ASU Complex Adaptive Systems Initiative
Arizona State University

Burrill & Company
Life Sciences: Venture Capital, Private Equity, Merchant Banking, Media

Technology Acceleration and Convergence: The Evolution of Novel Platforms for Improved Healthcare Delivery

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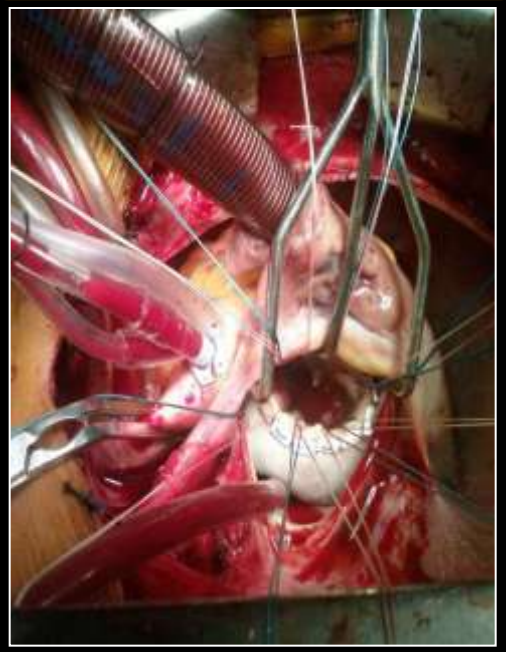
Burrill LP & Advisory Board Meeting
Cavallo Point, California: 20 April 2010

Major Challenges in Healthcare

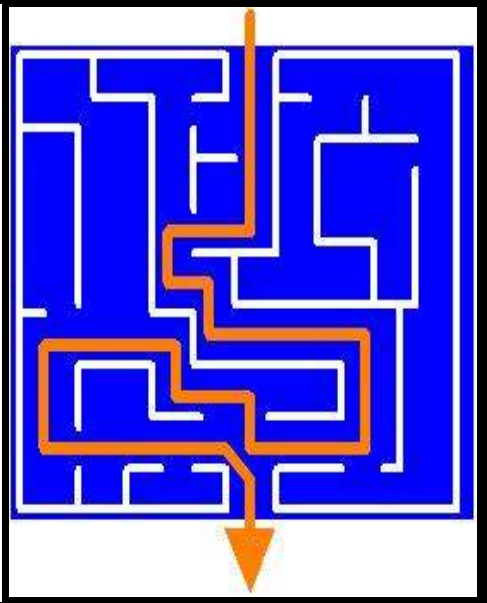
Cost	Demographics	Access	Variation in Clinical Practice
			

Major Challenges in Healthcare

Inefficient Use of Information

Fragmented Care Versus Integrated Care

Duplication, Defensive Medicine & Waste

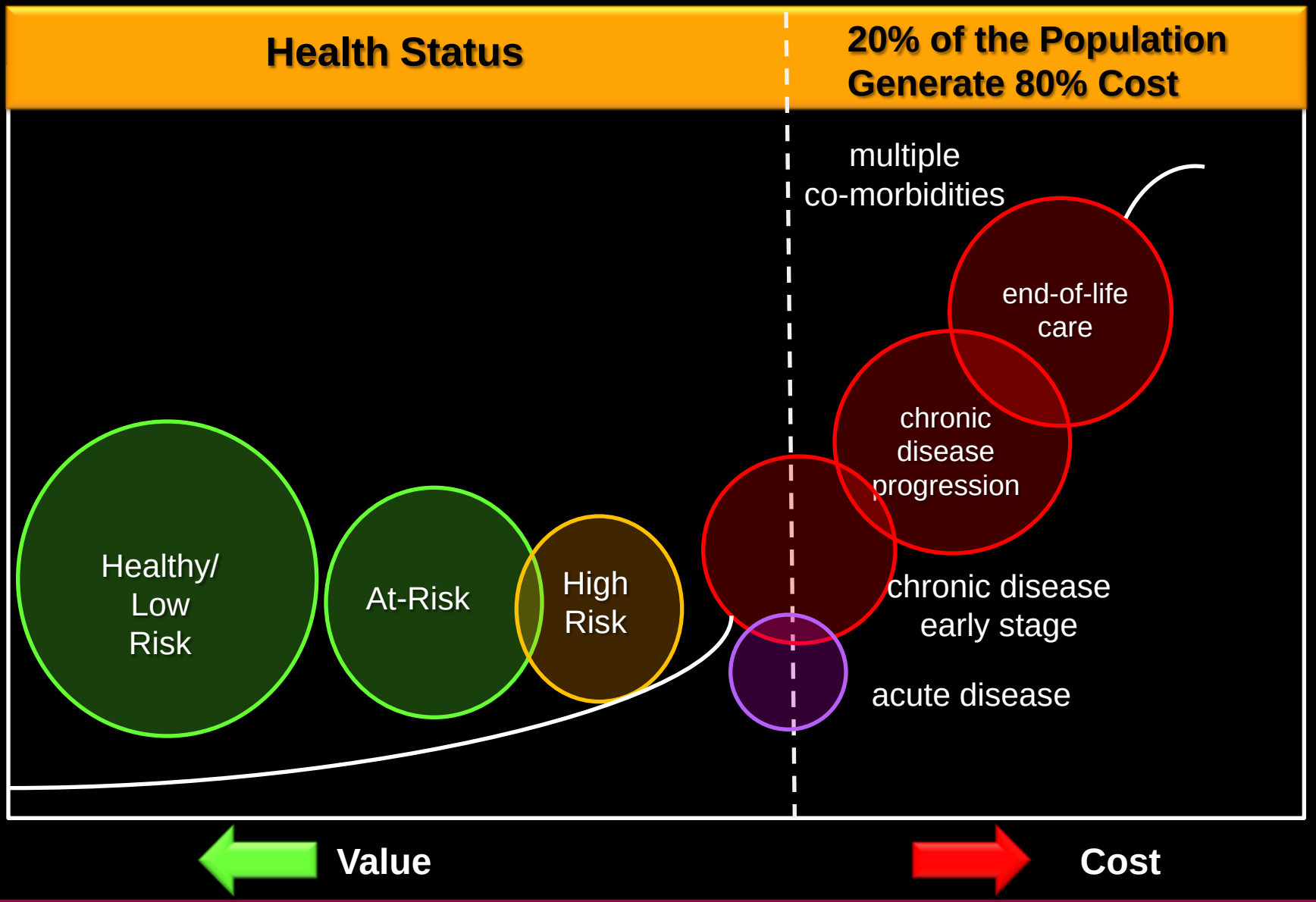


Protracted Adoption of Innovation

The Patient Protection and Affordable Care Act: Signed Into Law 23 March 2010

: blogs.nachc.com

The Economic, Social and Clinical Benefits of Proactive Mitigation of Disease Risk and Chronic Disease Co-Morbidities



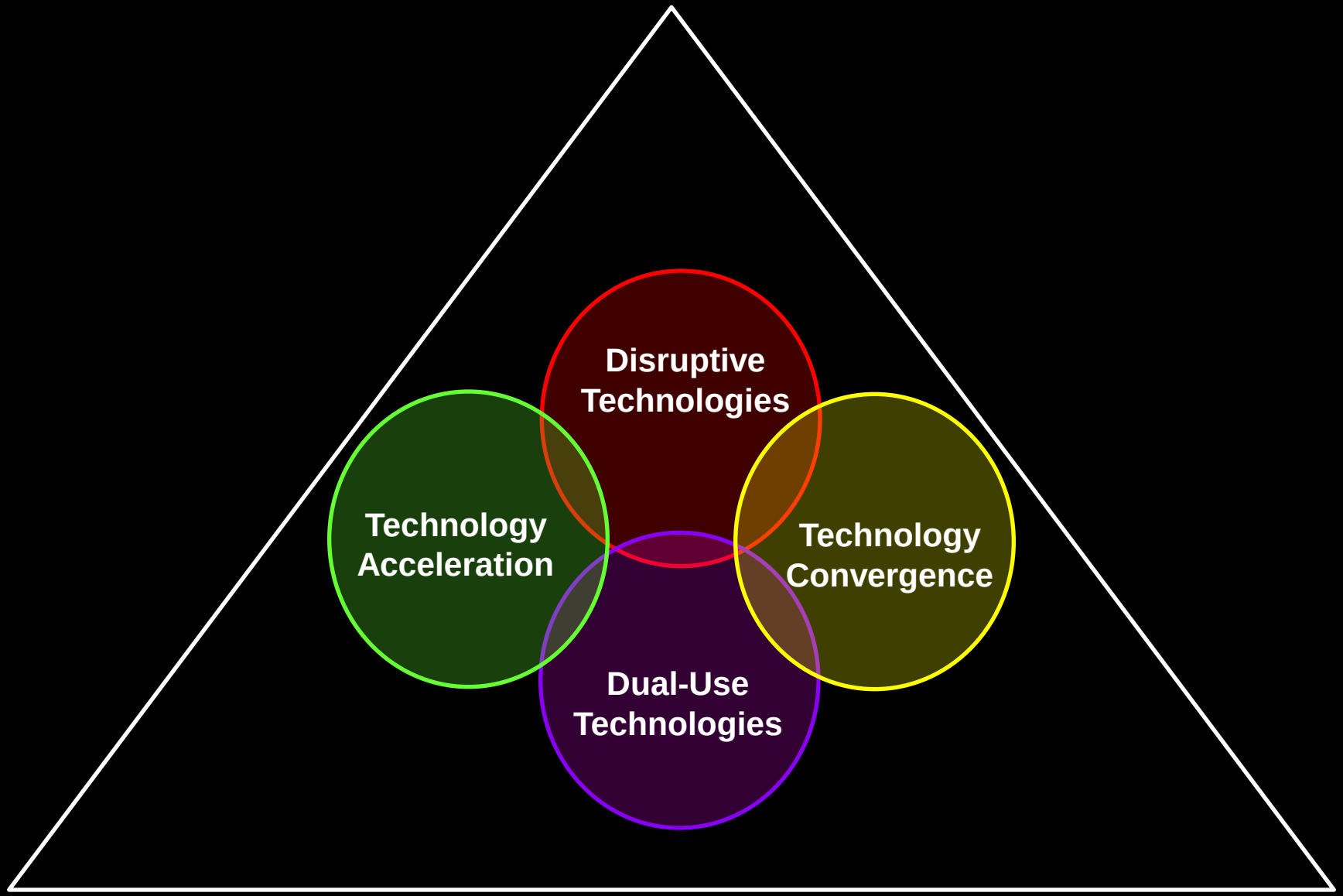
Reasonable Expectations for Rational Healthcare

- what works?
- why it works?
- who it works for?
- what works best?
- when should it be used optimally?

- validated evidence
- mechanism of action
- personalized medicine
- comparative effectiveness
- best practice guidelines, standard-of-care and malpractice

VALUE

The Strategic Environment for Technology

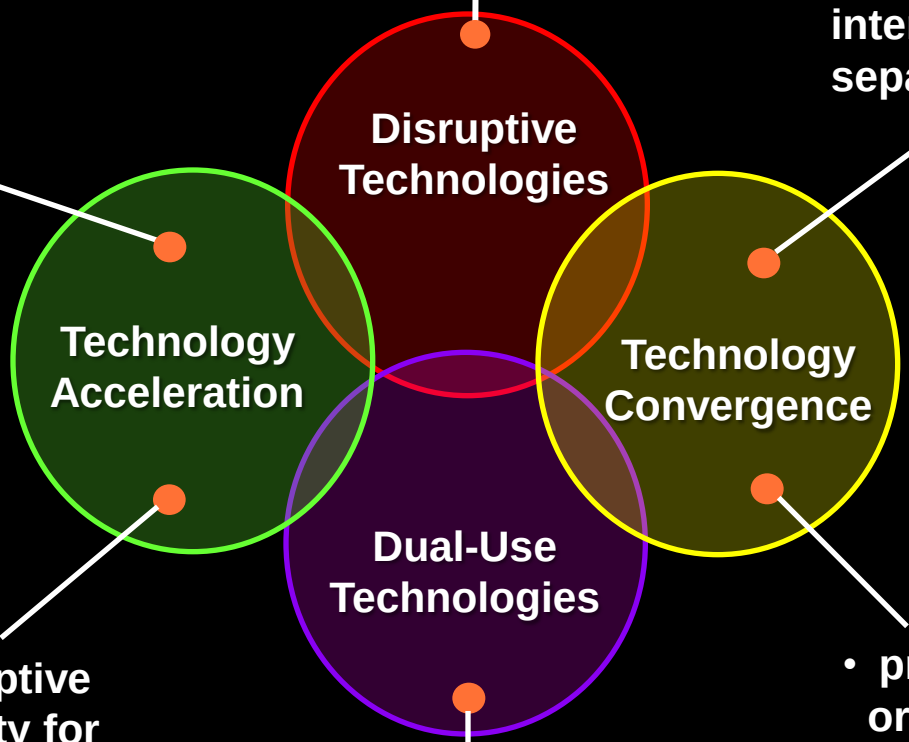


The Strategic Environment for Technology

- creative destruction, discontinuity, dislocation, inflection/tipping points, 'Black Swans'

- competition within a sector always arises at the margin

- new competitors/markets arise at the fusion interstices of previously separate sectors

