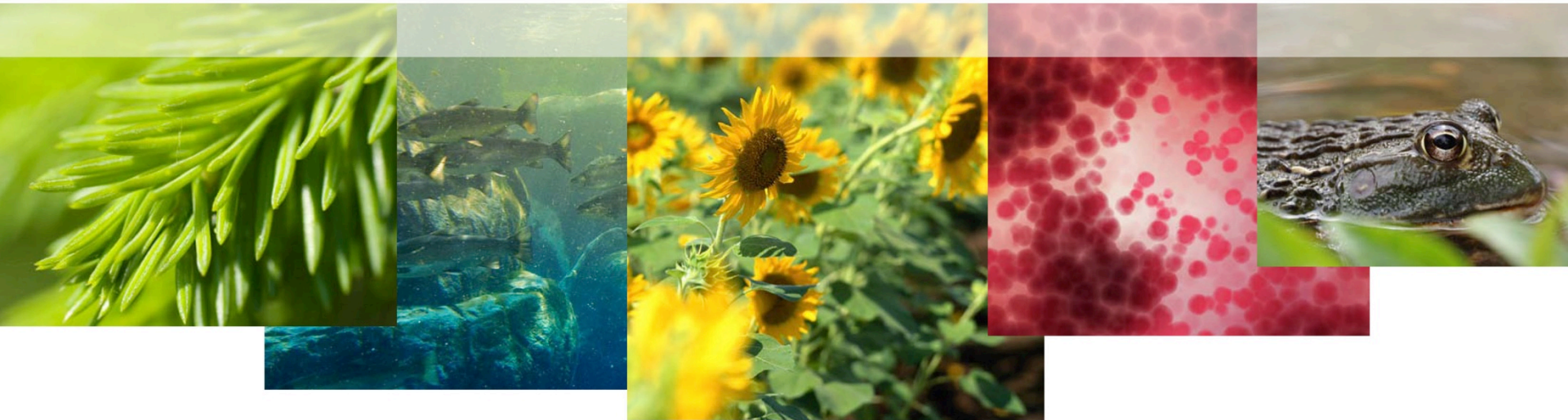


Implementing Genomics and Precision Health in Canada

Dr. Catalina Lopez-Correa

Chief Scientific Office and VP Sectors at Genome British Columbia





Canada's Genomics Enterprise



- **6** regional Genome Centres
- **10** Genomic Innovation Centers
- **210+** large-scale research projects/initiatives funded across all life science sectors
- **45** HQP on average, per project
- **58+** companies created or enhanced

Building a Future: Genome BC 2015-2020

- Invest **\$340M** into *Discovery, Applied* and *Translational* research key to Life Sciences jobs plan
- With \$85M from the Province, attract **\$255M from partner co-investors** for genomics R&D
- Focus on *sector-driven research* to deliver economic and social benefit of BC
- Continue to enhance BC's national/international competitiveness for *scientific excellence* in genomics
- Drive *opportunities for BC* through 2020 and beyond

