

CGP

Centre of Genomics and Policy

ACTIVATING THE HUMAN RIGHT TO SCIENCE

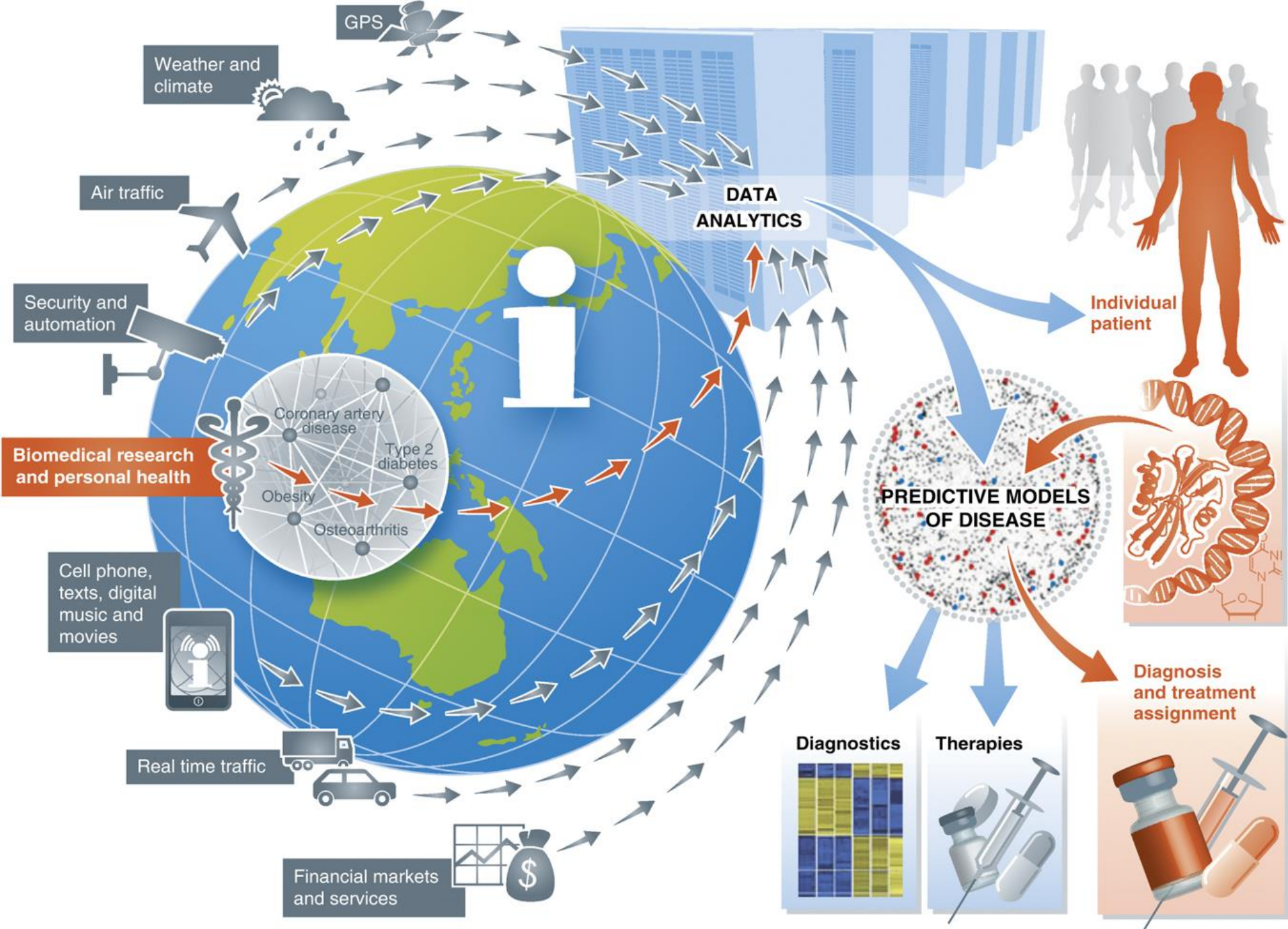
*Big Data and the responsible sharing of
genomic and health-related data*

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Canada Research Chair in Law and Medicine
McGill University



Global Alliance
for Genomics & Health
Collaborate. Innovate. Accelerate.



Eric E. Schadt, The Changing Privacy Landscape in the Era of Big Data, *Molecular Systems Biology* 8, 612 (2012).

Big Data Rationale

Broad scope of data sources

Genetic, medical, socio-economic, geospatial, cancer registry, primary care, air pollution, climate, contaminated soils or water, etc.