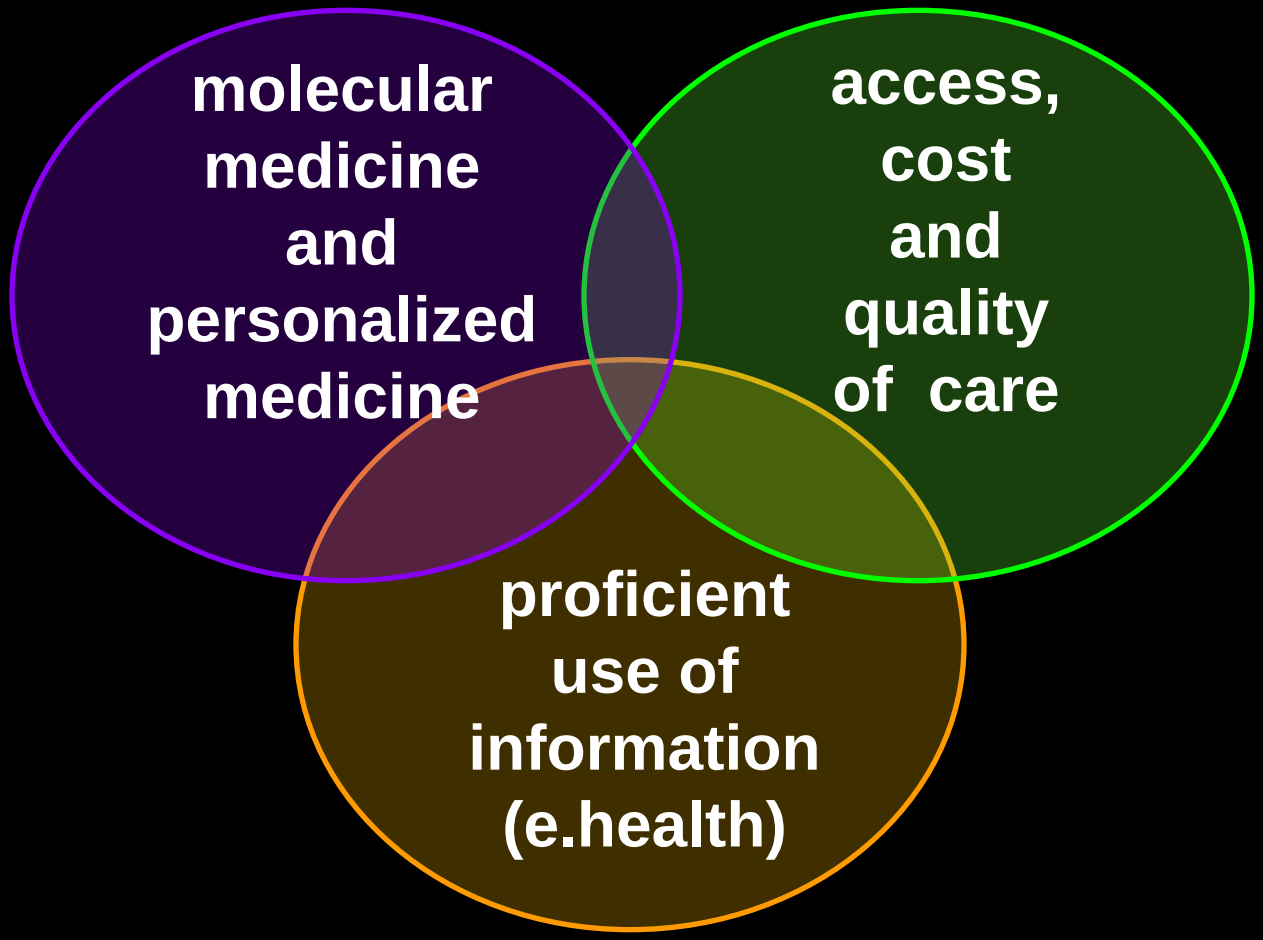


- adaptive agility for survival

- proactive adoption of new organizational and business models/networks

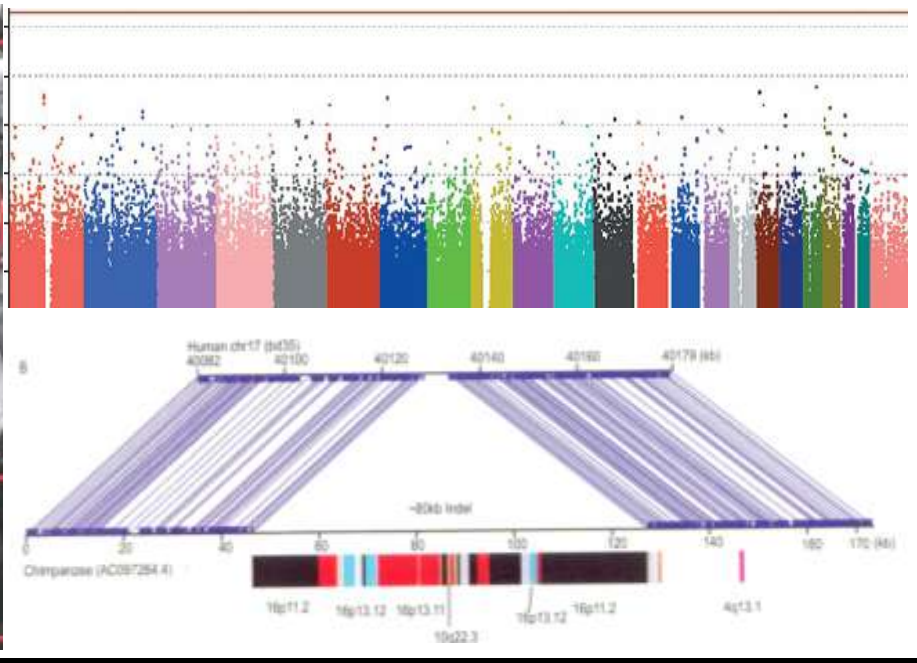
- new legislative and regulatory oversights

The Three Convergent Forces Shaping the Evolution of Healthcare



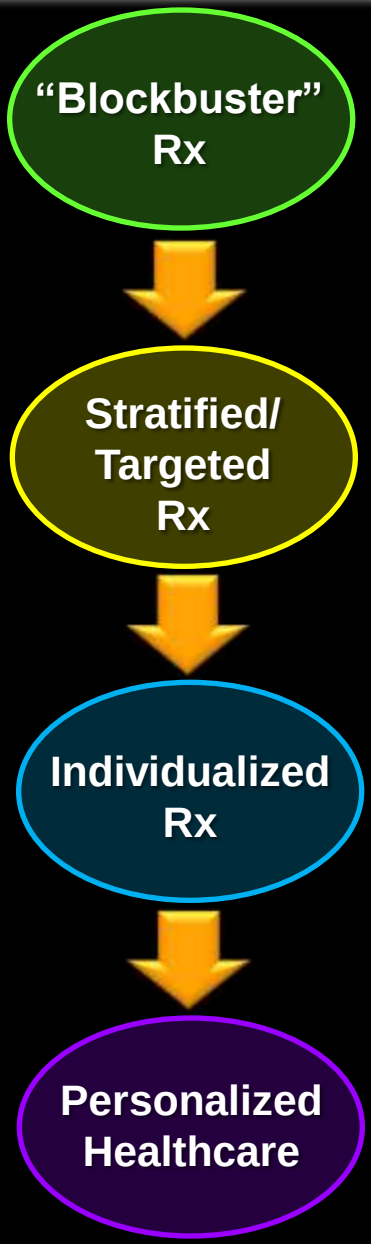
VALUE

Personalized Medicine and Technological and Commercial Discontinuities in Healthcare Markets



Establishing a Long-Term Strategy and New Value Propositions in a Short Term Environment

The Evolving Market for (Bio)Pharmaceutical Therapies



- empirical "one-size-fits-all"
- population-based Rx

- Rx targeted to patient subgroups with common molecular pathology
- Dx-Rx combinations and Rx labeling

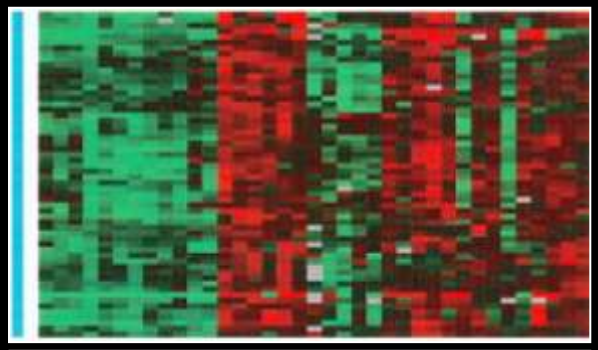
- individualized Rx
  - relevant disease subtype
  - AE risk profiling
  - compliance monitoring

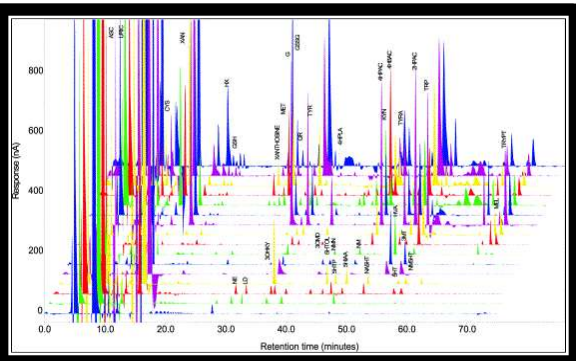
- integrated framework of coordinated care and longitudinal care

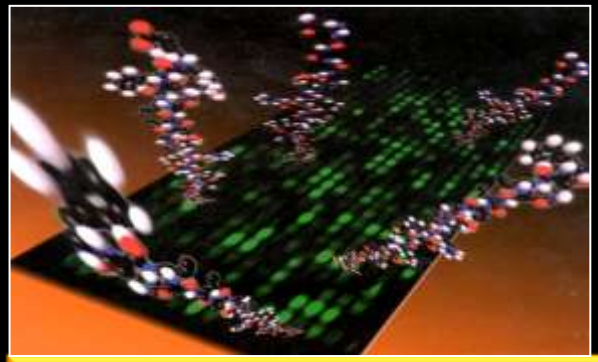
Molecular Diagnostics and Miniaturized Devices: A Key Future Driver in the Healthcare Value Chain

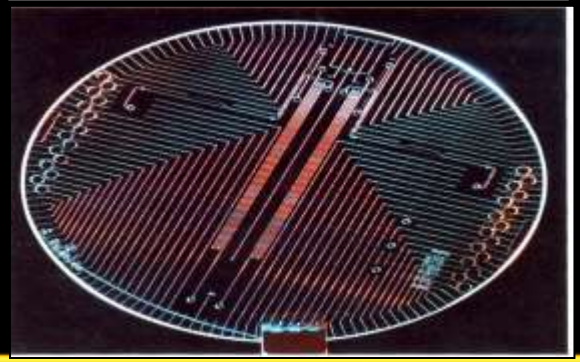
Complex Biosignature Profiling

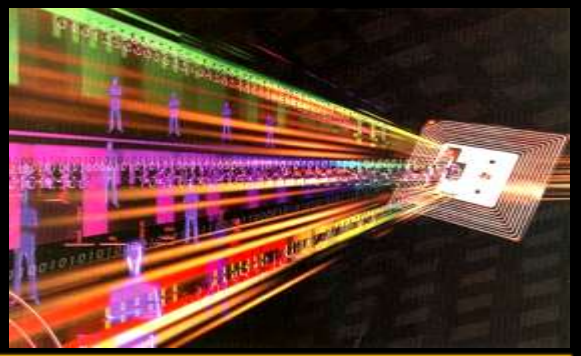
genomics	proteomics	immunosignatures











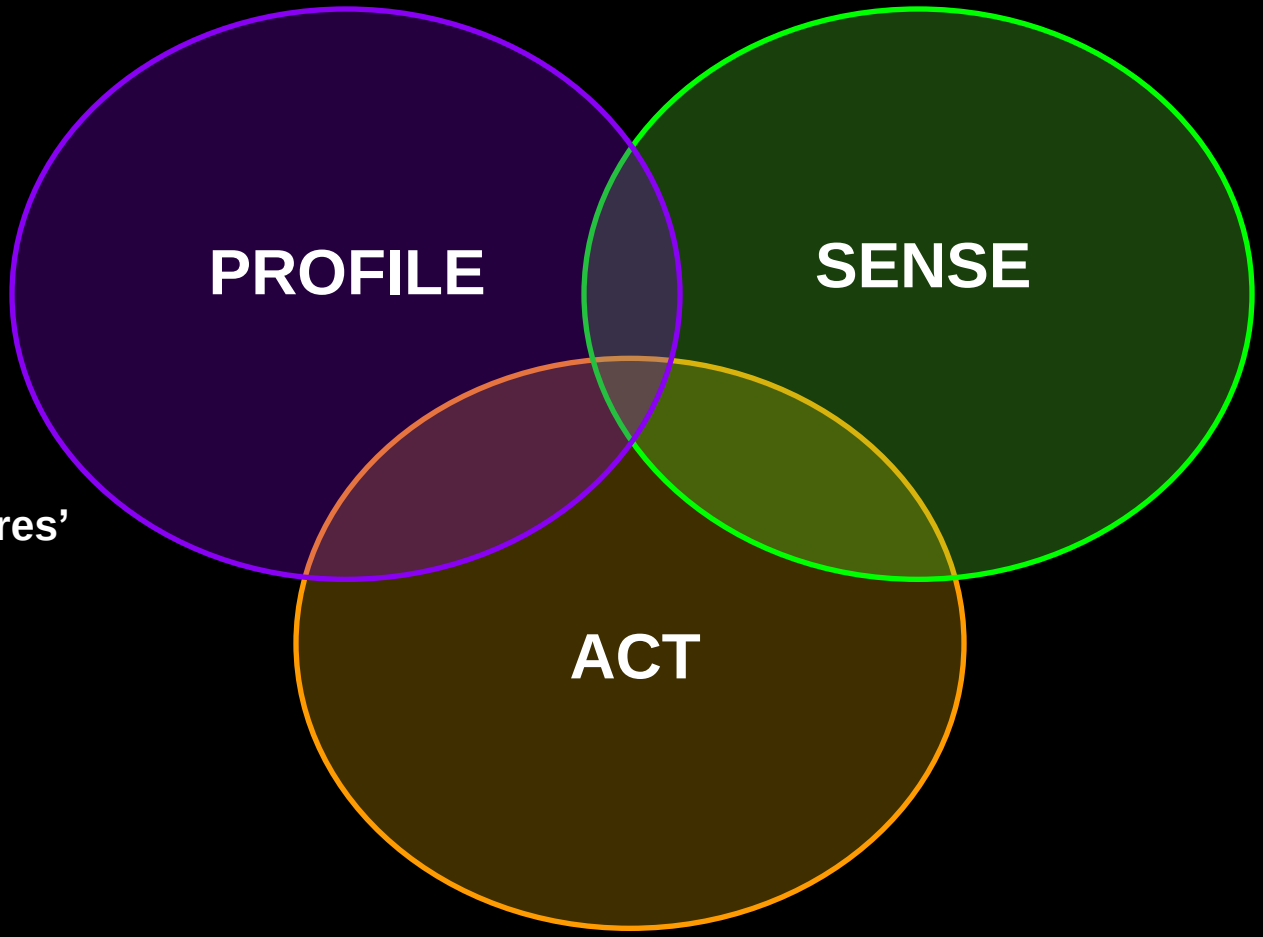
Signature Detection, Deconvolution and Multivariate Analysis

automated, high throughput multiplex assays	novel test formats and devices (POC)	new algorithms For complex signal/deconvolution

Mapping the Molecular Signatures of Disease: Building Integrated End-to-End Systems as the Foundation of Personalized Medicine

ID patterns of pathway and network dyregulation in disease

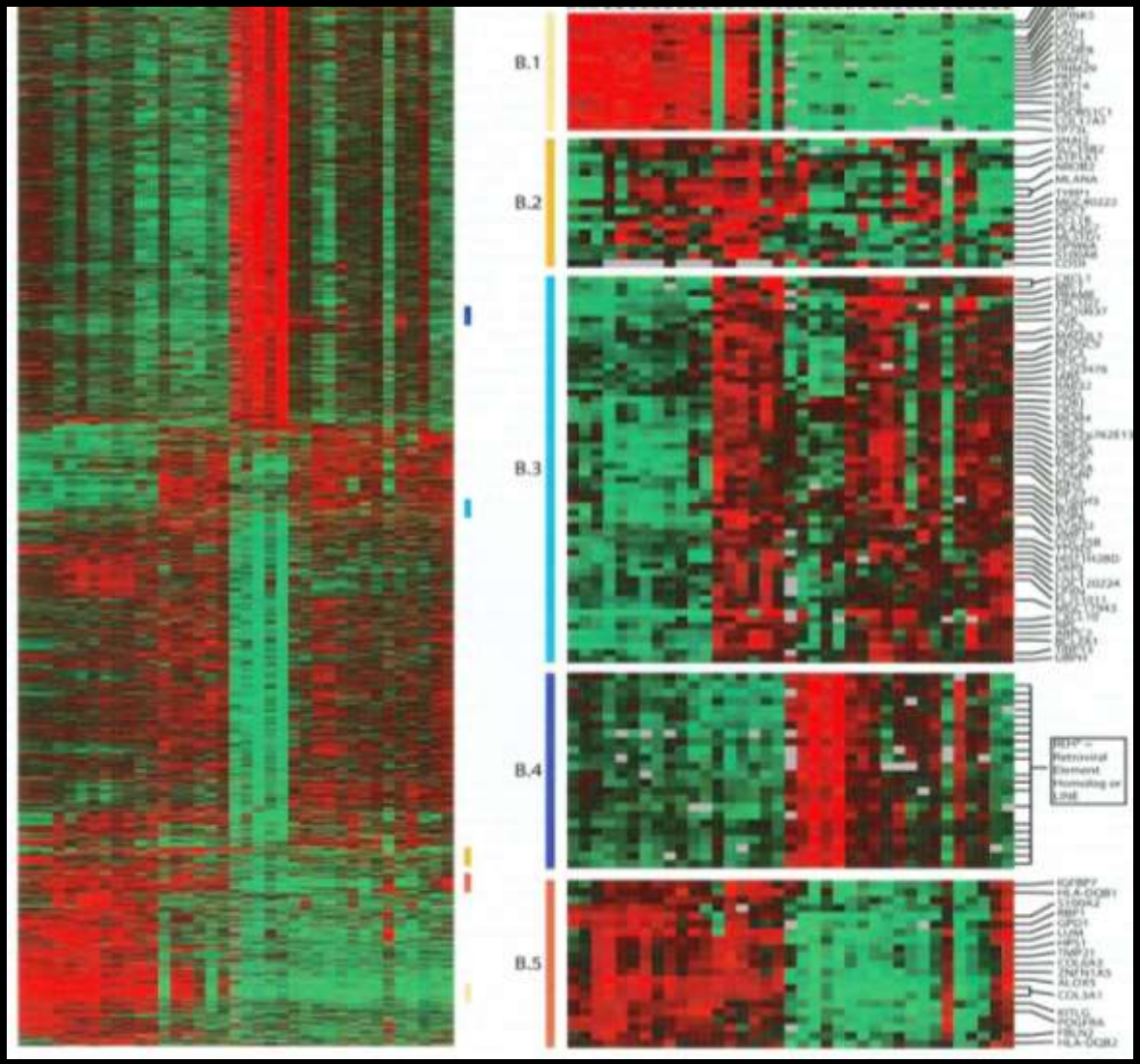
– "biosignatures'



automated platforms for rapid detection of multiplex analytes

rapid analytics and customized data formats/visualization to guide optimum decisions by clinicians, patients and payors

