Pathway to the Clinical Implementation of Genome-Wide Sequencing for Rare Disease
Precision Health: Genome Canada’s Approach

**Phase 1 – Laying the Foundation:**
Precision Health Large-Scale Applied Research Projects

**Phase 2 – Into the Clinic:**
Rare Disease Clinical Implementation

**Phase 3 – Beyond Rare Disease:**
Clinical Implementation of Other Disease Indications

**Phase 4 – This is Canada:**
Building a National Database through a Large Population Cohort
Phase 1 – Laying the Foundation

Precision Health Large-Scale Applied Research Projects

<table>
<thead>
<tr>
<th>Genome Canada Funding Competitions</th>
<th>Funding</th>
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<tbody>
<tr>
<td>2004 – Applied Human Health</td>
<td>$130 M</td>
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<tr>
<td>2010 – Advancing Technology Innovation through Discovery</td>
<td>$4M</td>
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<tr>
<td>2012 – Genomics and Personalized Health</td>
<td>$147 M</td>
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<tr>
<td>2017 – Genomics and Precision Health</td>
<td>$162 M</td>
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<tr>
<td>2012-2017 – Technology Development and Bioinformatics</td>
<td>$64 M</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$507 M</strong></td>
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LSARPs: Genomics and Precision Health

Goal – to support research that has an increased likelihood of being translated into applications

Projects are required to:

• demonstrate how genomics-based research could contribute to a more evidence-based approach to health and improve the cost-effectiveness of the health-care system.

• produce concrete deliverables with the potential to be translated into valuable treatments, tools or improved health-care policies and practices.

• Demonstrate user engagement in the development and execution of the research plan and include a user on the project team.

• Undertake GE³LS research to assist in the effective translation of research results into practice and policy, and the uptake of genomic-based applications into the health-care system.
Precision Health LSARPS

Silent genomes

Identifying novel genes and breaking the ‘Newfoundland Curse’

GenCOUNSEL

Care4Rare-Solve
Phase 2 – Into the Clinic

Recommendation #1

Develop a national vision for the implementation of genomics into the health-care system.

Start with a demonstration project in a targeted area to raise the profile of precision health in Canada and provide a framework to leverage synergies from existing work.
Rare Disease Clinical Implementation

Goal – establishment of a pan-Canadian program to implement genomics in the clinic, with an initial focus on rare disease.

Unmet Clinical Need in Canada

3-5 Specialists (>11 for 10%)

$15,000 ($8,000-$23,000) Cost per patient

40% Received >3 misdiagnoses

3-6 Years for a diagnosis
Building on our strengths

- 200 clinicians
- 21 sites
- 100 scientists
- 32 countries
- >1300 rare diseases studied
- >5000 families recruited
- 50% of families diagnosed
Building on our strengths

• RDMM Network, funded in partnership with CIHR, connects clinicians discovering new genes with scientists who study them in model organisms

• This work will lead to improved understanding of how specific gene mutations cause rare diseases, which will ultimately generate therapeutic leads
Access to clinical exome sequencing

Canada: 37,242,571
Statistics Canada estimates Q4 2018
Requesting clinical sequencing
Phase 1
The Canadian Genomics Partnership for Rare Disease (CGP4-RD)

- access to genome-wide sequencing
- data governance to tackle social, economic and policy issues
- a pan-Canadian data ecosystem for sharing to catalyze innovation
- a rare disease cohort to scale data
- patient and community engagement to align genomic solutions with relevant problems and
- health-care professional engagement and education to optimize precision health delivery and patient care.
Access to Genome-wide Sequencing

- Clinical genomic testing across Canada is inconsistent
- Genome Canada’s GAPP is being used to develop clinical genomic testing sites across the country.
- Four submissions received to date.
- Projects must:
  - have the support of the provincial or regional authority responsible for clinical implementation and placing the tests on the health-care formulary, and
  - commit to align with the principles and actions set out in the program’s Mission Statement
- Meetings are planned for the spring of 2019 with key provincial and regional stakeholders from across the country to ensure alignment and a shared path forward
Data Governance

- It is essential that genomic data be treated with utmost privacy and care while also ensuring their potential can be realized to benefit the individual’s health.
- Public trust and concerns must be effectively managed – identifying opportunities for social and economic benefit while ensuring individuals retain control over their intimate data.
- Canada has become a world leader on data governance policy, evidenced by our roles at the Global Alliance for Genomics and Health.
- P3G2 at McGill University, under the leadership of Bartha Knoppers, has been commissioned to develop a Regulatory and Ethics Toolbox.
Pan-Canadian Data Ecosystem

- The ecosystem will allow data sharing between institutions, across jurisdictional boundaries and between clinical and research settings.
- Three tiers are envisaged:
  - Local clinical sites
  - Provincial staging areas for data harmonization and
  - A general research cloud with de-identified and aggregated data.
- An overarching goal is the passive collection of data generated during clinical care to be leveraged for secondary use in research.
- A Data Working Group has convened Canadian and international experts to provide input on the model.
- A funding opportunity will be launched to develop the ecosystem.
Rare Disease Cohort

- The cohort will include 30,000 individuals (10,000 rare disease patients and 20,000 parents)
- It will enable discovery of new disease genes and serve as a powerful diagnostic tool
- Access to the resource will be governed by rules and regulations established by a stakeholder-focused governance group
- The cohort will initially be built through currently funded projects and the programs established through GAPP
- Additional funding is being sought
Patient Engagement
Health-care Professional Engagement
Phase 3 – Beyond Rare Disease: Clinical Implementation of Other Disease Indications

- The rare disease program will be a vehicle for supporting a learning health-care system and advancing next generation health-care delivery.

- It will lay the foundation for the next phase with a focus on advancing precision health for other disease indications.
Phase 4 – This is Canada: Building a National Population Cohort

- The health of a nation, as well as its wealth and innovation are increasingly based on management of large national data assets.
- These large data sets are essential for the delivery of precision health; providing the reference set – the baseline – AND can serve as powerful engines for innovation and economic development.
- Canada should build a large national population cohort—100,000 Canadians.
- It will be representative across disease, demographic, ancestry and region and capture the uniquely Canadian population, including Indigenous and founder populations.
QUESTIONS??

Cindy L. Bell, Executive Vice-President, Genome Canada