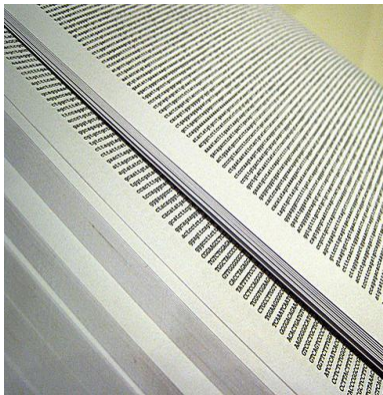
Associations with new factors, e.g. environmental

Stronger associations between phenotype, genotype

Benefits to public health, but also personalized medicine

The Challenge

Unparalleled generation of human genetic data



How do we unlock its health potential?



In a way that allows data to be shared on a global level



Thus empowering new knowledge, new diagnostics and new therapeutics for patients and populations



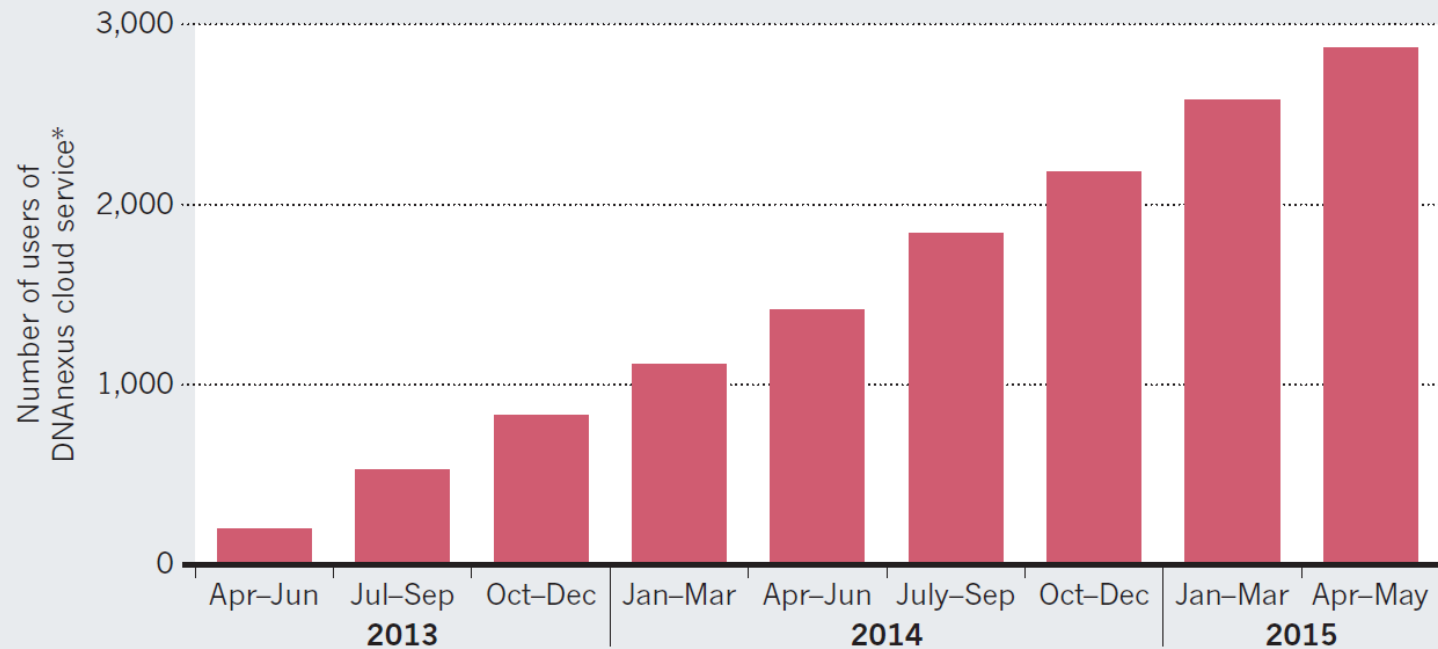
The Challenge

- Data from **millions of samples** may be needed to achieve results and progress, identifying patterns that would otherwise remain obscure.
- That will take new methods and organizational models.
- Right now:
 - Data is typically in silos: by type, by disease, by country, by institution
 - Analysis methods are non-standardized, few at scale
 - Approaches to regulation, consent and data sharing limit interoperability
- If we don't act: risk an overwhelming mass of fragmented data, as is the case with electronic medical records in many countries

Into the Clouds

REACHING FOR THE CLOUD

Internet cloud services, which provide large amounts of data storage and computing power, are becoming increasingly popular with geneticists grappling with vast data sets.



