Genomics to Health

Institute of Medicine

Roundtable on

Translating Genomic-Based Research for Health

December 3, 2012

Edison Liu, M.D.

The Jackson Laboratory

The Jackson Laboratory

Leading the search for tomorrow's cures

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I am a member of the Scientific Advisory Board for a diagnostics company,

Veracyte

(San Francisco)

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Leading the search for tomorrow's cures

Acknowledgement

Central Observation:

US biomedical research has led the world

Our management of public domain science is being emulated throughou

Indepe

Peer r

Transl e &
biotech

Bayh D

Overhead recovery

However, times are changing
Medical sciences have adva
Expectations have escalated
The economics are different

Our focus was correct:

Vannevar Bush → Basic sciences

NIH → conquering disease

Facilitating commercialization

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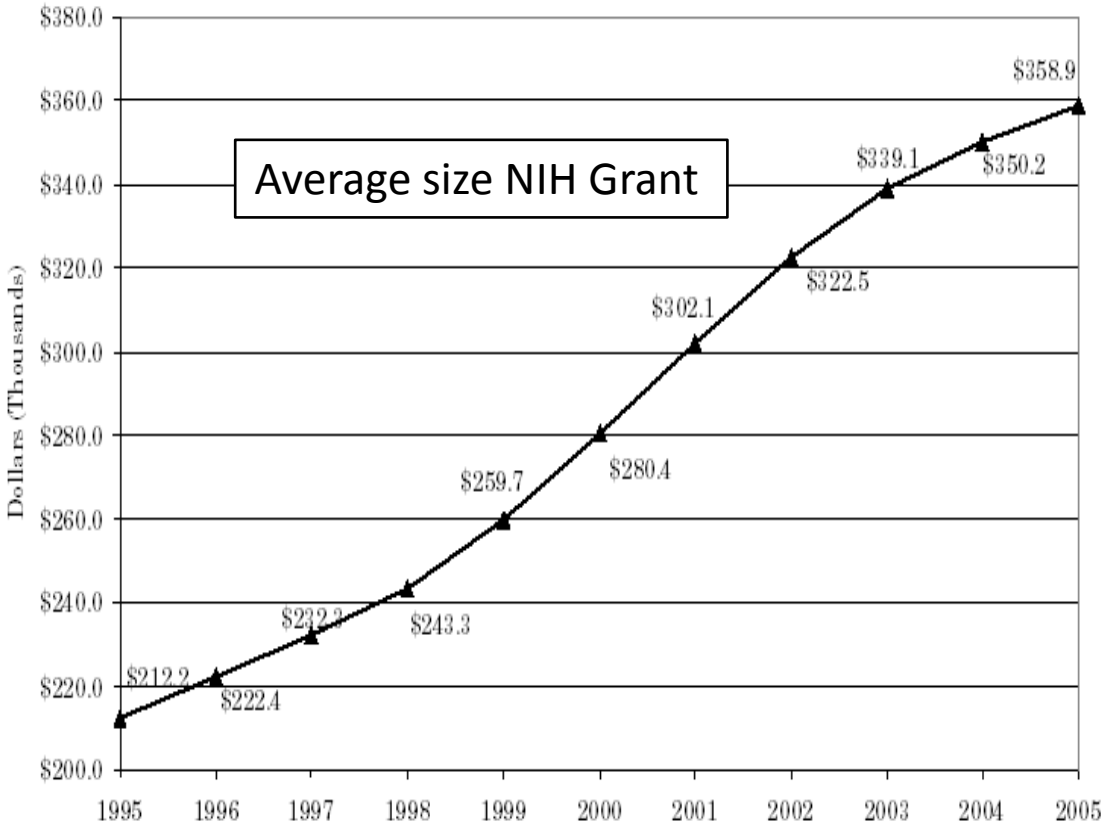


What is the difference?

