



Exceptional Challenges, Extraordinary Opportunities

Establishing Collaboration: the potential for an active relation between governments, industry and academia for research, development and education

Paul Keown, November, 2010



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Challenges and opportunities

Driving forces for change

- Changing demographics and expectations
- Health care costs and disease management
- Need for innovative cost-effective treatments

Public funding partners

- Governments and federal agencies
- Provincial, medical and related foundations
- Institutional and private philanthropy

Goals and directions

- Understanding the biology of disease
- Developing new diagnostics and therapies
- Improving treatment and healthcare delivery

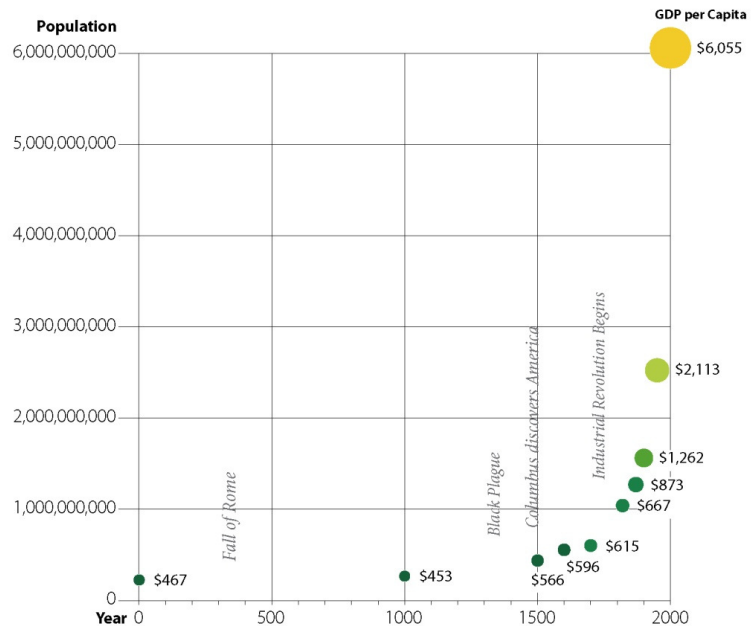


World wealth, social satisfaction

Wealth and health grow hand in hand

Visualizing Economics Visit www.visualizingeconomics.com to view more examples
 Making the Invisible Hand Visible

0-2000 World
World Population and GDP per Capita
 In 1990 International Geary-Khamis dollars

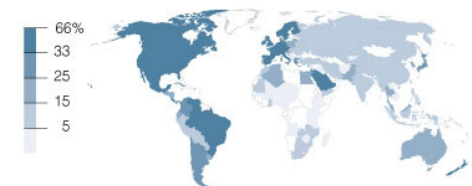


Source: Angus Maddison, University of Groningen

Measuring Satisfaction

A new study shows that people in wealthier countries are more likely to be satisfied with their lives. Earlier research had suggested that satisfaction did not necessarily increase once basic needs were met.

Percent who rate themselves an 8, 9 or 10 on a 10-point scale of satisfaction



KEY:

- Each dot represents one country
- The line around the dot shows how satisfaction relates to income within that country:
 - Higher-income people are more satisfied
 - Higher-income and lower-income people are equally satisfied



Source: Betsey Stevenson and Justin Wolfers, Wharton School at the University of Pennsylvania

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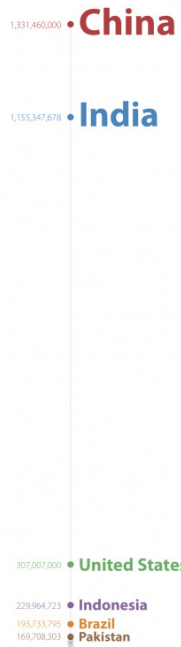
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The transition of global wealth

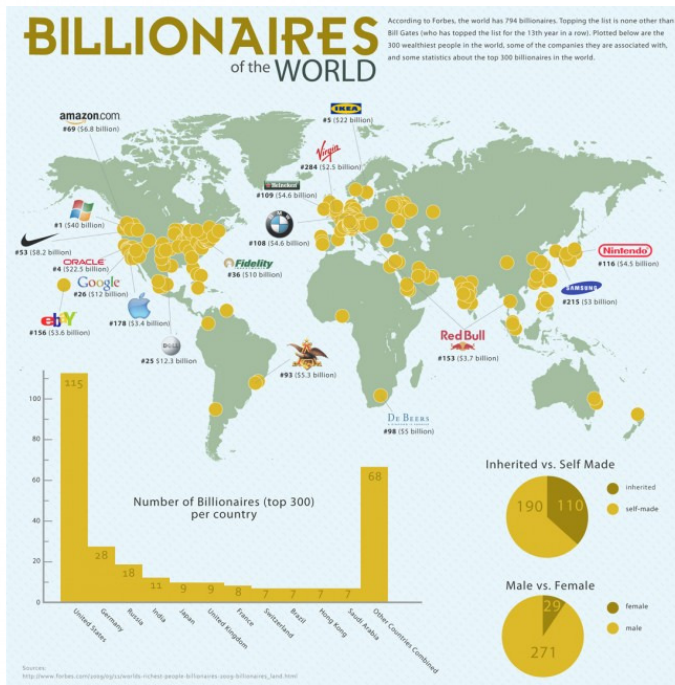
Half of the world's population live in just 6 countries...

Half the World's Population



Other 206 countries

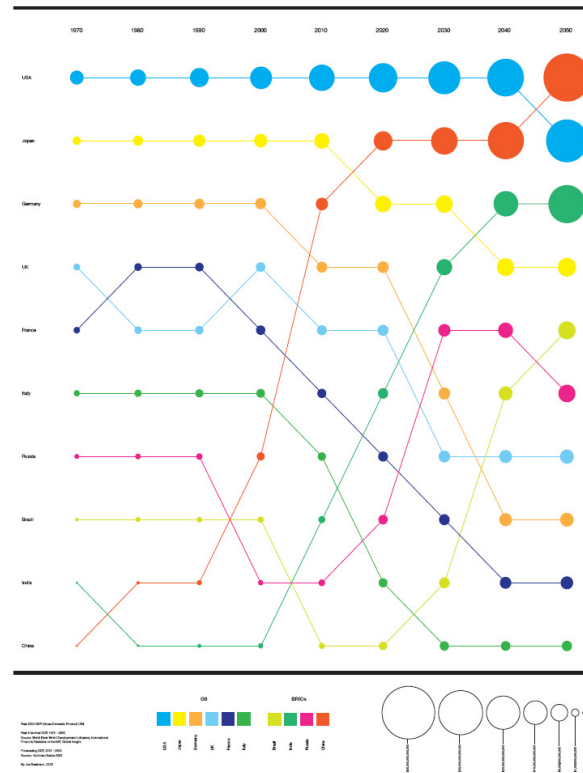
Data source: World Bank, data.worldbank.org



VisualizingEconomics.com

The Changing Face of Our World Economy 1970 - 2050

The chart illustrates the projected changes in the global economy from 1970 to 2050. The size of the circles represents the relative economic power of each country, and the color represents the country's dominant economic sector. The chart shows a significant shift in economic power from the USA and Europe in the 1970s to a more diversified global economy by 2050, with emerging economies like China and India showing rapid growth.



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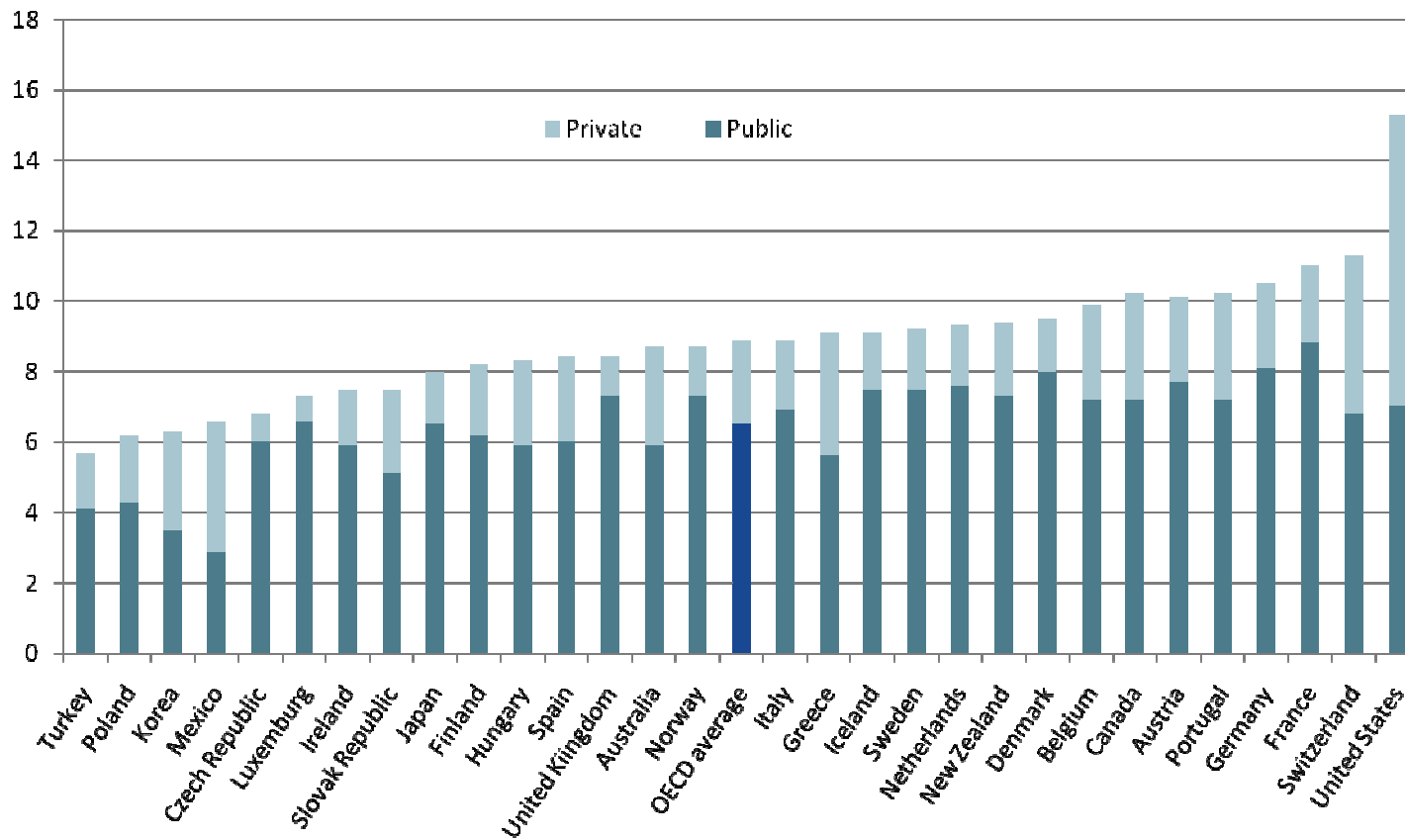