*Data from DNAnexus, a cloud-based genome informatics and data-management platform.

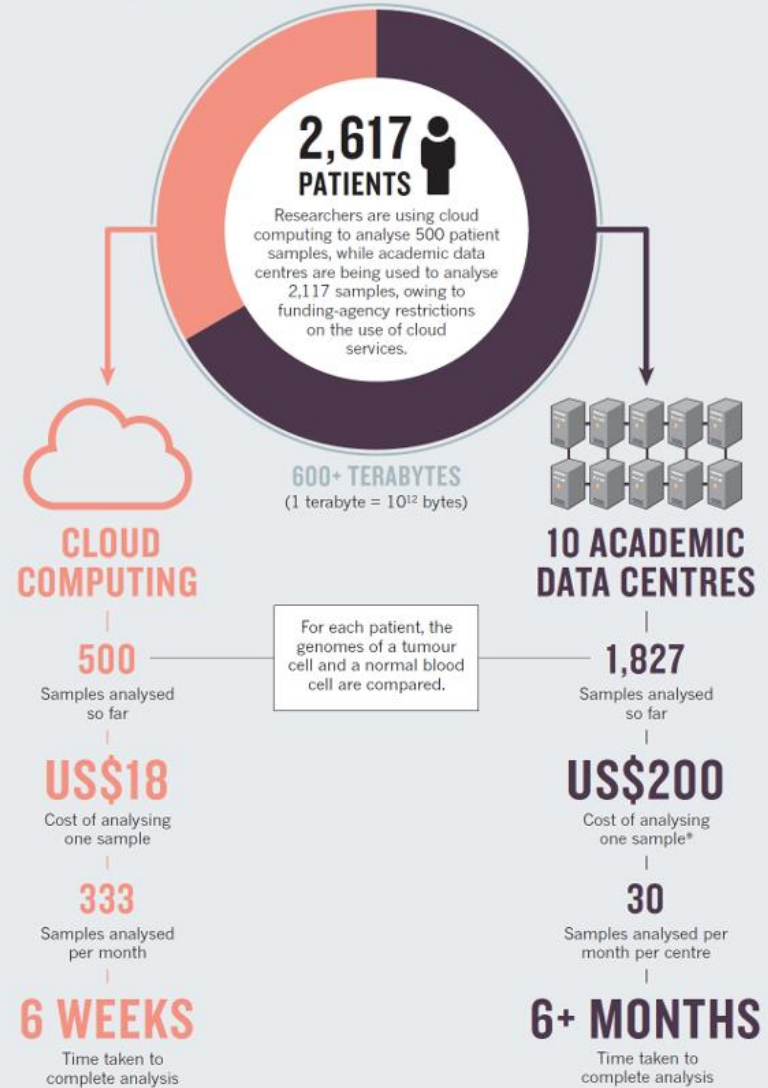
Scientific & Statistical Rationale

What accounts for the rapid rush into the clouds?

Economies of scale are making it difficult for genomic researchers to resist

EXPRESS LANE

The Pan Cancer Analysis of Whole Genomes project (in which L.D.S., P.C., G.G. and J.O.K. are involved), an effort to investigate the role of non-coding parts of the genome in cancer, demonstrates how much faster and cheaper it is to use cloud computing than to use conventional academic data centres when analysing vast biological data sets.



*If using a standard university computer system and buying the hardware.



Big Data and the cloud each pose new potential risks

- Broad linkage can jeopardize social rights, health care, welfare, housing, employment and education and equal treatment
- Loss of data control in the cloud takes various forms, from data integrity and availability issues, legal enforceability of contractual terms, to broad state surveillance practices

These risks must be addressed

Existing data privacy and other regulation has not been drafted with big data and the cloud in mind

IT'S NOT BORING
UP HERE - YOU GET TO
LOOK THROUGH EVERYONE'S
DATA!