Disease Subtyping: Next-Generation Molecular Diagnostics (MDx) and A New Molecular Taxonomy of Disease



MDx Platforms

- massive parallelism
- miniaturization
- automation
- rapid
- POC

RIGHT Rx for RIGHT DISEASE SUBTYPE

K-RAS Profiling and Anti-EGFR Monoclonal Antibody Therapy

- higher response in patients with K-RAS versus mutant-K-RAS
- estimated $604 million/year savings (ASCO)

clinical guidelines

- regulatory endorsement in product labeling

- payor adoption

Development of Companion Diagnostics and Dx Test Validation Standard

- ODAC rejection (3/2010) of *Omapro* for Gleevec-resistant CML due to T315I mutation

- failure to use single standardized assay for all patients
  - peripheral blood versus bone marrow
  - 1/3 tested locally; 2/3 tested centrally
  - centralized labs used different assays with 100 fold sensitivity difference for the mutation

Molecular Medicine and Rational Therapeutics: Targeted Rx and Rise of Molecular Diagnostics and Patient Profiling

- opening era in linking disease molecular pathology to rational Rx
- increasing payor, regulatory and public pressures for reliable ID of Rx-responsive patients
- demand for Dx-Rx combinations will intensify
- Dx-Rx combination will become an obligate element of NDA/BLA submission and product labeling
- development of Dx-Rx combinations as intrinsic components of R&D programs for investigational Rx

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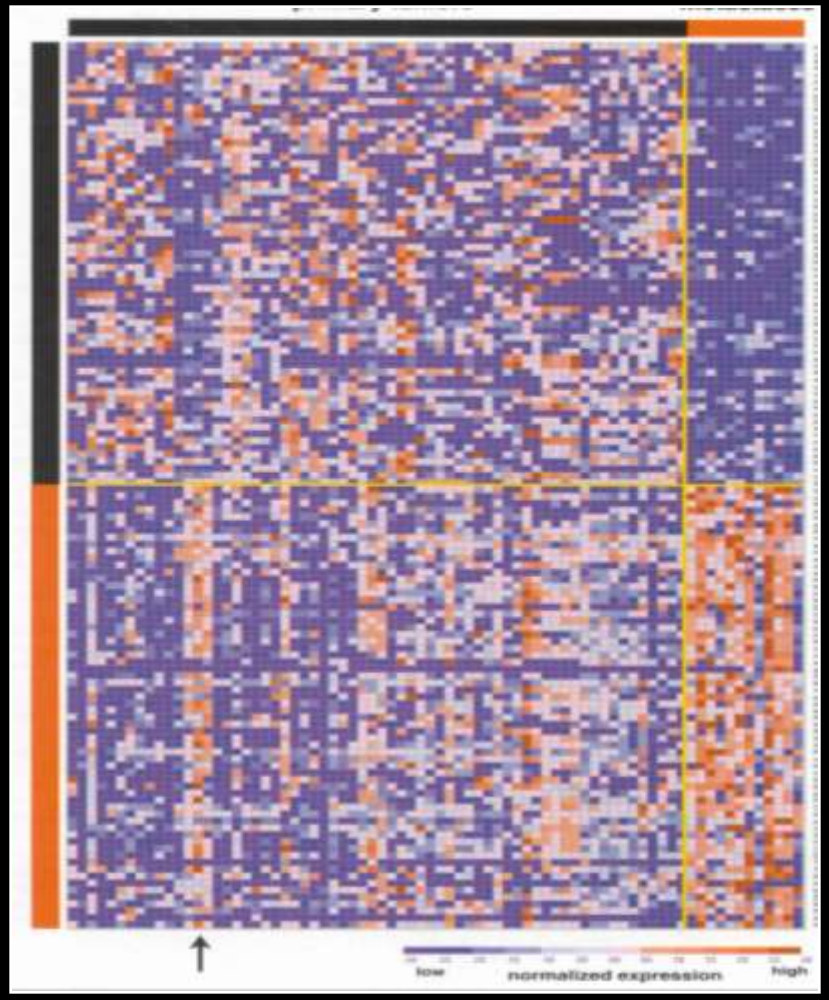
The New Reality (S. Burrill):
Companion Therapeutics Selected by Precision MDx

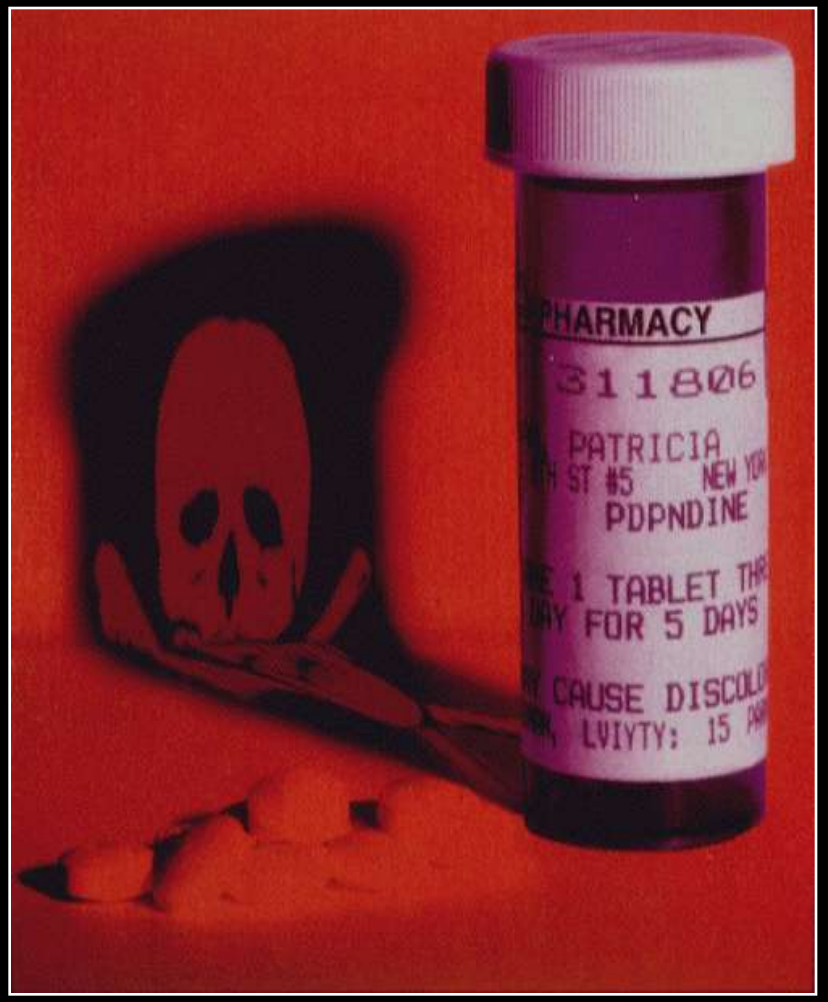
From Pharmaceuticals to Pharmasuitables

Disease Subtyping:



Right Rx for Right Disease

Individual Variation and AE risk

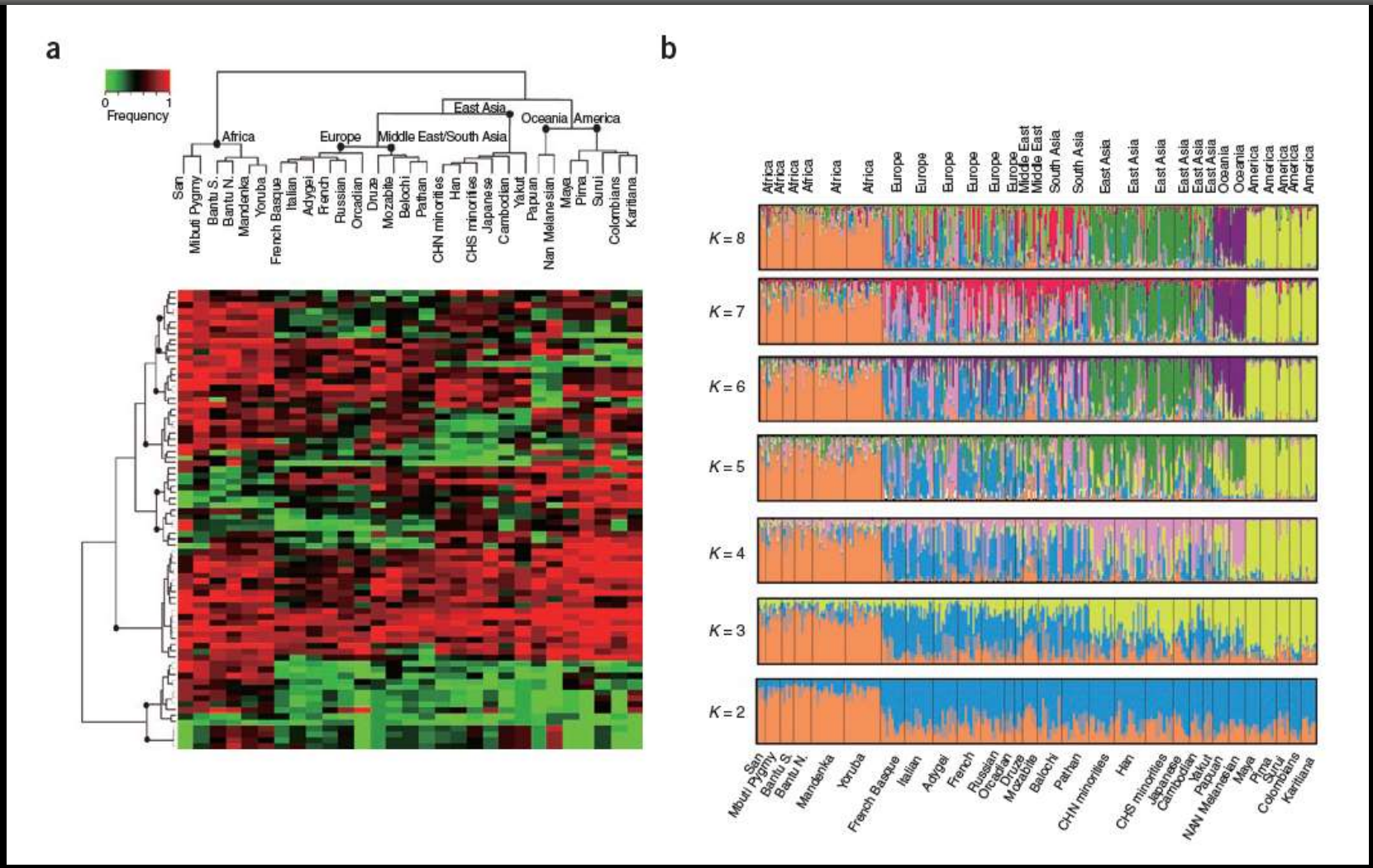


Right Rx for Right Patient

Molecular Diagnostics and Pharmacogenetic Profiling to Identify Individuals at Risk for Rx Adverse Events

- broader, more complex profiling platforms than MDx assays for ID of drug targets
  - number of isoforms for DMPK enzymes and scale of individual variation within populations
- ID of slow metabolizer genotypes
- unknown effects of genetic and environmental confounders in AD(M)E beyond genetic variation in drug-metabolism (I-III) repertoire
- growing recognition of importance of variation in HLA allels as additional risk factor

Mapping the Human Pan-Genome: Identification of Ethnic Differences and Implications for Rx Efficacy and Safety

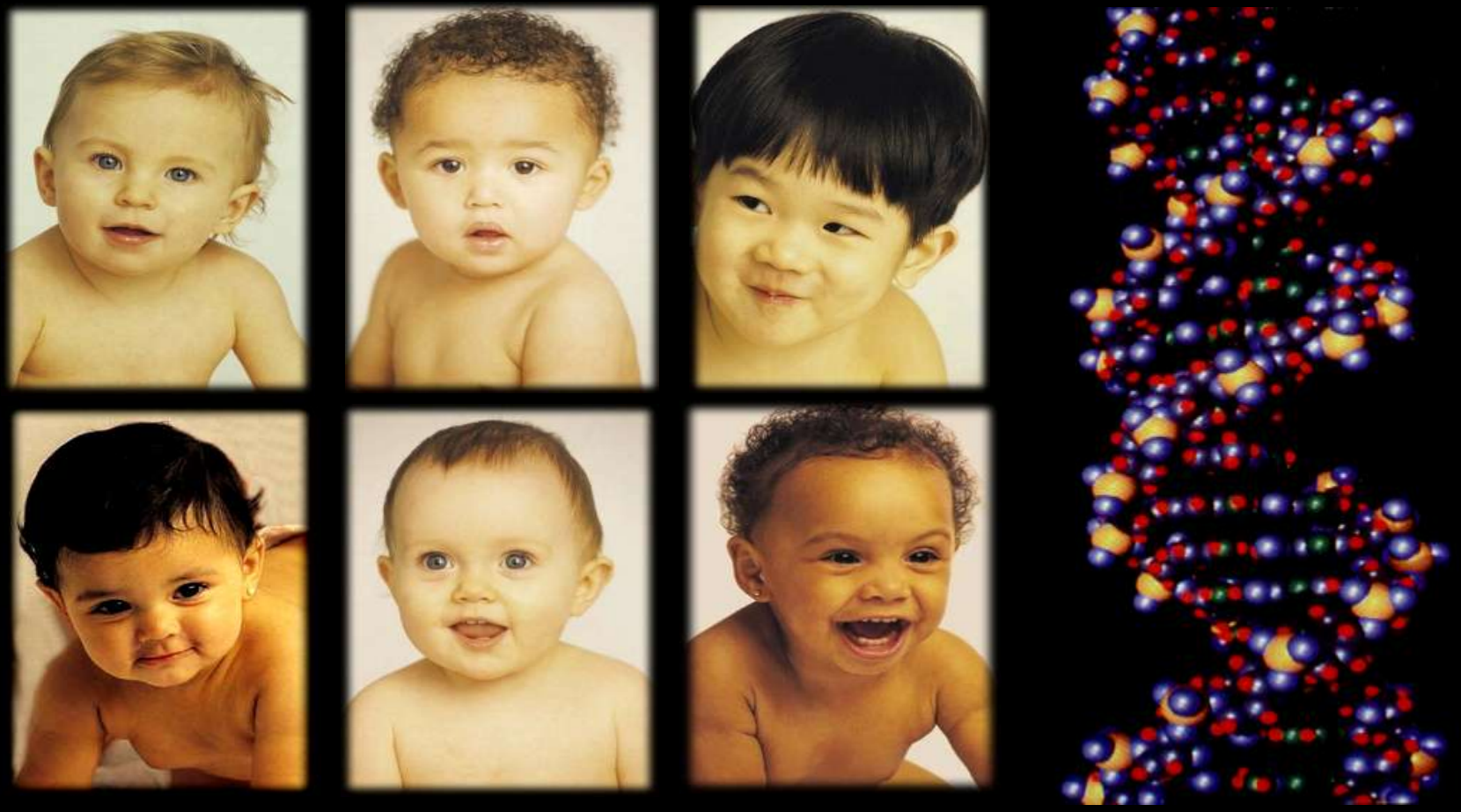


From: Ruiqiang Li et al. (January 2010) Nature Biotech. Vol. 28, p. 59

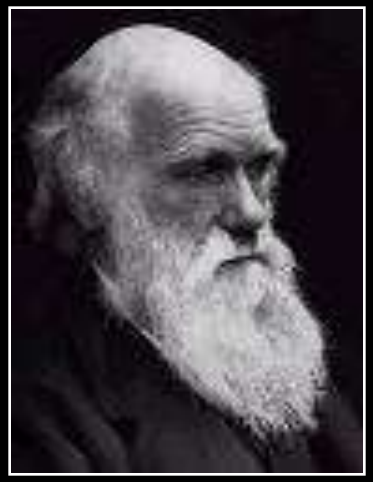
Mapping Human Genetic Diversity

- transcending PC and “biological egalitarianism”
- non-trivial genetically-based biological variation exists in individuals and groups
- ignoring such variations is illogical, poor science, poor clinical medicine and potentially dangerous
- mapping group genetic diversity is fundamental knowledge
  - human evolution and trait acquisition
  - interplay of genomes and environment in determining outcomes
  - variations in disease susceptibility, xenogeneic metabolism and clinical decisions for optimum treatment