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Expenditure on health, % GDP

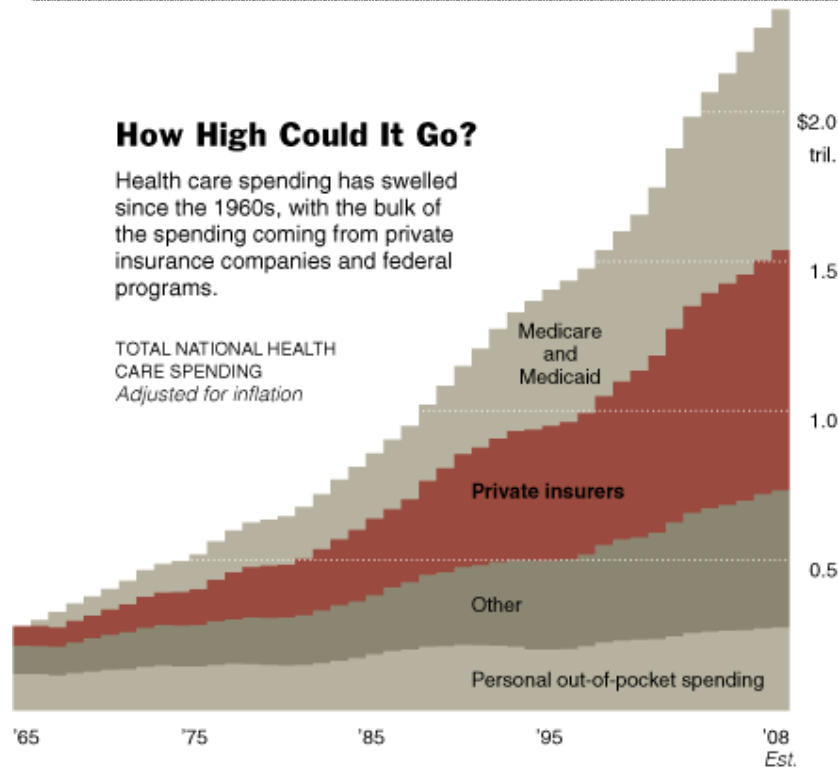
Economic, environmental and social statistics, OECD 2009





Challenging costs of health care

Healthcare costs and medical care inflation

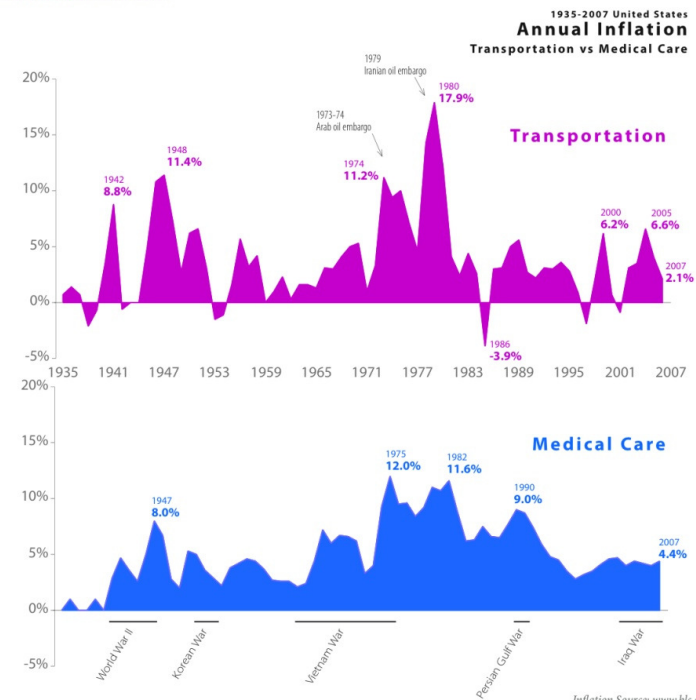


Out-of-pocket spending includes co-payments and deductibles. Other includes spending for the Department of Defense, Veterans Affairs, children's health and other programs.

Source: Centers for Medicare and Medicaid Services, Office of the Actuary

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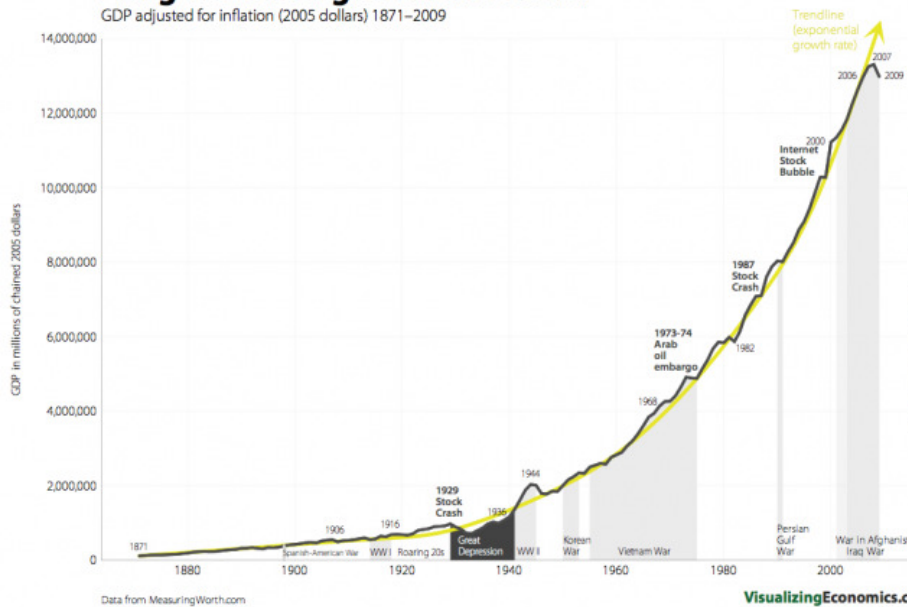