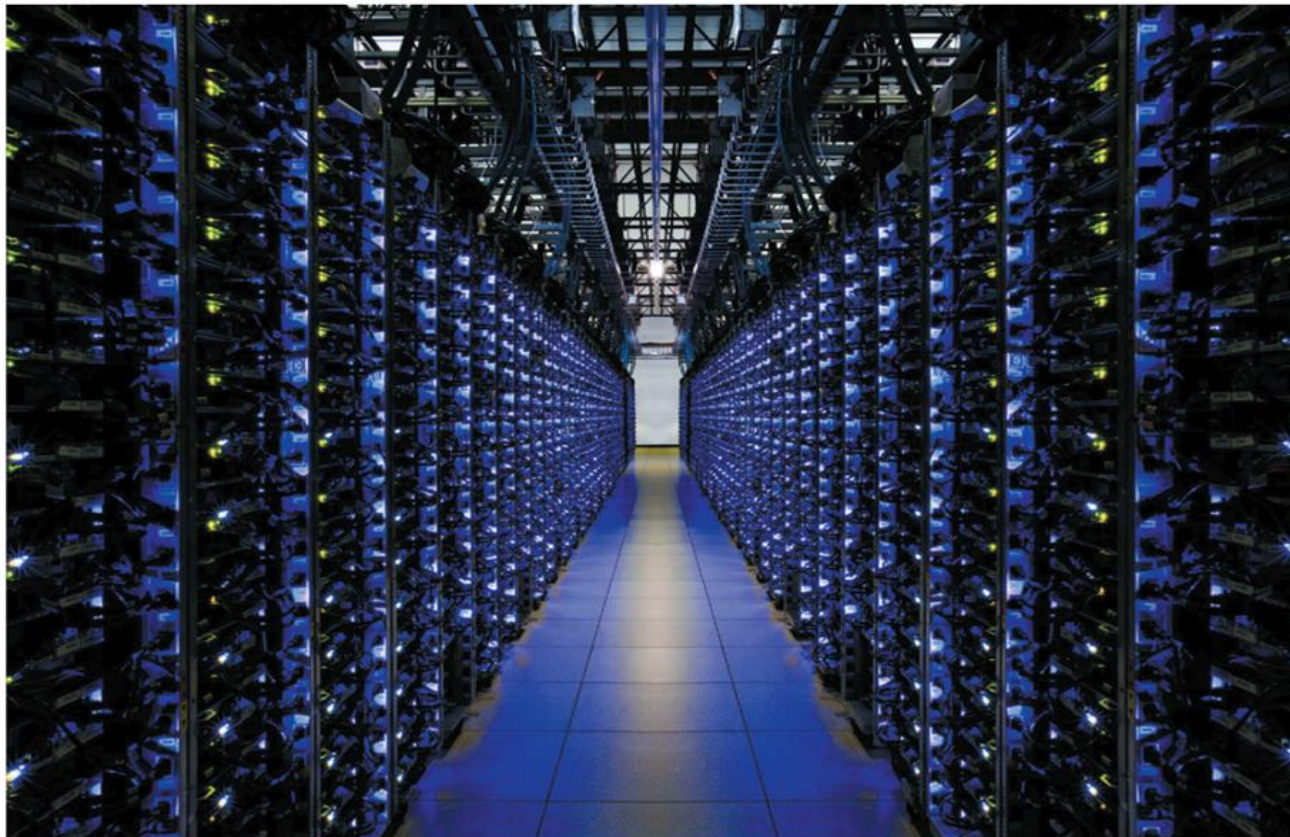


The EU Article 29 Working Party notes:

- a tension between Big Data and privacy limitations on collection, purpose, and processing of data
- Big Data “might require innovative thinking” but there is “no reason to believe that the EU data protection principles ... are no longer valid and appropriate for the development of big data”
- Quid: Safe Harbour



EUROPEAN
COMMISSION



Google's cloud services are among those increasingly being used by researchers who want to analyse large genomics data sets.

Create a cloud commons

Major funding agencies should ensure that large biological data sets are stored in cloud services to enable easy access and fast analysis, say **Lincoln D. Stein** and colleagues.

There was a collective cheer in the human genomics community earlier this year, as researchers — ever more stymied by the challenges of accessing vast data sets — saw a major roadblock disappear. In March, the US National Institutes of Health (NIH) lifted its 2007 restriction on the use of cloud computing to store and analyse the tens of thousands of genomes and other genetic information held in its

repository, the database of Genotypes and Phenotypes (dbGaP)¹.

Cloud services offer customers large amounts of storage and computing power on a pay-as-you-go basis. Because these services are available through the Internet, and multiple users share hardware, numerous funding agencies have been concerned that their use in genomics could threaten the privacy of people who supply samples².

The NIH turnaround is part of a growing suite of efforts aimed at addressing the fact that in the human genomics research community, the challenges of accessing big data sets are now blocking scientists' ability to do research, and especially to replicate and build on previous work (see go.nature.com/h9jgs1).