The Hunt for Gene Loci Associated with Complex Human Diseases

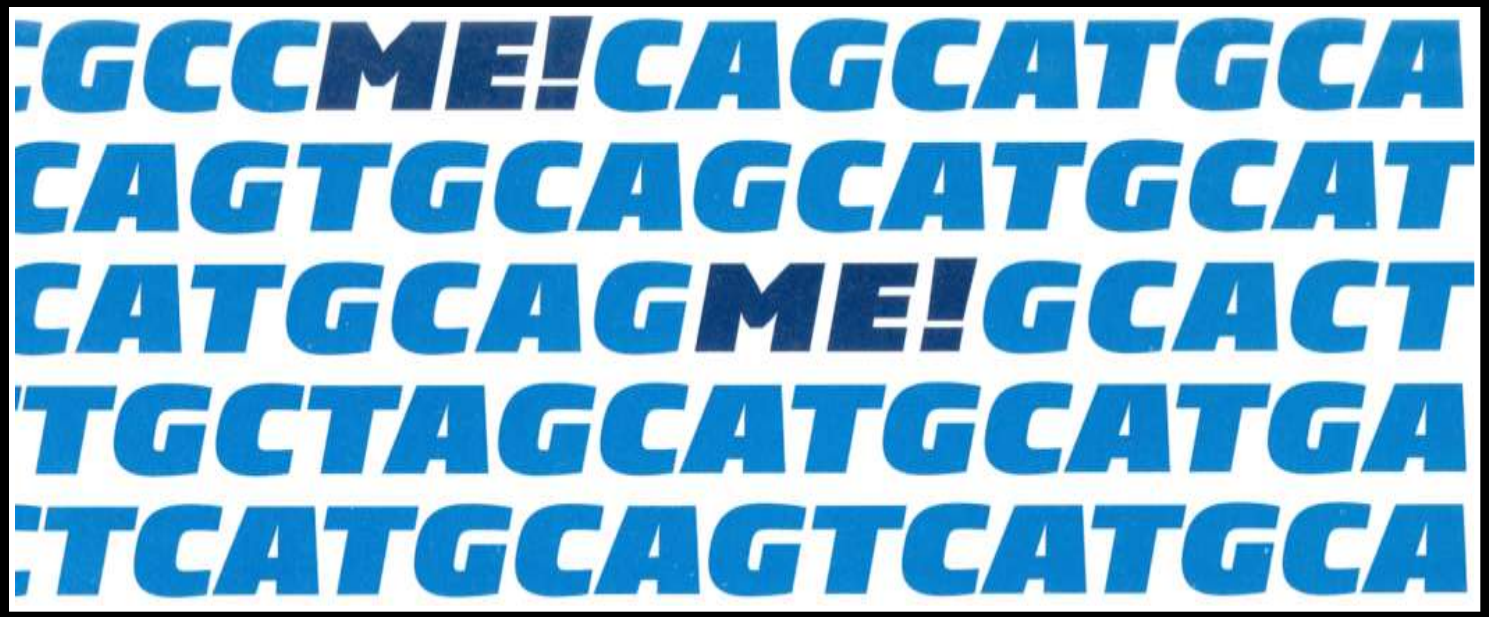


Mapping Human Diversity



“Our ignorance of the laws of variation is profound”

Charles Darwin



Disease Predisposition Risk Profiling for Common, Multigenic Late-Onset Disorders

- slower evolution than many predict
- Genome-Wide Association Studies (GWAS)
  - high cost and to date low yield in terms of clinically exploitable markers
  - disease origins from multiple low penetrance alleles versus small, dominant set of high penetrance alleles
- substantial ambiguities regarding probabilistic risk of overt disease
  - epistasis
  - epigenetics
  - environmental confounders
  - source of poor replication of GWAS studies?

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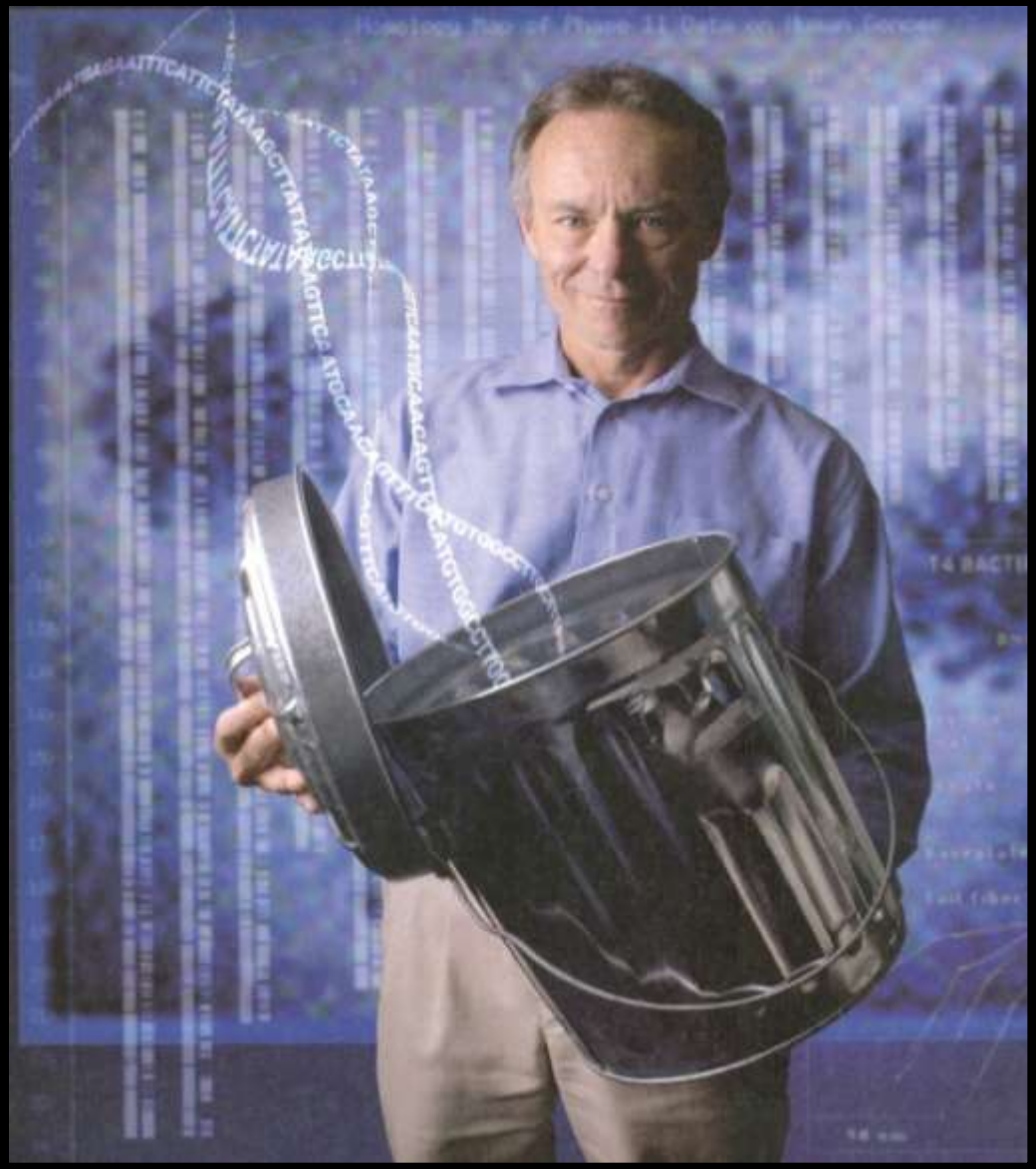
The premature quest to provide consumer genomic testing (CGx) for future risk of major diseases

Mapping the Complexity of Genome Organization



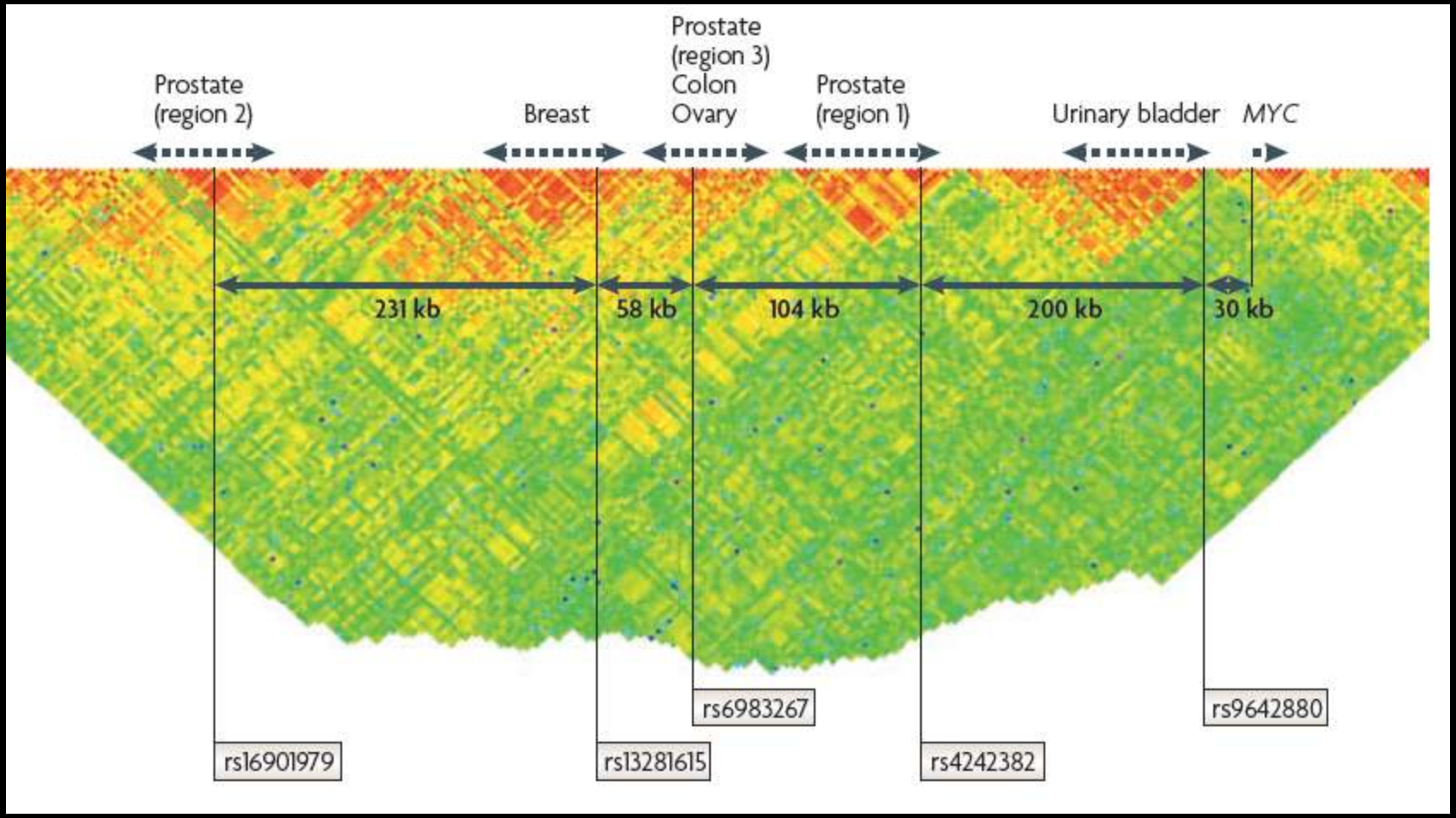
- recognition of increasing levels of organizational and regulatory complexity
  - haplotypes
  - CNV
  - indels
  - RNA universe
  - ‘dark’ elements
  - epistasis
  - epigenetics
  - nuclear compartmentalization and *trans*-expression

miRNAs Associated with Solid Cancers

Tumor	miRNA	Function
Breast cancer	miR-21, miR-125b	oncomiR
Breast cancer metastasis	miR-335, miR-206, miR-126	metastisis suppressor
Lung adenocarcinoma	let-7a, miR-143, miR-145	tumor suppressor
Lung adenocarcinoma	miR-17-92 cluster, miR-106b/93/25 cluster	oncomiR
Pancreatic ductal carcinoma	miR-196a, miR-196b	oncomiR
Ovarian carcinoma	miR-199a/b, miR-140, miR-145, miR-204, miR-125a/b	tumor suppressor
Ovarian carcinoma	miR-141, miR-200a/b/c	oncomiR
Hepatocellular carcinoma	miR-21, miR-224, miR-34a, miR-221/222, miR-106a, miR-203	oncomiR
Hepatocellular carcinoma	miR-122a, miR-422b, miR-145, miR-199a	tumor suppressor
Thyroid papillary cancer	miR-146b, miR-221, miR-222, miR-181b, miR-155, miR-224	oncomiR