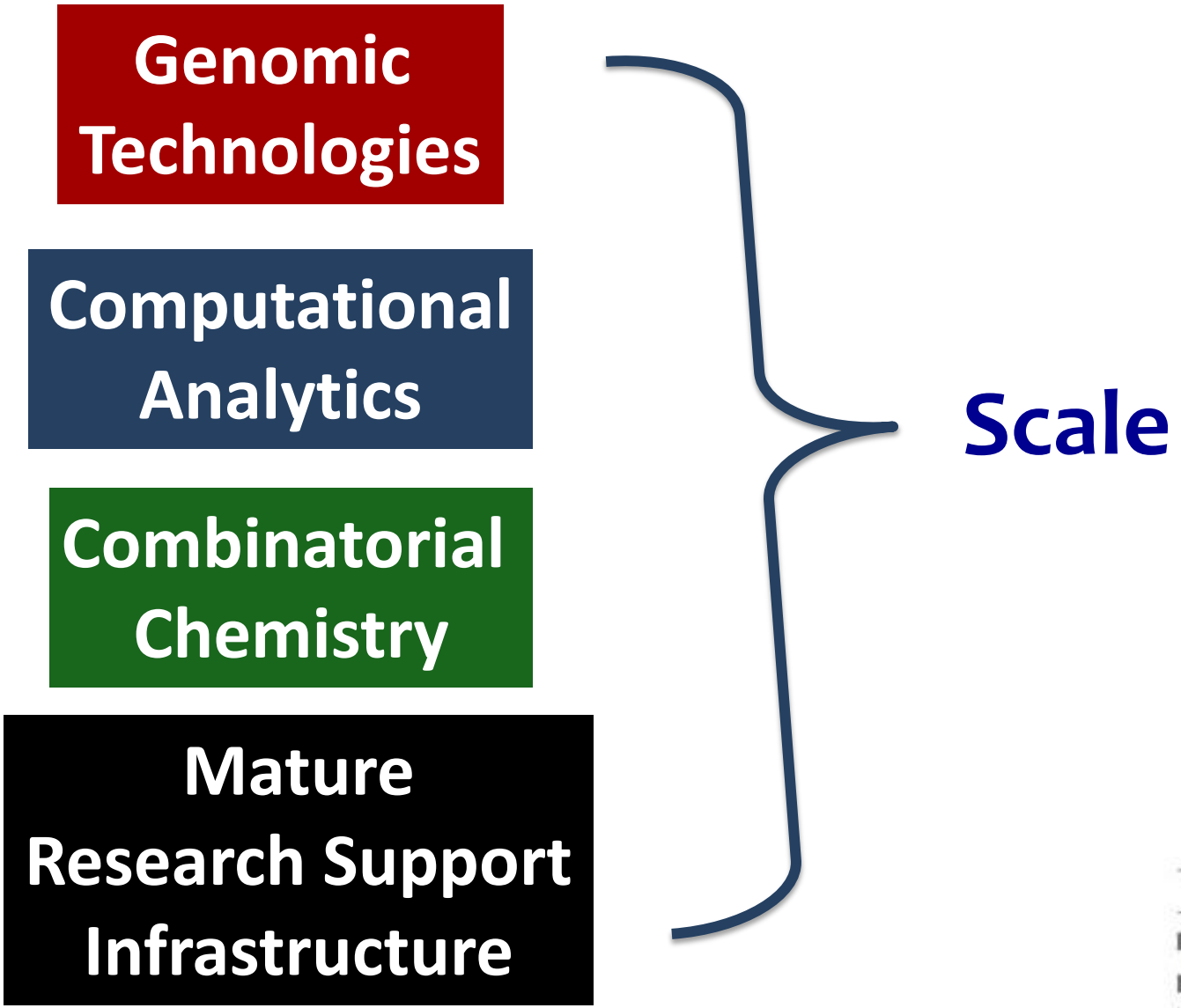
Cost of doing meaningful biomedical research is now high

Biomedical Research and development Price Index:

- Has exceeded GDP index every year
- Has over tripled between since 1980, doubled since 1990

Source NIH: http://officeofbudget.od.nih.gov/pdfs/FY12/BRDPI%20Table%20of%20Annual%20Values_05_18_2011.pdf

What is Different?