To take full advantage of the possibilities that cloud computing offers, we ►

Enabling a Cloud Commons

- Networked computing forms part of the “intellectual commons”
- Has led to emerging pushes toward a “genomic commons” directed and controlled by researchers themselves
- Allows architectures designed to maximize research benefits and privacy protection



Cancer Genome COLLABORATORY

Cloud computing for collaborative research

- Collaboration between OICR, University of Chicago, McGill University, BC Cancer Agency, MIT, UC San Diego, U Louisville, U Texas
- Development of cloud-based techniques to allow analysis of large cancer genomic datasets by vast array of research groups
- Designed to address two problems
 1. Lack of capacity to download and store the data
 2. Lack of compute power to analyze the data

- Cloud technology can address these computational difficulties
- But privacy and security concerns remain
- The CGC aims to address these through use of
 - Secure remote computing techniques
 - Robust but not burdensome access restrictions
 - Data localization controls





Global Alliance
for Genomics & Health
Collaborate. Innovate. Accelerate.

**What is the Global Alliance for
Genomics and Health?**

Mission

To accelerate progress in human health

by helping to establish a common framework of harmonized approaches to enable effective and responsible sharing of genomic and clinical data, and by catalyzing data sharing projects that drive and demonstrate the value of data sharing



Role

Convene stakeholders

Catalyze sharing of data

Create harmonized approaches

Act as a clearinghouse

Foster innovation

Commit to responsible data sharing



The Global Alliance does not *directly* ...

generate or store data

perform research or care for patients

interpret genomes

Membership is open to entities even if they do not hold or share data



Overall Approach

Work together **internationally** to ensure **interoperability** of data and of methods, to **harmonize** approaches to ethics and regulation, and to promote **participant** autonomy

Support pilots, reference implementations and data sharing **projects** that responsibly and effectively harmonize, analyze and share genomic and clinical data

Engage professional communities and the public; build **trust** and encourage appropriate sharing and learning



Organizational Members

Global Alliance members include:

1. Universities and research institutes (31%)
2. Academic medical centers and health systems (11%)
3. Disease advocacy organizations and patient groups (5%)
4. Consortia and professional societies (7%)
5. Funders and agencies (6%)
6. Life science and information technology companies (40%)





The **Clinical Working Group** aims to enable compatible, readily accessible, and scalable approaches for sharing clinical data and linking genomic data. Clinical Working Group strives to address both research and clinical use scenarios and be physician-oriented, researcher-focused, and patient-centered.



The **Data Working Group** concentrates on data representation, storage, and analysis of genomic data, including working with academic and industry leaders to develop approaches that facilitate interoperability. physician-oriented, researcher-focused, and patient-centered.



The **Regulatory and Ethics Working Group** focuses on ethics and the legal and social implications of the Global Alliance, including harmonizing policies and standards, and developing forward-looking consent, privacy procedures, and best-practices in data governance and transparency.



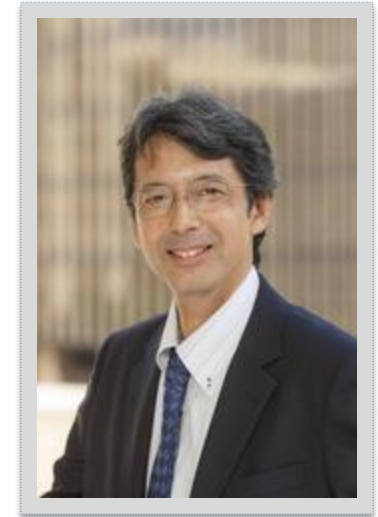
The **Security Working Group** leads the thinking on the technology aspects of data security, user access control, and audit functions, working to develop or adopt standards for data security, privacy protection, and user/owner access control.



Leadership



Bartha Maria Knoppers,
McGill University



Kazuto Kato,
Osaka University

Focuses on ethics and the legal and social implications of the Global Alliance, including harmonizing policies and standards, and developing forward-looking consent, privacy procedures, and best-practices in data governance and transparency.



GA4GH Framework for Responsible Sharing of Genomic and Health-Related Data

- Current frameworks are founded on the principle of protection from harm. In contrast,
- GA4GH Framework aims to **activate** the right to science and the right to recognition for scientific production by promoting responsible data sharing.

<http://genomicsandhealth.org/framework>

Universal Declaration of Human Rights, (1948)

“The Right to Science”

27(1)

“Everyone has the right freely to participate in the cultural life of the community, to enjoy the arts and to share in scientific advancement and its benefits.”

“The Right to Recognition”

27(2)

“Everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.”

Legal Force

- Dual rights rendered legally binding by the International Covenant on Economic, Social and Cultural Rights (ICESCR) (1966) – Article 15.
- 164 States have ratified the ICESCR.
- States are bound to implement the treaty in their national laws.

