> *"It [funding] only lasts a year, and then they cut it off."*

This inconsistent funding creates inequities in access to essential tests and treatments, particularly for patients with rare or complex mutations. Financial constraints also force clinicians to make difficult decisions about resource allocation, as described by one provider,

> *"All the new treatments are very expensive… we need to think about the cost-benefit, and it's not always feasible to cover everything."*

These financial hurdles emphasize the need for sustainable funding models that integrate diagnostics and therapies into standard healthcare budgets, ensuring continuity and equity in patient care.

Funding challenges are a persistent barrier to advancing precision oncology, with rigid approval processes and inconsistent allocations across provinces. One pathologist described how "new tests must demonstrate significant cost savings to gain approval," reflecting the constraints of cost-driven healthcare budgeting. This short-term focus inhibits innovation and the adoption of emerging technologies. For example, another pathologist emphasized,

"We don't even have resources for basic operational upgrades. Pathologists are overwhelmed, and it affects quality assurance."

A lab director emphasized this point and explained,

"Funding is annual and rigid, requiring any new test to pass through multiple committees."

In comparison, NS's slightly more flexible funding processes allow for greater alignment with national standards, though the region lags larger provinces like Ontario and Alberta in securing sustained investment. The implications are clear: without streamlined funding models and cross-provincial collaboration, the region risks falling further behind. NL's particular reliance on fee-for-service international labs emphasizes the financial inefficiencies of a decentralized system, while NB's structured but slow funding process highlights bureaucratic barriers that delay progress.

Opportunities for Action:

- **Establish Flexible Funding Models:** Advocate for multi-year funding that supports both innovation and operational needs without immediate cost-saving requirements.
- **Increase Government Support:** Support provincial and federal governments in prioritizing cancer care funding, emphasizing its long-term cost-effectiveness.
- **Private Sector Collaboration:** Expand partnerships with pharmaceutical and biotechnology companies to co-fund critical testing and treatment initiatives.
- **Leverage Cost-Benefit Analyses:** Use data-driven research to demonstrate the long-term value of precision oncology.

Fragmented Governance and Lack of Standardization

The lack of cohesive governance in precision oncology across Atlantic Canada has resulted in fragmented practices, variable patient experiences, and inefficiencies in service delivery. One clinician captured this issue succinctly:

> *"There is no overarching governance ... it's fragmented, and practices are inconsistent."*

In the absence of centralized oversight, decisions about precision oncology initiatives often fall to individual departments. This decentralization means that progress depends heavily on local leadership. As one clinician noted:

> *"It comes a little bit down to policy and will within the clinical departments to move it forward."*

The lack of standardized governance also affects funding and support for diagnostics. As a clinician explained:

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"There is no method... drug company pays for a validation and for a year, but there's no governing body to manage this."

This fragmented approach complicates coordination between provinces, exacerbating disparities in access and treatment quality.

The absence of cohesive governance structures across Atlantic Canada has led to fragmented service delivery, duplicative efforts, and inefficiencies. A provincial cancer administrator stated,

"A centralized governance model could position Atlantic Canada as a leader in precision oncology."

This vision aligns with perspectives from NL, where a pathologist advocated for "one Atlantic center of excellence to streamline costs and resources". A precision oncology research lead noted that

"No single province has the volume or resources to sustain standalone programs, making collaboration essential."

Data governance and connectivity also emerged as a recurring theme in advancing precision oncology in Atlantic Canada. Participants highlighted that the fragmentation of genomic and clinical data across institutions is a significant barrier to effective implementation. One expert described the current state as "informal and case-by-case," relying on ad hoc email exchanges to retrieve critical information. This inefficiency hinders timely clinical decisions, particularly when genetic data from one health authority could provide crucial insights for patients being treated in another.

Efforts are underway to address this issue, with some progress being made through regional and national initiatives. For instance, one participant referenced a collaborative project between NL and NS, stating,

"We're beginning to share sequencing data and analysis pipelines, which allows us to compare cases and harmonize interpretations."

However, these efforts are still in their infancy, and broader integration is needed to fully leverage the potential of shared data.

Another participant emphasized the transformative potential of interconnected data systems,

"If we could create a centralized genomic database, clinicians could instantly access critical insights, reducing delays and improving patient outcomes."

The vision extends beyond data sharing to include advanced technologies like virtual patient modeling, which could allow for personalized drug testing before treatments are administered in real life.

Despite shared aspirations, actual collaboration remains limited. NS has led in some areas, hosting centralized testing services, and coordinating with NB's ACRI for research integration. However, NL's limited capacity and PEI's heavy reliance on NS create dependencies that exacerbate regional inequities. The lack of shared governance also hinders the establishment of standardized protocols and ethical frameworks for data sharing. Establishing an Atlantic Precision Oncology Network could address these gaps by harmonizing policies, aligning funding priorities, and fostering interprovincial cooperation.

Opportunities for Action:

- **Create a Regional Governance Body:** Form an Atlantic Precision Oncology Network to coordinate policies, resources, and testing services across provinces.
- **Develop Shared Infrastructure:** Establish a central biobank and testing hub to pool resources and reduce redundancy.
- **Harmonize Guidelines:** Align testing protocols, ethics approvals, and data-sharing agreements to streamline operations and enhance equity.
- **Learn from Best Practices:** Analyze governance models from other jurisdictions to inform regional frameworks.

Workforce Shortages and Training Gaps

The shortage of skilled professionals, including genetic technologists, counselors, and molecular diagnosticians, emerged as a critical barrier to implementing precision oncology. One clinician described the situation bluntly:

"One of the barriers... is the lack of high-skilled individuals, particularly genetic technologists."

The availability of genetic counselors is similarly limited, slowing diagnostic timelines, and straining existing staff. As one participant noted:

"We have a limited number of genetic counselors, which is slowing down the entire process."

Beyond personnel shortages, gaps in training among healthcare providers further hinder progress. Many physicians lack awareness of available tests and their clinical applications. As one participant explained:

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"There's a lot of testing that's available, but it just doesn't seem that the physicians are really aware of what's out there."

These limitations showcase the need for both workforce development and ongoing education to ensure that clinicians are equipped to deliver precision oncology services effectively.

Opportunities and Actionable Steps

- **Expand Specialized Training Programs:** Partner with universities to build a pipeline of genetic technologists and counselors.
- **Provide Physician Education:** Offer workshops and webinars to familiarize clinicians with the latest diagnostic tools and treatments.
- **Recruit Skilled Professionals:** Create incentives to attract and retain experts in underserved regions.

Equity and Access Disparities

Access to precision oncology services varies widely across Atlantic Canada, with patients in rural and remote areas particularly disadvantaged. This geographic inequity was described by one participant:

"If we don't ensure that people have access regardless of where they live... then we're only going to increase disparities."

Smaller provinces like NL and PEI face additional challenges due to limited resources. As one clinician remarked:

"It's foolhardy to think we can do all of this... there's this unrealistic expectation for a province of only 500,000 people."

These disparities highlight the need for targeted initiatives to ensure that all patients, regardless of location, receive equitable care.

Patients across Atlantic Canada face significant inequities in accessing precision oncology services, with rural populations and smaller provinces disproportionately affected. A cancer care administrator raised concerns about the uneven availability of new technologies,

"How do you address inequities where it's available in one center but not another?"

Additionally, a radiation oncologist emphasized the impact on rural populations, stating,

"One focus is ensuring that patients outside major centers get access to testing and therapies."

Similarly, a medical oncologist highlighted disparities in biomarker testing, noting that lung cancer often receives priority while other cancers face delays. PEI, with its small population and complete reliance on NS for testing, experiences the most pronounced access barriers. In comparison, NS's relatively centralized structure provides better access for its residents, though rural areas still face logistical hurdles. Ensuring equitable access requires innovative solutions such as telemedicine, mobile labs, and standardized reflex testing protocols across all cancer types and locations. Expanding patient navigation services could further address disparities by guiding underserved populations through complex diagnostic and treatment pathways.

Opportunities for Action:

- **Expand Rural Outreach:** Use telemedicine and mobile labs to bring diagnostic and consultation services to underserved areas.
- **Enhance Equity in Testing:** Implement reflex testing policies for all cancer types, ensuring consistent access regardless of location.
- **Increase Patient Navigation Support:** Employ dedicated coordinators to guide rural patients through complex diagnostic and treatment pathways.
- **Expand Tele-Oncology Services:** Use virtual platforms to connect rural patients with precision oncology experts.
- **Promote Equity in Funding Allocations:** Ensure smaller provinces receive proportional investments in precision oncology resources.