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Spinning wheel

Cotton Gin

Let's be provocative

Central Premise:

Public/Academic Biomedical Research enterprise is inefficient relative to the technologies available

New mindset is needed

- Mission oriented research by collectives of like-minded scientists
- Milestone sensitive
- Attention to more efficient research processes
- Focusing on cost effective outcomes

New management approaches are required:

- Quality project management, expert project managers
- Strategic attention
- Expert review vs. peer review

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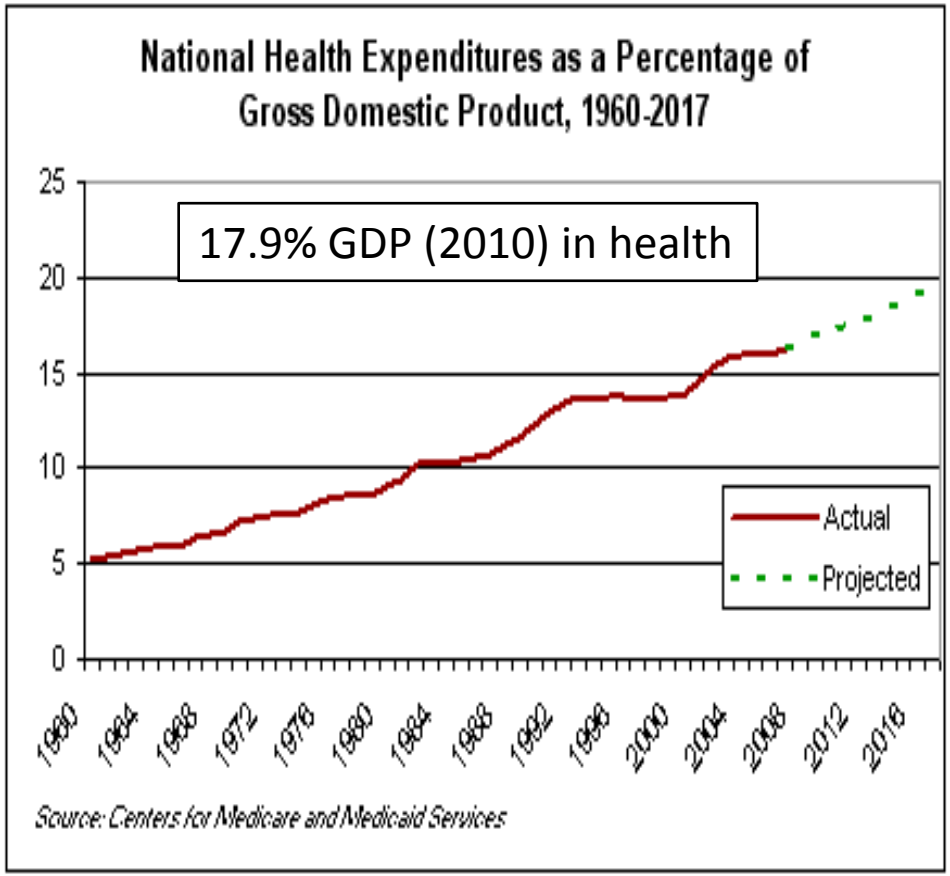
We are pretty inefficient

Spending on drug, biotechnology and medical device research over doubled from $37.1 billion in 1994 to $94.3 billion in 2003.

Journal of the American Medical Association Moses, H et al. Financial Anatomy of Biomedical Research. *JAMA* 2005;294-1333-1342

But…



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Inefficient despite the power of current science: Case studies

- Ph1 chromosome identified 1960 as a marker for CML (Nowell)
- bcr-abl cloned and shown to be the molecular mechanism 1984-1990 (Groffen and Lugo)
- Specific drug (Gleevec) to target gene abnormality 1999 (Druker)

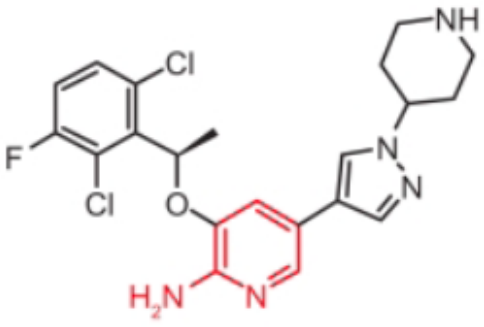
From discovery of a single oncogene to treatment: 39 years

Identification of the transforming *EML4–ALK* fusion gene in non-small-cell lung cancer