The Right to Science → Actionable

Why Human Rights?

- Universalizing force
- Political and legal dimensions that reach beyond the moral appeals of bioethics
- International legal force
- Belong to groups as well as individuals (reciprocity)
- Impose positive duties on governments and private actors

Strong Protection in Three Key Areas

Contours of responsible access, sharing, and attribution delineated by other human rights:

1. privacy;
2. anti-discrimination and fair access; and
3. procedural fairness.

Framework for Responsible Sharing of Genomic and Health-Related Data

Available in **11** languages on the GA4GH website. Thanks to all who contributed!

- Arabic إطار لتبادل مسؤول للمعلومات الجينومية والمتصلة بالصحة
- Chinese 基因组学与健康相关数据负责任的共享框架
- French Cadre pour un partage responsable des données génomiques et des données de santé
- Greek Πλαίσιο για την Υπεύθυνη Κοινοχρησία Γονιδιωματικών και άλλων Ιατρικών Δεδομένων
- Japanese ゲノム及び健康関連データの責任ある共有に関する枠組み
- Portuguese Framework para Compartilhamento Responsável de Dados Genômicos e Relacionados à Saúde
- Spanish Marco de actuación para el uso compartido responsable de datos genómicos y relativos a la salud
- German Rahmenkonzept für die den verantwortungsvollen Datenaustausch genomischer und gesundheitsbezogener Daten
- Hindi जीनोमिकी और स्वास्थ्य संबंधी डेटा को उत्तरदायित्वपूर्ण रूप से साझा करने के लिए रूपरेखा
- Italian Framework per la condivisione responsabile di dati genomici e relativi alla salute.
- Russian Рамки для ответственной передаче геномных и связанных со здоровьем данных

Framework for Responsible Sharing of Genomic and Health-Related Data

- Consent Policy
- Consent Clauses and Template for International Data Sharing



- Privacy & Security Policy
- Data Safe Havens
- Accountability Policy



Framework for Responsible Sharing of Genomic and Health-Related Data

Aims

- Foster responsible data sharing;
- Protect and promote the welfare, rights, and interests of groups and individuals who donate their data;
- Provide benchmarks for accountability;
- Establish a framework for greater international data sharing cooperation, collaboration, and good governance; and,
- Serve as a dynamic instrument.

Foundational Principles

- Promote Health, Wellbeing and the Fair Distribution of Benefits;
- Respect Individuals, Families and Communities;
- Advance Research and Scientific Knowledge; and,
- Foster Trust, Integrity and Reciprocity.



Framework for Responsible Sharing of Genomic and Health-Related Data

Core Elements for Responsible Data Sharing

- Transparency
- Accountability
- Engagement
- Data Quality and Security
- Privacy, Data Protection and Confidentiality
- Risk-Benefit Analysis
- Recognition and Attribution
- Sustainability
- Education and Training
- Accessibility and Dissemination



Consent Policy

- **Purpose:** To guide international data sharing in a way that respects autonomous decision making while promoting the common good.
- Gives principled and practical guidance on consent issues:
 - Transparency
 - Privacy Safeguards
 - Withdrawal
 - Consent to access policies and terms
 - Sharing of Legacy Data

<https://genomicsandhealth.org/consent-policy-read-online>



Privacy and Security Policy

- How to manage privacy and security risks and related expectations?
- **Proportionate Safeguards:** Data privacy safeguards should be proportionate to the sensitivity, nature, and possible benefits, risks, and uses of the Data
- Security: **organizational, technical and physical measures** to manage risks to privacy and data integrity.

<https://genomicsandhealth.org/privacy-and-security-policy-read-online>



Accountability Policy

- Sets forth how Members of the Global Alliance can be governed and held accountable for the trust they engender in the responsible sharing of genomic and clinical data.
- Explores mechanisms to **promote** responsible data sharing, as well as to **prevent** and appropriately **sanction** data misuse.
- Possible Inclusion: Why are you NOT sharing, if the participant consented to sharing?



Paediatric

- Explores the regulatory and ethical issues of data sharing in the paediatric context and develops policies, tools and guidelines to accelerate the sharing of such data.
- Initial focus: “Genomic Newborn Screening: Public Health Policy Considerations and Recommendations” [in preparation].