Innovation Through Public-Private Partnerships

Public-private partnerships have emerged as key enablers of precision oncology innovation, providing critical funding and infrastructure. A medical physicist described the benefits of such collaborations:

"Partnerships with private companies help us access advanced technologies and foster innovation."

A research institute leader highlighted a successful initiative:

"[Industry] funding enabled us to launch a lung cancer precision oncology platform, showcasing the potential of public-private efforts."

While these partnerships provide much-needed resources, they also raise concerns about dependency and alignment with public health goals. NL's reliance on fee-for-service arrangements with private labs in the United States highlights the limitations of outsourcing, where local capacity-building takes a backseat to immediate needs. NS and NB demonstrate more balanced approaches, leveraged private partnerships while maintaining

public oversight. These partnerships could be expanded regionally to fund shared infrastructure projects and provide training opportunities, ensuring long-term sustainability.

Opportunities for Action:

- **Foster Transparent Partnerships:** Ensure agreements with private companies prioritize public health goals and long-term sustainability.
- **Leverage Industry Expertise:** Use private-sector resources to train staff and deploy cutting-edge technologies.
- **Encourage Co-Investment Models:** Co-fund projects that benefit from public and private input, ensuring shared responsibility.

Research Integration and Capacity Building

Research-driven initiatives are central to precision oncology efforts across the region, yet integrating findings into clinical practice remains a challenge. A geneticist implemented a "mainstreaming" program, allowing oncologists to request genetic tests directly and reduce bottlenecks:

"This program reduced delays and improved efficiency."

In NL, a research lead described,

"Biobank samples are being used for retrospective cohort studies to identify treatment targets."

NS has been at the forefront of integrating research into clinical practice, leveraging national research networks like the Terry Fox Consortium to build capacity and share knowledge. However, translating these efforts into real-time clinical applications is slow due to limited infrastructure and funding. The regional disparities are clear: while NS and NB benefit from relatively advanced research integration, NL and PEI remain constrained by resource limitations. Expanding access to research findings through shared data platforms and increasing collaboration between researchers and clinicians could accelerate the adoption of precision oncology innovations across the region.

Opportunities for Action:

- **Regional Framework Development:** Establish a comprehensive Atlantic Canada Precision Oncology Strategy to address governance, equity, and resource allocation.
- **Invest in Workforce Capacity:** Recruit and retain pathologists, oncologists, and bioinformaticians to meet growing demand.
- **Scale Pilot Programs:** Expand successful initiatives, such as the "mainstreaming" program and public-private partnerships, across the region.

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Underutilized Opportunities for Collaborative Research

Precision oncology research in Atlantic Canada is hindered by the underutilization of collaborative opportunities between institutions, despite its potential to significantly advance the field. Existing partnerships and initiatives, though present, are limited in scope, leaving notable gaps in knowledge-sharing and resource pooling across the region. Providers emphasized that fostering a more cohesive approach to collaborative research could elevate the quality of evidence, establish a centralized knowledge base, and drive regionally tailored innovations for precision oncology.

A radiation oncologist noted the unfulfilled potential for regional collaboration,

"There's potential for more collaborative research… it would be beneficial if we could study the efficacy of precision treatments regionally."

This sentiment highlights the fragmented nature of current efforts, where institutions often operate independently, foregoing opportunities to combine data and expertise. Similarly, a research director remarked,

"We have the infrastructure for research, but cross-institutional partnerships are limited, and we miss out on insights that could improve care."

This lack of collaboration is particularly challenging for smaller provinces like PEI and NL, which rely on external partnerships but lack the capacity to independently lead large-scale studies.

Comparatively, NS and NB have demonstrated progress in fostering partnerships, particularly through its involvement in the ACC and national initiatives like the Terry Fox Marathon of Hope. However, even these efforts are under-leveraged. Integration across provinces remains sporadic, with participants highlighting the absence of formal mechanisms for consistent collaboration. A pathologist observed,

"We often don't realize how much we could benefit from each other's work until we see it presented at national conferences. There's no routine forum to share insights regionally."

This highlights the missed opportunity to establish structured platforms for ongoing knowledge exchange and joint research planning.

The implications of underutilized collaborative research are significant. Without a unified regional effort, Atlantic Canada risks duplicating efforts, overlooking critical insights, and failing to build robust evidence base tailored to the region's unique challenges. Collaborative research could address these shortcomings by enabling larger, more diverse studies, fostering innovation, and improving patient outcomes across provincial boundaries.

Opportunities for Action

- **Policy:** Governments and funding bodies should prioritize inter-institutional research funding and establish regional research initiatives across Atlantic Canada. Financial incentives for collaborative projects could mitigate logistical and resource-related challenges.
- **Practice:** Create structured knowledge-sharing forums where institutions can present research, identify shared challenges, and discuss collaboration opportunities. Annual regional conferences or virtual research networks could facilitate these interactions.
- **Research:** Initiate collaborative programs focusing on region-specific precision oncology challenges, such as rural patient access or targeted therapy efficacy in Atlantic Canadian populations. These initiatives could serve as models for other regions and establish Atlantic Canada as a leader in precision oncology innovation.

Summary

The findings reveal a precision oncology landscape that is advancing unevenly across Atlantic Canada, shaped by systemic barriers in funding, governance, and access. While each province faces unique challenges, shared aspirations for regional collaboration and innovation present opportunities for transformative change. Establishing an Atlantic Precision Oncology Network, harmonizing funding and governance, and investing in equitable access and education can help the region achieve its full potential in delivering cutting-edge cancer care. Precision oncology offers transformative potential for cancer care in Atlantic Canada, yet its full realization requires addressing systemic barriers. Challenges in testing infrastructure, financial sustainability, governance, workforce capacity, and equitable access must be tackled through coordinated regional efforts.

Provincial-Focused Analysis and Opportunities

The section focuses on specific province's state of precision oncology and synthesize the insights from key informants from each province. Each provincial section focuses on provincial centric insights and present opportunities for each province to advance precision oncology in areas tailored for them.

Nova Scotia

This report synthesizes insights from a series of qualitative interviews with key informants from NS's healthcare system to analyze the current state of precision oncology. The findings indicate that while NS has made strides in implementing genomic testing and collaborative strategies, significant gaps persist in terms of funding, awareness, and comprehensive governance. Recommendations include fostering interdisciplinary coordination, enhancing physician training, and securing sustainable funding models.

Infrastructure and Current Testing Capabilities: NS has established foundational infrastructure for precision oncology, primarily through the centralized molecular diagnostics lab at NSH. This facility conducts targeted sequencing panels covering 50-100

genes, enabling in-depth genomic analysis for various cancers, including lung, colorectal, and hematological malignancies. Such capabilities position NSH as a competent center for diagnostic testing; however, it does not yet match the advanced facilities found in larger Canadian centers like Toronto or Vancouver. Pathologists reported that while essential testing can be conducted in-house, more complex, or rare biomarker analyses often need to be sent out of province, which incurs delays and additional costs. The infrastructure for cutting-edge developments in pharmacogenomics, such as liquid biopsy, is in-development but requires consistent funding.

Funding and Sustainability Issues: A recurring theme across interviews was the challenge of securing long-term funding for new diagnostic technologies. Although basic cancer testing is funded by the provincial health system, new biomarkers and advanced testing methods often rely on ad hoc funding, such as one-time charitable donations or pharmaceutical partnerships. This reliance on non-sustainable funding models creates inconsistencies and limits the province's ability to maintain cutting-edge services. One pathologist shared the difficulties of obtaining consistent support for new test validations, particularly when pharmaceutical companies provide initial funding that does not cover comprehensive development costs. Moreover, delays in securing funding through complex internal approval processes were reported to slow down the implementation of necessary diagnostic advancements.

Education and Awareness Among Physicians: The awareness of precision oncology capabilities among healthcare providers varies significantly. Some professionals have a clear understanding of available testing and its implications, but others remain unaware of the full scope of local and potential services. The need for a strategic educational initiative was highlighted, as limited physician knowledge sometimes leads to underutilization of in-house services and reliance on external resources. Physicians' engagement with industry-sponsored tests further complicates data retention and consistency. While such options can provide patients with necessary testing, they often bypass the local health system's capacity to gather and retain genomic data. A genomics manager noted that the province would benefit from clearer communication and training pathways to standardize precision oncology knowledge.