Economic growth and turbulence

Rising wealth and rising expectations

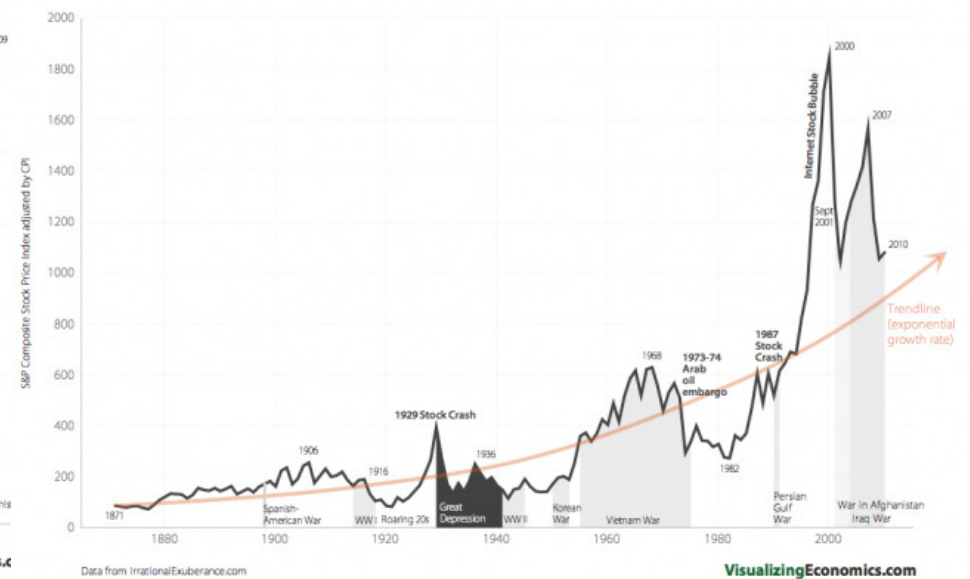
Long-term real growth in US GDP

GDP adjusted for inflation (2005 dollars) 1871–2009



Long-term real growth in US Stocks

Annual price index adjusted for inflation 1871–2010



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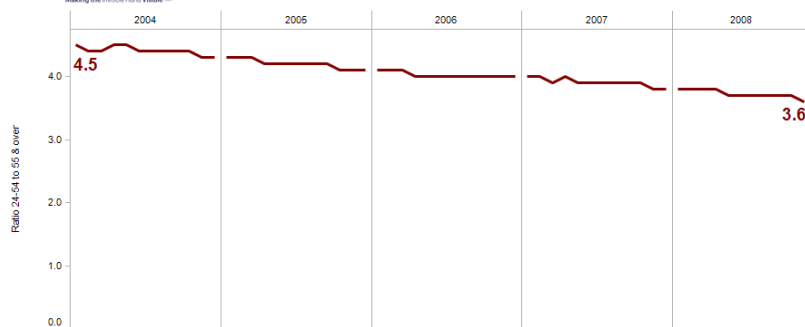
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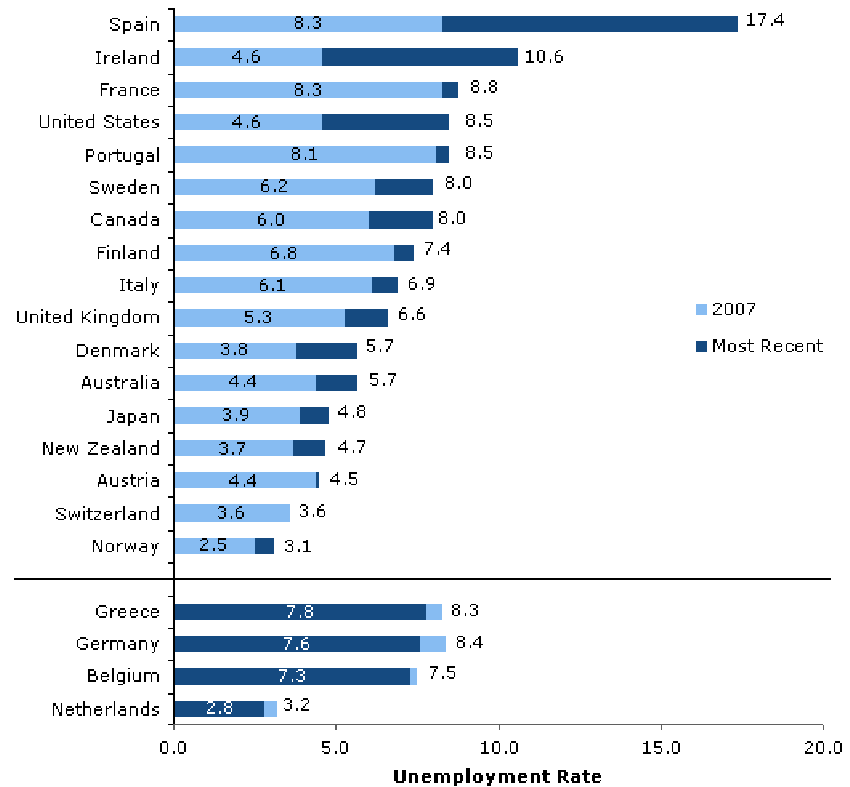
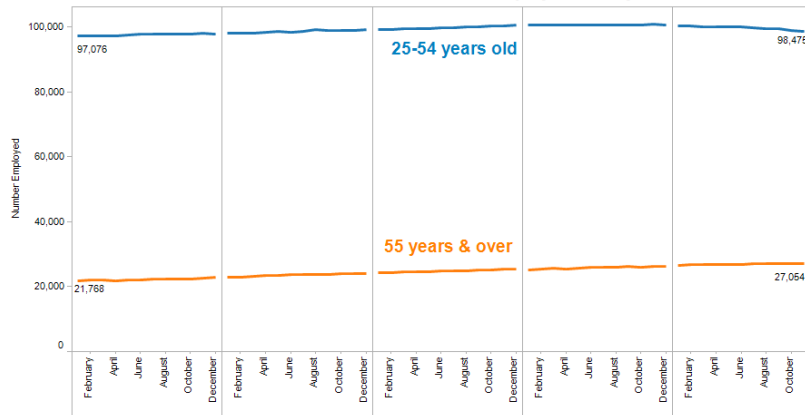
Challenges to health support

An aging population and rising unemployment

Visualizing Economics Making the Invisible Visible
Number of workers aged 25-54 for every worker over 55



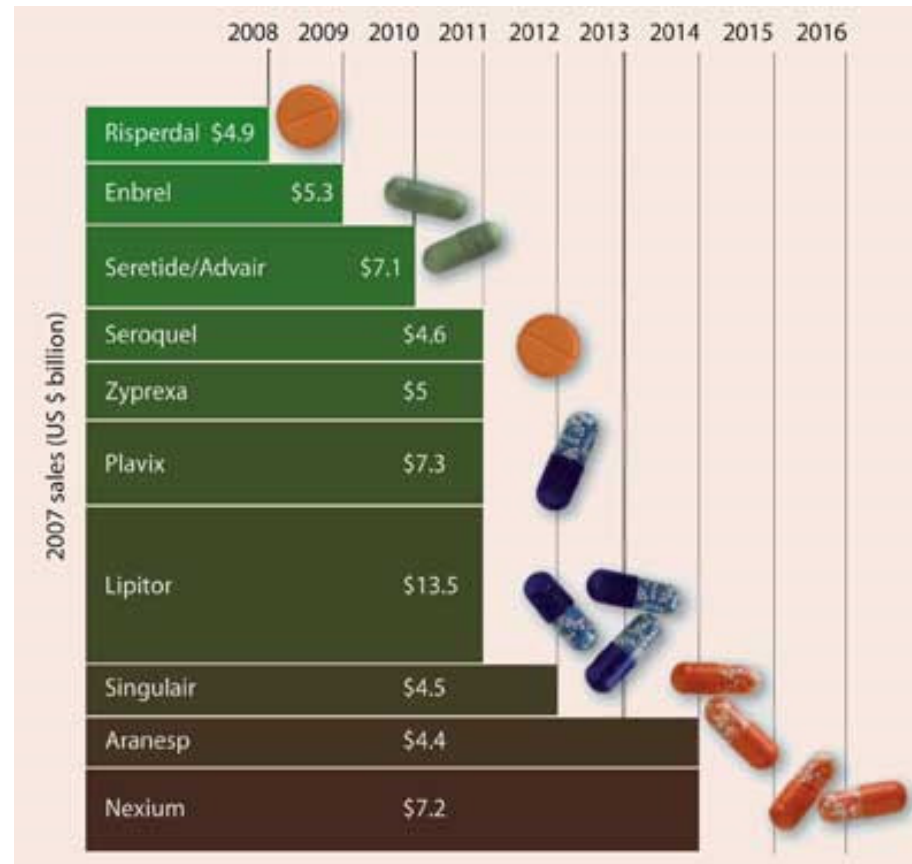
Employed 25-54 year olds vs 55 & over





The patent cliff, 2008-2016

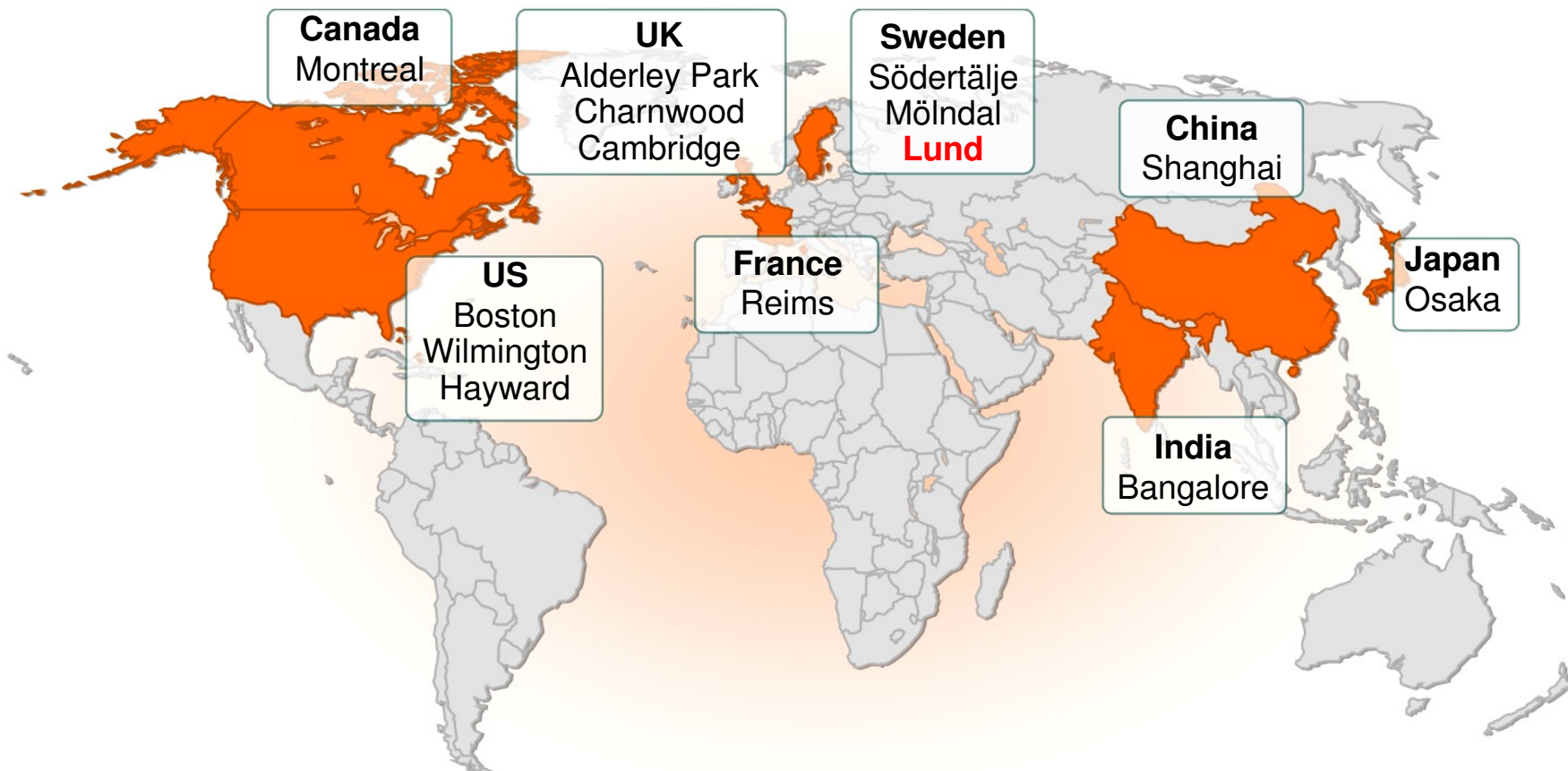
Economic, environmental and social statistics, OECD 2009