REWG – Current Initiatives



Accountability



Ageing and Dementia



BRCA Challenge
Ethico-Legal
and Engagement



Data Protection
Regulation



Data Sharing
Lexicon

Ethics Review
Equivalency



Individual Access



Machine Readable
Consent



Paediatric



Registered Access





- Myriad's BRCA patents lost their exclusivity
- Curation of the BRCA variants represents a critically needed resource for the community
- BRCA Challenge: An international non-commercial effort at federated database of variants for BRCA1/BRCA2

NCBI ClinVar database

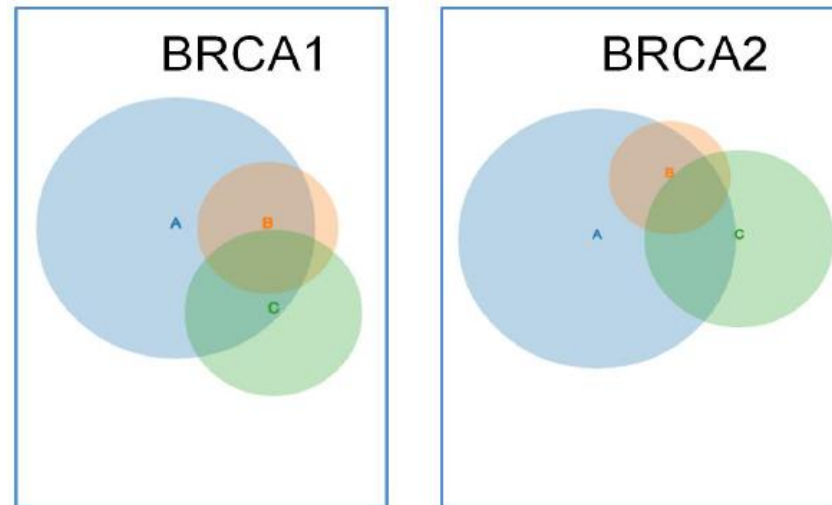
- 7536 variants

LOVD Databases

- 3362 variants

UMD (France)

- 3913 variants



A=ClinVar B=LOVD C=UMD

LSDB Updates

Courtesy of Xin Feng

Goal: Expand to include ENIGMA, CIMBA & many other DBs, as well as new data, to encompass all variant data

Roadmap

- Consensus on terminology & classification
- Broad inclusion of data sources
- Address potential liability concerns
- Single portal for access to several systems available for sharing
- Stable oversight of curation of deposited data



Public Population Project in Genomics and Society (P³G)



The screenshot shows the P3G website homepage. At the top left is the P3G logo and the text "PUBLIC POPULATION PROJECT IN GENOMICS AND SOCIETY". To the right is a search bar with the placeholder "[ENTER KEYWORDS]". Further right is a login box with fields for "[USERNAME]" and "[PASSWORD]", an "OK" button, and links for "Request an account" and "Request new password". A "Biobank Lexicon" button is also present. Below the search bar is a navigation menu with links for "About P3G", "Resources", "Programmes", "Membership", "Events", "News", and "Contact Us". The main content area features a collage of diverse people's faces and the heading "WHAT IS P3G?". Below this heading is a paragraph: "P3G is a not-for-profit organization that provides the international research community with access to the expertise, resources and innovative tools for health and social sciences research." At the bottom of the page is a blue banner for "IPAC International Policy interoperability and data Access Clearinghouse". Below this banner are six colored boxes, each with an icon and a title: "TOOLKIT" (red), "LIFESPAN" (green), "HUB" (orange), "TRAINING" (purple), "CATALOGUES" (yellow), and "BRIF" (light green). Each box contains a brief description of the module's function.

[USERNAME]
[PASSWORD] OK
[Request an account](#)
[Request new password](#)

Biobank Lexicon

[ENTER KEYWORDS]

About P3G Resources Programmes Membership Events News Contact Us

WHAT IS P3G?

❖ P3G is a not-for-profit organization that provides the international research community with access to the expertise, resources and innovative tools for health and social sciences research.