38 Companies Advanced by Genome BC:





GENOME BRITISH COLUMBIA PRECISION MEDICINE PROJECTS

**Cumulative investment in 145 projects • 53 Active
Total \$352.5M: GBC \$69.3M with Co-investment \$283.2M**

Prevention

Diagnosis

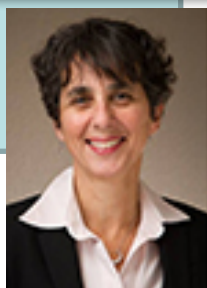
Treatment

Prognosis

Genomics



First Nations
Biobank



Prenatal
Screening



RapidOMICS



Genomics for
pharmacists



Biomarkers for COPD
Management

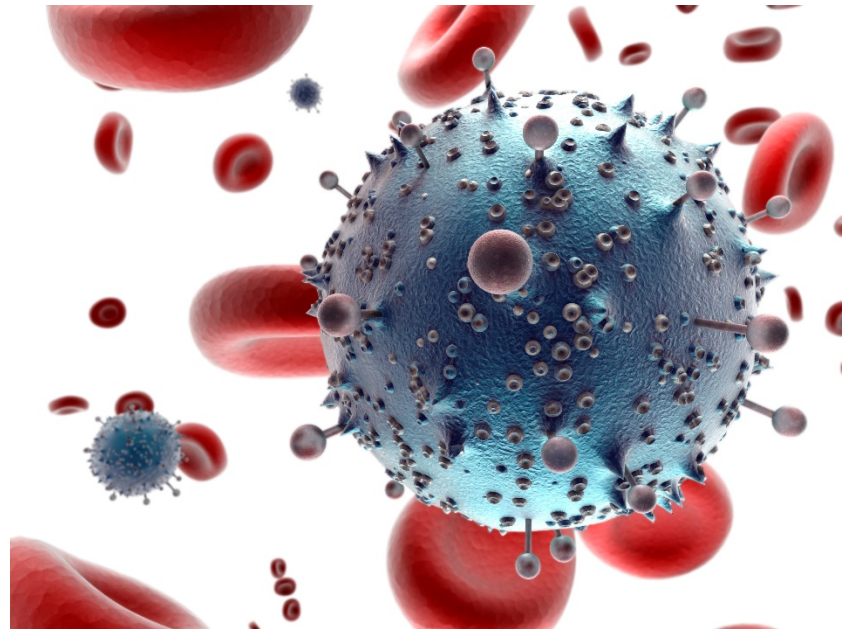
Leading the world in HIV/AIDS research

Researchers: Julio Montaner and Richard Harrigan

In Canada over **70,000** people are infected with HIV and nearly \$1 billion is spent on HIV drug cocktail therapies each year

The BC Centre for Excellence in HIV/AIDS is leading the world to reduce HIV/AIDS global burden by 90 % in 2030

Genome BC is supporting the BCCfE in developing an HIV drug-resistance test, real-time drug resistance surveillance and better methods for **personalizing treatment of HIV based on each patient's unique DNA**



The Personalized Onco-Genomics (POG) Program

Researchers: Janessa Laskin and Marco Marra

This BC Cancer Agency project looks at the specific mutations that cause cancer.

350 patients have received personalized treatment, based on their DNA representing 50 different cancer types.

The next phase: More patients, more cancers

Doctors can then **customize treatment options to target those mutations, increase efficacy and reduce overall cost**





Personalized Onco Genomics Program

	POG 1	POG 2	POG 3
Start Date	July 2012	July 2014	Fall 2015
Completion Date	August 2014	Ongoing	
Cases - Target	100	300	5,000
Cases – Consented*	106	225	
Cases – Completed**	85	80	
Cases – In Progress	0	95	
Funding	\$3.2M	\$9.5M	\$100M (target)

* Includes 20 pediatric cases

** For the 78 patients with outcome data available, results of POG analysis were clinically informative in 65 cases (85%); with 55 cases (70%) considered actionable; of these 34 cases received treatment and 14 cases experienced clinical benefit