Interdisciplinary Collaboration: NS has demonstrated notable efforts in fostering collaboration between different sectors of the healthcare system. Monthly meetings among genomics, pathology, and oncology professionals at NSH aim to synchronize practices and share insights. However, these collaborations are often informal and lack the overarching governance needed for systematic coordination. Key informants indicated that a more formalized approach, potentially through a provincial framework or partnership agreement, c00ould enhance integration and make multidisciplinary precision oncology efforts more effective.

Patient Awareness and Engagement: Patients' understanding of precision oncology remains minimal, a gap noted by oncologists and pathologists alike. The province lacks structured programs to educate patients about available testing and treatment options, limiting their ability to participate actively in treatment decisions. Increasing patient awareness through targeted educational campaigns could support better outcomes and higher utilization of precision services.

Opportunities to Advance Precision Oncology in Nova Scotia

Establish Formal Governance Structures

- Opportunity: Create an integrated provincial framework to coordinate precision oncology efforts across the healthcare system.
- Actionable Step: Develop a centralized governance model that formalizes interdisciplinary collaboration and streamlines decision-making for funding, technology adoption, and clinical integration.

Expand Local Testing Capabilities

- Opportunity: Strengthen the capacity of in-house facilities, such as the molecular diagnostics lab at NSH, to handle more complex biomarker analyses and advanced diagnostics like liquid biopsy and pharmacogenomics.
- Actionable Step: Invest in upgrading local infrastructure and training staff to expand testing services, reducing reliance on external laboratories and associated delays.

Secure Sustainable Funding Models

- Opportunity: Transition from ad hoc and charitable funding to stable, long-term government-funded programs to support precision oncology development and operations.
- Actionable Step: Advocate for dedicated budget allocations to maintain cutting-edge services, validate new tests, and support emerging technologies without interruptions.

Enhance Physician Training and Awareness

- Opportunity: Address the variability in physician knowledge about precision oncology services by implementing targeted training programs.
- Actionable Step: Conduct regular workshops and seminars to educate healthcare providers on available genomic testing, its clinical applications, and the implications of integrating these services into patient care.

Foster Multidisciplinary Collaboration

- Opportunity: Build on existing collaborative efforts by establishing formalized structures for regular interdisciplinary meetings and information sharing.
- Actionable Step: Create a provincial partnership agreement to facilitate structured interactions between genomics, pathology, and oncology teams, ensuring seamless integration of precision oncology into clinical workflows.

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Improve Data Management and Utilization

- Opportunity: Ensure that genomic data generated from tests, including those sponsored by external organizations, is retained within the provincial health system.
- Actionable Step: Develop standardized protocols for data collection and management, integrating insights into provincial databases for long-term research and clinical use.

Increase Patient Awareness and Engagement

- Opportunity: Address gaps in patient knowledge about precision oncology through structured educational initiatives.
- Actionable Step: Launch public awareness campaigns and provide accessible resources that explain genomic testing, its benefits, and how patients can participate in treatment decisions.

Advance Research and Innovation

- Opportunity: Leverage NS's existing expertise to engage in innovative research projects that drive precision oncology forward.
- Actionable Step: Collaborate with national and regional initiatives to conduct studies on advanced diagnostics, personalized therapies, and biomarker validation, ensuring NS remains a hub for PM innovation.

Streamline Adoption of Emerging Technologies

- Opportunity: Expedite the approval and integration of advanced diagnostic tools and treatments to improve patient outcomes.
- Actionable Step: Simplify internal approval processes and establish a dedicated task force to fast-track the adoption of promising technologies.

Support Comprehensive Patient-Centric Care

- Opportunity: Enhance the overall patient experience by aligning services with the principles of personalized care.
- Actionable Step: Implement navigator programs to guide patients through the complexities of precision oncology, from testing to treatment, ensuring equitable and efficient access to care.

Nova Scotia Summary

NS has the potential to lead in precision oncology by addressing its current gaps through strategic investments, policy reforms, and education initiatives. By focusing on sustainable funding, interdisciplinary collaboration, and patient engagement, the province can position itself as a model for innovative, patient-centered cancer care. Precision oncology in NS is at a crucial developmental stage. While the province has established a strong foundation for genomic testing and collaborative practices, barriers related to funding, governance, and education hinder further progress. Addressing these challenges through policy changes,

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interdisciplinary strategies, and comprehensive education will be vital to position NS as a leader in precision oncology.

New Brunswick

This section provides a comprehensive analysis of the current state of precision oncology in NB, highlighting key challenges and ongoing efforts to address them. Insights from oncologists, geneticists, and pathologists reveal six prominent themes: infrastructure limitations, human resource shortages, testing and treatment delays, regional disparities, financial constraints, and collaborative solutions.

Capacity and Funding Issues: NB faces capacity and funding challenges with internal testing that can result in outsourcing tests to other provinces and the U.S. While this reliance is decreasing, there still exists inadequate local capabilities and fragmented testing pathways which may delay test results. This reliance stems from inadequate local capabilities and has led to fragmented testing pathways. Efforts to develop in-house testing capabilities are underway, but progress is slow, and delays in diagnostic timelines persist. Although advanced molecular testing is available in some cases, the ability to integrate these results swiftly into treatment decisions is hindered by logistical inefficiencies and system fragmentation.

Human Resource Shortages and Capacity Challenges: A severe shortage of specialized personnel, such as genetic counselors, pathologists, and molecular technologists, significantly affects the province's ability to meet the growing demand for precision oncology services. The limited workforce places a heavy burden on the existing specialists, creating bottlenecks in service delivery and reducing the speed at which patients can receive care. Recruitment efforts have struggled to address these gaps, particularly given the challenges of attracting highly skilled professionals to the region.

Delays in Testing and Treatment: The reliance on external laboratories and logistical hurdles contributes to frequent delays in testing and treatment. In critical cases, such as lung cancer, where rapid molecular diagnostics are essential for treatment planning, these delays can adversely impact patient outcomes. Even when molecular data is available, issues with accessing reimbursed or approved treatments further prolong the initiation of appropriate therapies, leaving patients in limbo during crucial periods of care.

Regional Disparities and Lack of Harmonization: A lack of cohesive provincial guidelines exacerbates disparities in precision oncology access across NB. Differences between the two main health networks, Horizon and Vitalité, result in inconsistent treatment pathways, leaving patients in some areas with fewer options for care. Beyond provincial boundaries, Atlantic Canada lacks a unified regional approach to precision oncology, missing opportunities for collaboration that could alleviate some of NB's capacity challenges.

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Financial Constraints and Bureaucracy: Financial limitations and bureaucratic red tape are significant barriers to advancing precision oncology. While funding is often secured through short-term grants or partnerships, long-term sustainability remains elusive. The process of adopting new technologies is further hindered by lengthy bureaucratic procedures, delaying the integration of cutting-edge advancements into clinical practice. This slow adoption process prevents patients from accessing the latest diagnostic and treatment options in a timely manner.

Efforts Toward Collaborative Solutions: Despite these challenges, there are promising initiatives aimed at improving precision oncology in NB. One notable approach is the "mainstreaming" program, which enables oncologists to directly order genetic tests, bypassing the overburdened genetics clinics. This strategy has reduced wait times and improved access to diagnostics for specific cancers, such as breast and ovarian cancer. Additionally, tumor boards and educational initiatives have fostered collaboration among healthcare providers, though these efforts require more robust support to maximize their impact. By focusing on the following opportunities, NB can strengthen its precision oncology infrastructure, improve access to care, and position itself as a leader in the Atlantic region.

Opportunities to Advance Precision Oncology in New Brunswick

Build In-House Testing Capabilities

- Opportunity: Further develop local infrastructure for genetic and molecular testing to reduce reliance on external laboratories and improve diagnostic timelines.
- Actionable Step: Invest in molecular labs and NGS technology, prioritizing cancers with high diagnostic urgency, such as lung cancer.

Expand and Support the Workforce

- Opportunity: Address shortages of genetic counselors, pathologists, and molecular technologists by implementing targeted recruitment and training programs.
- Actionable Step: Establish partnerships with academic institutions to create specialized training programs and incentivize professionals to work in NB through competitive salaries and relocation assistance.