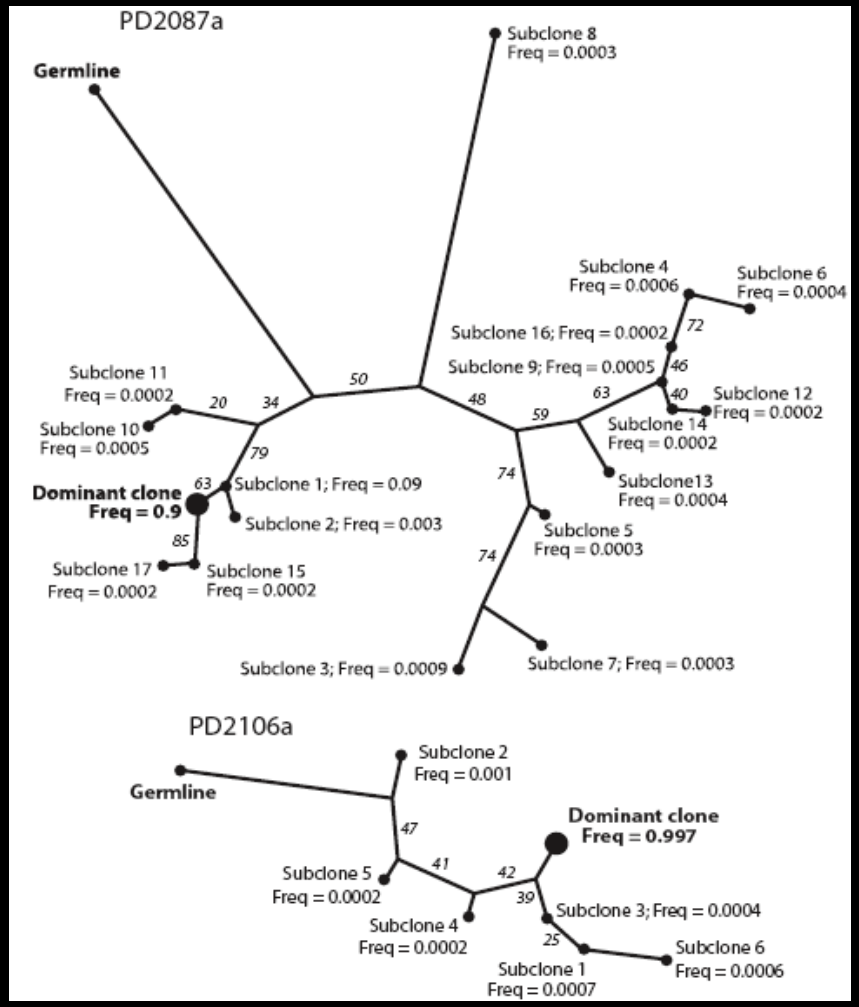
From: M. Galasso et. al. (2010) Genome Medicine 2, 12

Gene Deserts: The 8q24 Region and Cancer Susceptibility



From: J. P. A. Ioannidis et al. (May 2009) Nature Rev. Genetics 10, 318

Unrooted Parsimony Tree Profiles for Clonal Evolution in B-Cell Chromic Lymphocytic Leukemia Revealed by Ultra-Deep Genome Sequencing

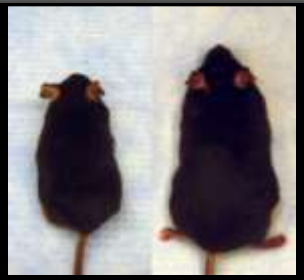


From: P. J. Campbell et al. (2008) PNAS 105, 13081

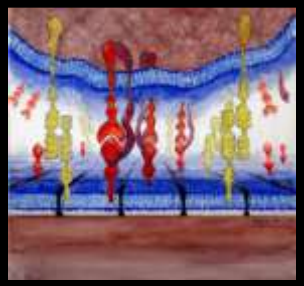
Length of branch is proportional to number of varying bases (evolutionary distance)

The Race for Low Cost ($<1000) Whole Human Genome Sequencing

The Evolution of Drug Discovery



- empirical screening

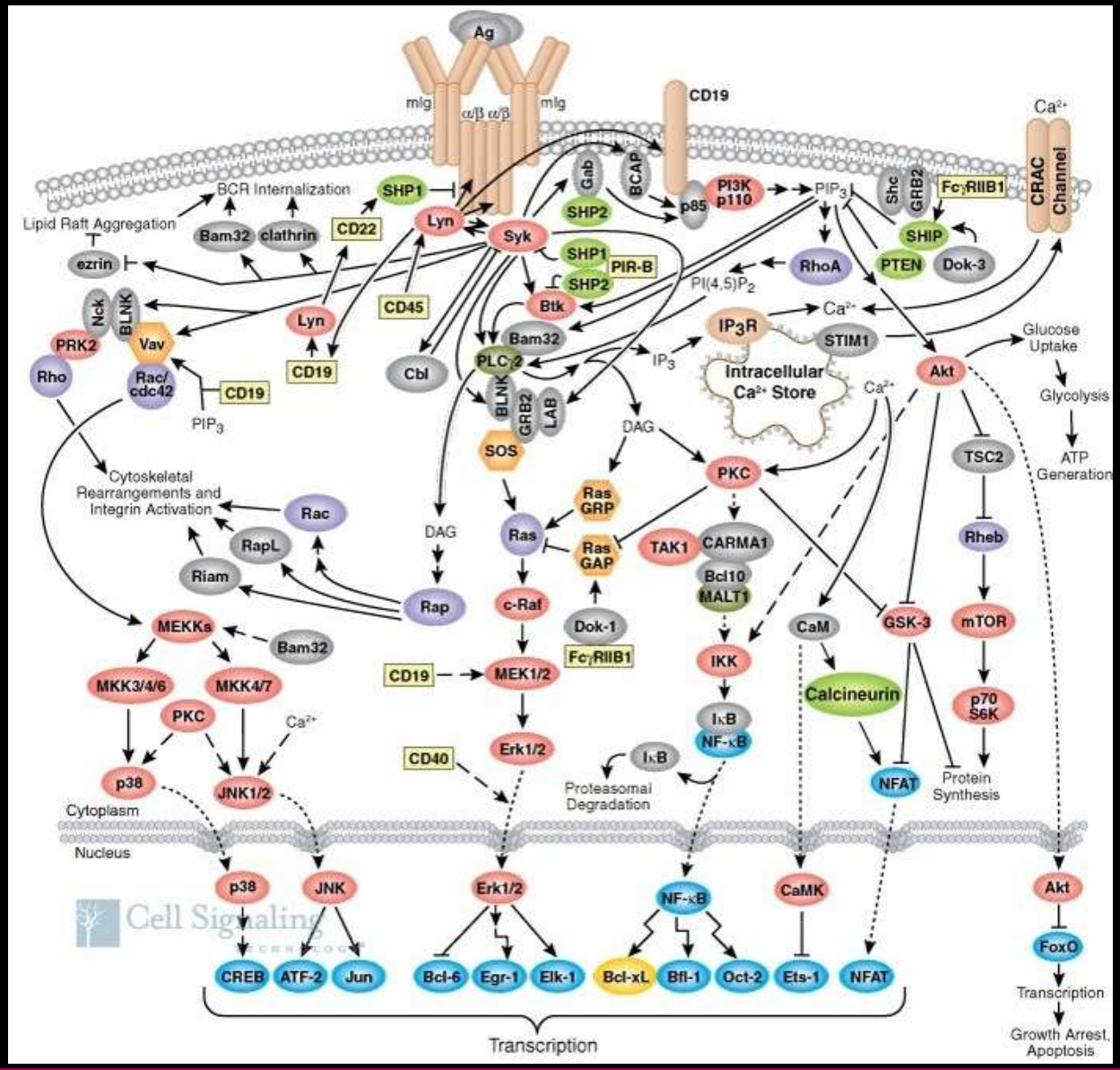


- cellular/receptor pharmacology

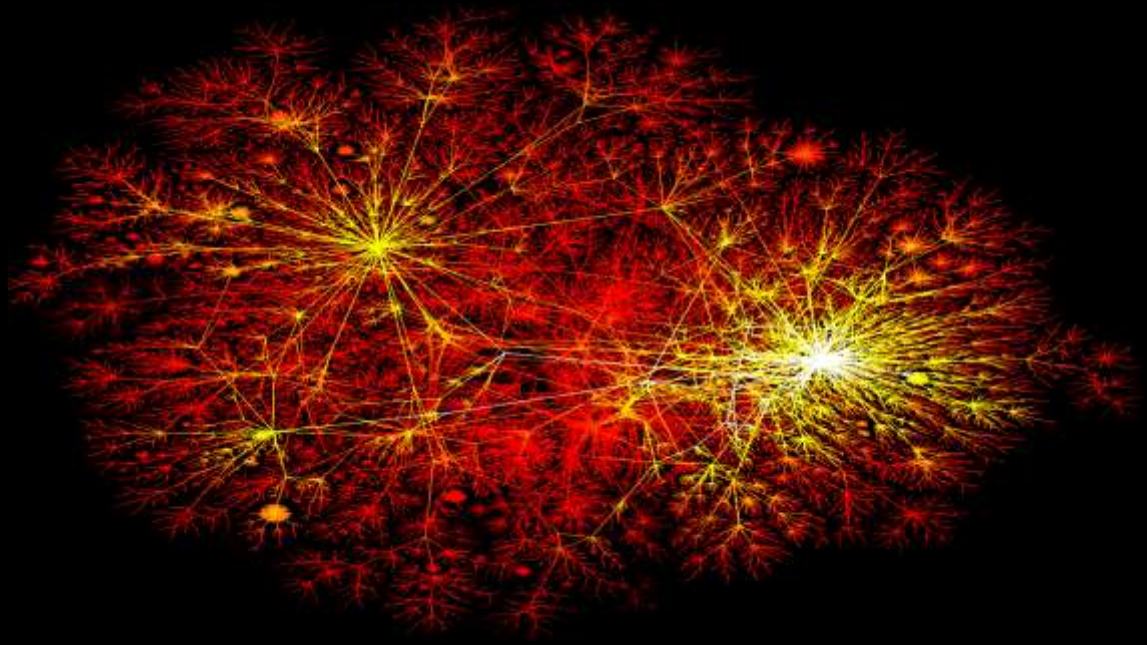
- genomics and individual molecular targets

- molecular pathways

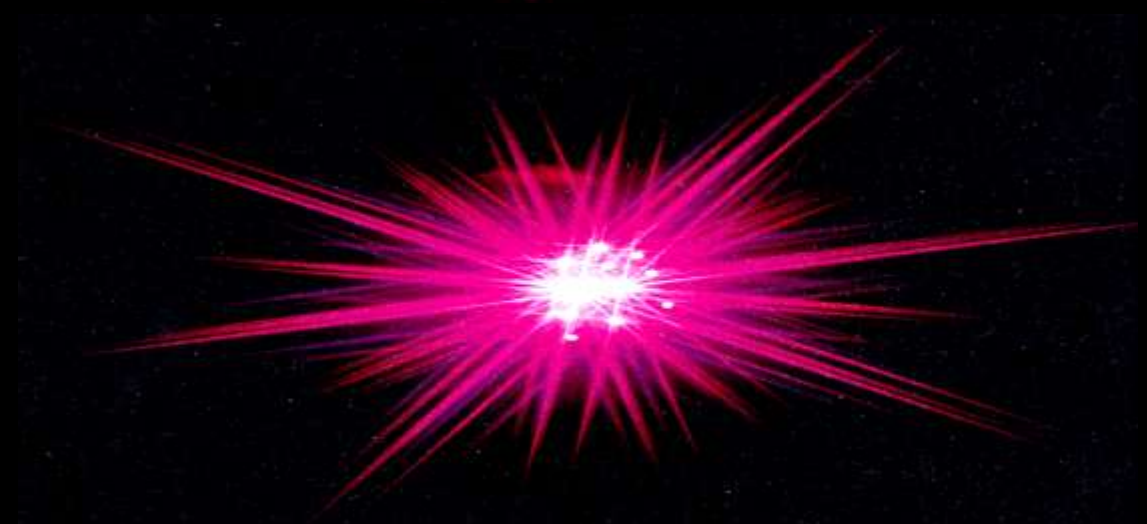
Systems Biology: Mapping Biological Pathways and the Generation of Complex Network Behaviors



Molecular Pathways and Network Analysis: Systems Pharmacology



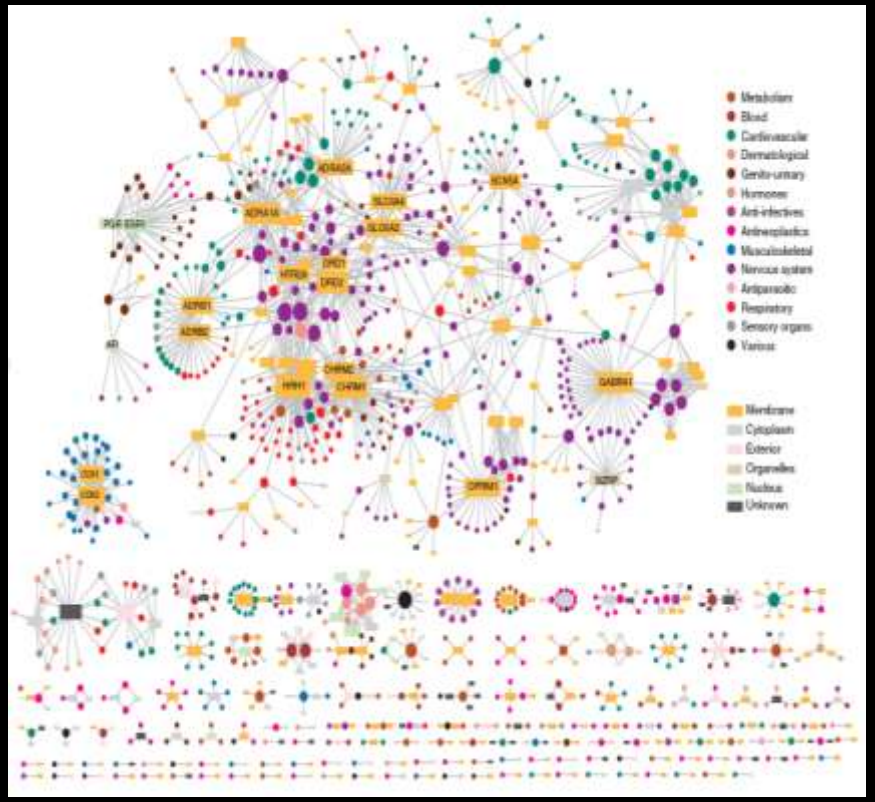
Deconvolution of Signaling Networks in Disease



Identification of ‘Fragile’ Nodes/Pathways for Targeted Rx

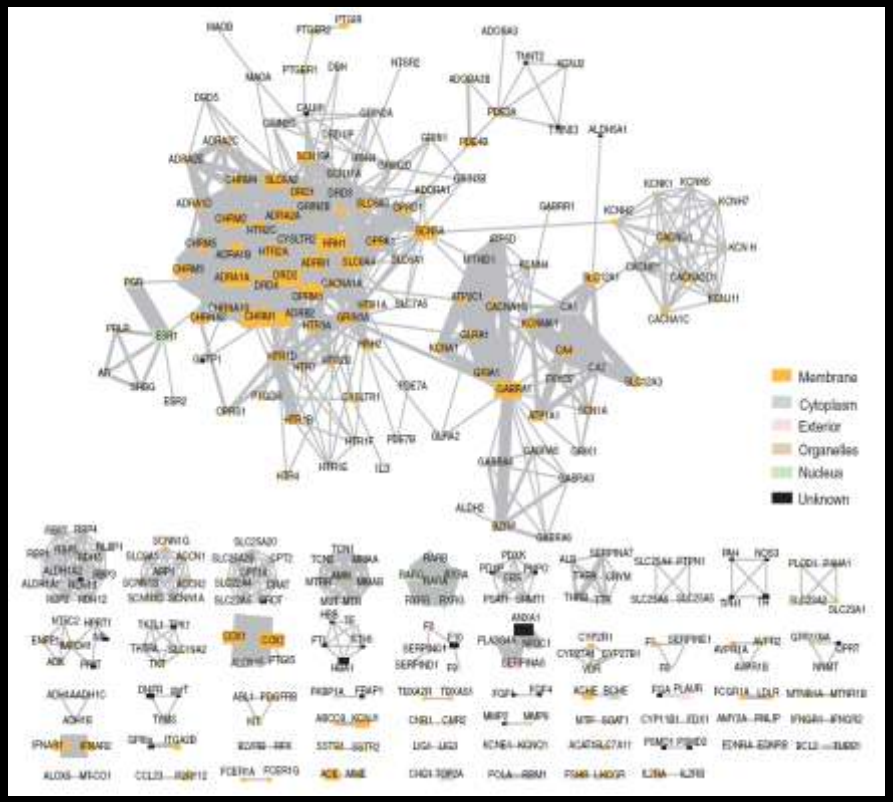
Rx Action Networks for FDA Approved Drugs