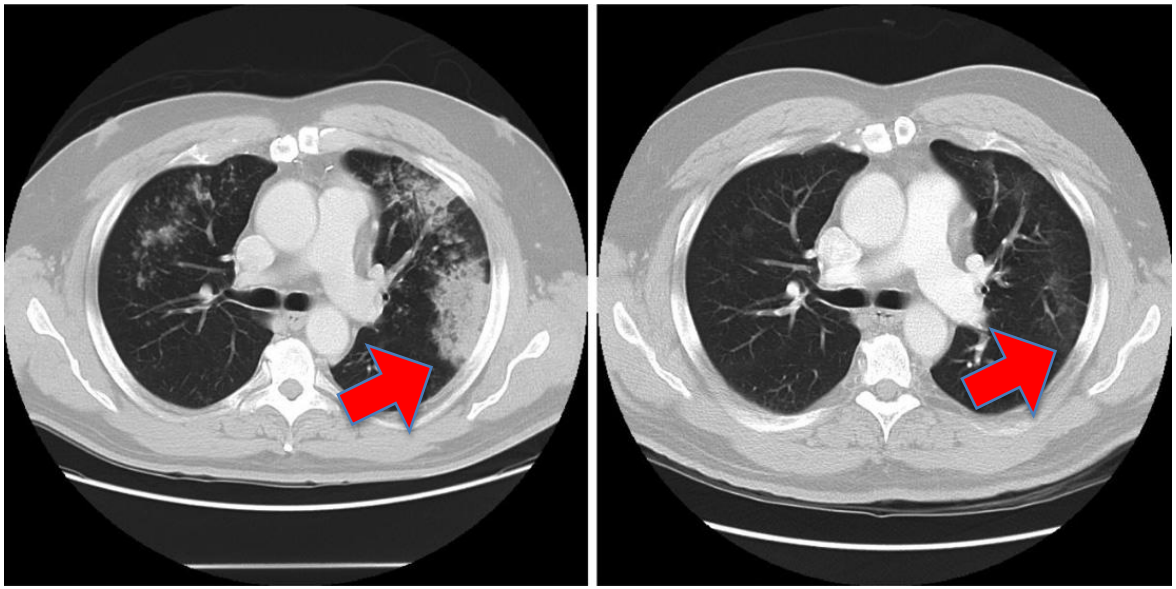
Nature 2007

Manabu Soda[1,2], Young Lim Choi[1], Munehiro Enomoto[1,2], Shuji Takada[1], Yoshihiro Yamashita[1], Shunpei Ishikawa[5], Shin-ichiro Fujiwara[1], Hideki Watanabe[1], Kentaro Kurashina[1], Hisashi Hatanaka[1], Masashi Bando[2], Shoji Ohno[2], Yuichi Ishikawa[6], Hiroyuki Aburatani[5,7], Toshiro Niki[3], Yasunori Sohara[4], Yukihiko Sugiyama[2] & Hiroyuki Mano[1,7]

In 2007, the genomic analysis of <u>one</u> lung cancer from a 62 year-old smoker
→ EML-ALK fusion in 6% of lung cancer patients



Crizotinib (PF-02341066)