Global research resources

Do not guarantee success in a rapidly changing environment





Assembling the pieces

1. Funding

- Government
- Federal agencies
- Industrial partners
- Research foundations

3. Environment

- Capital awards
- Major equipment
- Clinical research centres
- Streamlined regulation

2. People

- MD / PhD programs
- Academic fellowships
- Clinical fellowships
- Scholarships and Chairs

4. Projects

- Cohorts and biobanks
- Genomic technologies
- Advanced imaging
- Electronic records



The Canadian approach



Innovation:

- CIHR, Genome Canada and other federal bodies drive translational and clinical research

Commercialization:

- Canada Networks of Excellence for Research and Commercialization target key themes of fundamental importance

Application:

- Clinical Research Infrastructure Networks are developing to coordinate clinical research and biobanking with patients as partners



Networks of Centres of Excellence of Canada



NCE: 20 Networks, range \$2-78 million dollars

Stem Cell Network – SCN

University of Ottawa, Ottawa, Ontario (\$63.62 million 2001-2012)

PrioNet Canada

University of British Columbia, Vancouver, (\$35.8 million 2005-2012)

NeuroDevNet

University of British Columbia, Vancouver, (\$19.57 million 2009-2014)

Mathematics of Information Technology and Complex Systems

University of British Columbia, Vancouver, (\$64.03 million 1999-2012)

Canadian Arthritis Network – CAN

Mount Sinai Hospital, Toronto, Ontario (\$54.71 million 1999-2012)



Networks of Centres of Excellence of Canada



NCECR: 17 Networks, range \$12-15 million dollars

Centre of Excellence for the Prevention of Organ Failure –
Vancouver, British Columbia (\$14.95 million 2008-2013)

Institute for Research in Immunology and Cancer –
Montreal, Quebec (\$14.95 million 2008-2013)

Centre for Surgical Invention and Innovation
Hamilton, Ontario (\$14.81 million 2009-2014)

Centre of Excellence in Personalized Medicine
Montreal, Quebec (\$13.8 million 2008-2013)

Centre for Drug Research and Development
Vancouver, British Columbia (\$14.95 million 2008-2013)



Networks of Centres of Excellence of Canada



CRIN: Clinical Research Infrastructure Network

**Global investment in pharma research - \$130 billion 2008.
60%-70% spent on clinical research activities**

**Investment in Canada on clinical trials - \$540 million.
Approximately 75% of pharma applied research spending**

**CRIN integrating academic, government, health system
Structural change to enhance and streamline potential**

Co-ordinate clinical research activities.

Ethics approval, contract negotiations, quality systems

**Invest in human resources to attract “best and brightest”
Education, training, mentoring, recruitment and retention**



Pieces of the jigsaw

UK Clinical Research Enterprise

Sir Mark Walport, Wellcome Trust

- ***People***: scientists, physicians, allied health staff, related disciplines
- ***Research environment***: infrastructure, research tools, regulation
- ***Partnerships***: industry, academia, funders and foundations
- ***Funding***: NHS, Technology Strategy Board, Industry, Charity



Steps in the process: UK Clinical Research Enterprise

Opportunities. Sir Mark Walport, Wellcome Trust

- ***Phenotyping people:*** physiology, pathology, medical imaging, informatics
- ***Genetics and the environment:*** disease risk, disease subtypes, treatment response
- ***Complex diseases:*** understanding complex diseases and processes
- ***Healthcare innovations:*** new diagnostics, therapeutics and vaccines.



Goals and objectives: UK Clinical Research Enterprise

Sir Mark Walport, Wellcome Trust,,

- **Science:** build on the established excellence of UK sciences
- **Translation:** move best ideas from science, engineering and medicine to the clinic
- **Acceleration:** speeding development of innovative technologies and approaches
- **Policy:** promote policy review, integration and advancement



Clinical research centres: UK Clinical Research Enterprise

Design and intent. Sir Mark Walport, Wellcome Trust,

- **Develop a network of UK centres for experimental medicine**
- **Accelerate the translation of scientific advances into real benefits for patients**
- **Provide opportunities for basic scientists to work closely with clinical researchers enabling the development of new therapies and treatments**



Developing the structure:

ICRIN: Irish clinical research infrastructure network

Objectives, Pr. Dermot Kelleher, Trinity College, Dublin

- Network Molecular Medicine Ireland and Clinical Research Networks into a national infrastructure
- Develop and deliver clinical research / education / training programs
- Facilitate academic and industry clinical investigators to conduct multi-centre clinical studies
- Drive harmonization of clinical research procedures
- Contribute to the building of a European Clinical Research Infrastructure Network

Pr. Dermot Kelleher, 2010



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Next pieces of the jigsaw

ICRIN: Irish clinical research infrastructure network

Integration. Pr. Dermot Kelleher, Trinity College, Dublin

- ***Translational science*** through a network of research centres, imaging facilities, core molecular technologies and biobanks
- ***Drug development*** capability linking chemistry, biochemistry, pharmaceutical chemistry, toxicology, and related expertise
- ***Clinical services*** through AHSC model with translational medicine and advanced data management

Pr. Dermot Kelleher, 2010



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What do we need to know?

Gene-protein-pathway-drug-disease-patient connection

- ***Disease biology***: genomic, proteomic, molecular mechanisms and variants
- ***Clinical expression***: disease phenotypes, composite events, severity and variability
- ***Clinical management***: treatment patterns, responder genotype, adverse consequences
- ***Societal impact***: health outcomes, quality, costs, caregiver burden, opportunity costs



Networks of Centres of Excellence of Canada



Centre of Excellence for the Prevention of Organ Failure



Biomarker solutions to stem the tide of Organ Failure

Centre of Excellence for the Prevention of Organ Failure - PROOF Centre discovers, develops and commercializes biological markers (biomarkers) to diagnose, prevent and treat heart, lung and kidney failure. The PROOF Centre is a unique, multi-disciplinary hub of partners from industry, academia, healthcare, government, patients and the public. The PROOF Centre's “personalized medicine” approach — giving the right person, the right treatment, at the right time, in the right amount — will reduce the enormous burden of organ failure and improve health.



What is personalized medicine?

Individualization

- Non-genetic patient profiles and the adjustment of pre-existing treatment to individual needs

Patient-Centered Healthcare

- Respect for patients' values, preferences, and expressed needs, including consideration of 1) coordination and integration of care, 2) information, communication, and education, 3) physical comfort, 4) emotional support, and 5) involvement of family and friends
[Institute of Medicine (IOM) - "A New Health System for the 21st Century"]

Diagnostic testing

Medication prescribed

Monitoring of effects

Optimization of treatment

Genotype

Gene expression

Proteins

Metabolites



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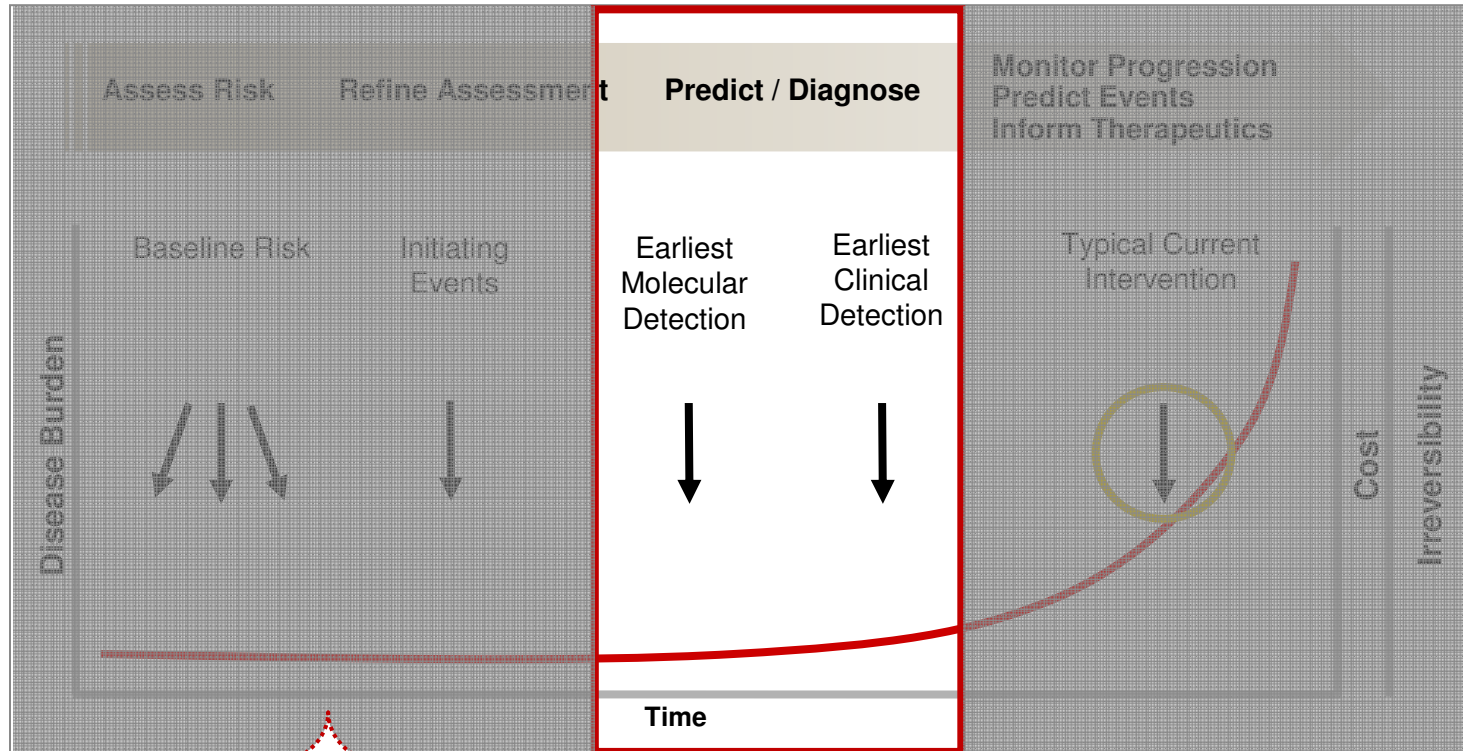
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The promise of personalized medicine