Drug-Target Networks



- 788/890 share targets with other Rx

Target-Protein Networks



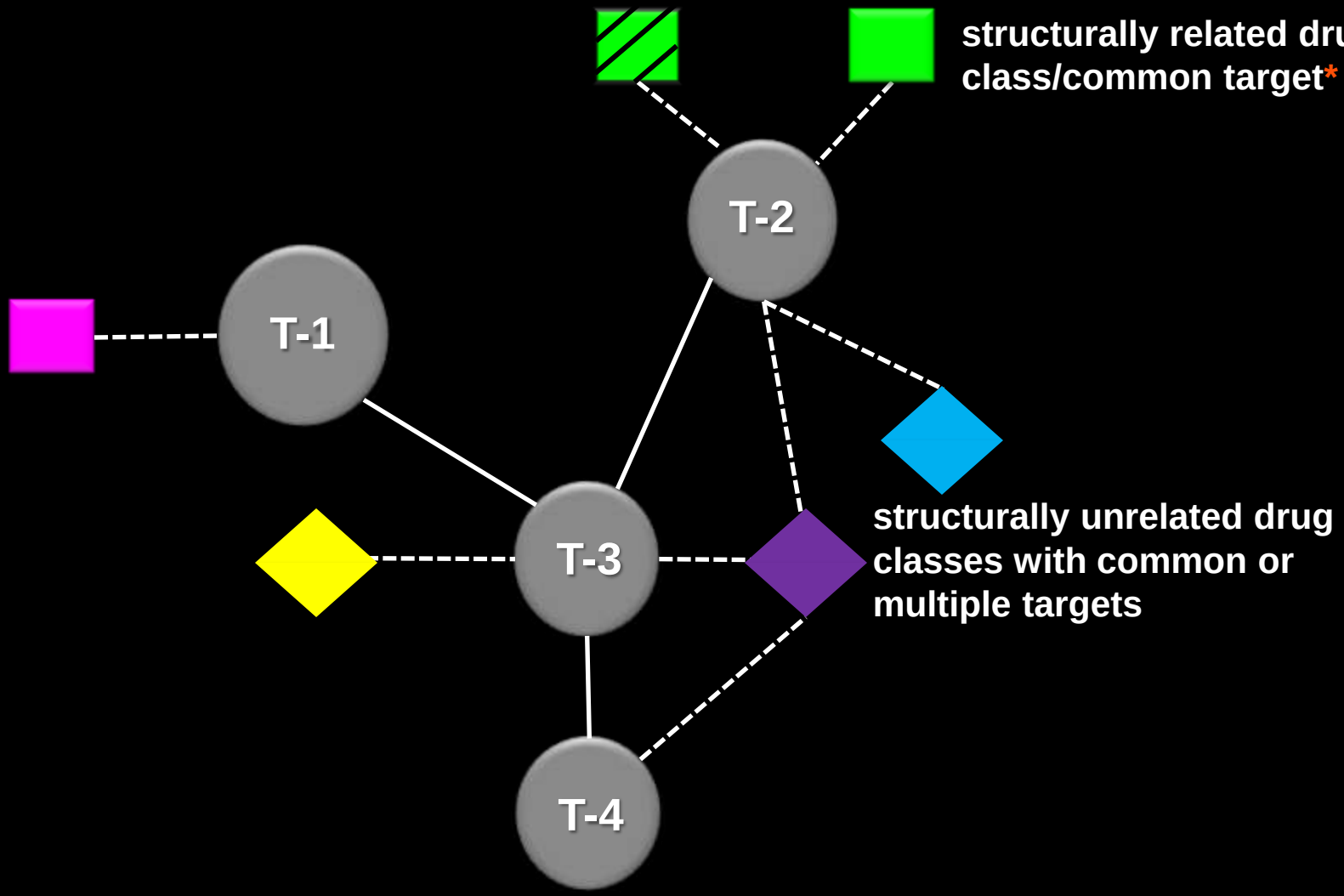
- 305/394 targets interact with two or more Rx

From: M.A. Yıldırım et al (2007) Nature Biotechnology. 25,1119

Network Pharmacology and Drug Discovery: Key Principles

- there are few single molecular targets for Rx action
- effective Rx requires modulation of pathways
- there are no linear pathways, only networks and subnetworks
- there are also highly interconnected networks/subnetworks between tissues
  - e.g. modulation of liver network induces changes in pancreatic islet network

Mapping Pharmacogenomic Molecular Networks



*Tanimoto coefficient of 166 structural features

Building Pharmacogenomic Drug: Network Datasets

83,338 concept terms for subtree of pathology descriptors

DRUGDEX

4068 concept terms matched to SNOMED-CT

Drug-Disease Knowledge Base (DrDKB)

726 diseases/2022 drugs

3517 approved drug indications, 8130 off label uses

12,460 genes (proteins)/400 drugs

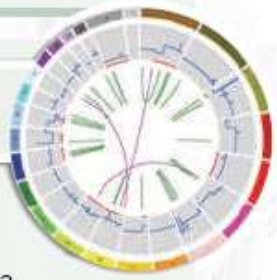
The Complexity of Cancer Genomes

LUNG CANCER
Cancer: small-cell lung carcinoma

- Sequenced: full genome
- Source: NCI-H209 cell line
- Point mutations: 22,910
- Point mutations in gene regions: 134
- Genomic rearrangements: 58
- Copy-number changes: 334

Highlights:
Duplication of the *CHD7* gene confirmed in two other small-cell lung carcinoma cell lines.

Source: E. D. Pleasance *et al. Nature* **463,** 184–190 (2010).

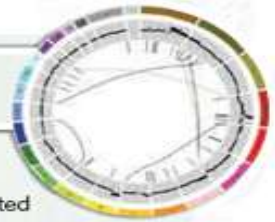


SKIN CANCER
Cancer: metastatic melanoma

- Sequenced: full genome
- Source: COLO-829 cell line
- Point mutations: 33,345
- Point mutations in gene regions: 292
- Genomic rearrangements: 51
- Copy-number changes: 41

Highlights:
Patterns of mutation reflect damage by ultraviolet light.

Source: E. D. Pleasance *et al. Nature* **463,** 191–196 (2010).



BREAST CANCER
Cancer: basal-like breast cancer

- Sequenced: full genome
- Source: primary tumour, brain metastasis, and tumours transplanted into mice
- Point mutations: 27,173 in primary, 51,710 in metastasis and 109,078 in transplant
- Point mutations in gene regions: 200 in primary, 225 in metastasis, 328 in transplant
- Genomic rearrangements: 34
- Copy-number changes: 155 in primary, 101 in metastasis, 97 in transplant

Highlights:
The *CTNNA1* gene encodes a putative suppressor of metastasis that is deleted in all tumour samples.

Source: L. Ding *et al. Nature* **464,** 999–1005 (2010).

BRAIN CANCER
Cancer: glioblastoma multiforme

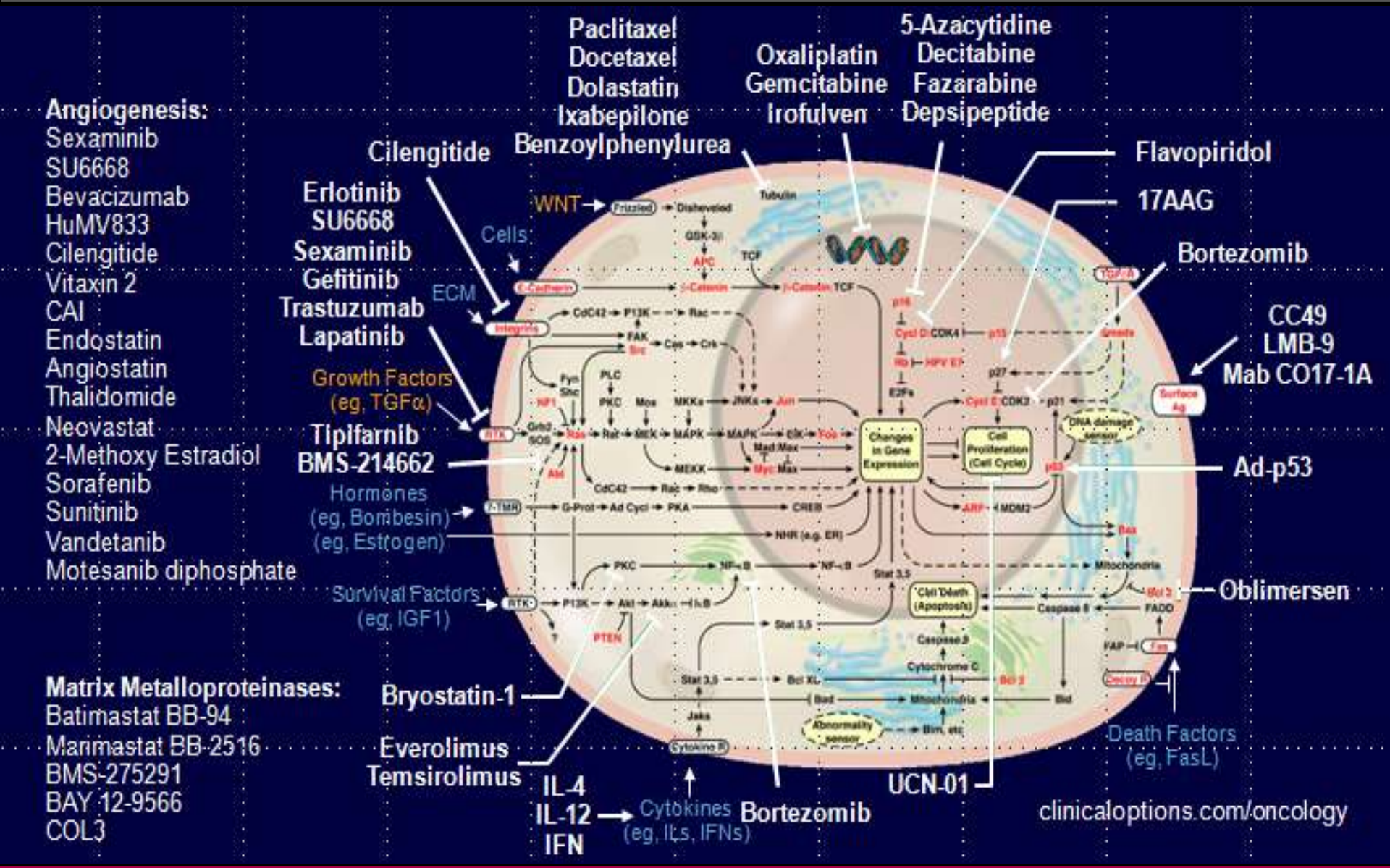
- Sequenced: exome (no complete Circos plot)
- Source: 7 patient tumours, 15 tumours transplanted into mice (follow-up sequencing on 21 genes for 83 additional samples)
- Genes containing at least one protein-altering mutation: 685
- Genes containing at least one protein-altering point mutation: 644
- Copy-number changes: 281

Highlights:
Mutations in the active site of *IDH1* have been found in 12% of patients.

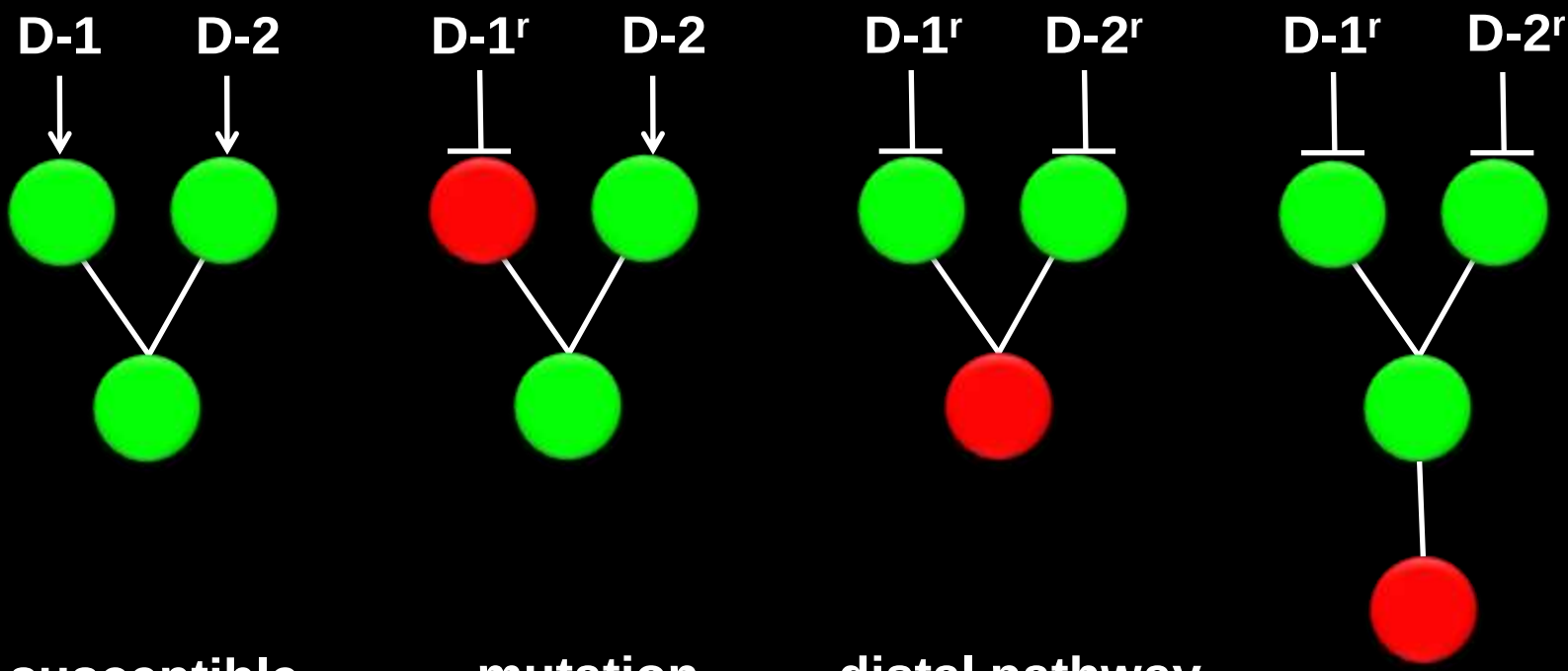
Source: E. R. Mardis *et al. N. Engl. J. Med.* **361,** 1058–1066 (2009).

http://www.nature.com/news/2010/100414/pdf/464972a.pdf

Selected Targeted Agents With Potential as Breast Cancer Therapeutics



Network Pharmacology, Pathway Redundancy and Drug Resistance (D^r)



susceptible to both D-1/D-2

mutation confers resistance to D-1

distal pathway mutations confer resistance to both D-1/D-2

Systems Pharmacology and Molecular Pathways Network Analysis

- ‘connectivity’ maps
  - correlations between genomic signatures and sets of proteins involved in Rx action
- Rx ‘promiscuity’
  - spectrum of ‘target’ effects required for optimum efficacy
  - network redundancy and Rx non-responsiveness/ resistance
- Rx ‘pleiotropy’
  - off-target effects and adverse event risk(s)
- ‘synthetic lethal’ screening
  - ID new Rx oncology targets in co-dependent genes required for cell survival
- ‘minimum knockout’ modeling
  - ID/predict smallest number of drug targets to fully block a cellular process