Enhance Provincial Coordination

- Opportunity: Develop a unified provincial strategy for precision oncology, aligning protocols and resource allocation across Horizon and Vitalité health networks.
- Actionable Step: Establish a provincial oversight body to standardize testing protocols and ensure equitable access to services, regardless of geographic location.

Strengthen Regional Collaborations

- Opportunity: Partner with other Atlantic provinces to create a centralized molecular testing hub that serves the region.

- Actionable Step: Advocate for a shared Atlantic Center of Excellence in Precision Oncology to pool resources and expertise while reducing redundancies in testing and care delivery.

Implement Innovative Testing Pathways

- Opportunity: Expand initiatives like the "mainstreaming" program, allowing oncologists to order genetic tests directly.
- Actionable Step: Broaden the scope of mainstreaming to include additional cancers and ensure adequate training for oncologists in genetic testing.

Address Financial Barriers

- Opportunity: Secure sustainable funding models to support testing infrastructure, workforce development, and access to treatments.
- Actionable Step: Advocate for dedicated government funding for precision oncology, with specific allocations for diagnostics and reimbursable treatment options.

Leverage Technology for Equity

- Opportunity: Use digital health tools, such as telemedicine, to improve access to precision oncology services in rural and underserved areas.
- Actionable Step: Pilot tele-oncology initiatives to provide remote genetic counseling and follow-up care, reducing geographic disparities.

Foster Collaborative Research

- Opportunity: Promote cross-institutional studies to address region-specific challenges, such as the validation of biomarkers and treatment disparities.
- Actionable Step: Launch regional research programs under a shared data governance framework to drive innovation and evidence-based practices.

Streamline Bureaucratic Processes

- Opportunity: Simplify the process for approving new diagnostic technologies and integrating them into clinical workflows.
- Actionable Step: Create a task force to expedite the review and adoption of emerging technologies, ensuring they are implemented before becoming outdated.

Increase Public and Provider Education

- Opportunity: Raise awareness among patients and healthcare providers about the benefits and applications of precision oncology.
- Actionable Step: Develop patient-facing educational resources and provide training workshops for general practitioners and oncologists on the latest advancements in precision oncology.

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New Brunswick Summary

While precision oncology in NB continues to evolve, substantial barriers in infrastructure, staffing, and funding hinder its progress. Addressing these challenges will require a concerted effort to strengthen provincial and regional collaborations, standardize care pathways, and streamline access to genetic testing and targeted therapies. Innovative programs, such as mainstreaming and tumor boards, demonstrate the potential for improvement, but sustained investments and policy reforms are essential for realizing the full promise of precision oncology in the province.

Newfoundland

This section synthesizes insights from key informant interviews conducted with healthcare professionals in NL to evaluate the state of precision oncology. The findings highlight significant gaps in infrastructure, staffing, and coordination, alongside areas of promise such as collaborative research initiatives and government funding. Opportunities for advancement include standardizing testing practices, enhancing local capabilities, and fostering regional cooperation among Atlantic provinces.

Infrastructure and Clinical Capacity: The precision oncology landscape in NL is marked by significant structural and logistical challenges. While the province is equipped with foundational genomic testing infrastructure, such as the Center for Translational Genomics, it struggles with limited local testing capabilities. The outsourcing of complex testing, particularly NGS for solid tumors, to external labs in Halifax, Miami, and other centers emphasizes the lack of fully operational in-house facilities. Key informants noted that, despite adequate technical infrastructure, a shortage of skilled pathologists and genetic technologists poses a critical barrier. The province currently operates at a substantial staffing deficit, with a reported 30-40% shortage of pathologists. This shortage strains current services and complicates efforts to build comprehensive, locally managed precision oncology programs.

Testing and Technological Limitations: Many biomarkers and molecular diagnostic tests required for precision oncology are sent out of province due to limitations in local expertise and established procedures. Interviewees emphasized that certain critical tests, such as those for lung and gastrointestinal cancers, are routinely outsourced. These practices delay the turnaround time for test results, impacting clinical decision-making and the timely initiation of treatment. Although NL has initiated steps to repatriate testing, the process remains in early stages. The current focus on germline testing within the initial phase of clinical translational genomics reflects the province's incremental approach toward broader precision oncology integration.

Research and Collaborative Efforts: NL benefits from its involvement in larger research projects, such as the MHCCN. This initiative includes whole genome and transcriptome sequencing aimed at generating a comprehensive cancer data repository. However, the real-time clinical applicability of such research remains limited, as current projects are not

structured to provide actionable, real-time data to influence patient treatment. Collaboration with institutions across Atlantic Canada is crucial for NL. Informants highlighted the potential for a shared Atlantic Center of Excellence to streamline testing and resource allocation. This approach could leverage collective expertise and reduce duplication of services, making precision oncology more accessible and efficient.

Policy and Funding Challenges: While the province has secured initial government funding for certain phases of its translational genomics programs, long-term sustainability and strategic integration into clinical practice remain concerns. The lack of a comprehensive provincial precision oncology strategy further exacerbates these challenges. Informants pointed to a disconnect between drug approval processes and the corresponding diagnostic testing required, leading to scenarios where approved treatments are inaccessible due to the absence of mandated testing. There is a growing recognition of the need for cohesive policies that integrate the funding and approval of both tests and corresponding treatments to ensure streamlined patient care.

Human Resources and Expertise: The shortage of qualified personnel, particularly genetic technologists and pathologists with expertise in molecular diagnostics, significantly impacts the province's precision oncology capabilities. Informants expressed concerns that without targeted training programs and recruitment efforts, the gap in expertise will continue to hinder advancements. Efforts to cultivate specialized training and attract professionals to NL are needed to build local expertise. The reliance on external pathologists and laboratories limits the province's ability to independently support comprehensive precision oncology services.

Opportunities to Advance Precision Oncology in Newfoundland and Labrador

Based on the findings, NL has several opportunities to strengthen its precision oncology landscape by addressing systemic challenges while building on existing infrastructure and collaborations. These opportunities focus on enhancing capacity, fostering regional partnerships, and aligning policies to improve access and outcomes.

Standardize Testing Practices

- Opportunity: Develop provincial and regional guidelines for molecular diagnostics and reflex testing to ensure equitable and consistent care.
- Actionable Step: Collaborate with healthcare stakeholders to establish standardized protocols, streamlining the use of molecular testing for cancers like lung and gastrointestinal, which often require rapid diagnostics.

Develop a Regional Center of Excellence

- Opportunity: Create a shared Atlantic Center of Excellence for advanced diagnostic testing to pool resources and expertise, reducing duplication of services.
- Actionable Step: Partner with other Atlantic provinces to centralize complex testing capabilities, such as NGS, ensuring timely access for NL patients.

Expand Training and Recruitment Initiatives

- **Opportunity:** Address workforce shortages by introducing targeted programs to train and attract pathologists, genetic technologists, and molecular diagnosticians.
- **Actionable Step:** Collaborate with academic institutions to develop specialized training pathways and offer competitive incentives to recruit skilled professionals to the region.

Invest in Local Testing Capabilities

- **Opportunity:** Incrementally repatriate critical diagnostic tests to NL to reduce reliance on external laboratories and improve turnaround times.
- **Actionable Step:** Focus on building in-house capabilities for high-demand tests while leveraging existing infrastructure, such as the Center for Translational Genomics, to expand local services.

Enhance Regional Collaboration

- **Opportunity:** Strengthen partnerships within Atlantic Canada to align policies, share resources, and support collaborative research.
- **Actionable Step:** Participate in cross-provincial tumor boards and data-sharing initiatives to foster knowledge exchange and improve regional precision oncology strategies.

Align Policy and Funding for Comprehensive Care

- **Opportunity:** Ensure that funding models for precision oncology account for both diagnostic testing and treatment, bridging gaps in the current approval processes.
- **Actionable Step:** Advocate for policies that mandate diagnostic testing as part of the drug approval process, ensuring patients can access appropriate therapies without delays.

Leverage Research Initiatives for Clinical Applications

- **Opportunity:** Translate insights from national research projects, such as the MHCCN, into actionable clinical strategies.
- **Actionable Step:** Develop frameworks to integrate real-time data from research studies into patient care, maximizing the practical benefits of ongoing genomic research.