43 year old woman with metastatic lung cancer in 2013

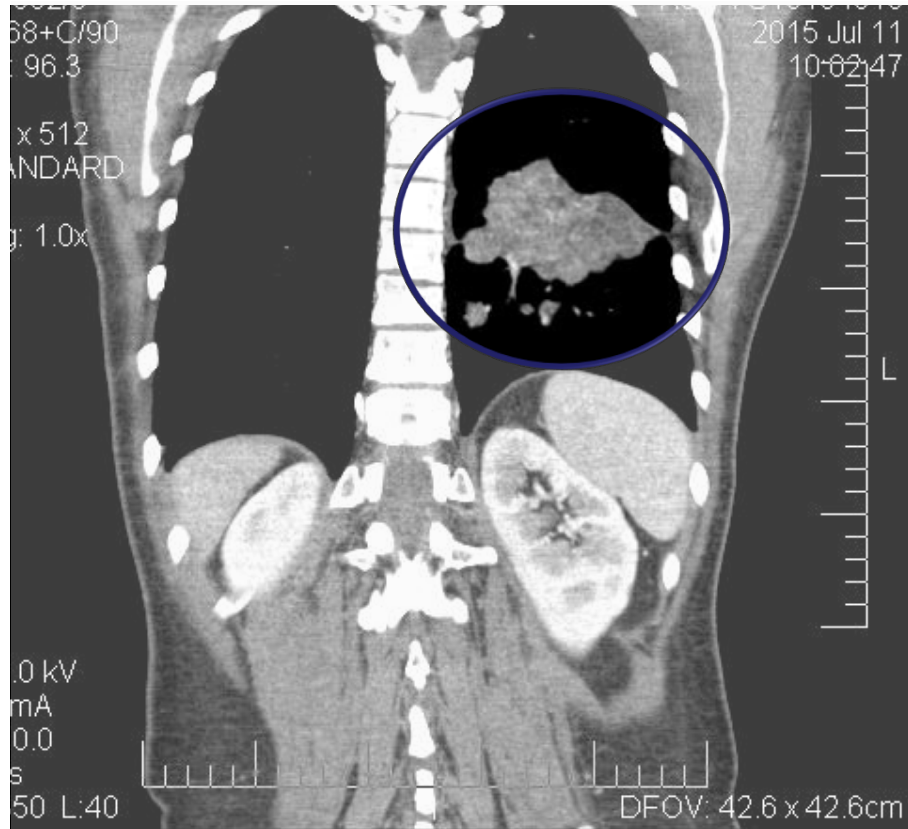
- lifetime never smoker

Standard chemo – some response

Sequenced upon progression

Analysis revealed gene fusion involving NRG1

- Applied afatinib (drug approved in lung but not in this setting)
- “...inhibitor of the receptor tyrosine kinase (RTK) epidermal growth factor receptor (ErbB; EGFR) family, with antineoplastic activity



Baseline July 11
Afatinib started July 16



Sept 10
(8 weeks on therapy)

Lessons learned

Determined the feasibility of this approach in a **tertiary cancer care centre**.

- **Feasible....but scalable?**

Can the biopsy and subsequent analyses be completed in a **timely fashion**?

- **5 – 6 week turn around time. Opportunities for decreasing?**

What is the frequency of **“actionable”** results?

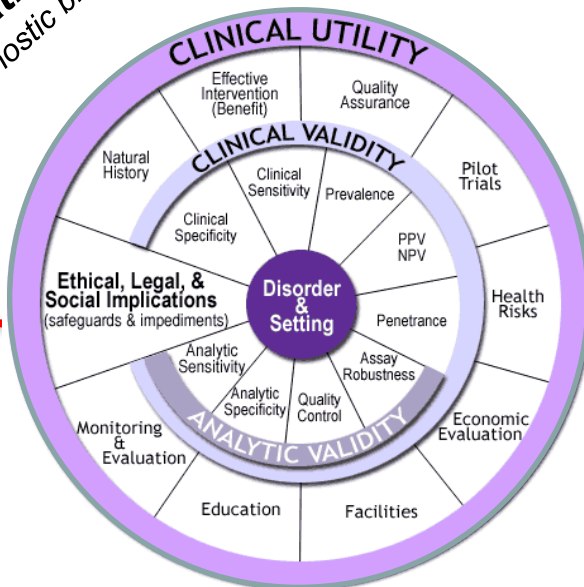
- **Depending on the definition of actionable...**

What is the frequency with which these actually result in a subject **receiving a drug** related to this test?

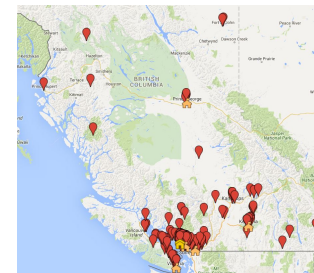
- **In majority of cases have influenced treatment planning.**

Path to the clinic

- Personalized OncoGenomics Program**
 - Whole genome + transcriptome analysis of metastatic diseases.
 - 93 oncologists; 691 cases enrolled (46 pediatric); 391 analyses
 - Drug repositioning; novel target discovery; genomic reports
- Personalized Treatment of Lymphoid Cancer**
 - Infrastructure for diagnostic biopsies & real time "targetted" profiling
 - 520 cases enrolled



**Ethics
Privacy
Economic evaluation**



**Populations
(BC and beyond)**

**Centre for
Clinical Genomics**

“Test” e.g.
Hereditary cancer panel
Oncopanel
Myeloid Panel

LSARP 2017: Genomics and Precision Health

Parameters:

- Genome Canada/CIHR will invest up to 50% and max \$5M per project
- Total budgets in the range of \$2-10M
- Project terms of up to 4 years
- Projects must have high potential to attain concrete deliverables within a short time-frame
- Process: Registration, Pre-application, Full Application and face-to-face meeting with Genome Canada's review committee
- All proposals from BC researchers must come through Genome BC



Genome BC's strategy for investment in health

Genome BC
focus areas

Invest in genomic health
research across diseases based
on merit and potential impact

MIND THE GAP

Enable targeted application of
genomics at the level of populations

External
guidance

Research Oversight Committee

Oversight Committee

Cancer

Infectious
diseases

Common
requirements

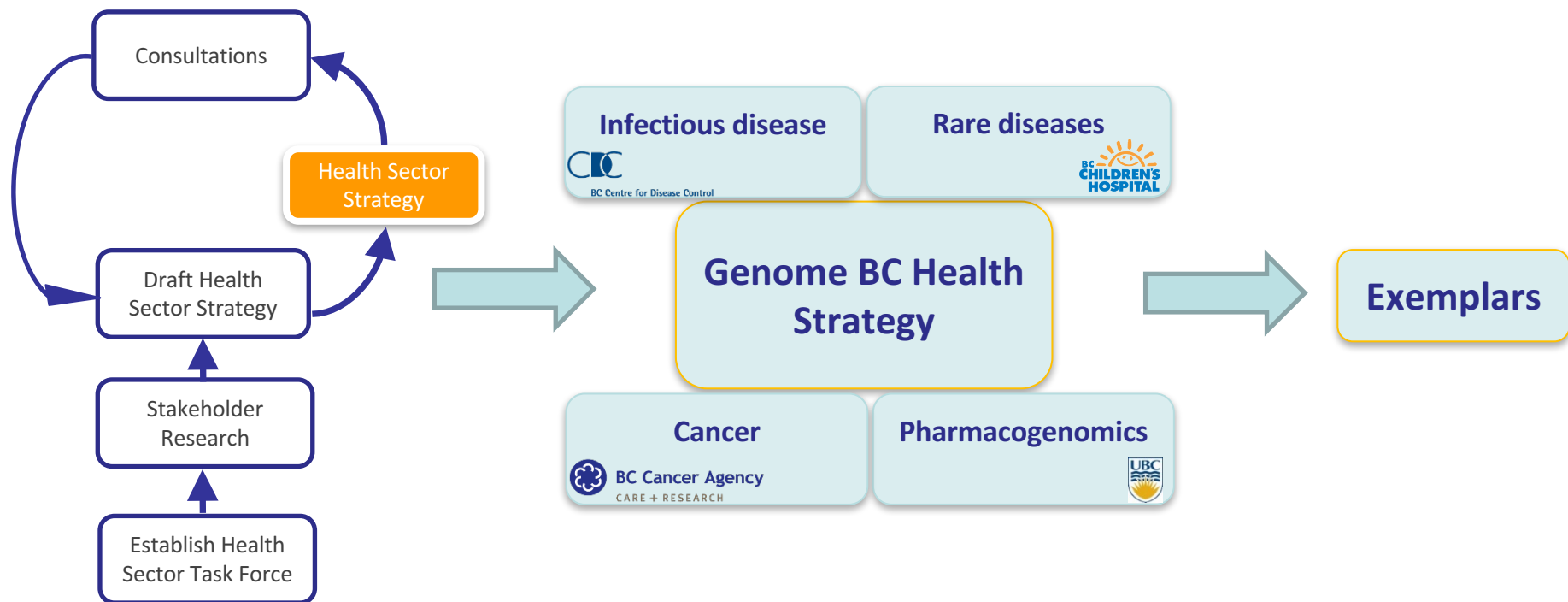
Rare diseases

Pharmaco-
genomics

Funding /
partners

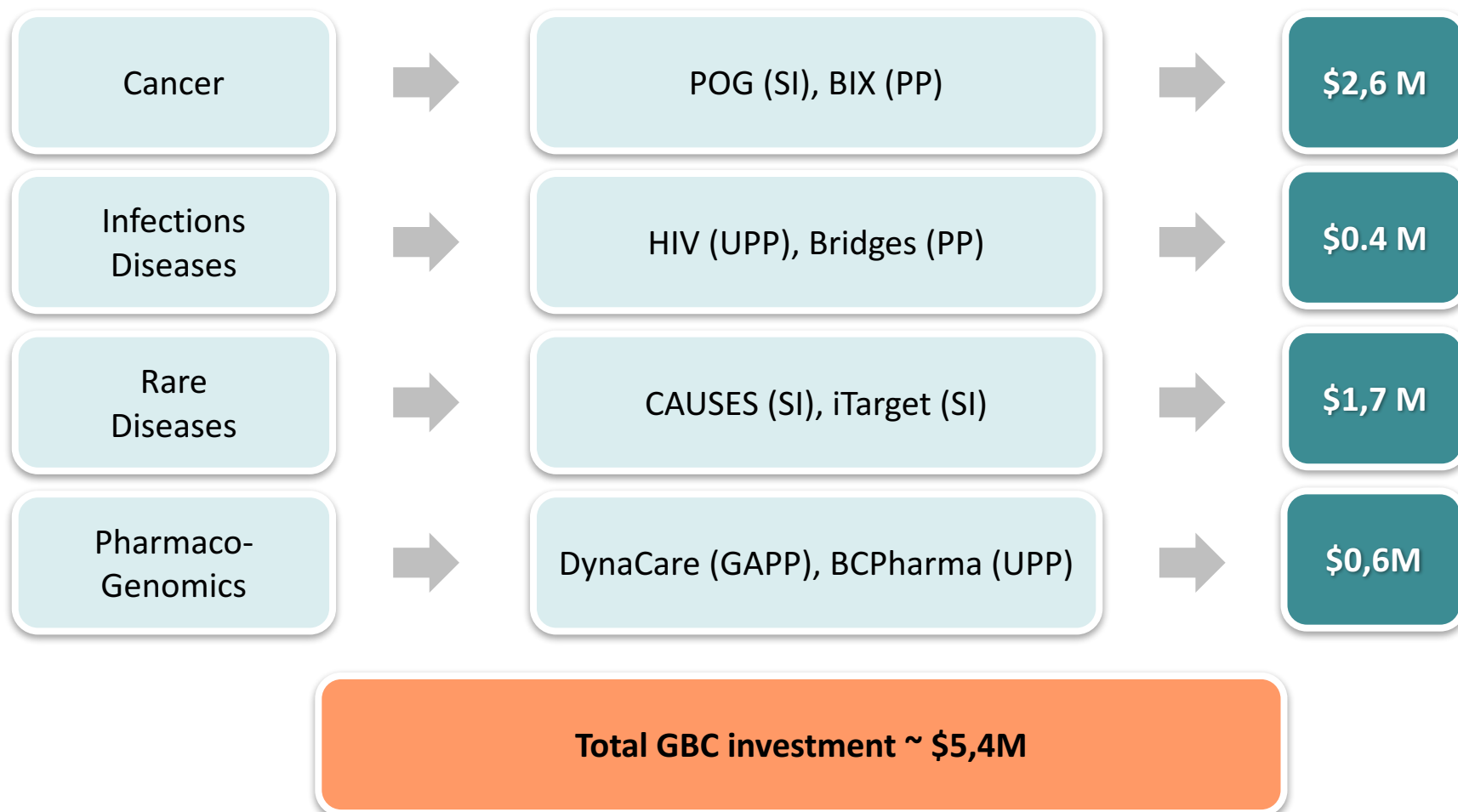
Genome BC, Genome Canada, CIHR, Industry partners, other partners

Genome BC Health strategy





Total GBC investment in four priority areas



Implementation Barriers

1. Lack of **coordination and centralization**
2. Need to establish an official mechanism of **Genomic Data Sharing (GDS)**
3. Bioinformatics focusing mostly on research instead of **data interpretation** and **data integration** into the clinic
4. Limited number of Genetic **Counselors & Bioinformatics** (interpretation)
5. **Several EHR systems** are being used (work in isolation and implementation varies greatly between regions)
6. Lack of unique/harmonized system to evaluate new technologies (NICE, FDA)
7. **Education** of health care providers



Crosscutting Areas to Accelerate Implementation

Cancer

Infectious
Diseases

Rare
Diseases

Pharmaco-
Genomics

Education of Health Care Providers

Big Data (Data integration, data sharing)

Capacity (Biobanking, Sequencing, etc)

Access (policy, reimbursement, economics, etc)

Implementation



Inspiring the next generation of scientists

Geneskool Workshops for students across BC

Examples of communities throughout the province where Geneskool Workshops have been presented.