Genotype

Gene
expression

Proteins

Metabolites



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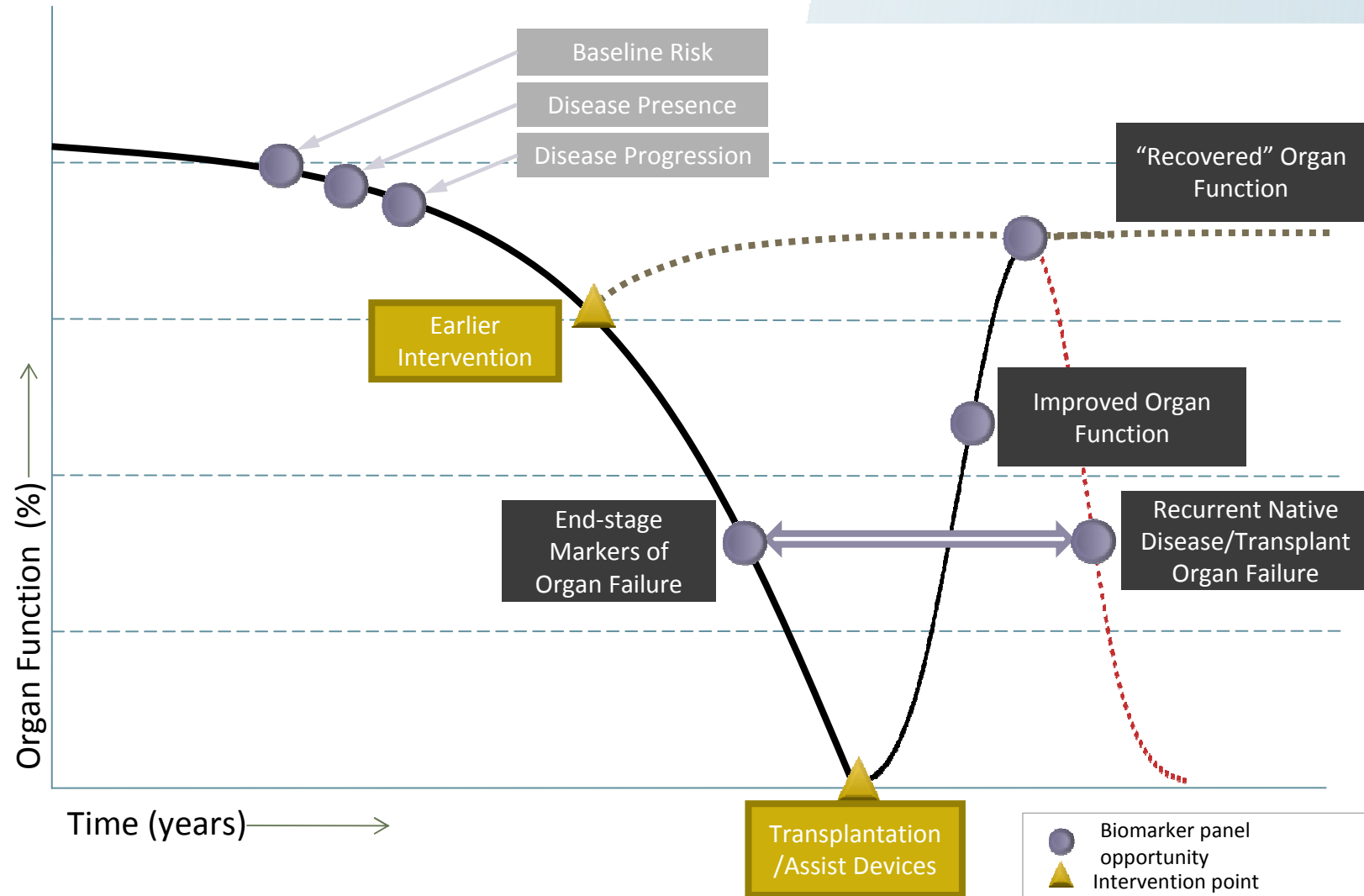
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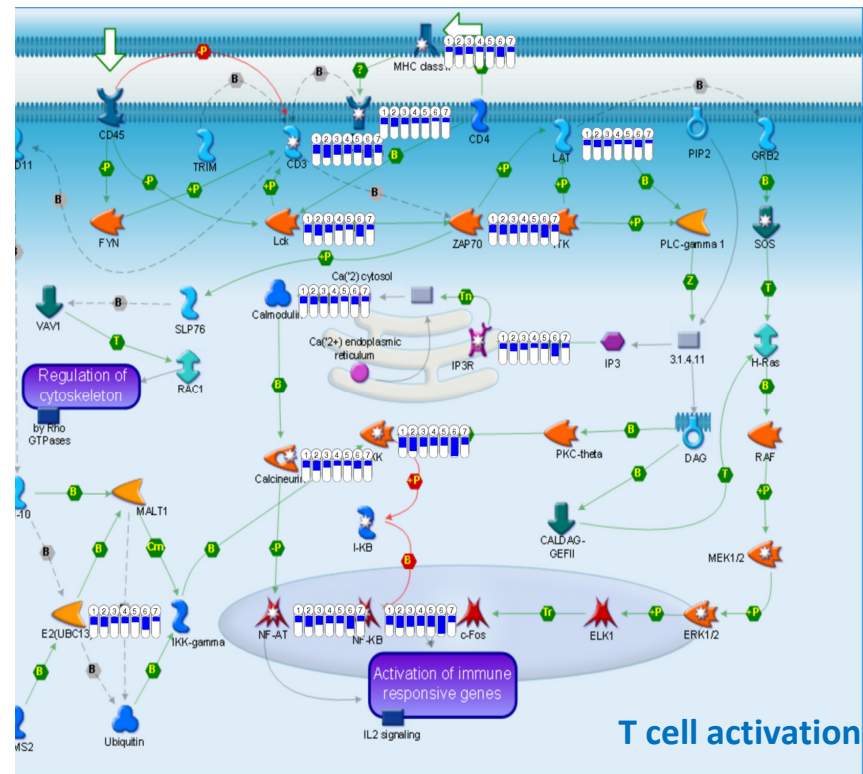
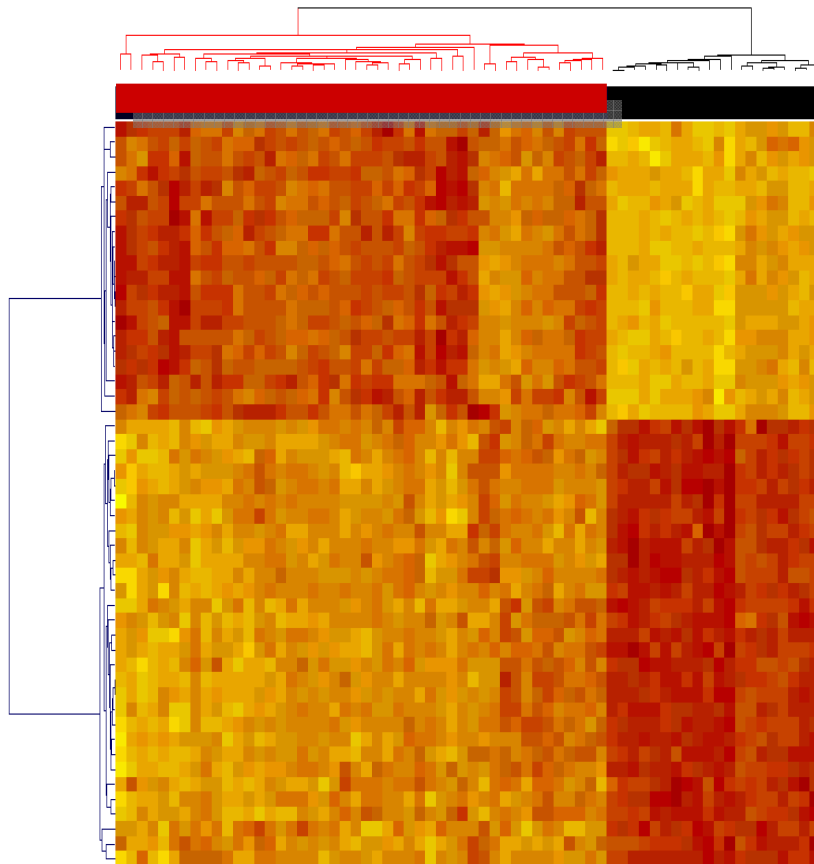
Life Cycle of Organ Failure