Streamline Bureaucratic Processes

- **Opportunity:** Expedite the approval and integration of new diagnostic technologies to minimize delays in patient access to advanced treatments.
- **Actionable Step:** Create a task force to review and fast-track promising technologies, ensuring they are implemented in clinical settings without unnecessary delays.

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Enhance Public and Provider Education

- **Opportunity:** Improve awareness of precision oncology among patients and healthcare providers to ensure informed decision-making and better utilization of available resources.
- **Actionable Step:** Develop educational materials and training programs that explain the value and applications of precision oncology, targeting both clinicians and the general public.

Focus on Sustainable Workforce Solutions

- **Opportunity:** Establish long-term plans for workforce sustainability to address the current 30-40% shortage of pathologists and other specialists.
- **Actionable Step:** Implement mentorship programs, create partnerships with larger provinces, and provide relocation support to attract and retain skilled professionals in NL.

Newfoundland and Labrador Summary

By addressing these opportunities, NL can advance its precision oncology capabilities, improve care accessibility, and enhance patient outcomes. Collaborative regional strategies, investments in human resources, and policy alignment will be key to overcoming logistical and staffing challenges, positioning NL as a leader in patient-centered cancer care within Atlantic Canada. NL's precision oncology landscape shows promise but is constrained by significant logistical and policy challenges. Addressing these through strategic regional collaborations, investments in human resources, and comprehensive policy adjustments will be essential for advancing precision oncology in the province. These changes will help align NL's capabilities with broader national and international standards, fostering a more effective, patient-centered approach to cancer care.

Prince Edward Island

This section presents an analysis of qualitative interviews conducted with key informants in PEI to assess the current state of precision oncology. The findings highlight structural strengths, notable challenges, and strategic opportunities for the future. Despite advancements in testing processes and collaborations, significant limitations exist in infrastructure, expertise, and standardized care protocols. Recommendations are offered to improve the integration and efficiency of precision oncology services in PEI.

Infrastructure and Resource Allocation: The existing infrastructure in PEI for precision oncology is developing but constrained by significant limitations. A key informant noted that most molecular biomarker testing is outsourced, primarily to facilities in Halifax, due to a lack of local expertise and infrastructure. This reliance on external laboratories introduces logistical inefficiencies, particularly when considering the small volume of cases that do not justify extensive local capabilities. Pathologists in PEI act as intermediaries, coordinating the collection and shipment of tissue samples to larger centers. While they have established efficient processes for sending specimens, this outsourcing contributes to delays in results,

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although these are typically within an acceptable range of two to three weeks. The practical limitations related to volume and expertise were emphasized, suggesting that scaling local services remains economically unfeasible.

Clinical Integration and Knowledge Gaps: Clinicians, including medical oncologists, highlighted that the integration of precision oncology into standard practice is reactive rather than proactive. They frequently discover available tests and treatments through indirect channels, such as new publications or updates from pharmaceutical companies, rather than through a centralized communication system. This ad hoc approach means that awareness and application of the latest precision oncology practices vary widely.
A recurring theme in interviews was the lack of a cohesive strategy or comprehensive database that informs clinicians about the availability of new diagnostic tests and their funding. This creates challenges in keeping pace with rapid advancements in testing technology and treatment protocols, often leaving clinicians to independently seek out resources and options for their patients.

Strategic Collaborations and Standardization Needs: Pathologists expressed the importance of enhancing collaborative efforts with regional centers, such as those in NS, to streamline testing and ensure consistency in practice. A pathologist mentioned the potential benefits of a regional, centralized molecular testing lab that could serve the Atlantic provinces collectively, which would alleviate some of the volume and expertise constraints. The lack of standardized guidelines was identified as a critical issue. For instance, decision-making about which cases should undergo specific genetic tests often lacks clear directives, leading to variability in practice. One pathologist highlighted that while reflex testing is sometimes employed to anticipate future needs, these practices are not uniformly applied. Standardization could lead to more predictable and equitable patient care, aligning PEI's practices with those of larger, more resourced provinces.

Patient Awareness and Education: Patient awareness of precision oncology is notably low in PEI. Clinicians noted that while a small percentage of patients actively seek information online, their understanding is often superficial or based on incomplete data. This limited awareness affects patient engagement in treatment decisions, underscoring the need for educational initiatives to bridge knowledge gaps and empower patients.

Funding and Policy Challenges: Financially, precision oncology in PEI is supported sufficiently in that no reasonable test requests from oncologists are denied due to budget constraints. However, broader issues related to funding treatments, especially newer and more costly drugs, present ongoing challenges. An oncologist pointed out the inherent tension between the high costs of emerging therapies and the sustainability of public healthcare budgets.

Opportunities to Advance Precision Oncology in Prince Edward Island

Based on the analysis, several opportunities emerge for advancing precision oncology in PEI, addressing the structural and systemic challenges while leveraging existing strengths. By addressing opportunities, PEI can advance its precision oncology capabilities, improve patient outcomes, and strengthen its role within the broader Atlantic Canadian healthcare network.

Develop Regional Molecular Testing Partnerships

- Opportunity: Establish a regional, centralized molecular testing facility to streamline processes and reduce dependency on external laboratories.
- Actionable Step: Collaborate with neighboring Atlantic provinces to pool resources, creating a shared facility for high-volume, standardized molecular testing.

Expand Local Testing Capacity

- Opportunity: While scaling full in-house capabilities may be unfeasible due to low case volumes, PEI can strategically expand its local testing infrastructure for high-frequency tests.
- Actionable Step: Focus on developing capabilities for frequently needed tests (e.g., common biomarkers) to reduce turnaround times for key diagnostic results.

Standardize Testing and Treatment Guidelines

- Opportunity: Address inconsistencies in testing practices by implementing standardized provincial and regional protocols.
- Actionable Step: Collaborate with healthcare networks in Atlantic Canada to adopt reflex testing protocols and decision-making guidelines, ensuring predictable and equitable patient care.

Enhance Clinical Communication

- Opportunity: Establish centralized communication systems to keep clinicians updated on available diagnostic tests, funding options, and advancements in precision oncology.
- Actionable Step: Create an accessible database that aggregates information on testing and treatment protocols, enabling clinicians to make informed decisions quickly.

Improve Patient Awareness and Education

- Opportunity: Increase patient engagement by addressing gaps in their understanding of precision oncology's benefits and applications.
- Actionable Step: Develop educational resources, such as brochures, online platforms, and community outreach programs, to empower patients with reliable and actionable information.

Leverage Regional Collaborations for Knowledge Sharing

- Opportunity: Strengthen partnerships with centers in Atlantic provinces to align practices and share expertise.
- Actionable Step: Participate in cross-provincial tumor boards and training programs to ensure clinicians are equipped with up-to-date knowledge and best practices.

Secure Sustainable Funding for Emerging Therapies

- Opportunity: Advocate for dedicated, long-term funding mechanisms for precision oncology treatments, particularly high-cost, cutting-edge therapies.
- Actionable Step: Work with policymakers to balance the integration of innovative treatments into the public healthcare budget without compromising sustainability.

Focus on Collaborative Reflex Testing Protocols

- Opportunity: Use reflex testing for high-priority cancers to ensure biomarker testing is performed proactively, reducing delays in treatment initiation.
- Actionable Step: Implement uniform reflex testing policies for specific cancers across institutions in PEI, modeled on successful practices in larger provinces.

Advance Healthcare Provider Training

- Opportunity: Bridge the knowledge gap among clinicians by providing targeted training in the latest precision oncology techniques and protocols.
- Actionable Step: Develop continuous education programs, including workshops and online modules, to train general practitioners and oncologists in molecular diagnostics and genomic medicine.

Optimize Turnaround Times Through Digital Innovations

- Opportunity: Utilize digital health tools to improve the logistics of test ordering, result reporting, and patient follow-ups.
- Actionable Step: Invest in telemedicine and EMR systems to streamline communication between PEI's healthcare providers and external labs, minimizing delays.

Prince Edward Island Summary

The findings from PEI highlight a mixed landscape where progress in precision oncology is evident but uneven. The heavy reliance on external laboratories indicates that while PEI benefits from regional partnerships, this dependency also creates vulnerabilities related to turnaround times and limited control over testing processes. The absence of formalized strategies or shared guidelines exacerbates these challenges, as does the varying level of awareness among both healthcare providers and patients.