High Content Cellular Screens: Cyto-omics

- rapid expansion of single cell analysis methods
- linking gene expression to functional pathways/ networks/ compartments
- obvious requirement to validate in vitro/ex vivo phenotypes to events in vivo
  - higher level of ‘stochastic’ drift in vitro?
  - failure of 2D cultures to mimic complex signaling environment of organized multi-cellular tissues
- parallel evolution of technologies for imaging in vitro and in vivo for biomarker validation

New Incentives for R&D Investment in Diagnostics, Drugs and Vaccines to Outpace Infectious Diseases

The Valley of Dearth: The Consequence of Declining R&D Investment in Antibiotic Discovery*

- 75% decrease in antibacterials approved from 1983 to 2009
- only 16 agents currently in Phase II / III clinical trials
  - only 3 as new ‘classes’ with novel mechanisms of action
  - absence of agents for therapy of AMR in Gram-negative bacilli
  - lack of systemic agents in advanced development for organisms resistant to all current antibacterials

* source: H.W. Boucher et. al. (2009) Clin. Inf. Dis. 48, 1

The Growing Challenge Posed by Antimicrobial Drug Resistance (AMR)

NO ESKAPE

***E*nterococcus faecium**

***S*taphylococcus aureus**

***K*lebsiella Pneumoniae**

***A*cinetobacter baumannii**

***P*seudomonas aeruginosa**

***E*nterobacter species**


New US-EU Task Force (2 Nov. 2009)

- encourage R&D on new antimicrobial drugs
- yet to be defined strategy/funding

IDSA
Infectious Diseases Society of America

The I0 X ’20 Initiative (20 Nov. 2009)

- grand challenge to develop 10 new antibiotics by 2020

ERA-NET
PathoGenoMics

Multi-Country Program on AMR (12 Jan. 2010)

- € 12.4 million

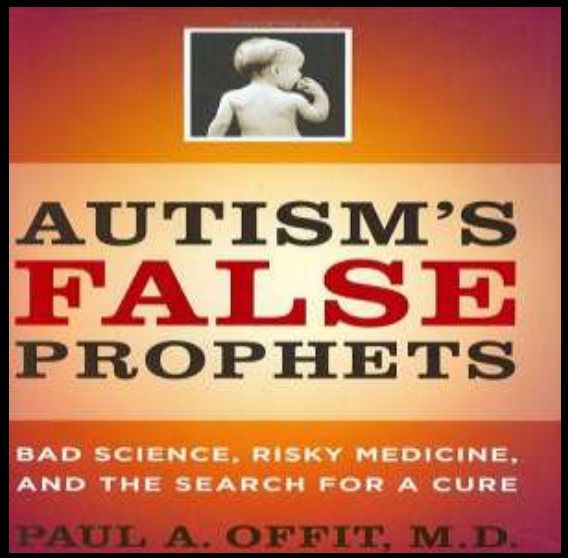
Public Response to H1N1 Vaccine for Pandemic Protection

“Millions demand it,
millions refuse it,
and millions don’t know what to think”

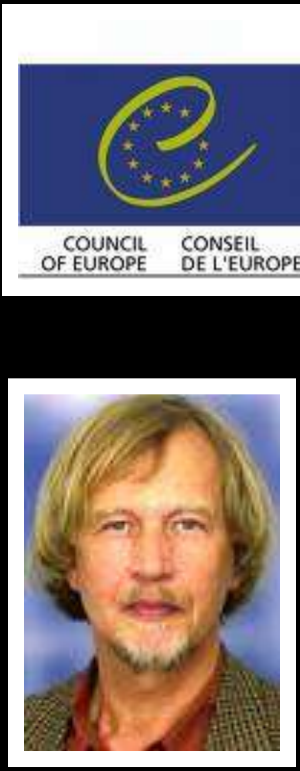
John Carroll
Editor, FierceBiotech (23 Oct. 2009)

Vaccine Safety:
Informing the Misinformed

Vaccine Safety:
Media Sensationalism and Celebrity Quackery



“Faked Pandemics- a Threat for Health”



- Motion to COE by Wolfgang Wodarg, Chair, Healthcare Committee, January 2010
- “WHO in cooperation with some big pharmaceutical companies and their scientists re-defined pandemics and lowered the alarm threshold”
- “Those standards forced politicians…… to sign marketing commitments for vaccines against swine flu and spend billions to catch up with the alarming scenario that big pharma, media and WHO are spreading”

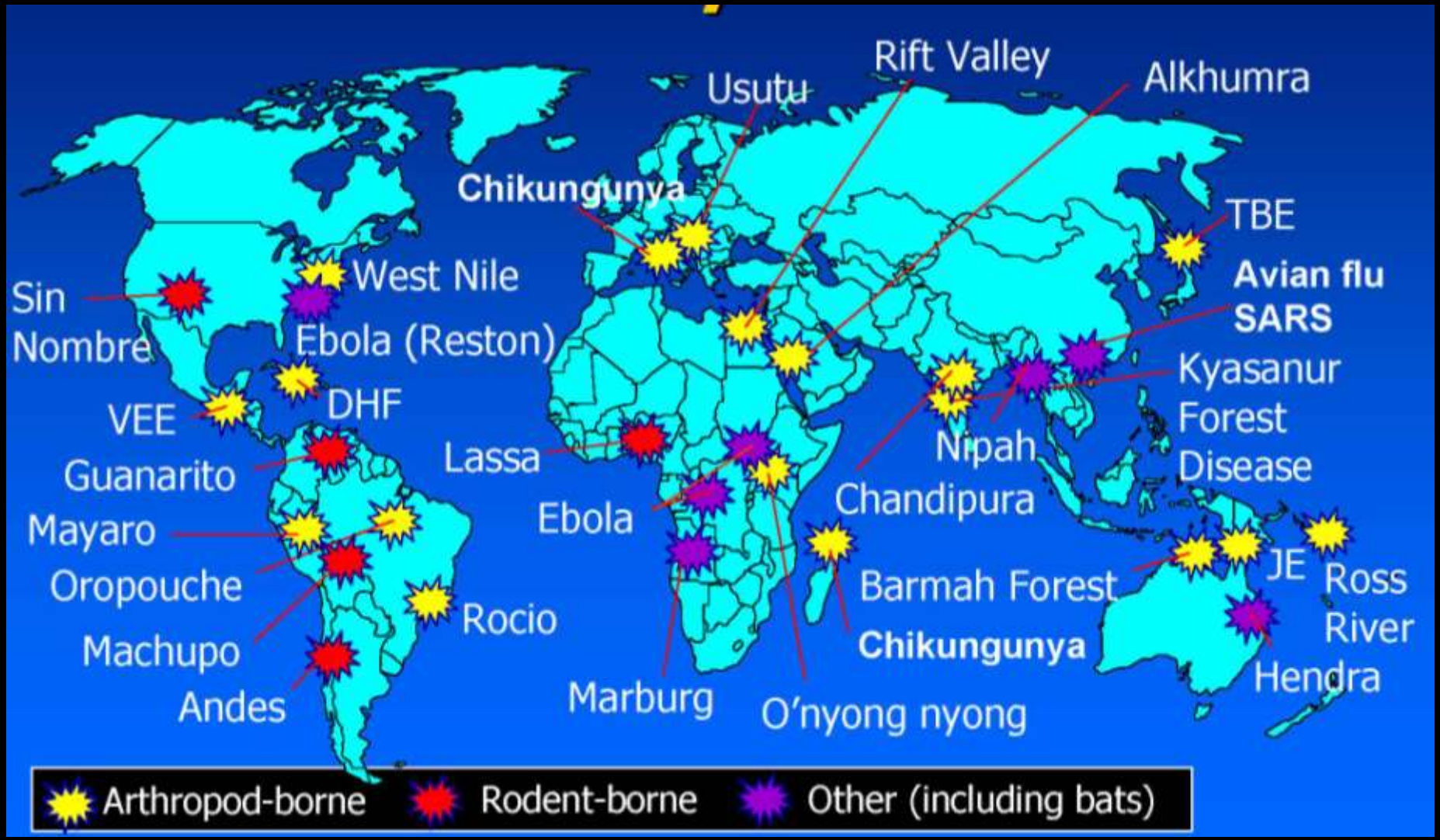
Source: Scrip News 6 Jan. 2010

Media Sensationalism and Public Response to H1N1 Threat

Maintaining Global Preparedness for a High Virulence Pandemic

- H1N1: high transmissibility - low virulence/mortality
- H5N1: low transmissibility – high virulence/mortality
- H5N1 x (H1N1) or (X): potential for devastating pandemic

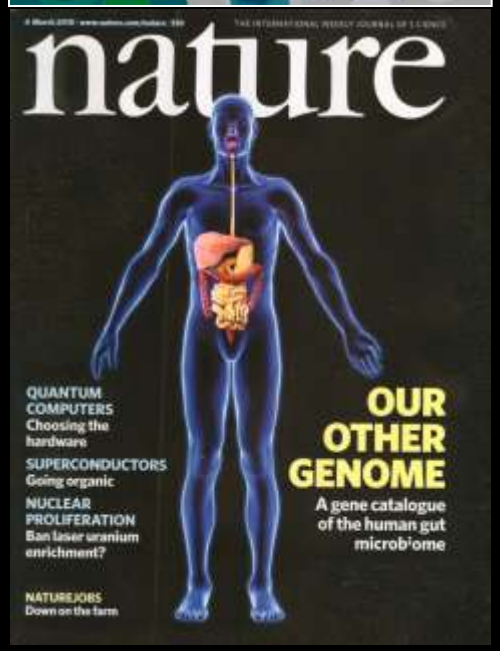
Emerging Infections:



Combating “Agent-X”

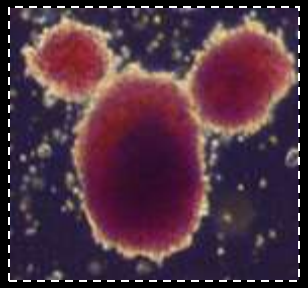
- new infectious agent
  - natural or nefarious origin
- highly virulent, high transmissibility
- major gaps in public health preparedness
  - outmoded vaccine technologies and production methods
  - inadequate scale of vaccine manufacturing infrastructure
  - cost and lead time for new vaccine production facilities
  - lack of novel Rx classes
  - high cost and protracted R&D cycles
- inadequate investment incentives
- public policy neglect

The Human Microbiome: A Barely Understood Influence in Health



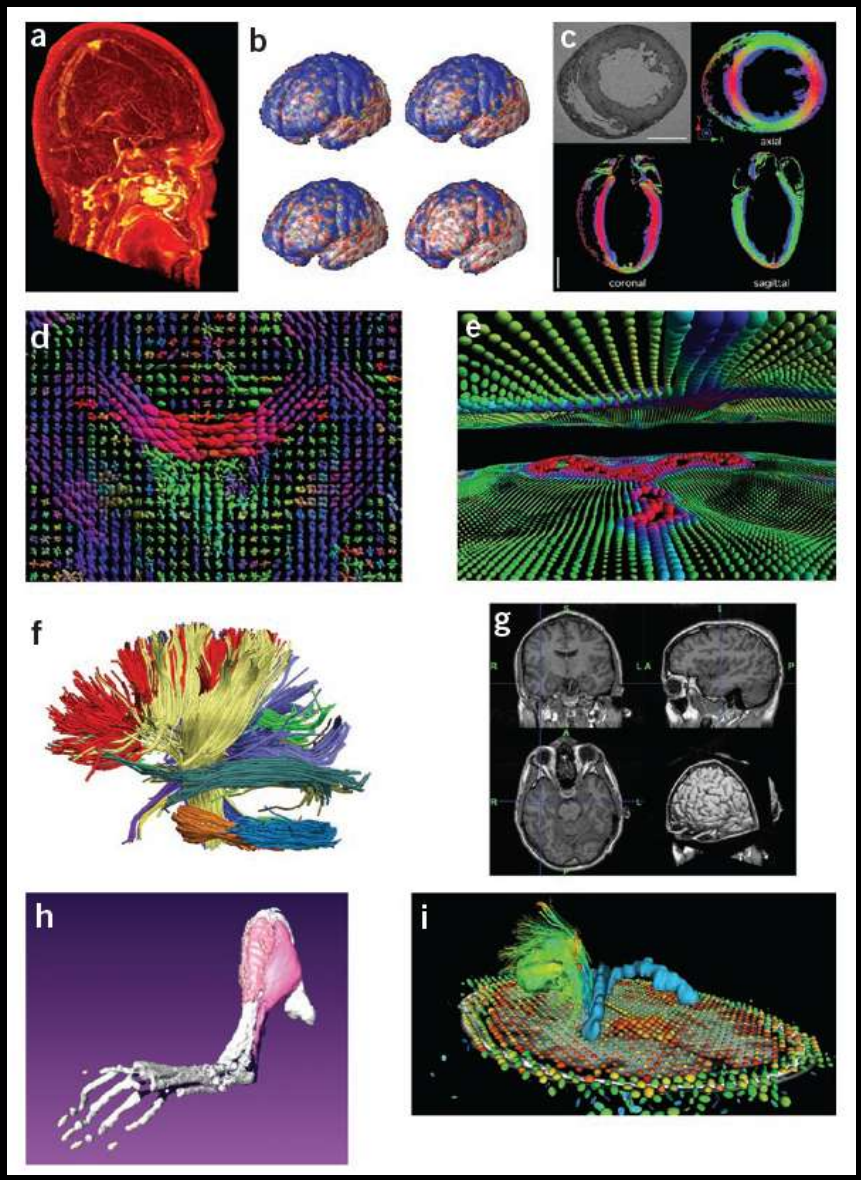
- complex meta-system
  - host, microbes, viruses, other organisms, metabolites, xenobiotics
  - is there a core microbiome?
  - how do perturbations affect disease and vice-versa?
  - does the microbiome influence xenobiotic metabolism and the metabolite spectrum?