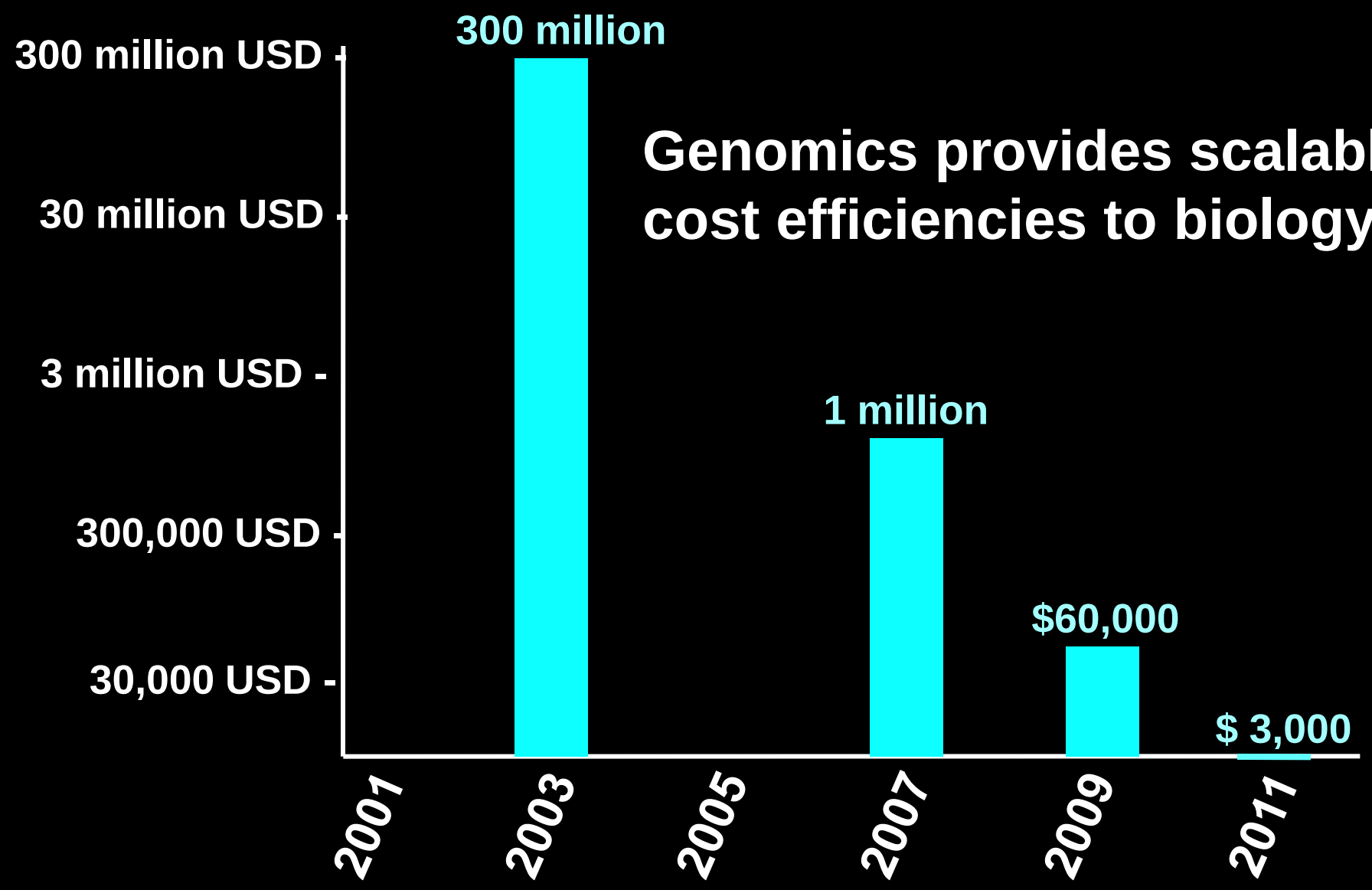


Crizotinib → 60% response rate in those 6% of patients with lung cancer with the EML-ALK mutation.
On August 26, 2011, the US FDA gave approval of crizotinib by for the treatment of *ALK*-rearranged lung cancer

4 years from genomic discovery to treatment

Ou, Drug Des Devel Ther. 2011; 5: 471–485.

Cost of sequencing a human genome



Genomics provides scalable cost efficiencies to biology

Let's be provocative

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New mindset is needed (changing cultures)

Mission oriented research by collectives of like-minded scientists

Milestone sensitive

Attention to more efficient research processes

Focusing on cost effective outcomes

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Quality project management, expert project ma

Strategic attention

Expert review vs. peer review

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Examples

Energy Biosciences Institute (EBI): $500 million over 10 years, sponsored by BP. UC Berkeley and University of Illinois CU

Janelia Farm: Diverse skills, common focus, freedom to explore, science as a social enterprise (patterned after Bell Labs)

Genome Institute of Singapore: $300 million over 10 years. Diverse skills, Collective decision making, integrated platforms

Liu ET. Integrative biology - a strategy for systems biomedicine. Nat Rev Genet. 2009 Jan;10(1):64-8.

Examples: Focus on cost effective outcomes
Diagnostics as a systems optimizer

The Jackson Laboratory for Genomic Medicine and medical insurers:

Direct us to the clinical cancer problem that not only is a health problem but is also most costly to the health system. Could we derived a genomic solution for this indication?