Learning from Global Insights

Precision oncology in Atlantic Canada is developing amid significant challenges, including limited infrastructure, fragmented governance, financial constraints, and workforce shortages. These issues resonate with global barriers, yet regions worldwide provide examples of how strategic initiatives can enhance precision oncology implementation. Comparing the Atlantic Canadian experience with global advancements illuminates actionable pathways to address local gaps while aligning with global best practices.

Infrastructure and Testing Capacity

In Atlantic Canada, the reliance on external laboratories for molecular and genomic testing is a critical bottleneck. The outsourcing of NGS tests leads to diagnostic delays that directly impact patient care. This is not unique to the region. Italy faces similar challenges, where the establishment of specialized centers for NGS testing is still in its infancy. However, Italy has emphasized the need for a national laboratory framework that integrates biobanks and centralized platforms for data sharing(39). Australia also highlights the importance of standard operating procedures (SOPs) for radiopharmaceutical production and the need for collaboration between central and community laboratories to ensure quality and compliance (40).

Adaptable Opportunities for Atlantic Canada

- Establish regional molecular testing hubs akin to Italy's proposed laboratory network to reduce reliance on external facilities and improve testing efficiency.
- Adopt SOPs and external quality assurance programs as seen in Australia to standardize and streamline testing processes across Atlantic Canada.

Governance and Standardization

Atlantic Canada's lack of cohesive governance has led to fragmented practices and inconsistencies in care. Globally, governance plays a pivotal role in advancing precision oncology. The UK's All Wales Genomics Oncology Group (AWGOG) ensures a coordinated, multidisciplinary approach to developing and implementing genomic services, aligning strategies with healthcare objectives (41). Similarly, the European Union emphasizes harmonized workflows and interdisciplinary collaboration through initiatives like the Molecular Tumor Board Pipeline (MTBP), which integrates bioinformatics tools to improve care delivery (42).

Adaptable Opportunities for Atlantic Canada

- Create a regional governance body like AWGOG to standardize precision oncology protocols and foster interdisciplinary collaboration across Atlantic provinces.
- Implement harmonized workflows modeled after the EU to ensure equitable access and consistency in patient care.

Workforce and Education

Workforce shortages in Atlantic Canada hinder the adoption of precision oncology. The need for workforce development is echoed globally. Italy emphasizes training clinicians in NGS technologies and precision oncology applications (39), while Australia addresses gaps in clinician confidence through structured educational initiatives, including multidisciplinary tumor boards(43).

Adaptable Opportunities for Atlantic Canada

- Partner with academic institutions to implement specialized training programs for genetic technologists and bioinformaticians, modeled after Italy's approach.
- Establish multidisciplinary tumor boards with a strong emphasis on education and collaboration, as seen in Australia(43).

Financial Sustainability

In Atlantic Canada, financial constraints create inequities in access to precision oncology services. Globally, funding models highlight sustainable approaches. The UK's national commissioning frameworks and partnerships between public and charitable organizations have ensured robust financial support for genomic services(44). Similarly, Canada has piloted adaptable funding models that prioritize test development and additional resource costs(20).

Adaptable Opportunities for Atlantic Canada

- Advocate for integrated funding models that encompass both testing and therapies, drawing on the UK's commissioning frameworks.
- Pilot adaptive funding strategies that allocate resources for new technologies, as demonstrated in Canada.

Equity in Access

Access disparities are a prominent concern in Atlantic Canada, where rural patients face significant barriers. Globally, telemedicine and mobile units have proven effective in bridging geographic gaps. Australia has leveraged tele-oncology to connect rural patients with specialists(7), while Finland's Cancer Centre Initiative ensures equitable access through regional coordination(45).

Adaptable Opportunities for Atlantic Canada

- Expand telemedicine platforms to provide rural patients with remote access to genetic counseling and specialist consultations, mirroring Australia's success.
- Implement mobile diagnostic units based on Finland's regional models to ensure timely and equitable access to precision oncology services.

Limitations

This report offers a comprehensive overview of the state of precision oncology in Atlantic Canada but has some limitations that should be considered to fully understand its findings and recommendations. The insights presented are largely based on input from healthcare professionals, researchers, and other key stakeholders in precision oncology. However, despite efforts to gather diverse perspectives, voices from provincial government representatives and patients were not included. Without input from policymakers, the report cannot fully evaluate how well the recommendations align with existing policies, funding priorities, and regulatory frameworks. Future work should actively engage policymakers to better address systemic and governance challenges. Similarly, the absence of patient perspectives limits our understanding of the user experience, including potential barriers like accessibility, affordability, and awareness of precision oncology services. Including patients in future research would help ensure the recommendations are more relevant and practical from an end-user standpoint.

Although the report includes interviews of 24 experts in precision oncology across all Atlantic Provinces, the survey only included 11 participants, with 6 being from NS. During the recruitment stage over 50 stakeholders were reached out to for the survey, many of which were selected again for the interview stage. This low level of recruitment may support this reports finding that awareness regarding specifics of precision oncology is low in Atlantic Canada. There are several possibilities for lack of participation including: (1) stakeholders may not be knowledgeable enough to speak to these issues and declined to participate; (2) stakeholders may feel there is no current issues to discuss; or (3) they may not want to encourage a shift in the current state. Further research to address the absent perspective is needed to gain a more comprehensive snapshot of the current state across all Atlantic Provinces and professions.

The report also highlights several collaborative efforts, such as the Atlantic Cancer Consortium, as promising models for advancing precision oncology. However, the lack of formal evaluations of these initiatives makes it difficult to assess their effectiveness or their potential for broader implementation across the region. Addressing these gaps in future studies would strengthen the foundation for actionable, inclusive, and scalable strategies in precision oncology.

Conclusion and Path Forward

This report synthesizes insights from leading oncologists, pathologists, geneticists, and healthcare administrators across Atlantic Canada to assess the current landscape of precision oncology and identify opportunities for transformation. The findings underscore both progressive initiatives and structural barriers impeding the widespread adoption of precision oncology. The perspectives captured in this report reflect the real-world challenges faced by healthcare professionals, as well as their collective vision for a more

equitable and effective cancer care system. The time for incremental progress has passed. Healthcare leaders and policymakers must act decisively to ensure that every cancer patient in Atlantic Canada has access to timely, personalized, and effective treatments—regardless of where they live.

Precision oncology represents a paradigm shift in cancer treatment, tailoring therapies based on an individual's genetic, molecular, and environmental profiles. This approach has the potential to dramatically improve patient outcomes, reduce unnecessary treatments, and enhance the efficiency of healthcare systems. However, in Atlantic Canada, the integration of precision oncology remains uneven, with significant gaps in testing infrastructure, funding, governance, and workforce capacity. The integration of precision oncology into Atlantic Canada's healthcare system is not just an aspiration—it is an urgent necessity. While the region has leading-edge research programs and dedicated healthcare professionals, systemic barriers such as governance fragmentation, workforce shortages, and infrastructure gaps continue to slow progress. By adopting a regional governance model and strategy, securing long-term funding, expanding testing infrastructure, and enhancing clinician education, Atlantic Canada can create a more efficient and equitable precision oncology system.

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Appendices

APPENDIX A: Methodology for Thematic Analysis

Methods

We conducted a thematic analysis of qualitative interviews and document reviews to explore the current state of precision oncology in Atlantic Canada. Thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within qualitative data, providing a rich, detailed, and nuanced account of the data (24).

Data Collection

Interviews were conducted with key informants, including pathologists, oncologists, healthcare administrators, and policymakers, using a semi-structured format. Document reviews included government reports, academic articles, and organizational publications.

Data Analysis

The data were analyzed using Braun and Clarke's six-step framework:

- **Familiarization:** Transcripts were read multiple times to immerse in the data.
- **Generating Initial Codes:** Key phrases and ideas were coded systematically across the dataset.
- **Searching for Themes:** Codes were grouped into broader themes based on shared patterns.
- **Reviewing Themes:** Themes were refined to ensure they accurately captured the data.
- **Defining and Naming Themes:** Each theme was clearly defined, with illustrative quotes selected for support.
- **Producing the Report:** Themes were contextualized within the broader literature on precision oncology.