Mining the human genome

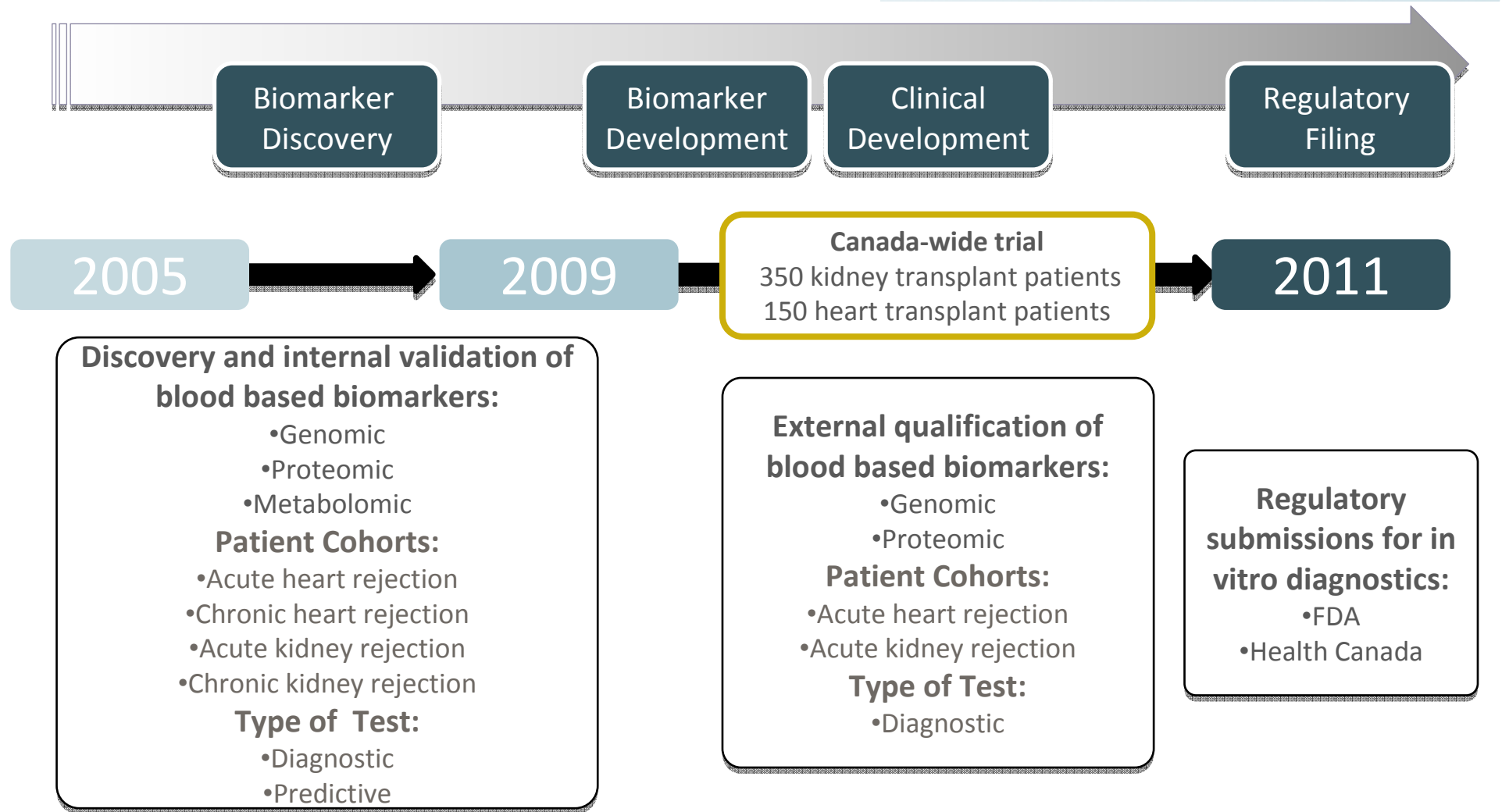
Gene structure and expression Gene pathways and drugs





Proof of PROOF

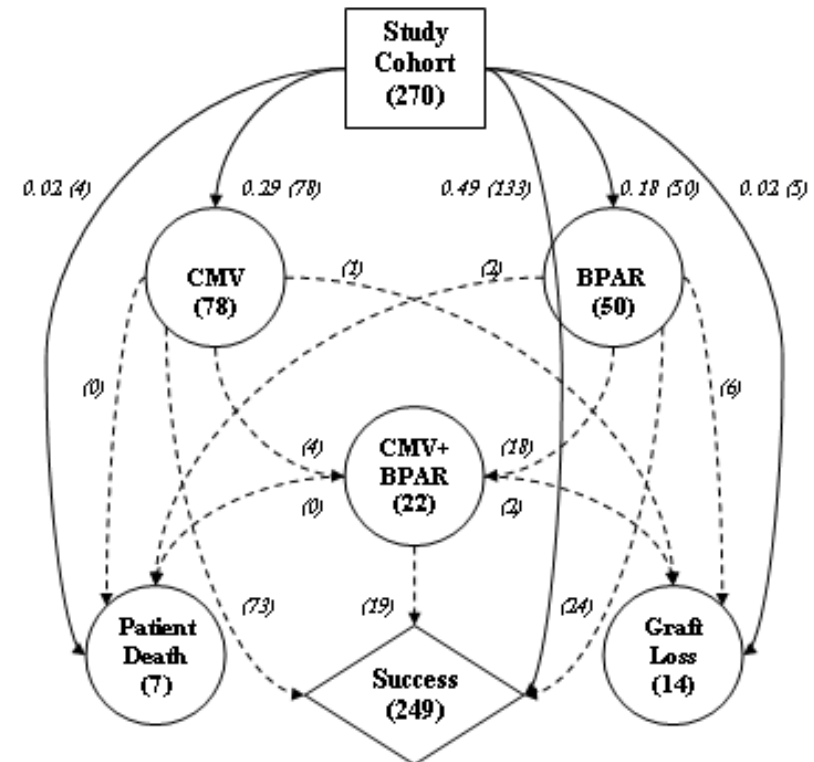
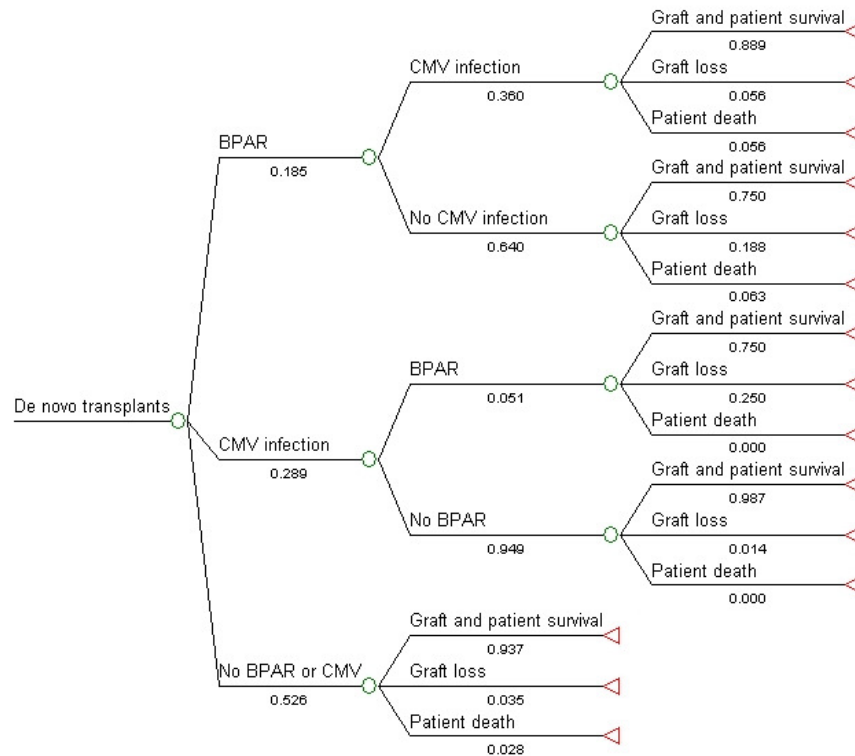
Biomarkers in Transplantation





Relation between infection and immunity

BCAR predisposes to CMV infection, not vice versa





Biosimulation of complex disease

Primary

Absorbing

Primary

Absorbing

Diabetes mellitus

Vascular disease

Glomerulonephritis

Systemic vasculitis

Renal infection

Systemic disorders

CKD

HD

PD

Delayed function

Acute rejection

Viral infection

Nephrotoxicity

Chronic rejection

Disease recurrence

Graft loss

Death

Kidney disease

Kidney transplant



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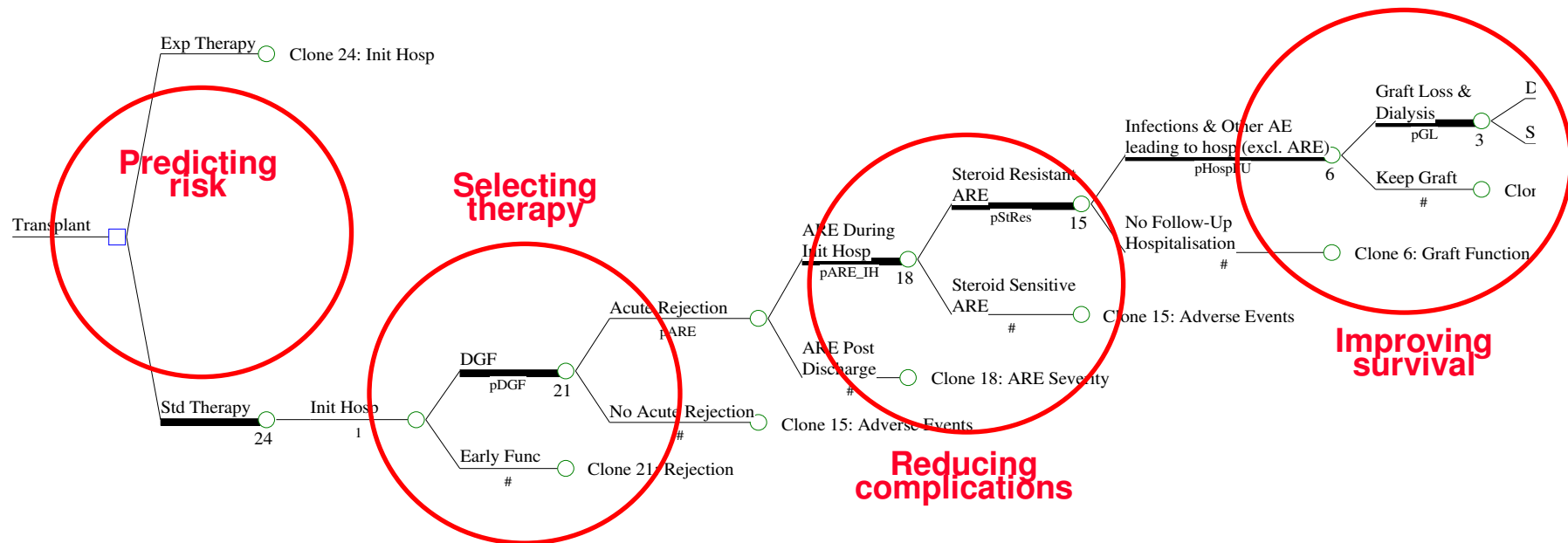
Biosimulation of complex disease