Veracyte: Afirma Thyroid FNA diagnosis

(I am on Veracyte's Scientific Advisory Board)

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Future scenario for Genomic Medicine:

- All children with developmental disorders will be sequenced
- All cancers will be sequenced
- Whole Genome solutions are more cost effective than multiple single test
- Medical analytics in a secure and honest broker environment will be important
- All these efforts should improve cost effectiveness of delivering health care

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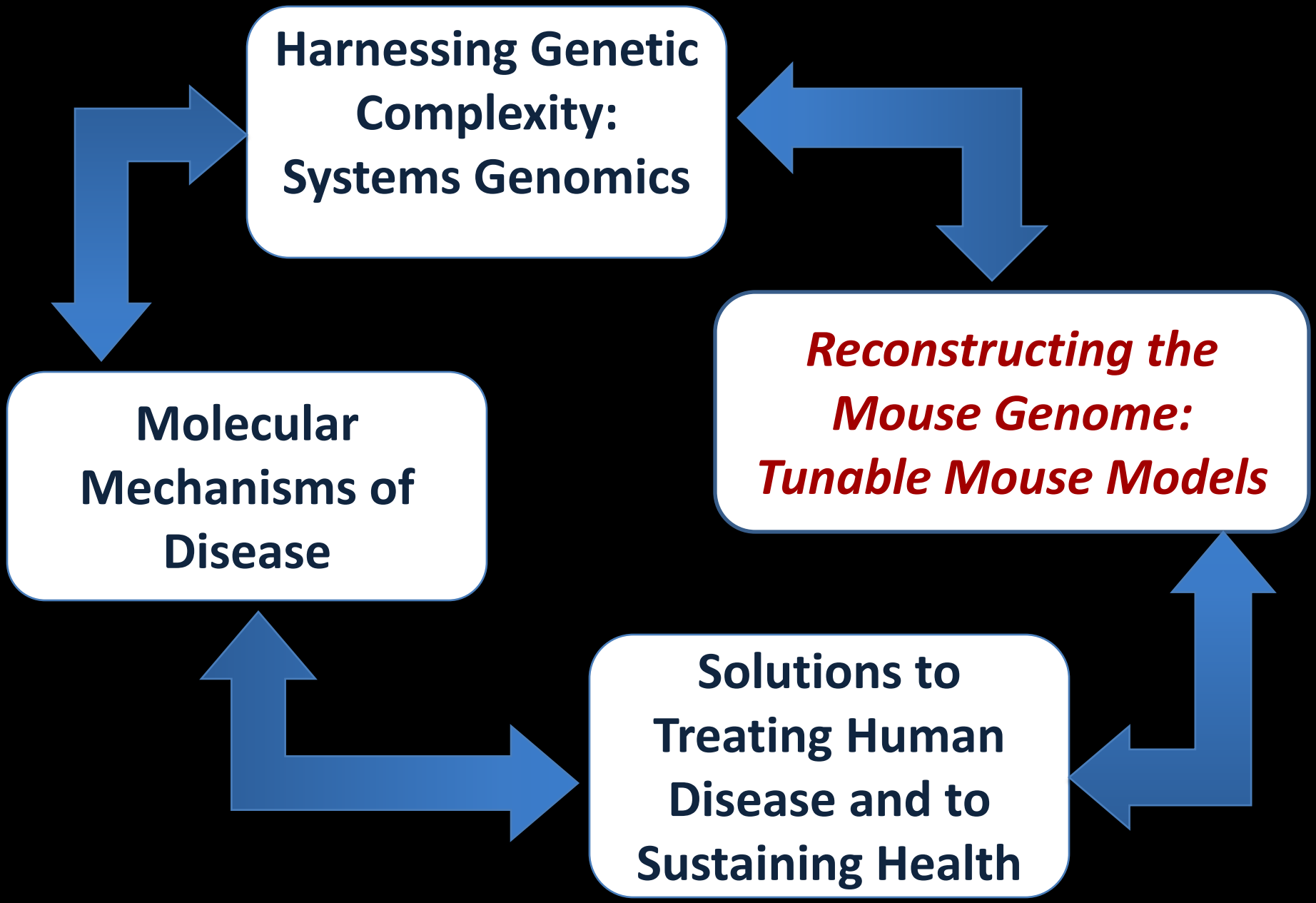
Harnessing Genetic Complexity: Systems Genomics
Reconstructing the Mouse Genome: Tunable Mouse Models
Solutions to Treating Human Disease and to Sustaining Health
Molecular Mechanisms of Disease