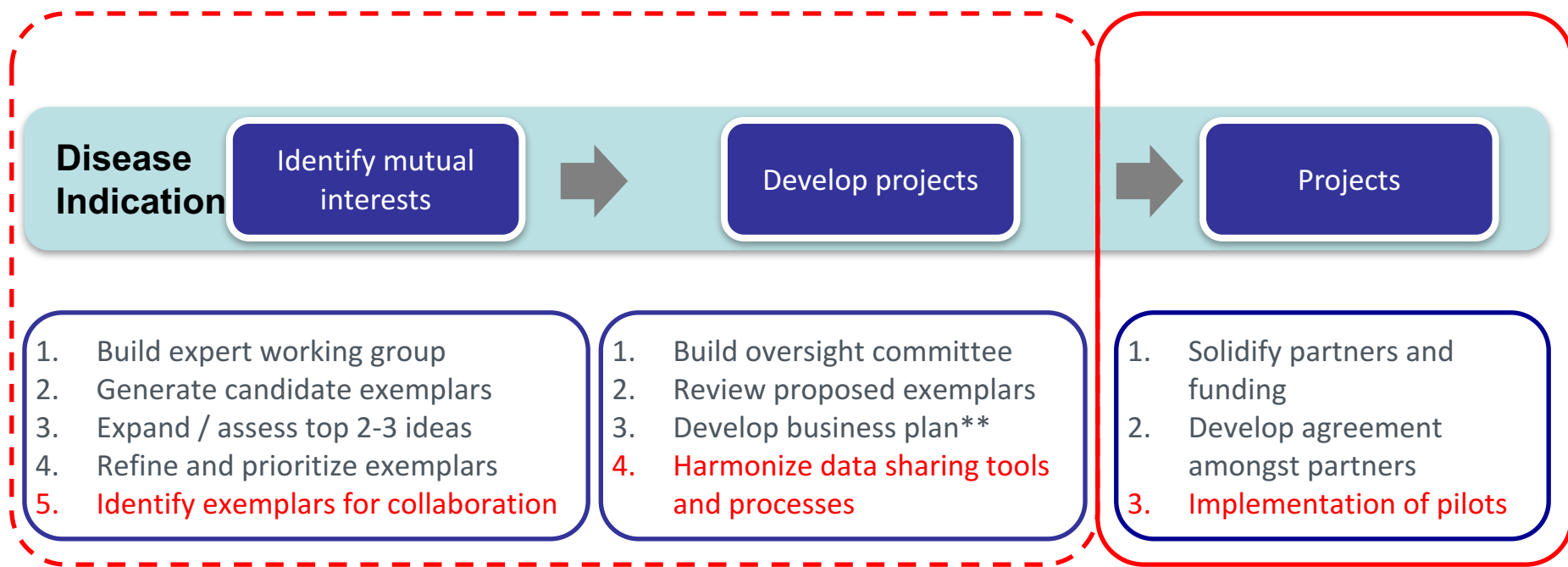
- | | |
|----------------|-----------------|
| Abbotsford | Mackenzie |
| Burns Lake | Nanaimo |
| Campbell River | Nelson |
| Castlegar | North Delta |
| Chetwynd | North Vancouver |
| Coquitlam | Parksville |
| Dawson Creek | Prince George |
| Fort Nelson | Quesnel |
| Fort St. James | Richmond |
| Fraser Lake | Surrey |
| Haida Gwaii | Vancouver |
| Invermere | Williams Lake |
| Kamloops | |
| Kelowna | |

Policy Framework for Genomic Services in BC

- Future directions for Genomic services in BC
- Close collaboration between Genome BC and the Ministry of Health in BC
- Aspect covered by the policy
 - Reimbursement
 - Genetic non-discrimination
 - Education
 - Evaluation of new test and new genomic technologies
 - Innovation and best practices
 - Role and interactions with industry partners