Coding was conducted using qualitative analysis software (NVivo) to ensure systematic categorization and transparency. Themes were validated through peer debriefing and iterative refinement with the research team.

APPENDIX B: Atlantic Canada Search Strategy

Methods:

To search the Atlantic Provinces (NS, PEI, NL, NB) several databases, targeted websites and advanced Google searches were completed. Search of two news databases: Lexis Nexis and Factiva, using variation of the words "Precis, Medic, Cancer, target, innovat, pharm" to search. Also legislature's HANSARD documents were searched for mentions of PO (and PM in general). Advanced Googles Searches were also performed using a similar, iteratively modified, search string. Fourteen articles related to the state of precision oncology in Atlantic Provinces were found (NB=4, NL=1, NS=8, PE=1).

Sites Searched
MoH
Health Authority
Cancer Society
Oncology Society
Legislation
Research Foundations
Universities
Pharmaceutical companies

The following pharmaceutical company websites were also searched:

Pharmaceutical Company Websites
Amgen
Astellas
AstraZeneca
Bristol Myers Squibb
GSK
Janssen
Merck
Novartis
Roche
Thermo Fisher Scientific

Results

After a thorough search of websites, reports, and other publications that describes the state of PO in AC, only 14 articles were found that provided relevant information. The limited results suggest a lack of documented information for PO in AC. This section provides the details from identified sources.

APPENDIX C: State of Precision Oncology in Canada

In Canada, the integration of precision oncology into healthcare systems is evolving, but progress is uneven across provinces. Key challenges include limited awareness among healthcare providers, inconsistent testing infrastructures, fragmented funding models, and gaps in regulatory and organizational frameworks. These barriers hinder the delivery of equitable and efficient precision oncology services nationwide. This appendix synthesizes insights from key studies to provide a cohesive overview of Canada's precision oncology landscape (1,17,19). It identifies systemic gaps while highlighting actionable recommendations that can guide improvements in awareness, testing, treatment, funding, and regulation.

Awareness

In Canada, the state of awareness regarding precision oncology reflects several areas for improvement. There is a need for continual professional development to match the pace of innovation in PM (20). Many healthcare professionals have limited knowledge of how to order and interpret PM tests, particularly when caring for underrepresented populations (19). There is a lack of awareness across all provinces, likely due to stakeholder unawareness and the absence of navigation tools for practitioners (1). While physicians may have a general awareness of oncology PM, they lack in-depth clinical knowledge of the subject and its associated technologies, hindering its integration into practices (46). Deterrents to adoption for healthcare providers include the costs and time required to stay updated, uncertainty in adopting new guidelines, and a lack of technology or AI support for managing complex information. Additionally, researchers highlighted frustrations among participants regarding the lack of information on testing and treatment access, reimbursement issues, and gaps in evidence supporting value-for-money treatments. Addressing these challenges and improving clinician awareness through enhanced access to education resources are crucial steps in advancing precision oncology in Canada (47).

Testing

A readiness of several Canadian provinces (>85% of population) highlighted a need for better integrated informatics, including real-time EMRs to support clinical decision-making through sharing test results and integration with external databases (20). The report stressed the need for comprehensive evaluation of value, considering both pre-market and post-market data, alongside cost considerations. The current state of test ordering is overcomplicated due to variations in processes across institutions and jurisdictions, particularly regarding funding. The lack of structured workflows further complicates result interpretation and delivery (19). The report proposes building patient-centered models of care and enhancing provider awareness to improve testing practices. Province-specific reviews reveal variations in testing infrastructure and coordination. While health system arrangements different between provinces, Alberta, Quebec, and British Columbia have developed a centralized testing organizations, NS lacks a single point of entry. Testing timelines and review processes vary across provinces, with issues such as insufficient laboratory information persisting. The development of genetic testing at facilities like the

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McCain GU BioBank (MGB) highlight the importance of sample quality and meticulous processing protocols, which may be a model to follow for national standards that encourage widespread adoption (23).

Treatment

Using expert perspectives and pre-specified selection criteria (emerging impact, clinical relevance, feasibility, accessibility, health system alignment, and evidence base) the Canadian Agency for Drugs and Technology in Health (now the Canadian Drug Agency) identified five potential technologies and treatment avenues including digital tools facilitating access to genetic information and aiding in care navigation, liquid biopsy techniques, omics-based sequencing methods, and population-based genetic screening initiatives(19). Each of these interventions is accompanied by ongoing or proposed pilot studies and initiatives aimed at evaluating their value, feasibility, and implementation considerations within the Canadian healthcare landscape. The analyzes describes that liquid biopsies, which analyze tumor DNA from blood samples, offer a less invasive alternative to traditional tissue biopsies, with applications in monitoring disease progression, therapeutic response, and early detection. Omics-based sequencing technologies, including whole genome, exome, and transcriptome sequencing, offer promise by providing a comprehensive molecular profile of tumors, enabling more precise diagnosis and tailored treatments, particularly for rare and complex cancers. Despite these advancements, challenges persist in clinical implementation and interpretation of test results. Many healthcare professionals lack training in using PM tools effectively, and health systems face barriers in funding, infrastructure, and standardization. Moreover, disparities in access to cutting-edge technologies remain a pressing issue, particularly in rural and underrepresented populations. Addressing these gaps will require better clinician education, streamlined testing protocols, and robust governance frameworks.

Funding

In Canada, the funding landscape for precision oncology is characterized by a mixture of sources and varying levels of coverage across provinces. While some costs are covered by well-established investigational testing funds and the flexibility of provincial systems, there is a notable absence of an overarching funding formula. There is an argument for immediate availability of funding upon adoption, advocating for a value-based but adaptable funding model that includes dedicated funding for test development and additional resource costs. Provincial funding tends to prioritize drug-based treatments, potentially leaving gaps where tests may be available without corresponding treatments or vice versa(20). Funding for in-house laboratory testing often relies on baseline operational funds, pharmaceutical grants, and public sector research, with variations between provinces (20). For instance, British Columbia and Alberta offer more comprehensive coverage of lab testing, while NS's and NB's funding for testing is at the discretion of individual hospitals. Quebec's funding is limited to "medically necessary" testing, excluding investigational tests and potentially unfunded treatments (1). Hospitals often supplement provincial funding with private fundraising and research funds, creating a reliance on the private sector for services.

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Moreover, maintaining specialized facilities like the MGB incurs significant costs, partly covered through grant funding, institutional support, and philanthropic donations (23). However, the lack of evidence on the cost-effectiveness of precision oncology poses a barrier to implementation, and the burden of financing often falls on patients, hindering their access to care (47).

Data Quality and Management

In Canada, the regulation of precision oncology practices is advocated to ensure a standard of care, covering training, qualifications, and record maintenance. Accreditation standards, such as those set by the Clinical Laboratory Improvement Amendments Act of 1988 (CLIA), are proposed to maintain quality standards (20). The MGB at the University Health Network in Toronto exemplifies structured organization, employing a clinical team for patient consent and sample collection, a biospecimen handling team for transport and processing, a data management team for clinical data, and research support (23). Strong relationships with research ethics boards are crucial for informed consent procedures and systematic data collection that ensures compliance with biobank responsibilities.

Links between biobanks and databases at regional, provincial, or national levels are recommended for optimal care quality (23). However, challenges persist in resource availability for promoting oncological innovations, both in personnel and financial aspects (46). For example, British Columbia's Gynecological Cancer Research Program (OVCARE) data governance structure employs a centralized portal to manage requests, researchers, project descriptions, and ethics applications (48). With concerns about the limitations of randomized controlled trials in precision oncology, a shift toward real-world data, supported by legislative measures for data-linking, is advised to address uncertainties and bridge gaps in knowledge (47).

Recommendations to Improve the State of Integration

To enhance the integration of precision oncology in Canada, various recommendations have been proposed.

- Firstly, there is a call for regulation across training, qualifications, record maintenance, and documentation to ensure a standard of care, similar to the CLIA for clinical genetic testing.
- Establishing a network for shared data, resources, and standards is crucial, along with regular assessments to sustain quality care (20).
- Strong private-public partnerships are advocated to reduce care lag, and a proactive shift toward single-entry testing for example, like the one supported by horizon scanning is recommended. Furthermore, the Ministry of Health is advised to act more as a steward in the process (20).
- Consolidating laboratory services into single service organizations is highlighted as pivotal for forming regional networks and ensuring consistent regulatory standards (17).