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Venture, DARPA

Strategic attention

Horizon scanning, advocacy

Expert review vs. peer review

HHMI vs. NIH study section

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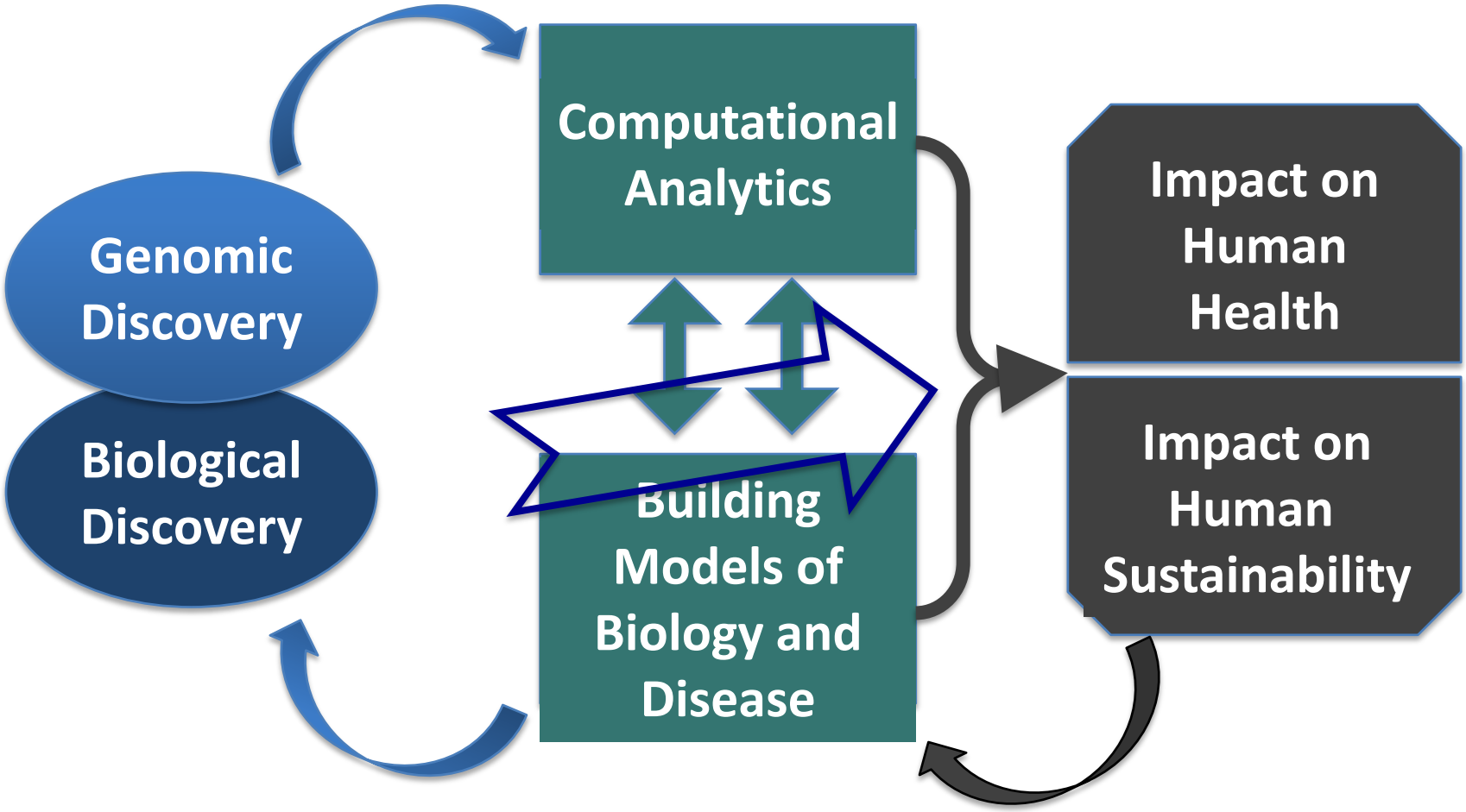
Emerging Demands in Biomedical Sciences



Emerging Demands in Biomedical Sciences

Research Realities – who will succeed:

Those who execute with speed

Those who are flexible

Those who can scale or have access to massively scaled capabilities

Those who can assemble functional teams quickly

Those with quality scientific managers

Those who can quickly embrace new and powerful technologies

Those who can understand and harness genetic complexity

Those who achieve direct relevance to human health

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