Step 1

Step 2

Step 3

Step 4



Early course

Late course



Prescribing problems

Need for continuous and real-time surveillance

- Use of drugs when no therapy is needed
- Use of wrong drugs for a specific condition
- Use of drugs with doubtful efficacy
- Use of drugs with uncertain safety status
- Failure to prescribe safe and effective drugs
- Incorrect administration, dose or duration
- Indiscriminate or over-use of therapies





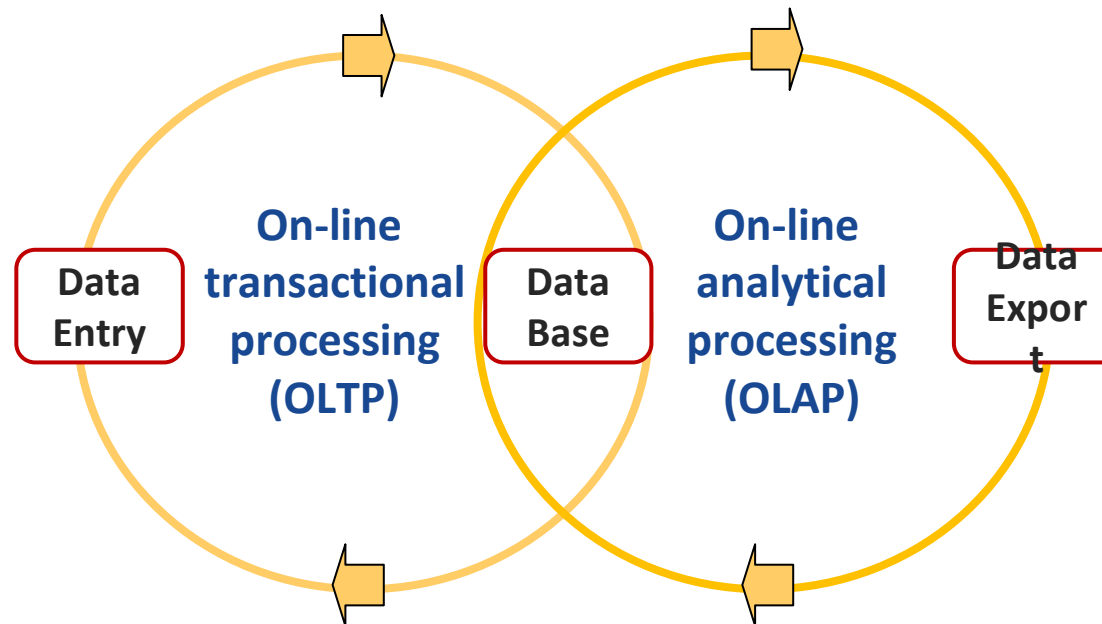
Clinical surveillance networks

Inputs

Informatics operations & analysis

Outputs

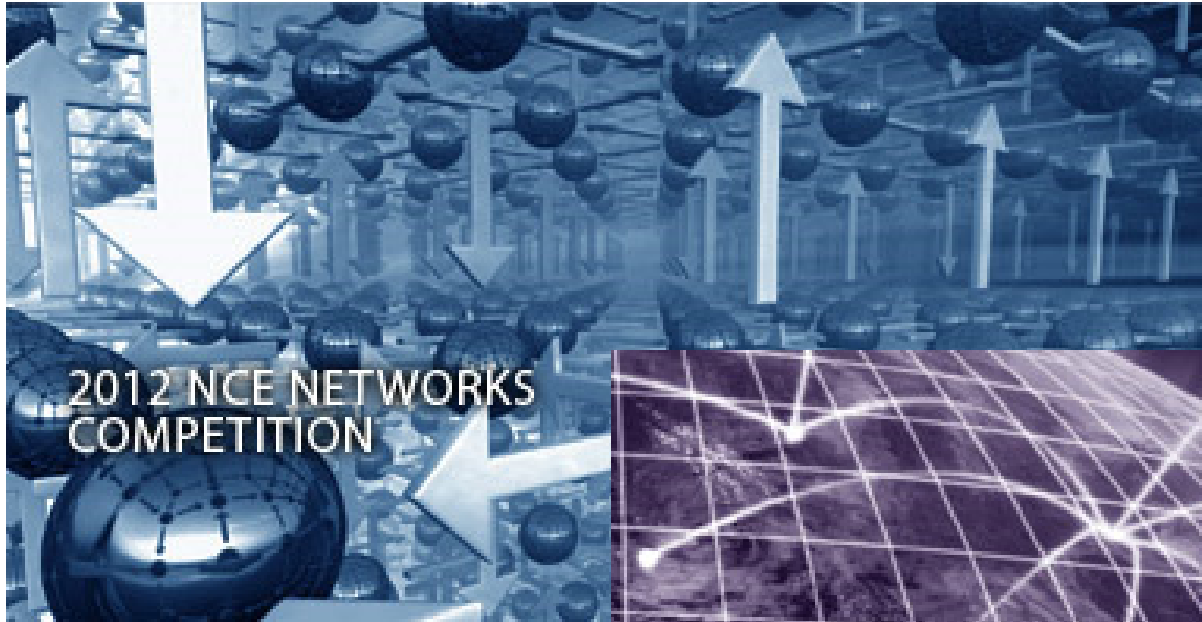
Physician
Patient
Hospital
Laboratory
Payer
Provider
Pharma



Physician
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Hospital
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Continuing support



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Partnerships Are Essential



Genome Canada



Genome British Columbia



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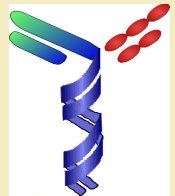


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Vancouver Hospital Foundation, St. Paul's Hospital Foundation, UBC, Genome BC, The James Hogg iCAPTURE Centre, BC Transplant Research Institute, Affymetrix, and Eksigent

Supporting Organizations



Immunity & Infection Research Centre

Vancouver Coastal Health Research Institute
Healthier lives through discovery



PROVIDENCE HEART + LUNG INSTITUTE
AT ST. PAUL'S HOSPITAL
New solutions for health



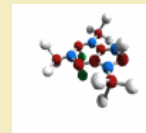
James Hogg iCAPTURE Centre
for Cardiovascular and Pulmonary Research



BC TRANSPLANT
An agency of the Provincial Health Services Authority



University of Victoria-Genome BC Proteomics Centre



USC/CHLA Microarray Core

Vancouver Coastal Health Research Institute
Healthier lives through discovery



How you want to be treated.





Thank you!

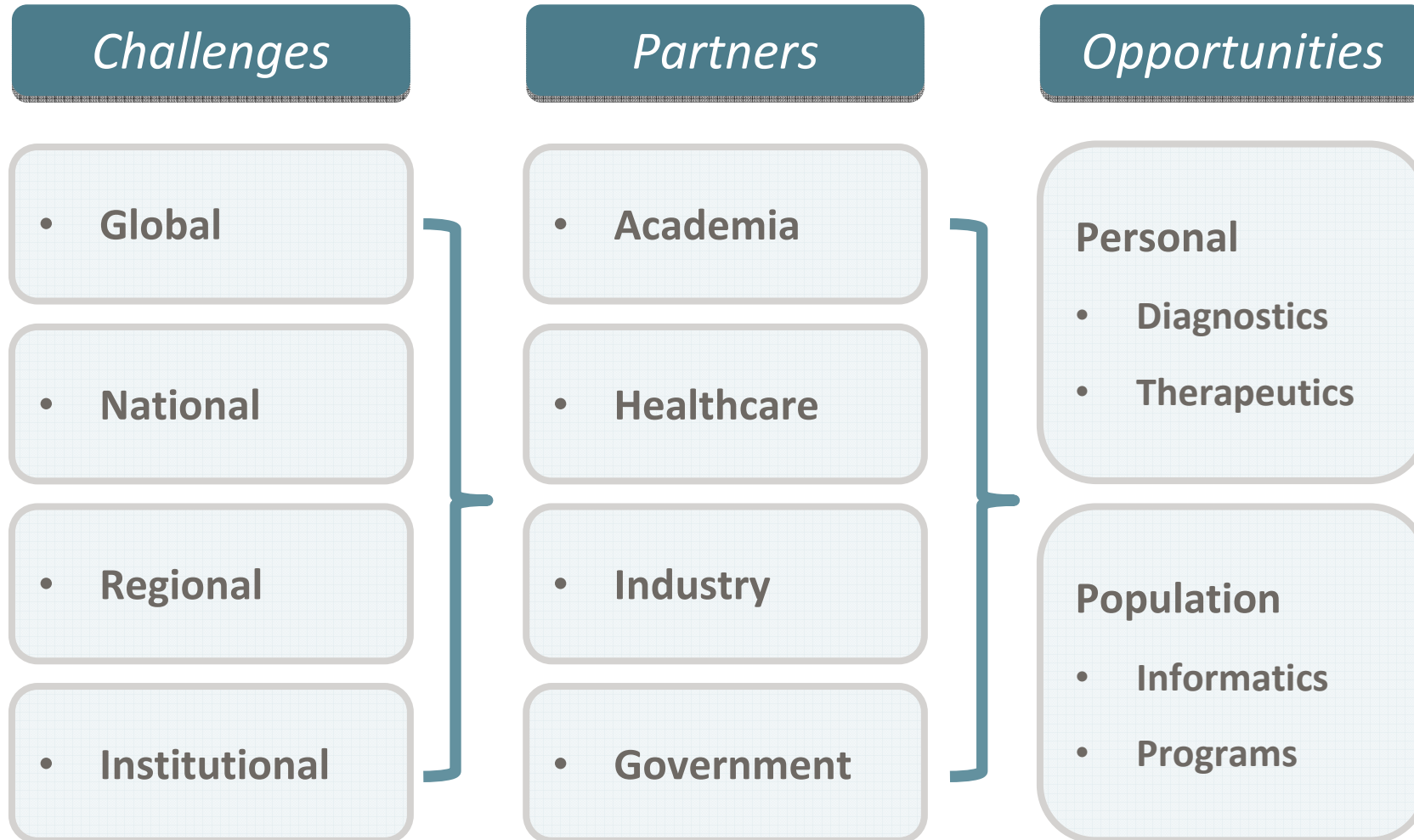
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Paul Keown, November, 2010