IPAC
International Policy interoperability and data Access Clearinghouse

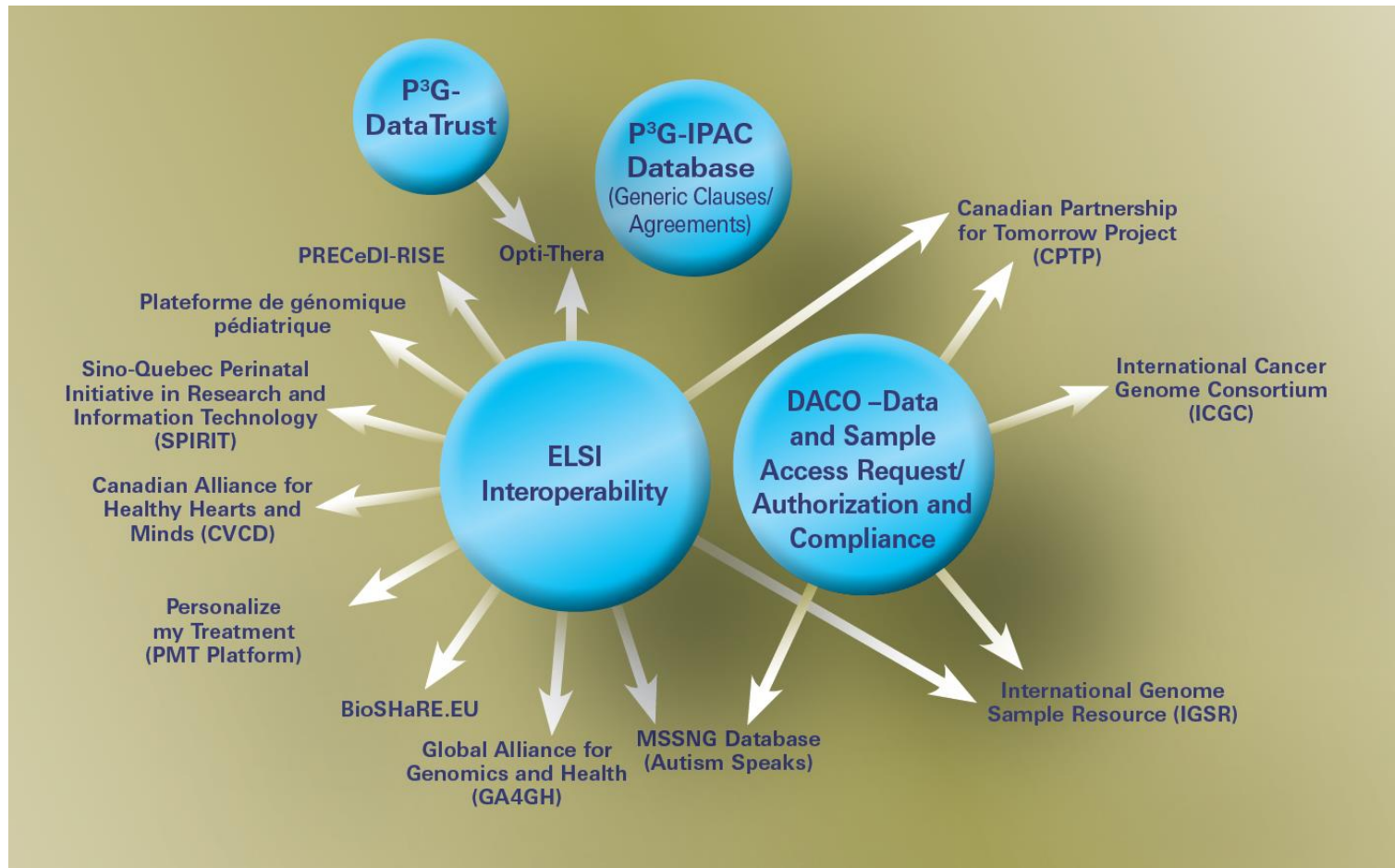
 TOOLKIT SEARCH BIOBANKING TOOLS BY NAME, CATEGORY OR TYPE	 LIFESPAN BROWSE THROUGH THE DIFFERENT PHASES AND STEPS OF THE BIOBANKING LIFECYCLE	 HUB DISCUSS, EXCHANGE AND COLLABORATE WITH EXPERTS AROUND THE WORLD	 TRAINING ACCESS TUTORIALS AND INFORMATION SESSIONS	 CATALOGUES SEARCH FOR INFORMATION ABOUT POPULATION-BASED BIOBANKS	 BRIF REQUEST/SEARCH FOR A BIORESOURCES RESEARCH IMPACT FACTOR
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First time on our new site? Visit the [Resources](#) section to learn more about these modules

www.p3g.org



International Policy interoperability and data Access Clearinghouse (IPAC)





International Policy interoperability and data Access Clearinghouse (IPAC)



A one-stop service for researchers

Data/Sample
Collection – ELSI
Interoperability

Validate whether
studies can work
together (e.g.
consent;
confidentiality;
etc.);
If not, create tools.

DACO – Review of
Data and Samples
Access Request/
Authorization and
Compliance

Authorize studies
to access
controlled
databases (e.g.
ethics
approval/waiver;
institutional sign
off; etc.).

ELSI Clauses/
Agreements
Database

Open access
resource allowing
users to search
and select models
of clauses that
best suit their
needs.

DataTrust

Support process
of re-contacting
participants and
returning
individual-level
results in
translational
research projects.

CanSHARE