Genome BC & Genomics England Collaboration



**Phase 1: Implementing the MOU
(Sept-December 2015)**

**Phase 2:
Implementing Pilots
(Dec 2015-Dec 2016)**



Activities

Steering Committee Meeting (Monthly)

MOU Advisory Council meeting (February, March, May, October)

Pilots Status

Pilots

Infectious

Concept



Submission



Review



Resubmission
/ Review



Launch

Rare

Concept



Submission



Review



Resubmission
/ Review



Launch

Cancer

Concept



Submission



Review



Resubmission
/ Review



Launch

**Bio-
informatic**

Concept



Submission



Review



Resubmission
/ Review



Launch



Global Alliance
for Genomics & Health

Can **SHARE**»

- GA4GH to establish a common framework to enable effective and responsible sharing of genomic and clinical data, Can-SHARE will further the objectives of Global Alliance.
- Working Groups – Data, Clinical, Security, Regulatory and Ethics
- Demonstration projects use and improve tools and solutions created by Task Teams

Canadian-led Demonstration Projects:



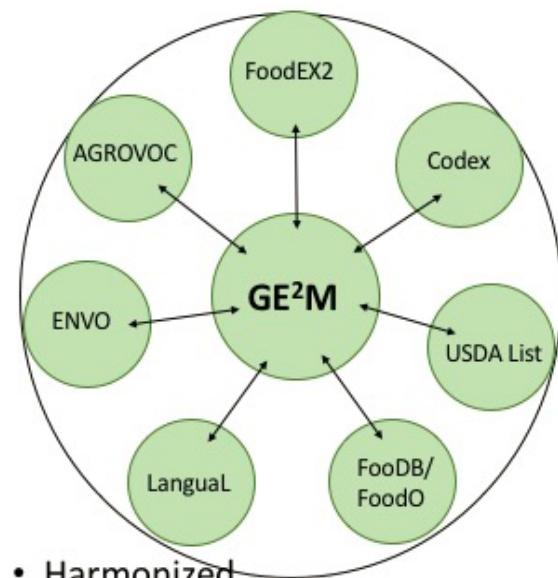


Emerging New Initiatives

Genomic Epidemiology Entity Mart (GE²M) – Data Harmonization Made Easier

Lead: William Hsiao, Natalie Prystajeky, Fiona Brinkman

- Genomic Epidemiology Ontology – infectious diseases
- Improve the harmonization of pathogen genomics data with other contextual and clinical health data
- Web portal links to other terminology databases, and entity fields and structures can be selected and placed into a “shopping cart”, and users can then export them in standard data format
- \$200,000 funding over 2 years



- Harmonized
- Mapping Through GE²M



Emerging New Initiatives

User-centric Genomics Data Exchange and Aggregation with BlockChain Technologies

Lead: Bruce McManus, Raymond Ng

- Remove silos in data sharing between health researchers, caregivers and patients while giving the latter more control over their personal information.
- Using BlockChain, the peer-to-peer technology behind Bitcoin, to apply it to health and genomics data.
- \$400,000 funding investment over 2 years.





Emerging New Initiatives

Beacon 2.0 - Beacons for Genomic and Clinical Data Discovery

Lead: Marc Fiume

- Beacon – web-accessible service that can be queried for information about a specific allele.
- This project will aim to develop “Clinical Beacons” services that will enable the discovery and sharing of patient and clinical information associated with genotypes of interest.
- \$100,000 funding over 2 years



DNASTACK



GENOMIC MEDICINE IN EMERGING ECONOMIES

GENOMICS FOR EVERY NATION

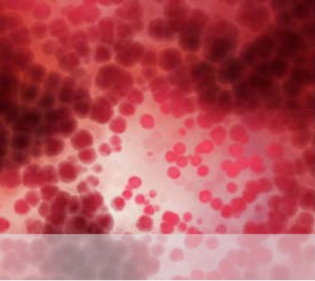


Edited by
Catalina Lopez-Correa
George P. Patrinos



Participating countries:

- Estonia
- Sri Lanka
- Thailand
- Chile
- Korea
- China
- Malaysia
- India
- South Africa
- Colombia
- Argentina
- Mexico
- Grece
- and many more



Genome
British Columbia
Leading > Investing > Connecting



Thank you!