- Healthcare systems need to facilitate frequent resource planning, nimble funding, and integrate EMRs for efficient coordination.
- Partnerships with educational institutions, hospitals, and population health databases are emphasized to increase sample use and translational discoveries.
- Fostering relationships between researchers and biobanks can enhance data sharing and future studies.
- Patient engagement in the biobank process, including participation in steering committees (23).
- Carefully planned strategies encompassing policies, resource planning, and decision-support tools for sustainable diffusion and adoption of precision oncology, considering individual behavior change theories (46).
- Transparency across jurisdictions regarding reimbursement and resource allocation is recommended, along with open discussions to foster understanding of the economic and patient benefits of precision testing and treatments.
- Comprehensive data collection, integration of bio-statisticians and data scientists, and accessible education resources for both clinicians and patients are essential for informed decision-making and reimbursement decision support (47).

Summary

The integration of precision oncology into Canada's healthcare system presents both opportunities and challenges. While significant strides have been made, particularly in provinces with centralized testing organizations, much work remains to ensure equitable access, consistent quality, and sustainable funding across the country. The disparities in awareness, infrastructure, and coordination emphasize the need for a unified national approach. Canada can adopt frameworks to enhance clinician knowledge, streamline testing workflows, and foster interdisciplinary cooperation. Investment in EMRs and real-world data collection can further support data integration and clinical decision-making. Addressing the funding challenges requires innovative, value-based approaches that balance immediate costs with long-term benefits. Consolidating laboratory services into single organizations can optimize resource allocation and ensure regulatory consistency (20). Strengthening public-private partnerships and leveraging philanthropic contributions, as seen with institutions like the MGB, can provide additional financial support for specialized facilities.

Lastly, fostering patient engagement and transparency in reimbursement decisions is critical for building trust and ensuring equitable access to precision oncology services. Strategies such as patient inclusion in steering committees and clear communication about testing and treatment options can empower individuals and reduce hesitancy. By integrating these insights and leveraging global best practices, Canada can create a cohesive, equitable, and innovative precision oncology ecosystem. This transformation requires collaboration among policymakers, healthcare providers, and researchers to overcome systemic barriers and deliver personalized care to all Canadians, regardless of geographic or socioeconomic status.

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APPENDIX D: International Search of Precision Oncology Programs and Policies

Globally, Precision Oncology's integration into healthcare systems varies significantly, shaped by differences in awareness, testing infrastructure, multidisciplinary collaboration, funding, and governance, among others. While some countries have made remarkable progress in standardizing precision oncology practices, others face barriers such as resource limitations, fragmented policies, and disparities in access.

Awareness of Precision Oncology

Awareness of precision oncology among healthcare providers and patients is fundamental to its successful integration into clinical practice. In many regions, however, knowledge gaps persist, limiting the adoption of advanced molecular profiling technologies. Efforts to enhance awareness often include structured educational initiatives, interdisciplinary training programs, and public engagement strategies to bridge these divides.

In the UK, the Genomics Education Programme equips healthcare providers with practical knowledge of genomic technologies, making advanced testing and treatment options accessible even in rural settings (5). In the European Union, annual training courses and interdisciplinary programs offer comprehensive insights into molecular diagnostics, enabling healthcare professionals to interpret genomic data effectively (6). Australia, through the International Atomic Energy Agency's training curriculum, emphasizes theragnostic applications, educating clinicians on the principles of radiopharmaceuticals (40).

In contrast, awareness in Italy is hindered by a lack of standardized education, leaving many clinicians unfamiliar with NGS and molecular profiling (8). Similarly, the United States struggles with disparities in precision oncology education, particularly in underrepresented communities, where structural inequities compound these gaps (49).

Testing Infrastructure and Coordination

The successful implementation of precision oncology relies on robust testing infrastructure and well-coordinated workflows. Testing capabilities vary greatly between countries, influenced by access to advanced technologies, standardized methodologies, and national policies promoting integration.

In the UK, centralized facilities like the AWMGS (All Wales Medical Genomics Service) ensure rapid and equitable access to genomic testing (41). Reflex biomarker testing and streamlined workflows facilitate quick turnaround times, with results from NGS tests available within 10 days of biopsy (41). The European Union employs initiatives such as the MTBP to integrate bioinformatics tools into testing and prioritize actionable mutations (42). In Australia, the Zero Childhood Cancer Initiative combines clinical and genomic data to tailor pediatric cancer treatments, supported by adherence to strict regulatory frameworks (7).

Italy faces challenges in developing a cohesive laboratory network, with fragmented services that rely heavily on narrow gene panels for specific cancers. Efforts to establish standardized workflows and external quality assessments are ongoing (39). In the United States, initiatives like the I-PREDICT Trial incorporate NGS and liquid biopsies into therapeutic decisions, though testing availability remains uneven (50). These contrasts highlight the need for more cohesive and scalable testing strategies in regions with fragmented infrastructure.

Treatment Integration and Multidisciplinary Collaboration

Precision oncology treatments require effective interpretation of genomic data, interdisciplinary collaboration, and robust decision-making frameworks. Multidisciplinary teams, including oncologists, pathologists, bioinformaticians, and genetic counselors, play a vital role in ensuring tailored and effective care.

In the UK, the use of Molecular Oncology Consults and Molecular Tumor Boards (MTBs) connects genomic findings to clinical recommendations, enhancing patient outcomes (41). The European Union integrates genomic and clinical data through the OSIRIS Initiative, enabling longitudinal tracking of disease progression and treatment responses (42). In Australia, multiomics data is combined with deep learning tools like CDR scan, which predicts drug efficacy and identifies optimal therapeutic strategies (51).

Italy has a strong reliance on MTBs for treatment decisions, though a lack of connectivity and role clarity limits their effectiveness (52). Similarly, in the United States, MTBs underpin treatment recommendations in trials like MOSCATO, yet disparities in access to targeted therapies and challenges in interpreting complex data persist (50) . Across all regions, MTBs have proven essential for advancing precision oncology, but their implementation varies widely.

Funding and Resource Allocation

Sustainable funding models are essential to advancing precision oncology, ensuring access to testing, treatments, and necessary infrastructure. Across the globe, funding approaches differ in terms of public investment, private partnerships, and reliance on charitable contributions.

In the UK, centralized funding for genomic services through organizations like the AWMGS ensures equitable access. Charitable initiatives, such as the Breast Cancer Now Tissue Bank, supplement public funding to expand precision oncology resources (44). In the United States, programs like MCGI subsidize testing for uninsured patients, though reimbursement policies remain inconsistent (53).

The European Union often relies on project-based funding and public-private partnerships, such as grants supporting the iTHER program for biomarker-driven trials (54). Australia combines federal government funding with private donations to support programs like the PRISM Program, which focuses on pediatric cancer care (7). Italy provides public funding for

molecular testing as part of diagnostics but struggles with reimbursement gaps for personalized treatments, emphasizing the need for innovative value-based funding models (8).

Governance

Effective governance frameworks ensure standardization, equity, and quality in precision oncology. Centralized oversight allows for consistent application of genomic services and integration with broader healthcare strategies.

In the UK, the AWGOG ensures a coordinated approach to genomic service delivery, aligning testing and treatment strategies with healthcare objectives (41). The European Union fosters collaboration through the InPreD PM Program, which enhances access to biomarker-driven trials and advanced testing pathways (55).

Australia emphasizes compliance with strict regulatory standards for radiopharmaceuticals, ensuring safety and quality in testing and treatment (40). Italy, however, lacks centralized guidelines for MTBs, resulting in variability in practices and inconsistencies in care delivery (8). Similarly, the United States faces challenges in aligning testing and treatment pathways across a fragmented healthcare system (50).

Summary

The global state of precision oncology reveals significant variability in how countries implement and integrate genomic technologies into healthcare systems. While regions like the UK and EU exemplify robust governance, standardized workflows, and centralized funding, challenges in awareness, testing coordination, and equitable access persist in countries like Italy and the United States.

By adopting proven strategies, such as centralized genomic services in the UK (41), interdisciplinary collaboration in Australia, and real-world data integration in the EU (42), countries can enhance their precision oncology ecosystems. As genomic technologies continue to evolve, fostering global collaboration and knowledge sharing will be critical to ensuring that all patients benefit from personalized cancer care.

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