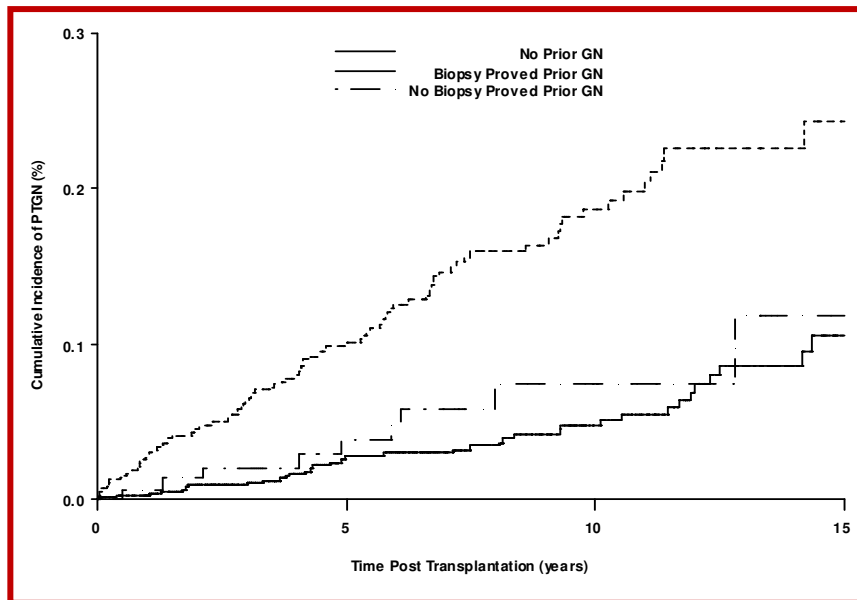
Challenges and opportunities



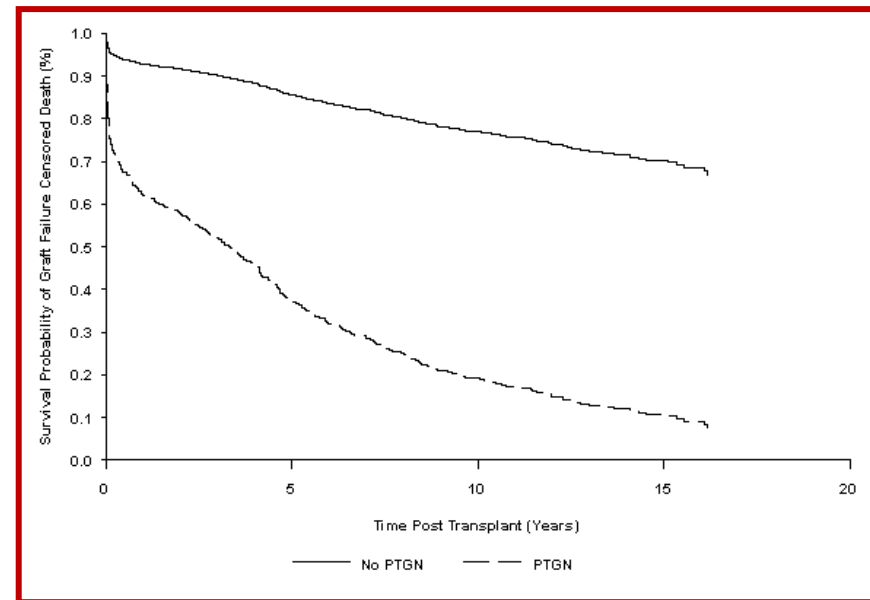


Recurrence of original disease

Probability of recurrence



Consequence of recurrence





The American reaction

...or, "this is all Mr. Obama's fault"!



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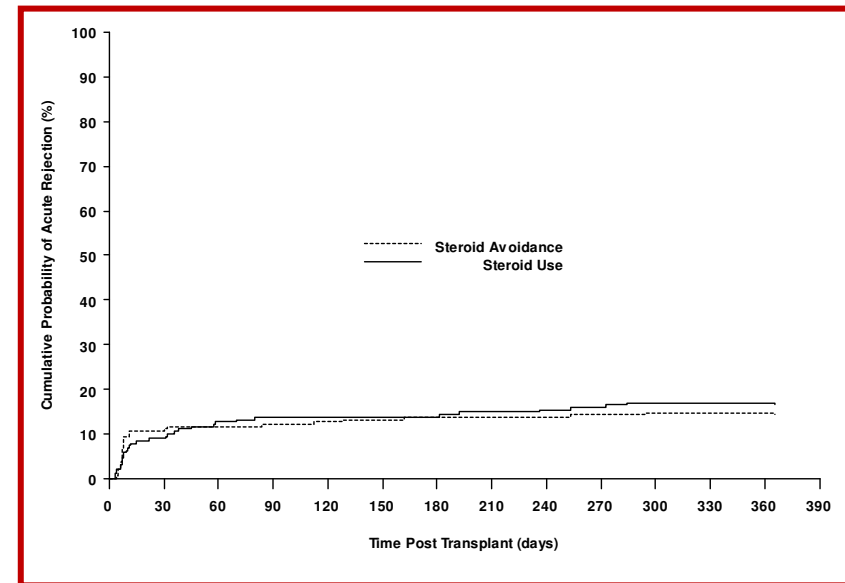
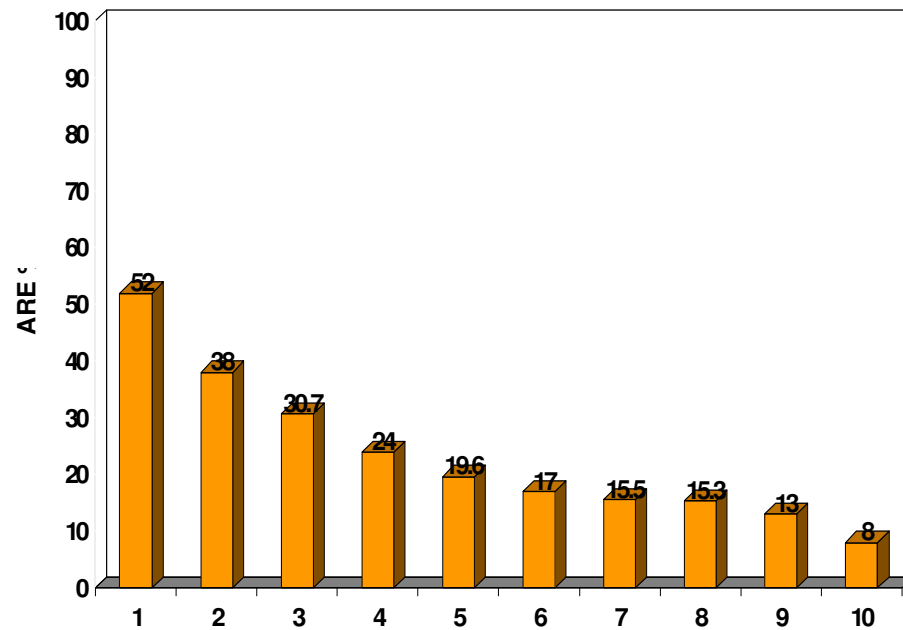


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Spectrum of acute rejection

- ❖ Incidence of biopsy-proven acute rejection has declined
- ❖ Most events occur in the first 60 days post transplant
- ❖ Most of these episodes are mild and without sequelae
- ❖ Later episodes of rejection may portend graft loss





The Canadian approach

Rank	Company	Year Established
9	Apotex Inc.	2008
10	sanofi-aventis Canada	2007
13	GlaxoSmithKline Canada	2006
15	Pfizer Canada Inc.	2007
19	Hydro-Québec	2008
21	Novartis Pharmaceuticals Canada Inc.	2007
22	Merck Frosst Canada Inc.	2008
23	AstraZeneca Canada Inc.	2007
29	Wyeth Pharmaceuticals	2007
57	Bayer Inc.	2008
91	Vifor Pharma, Aspreva International Ltd	2008
98	Bioniche Life Sciences Inc.	2007