The Evolution of Drug Discovery



- systems biology
  - elucidation of biological networks and their regularity
- regenerative biology
  - reprogramming cell function and directed differentiation (ESC/iPS)
- synthetic biology
  - de novo design of novel organisms and a new industrial ecology
- predictive biology
  - information flow in complex adaptive systems

New Imaging Technologies



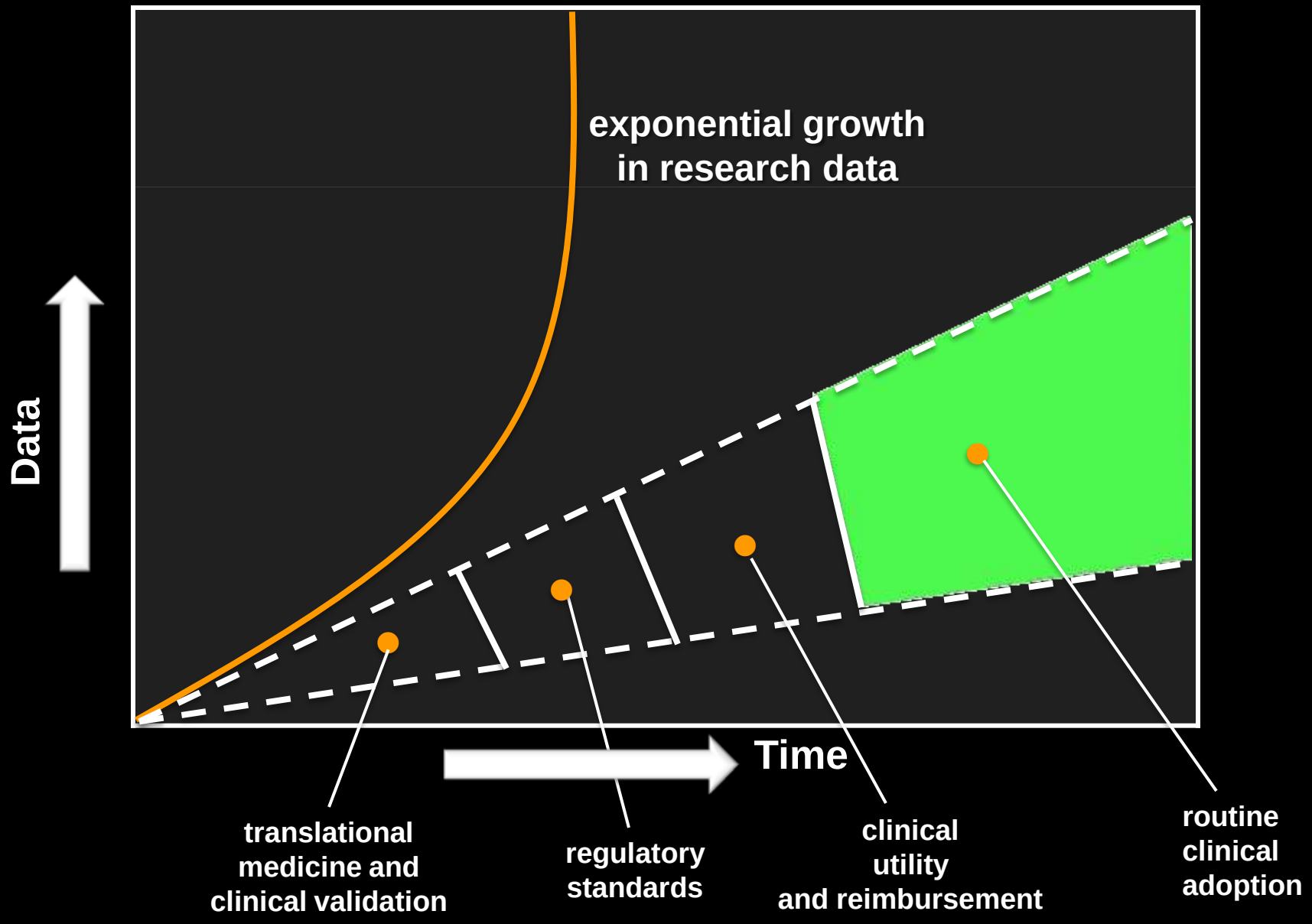
In Theater Imaging and Surgical Robotics

"Biomedical research in academia has been very successful in generating an immense amount of information, leading to a true revolution in molecular medicine"

S. Albani and B. Prakken
Nature Medicine (2009) 15, 1006

TRUE OR FALSE?

The Trajectories for Molecular Medicine

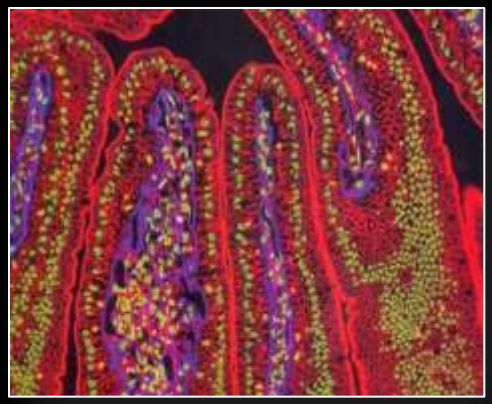


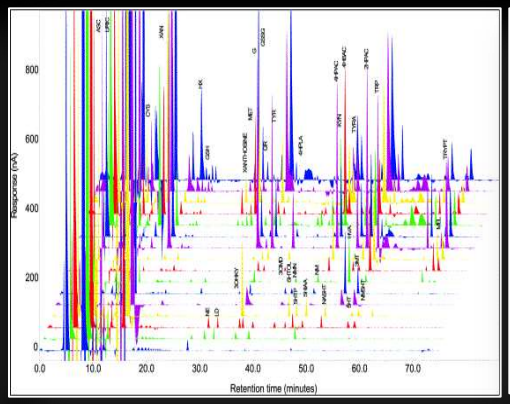
Knowledge and Evidence Doesn't Translate Easily into New (or Rational) Behaviors

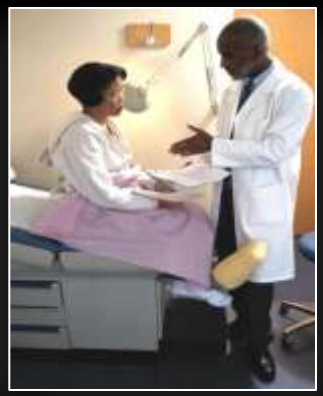
- science (impact is too often unknown or abstract)
- industry (incremental timidity driven by short-term focus on markets and stock valuation)
- payors (cost control)
- physicians and healthcare professionals (status, revenue and recognition)
- patients (unaware and uninvolved in healthcare decisions)
- politicians (populism and short-term fixes)

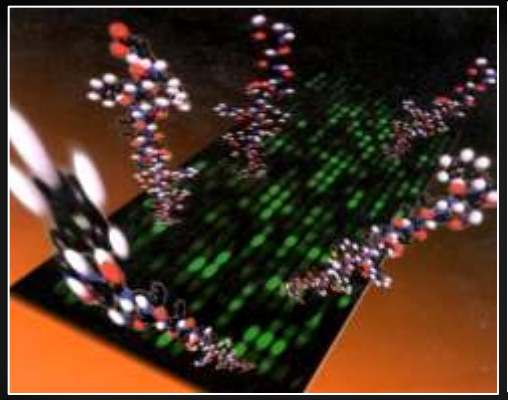
The Pragmatic Challenge:
Who Pays, Who Benefits and Who Decides?

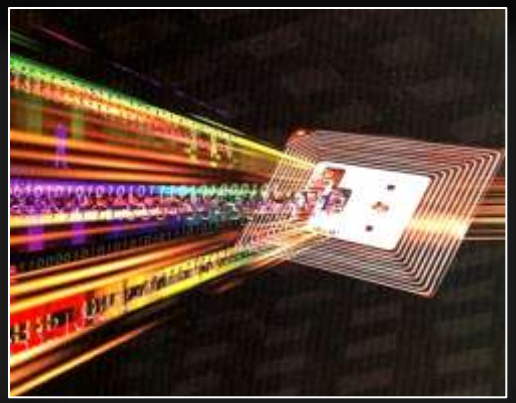
Identification and Validation of Disease-Associated Biomarkers: Obligate Need for a Systems-Based Approaches











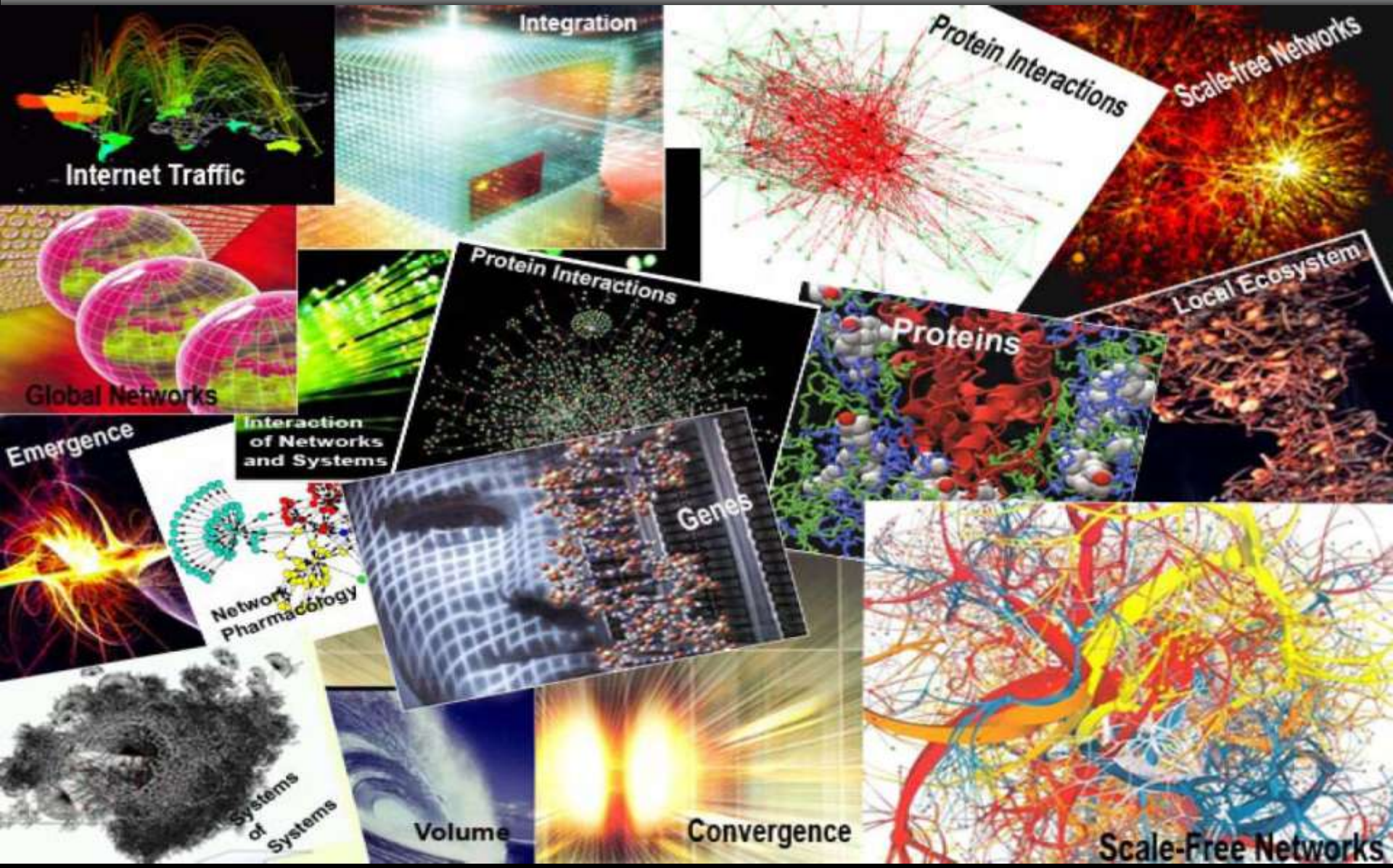
Biospecimens and Molecular Pathway Analysis

Biomarker Validation and Multiplex Assays

Instrumentation and Informatics

Clinical Impact and Patient Monitoring

Data: The Fastest Growing Resource on Earth



Standards for ‘Omics’ Data Cross-Domain Integration, Open-Source Data Sharing and Computational Analysis

OBO Foundry Ontologies

Nature Biotechnology 25, 1251 - 1255 (2009)


The Open Biomedical Ontologies

Cell Ontology (CL)

Gene Ontology (GO)

Foundational Model of Anatomy

ZFIN

Zebrafish Anatomical Ontology

Chemical Entities of Biological Interest (ChEBI)

Disease Ontology (DO)

Plant Ontology (PO)

Sequence Ontology (SO)

Ontology for Clinical Investigations (OCI)


The Open Biomedical Ontologies

Common Anatomy Reference Ontology


The Open Biomedical Ontologies

Environment Ontology

Ontology for Biomedical Investigations

Phenotypic Quality Ontology (PATO)

Protein Ontology (PRO)

OBO Relation Ontology

RNA Ontology (RnaO)

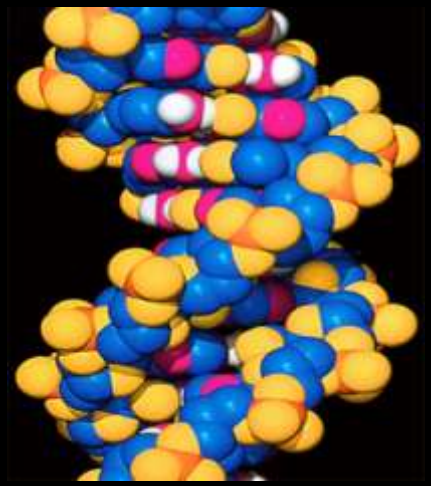
The Rise of Open-Source Networks and Consortia

“Managing Mega-Data”: (Who Knows Wins)

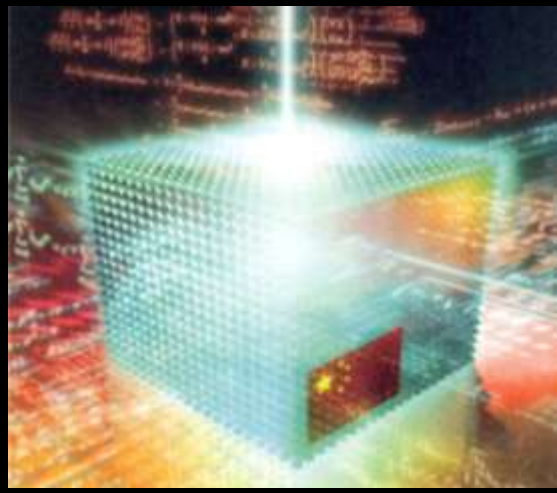
volume

scale

global networks

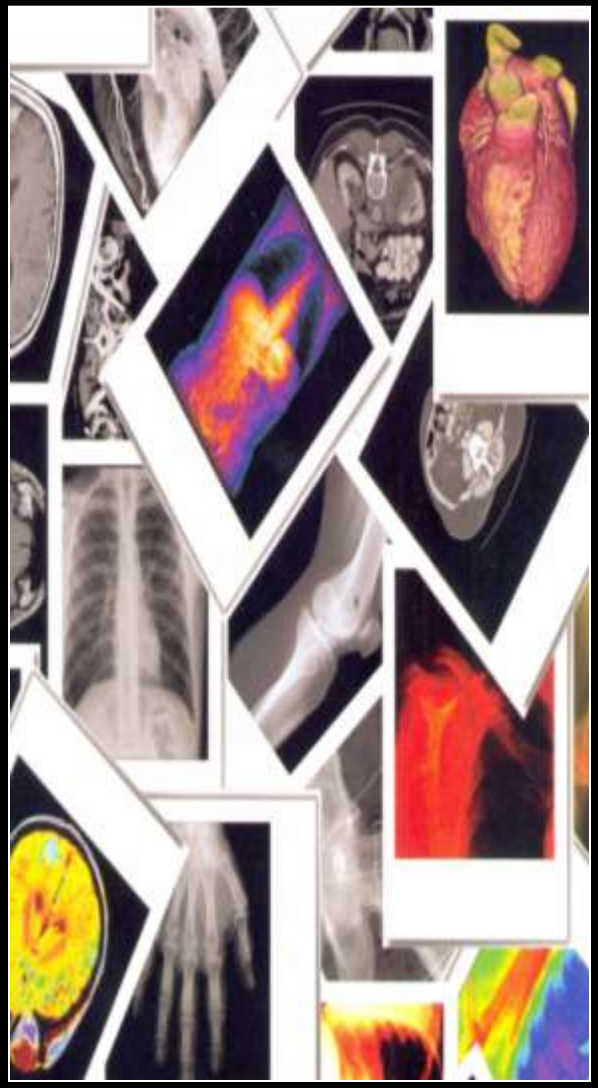


heterogeneity



integration

How Much New Technology Can We Afford?

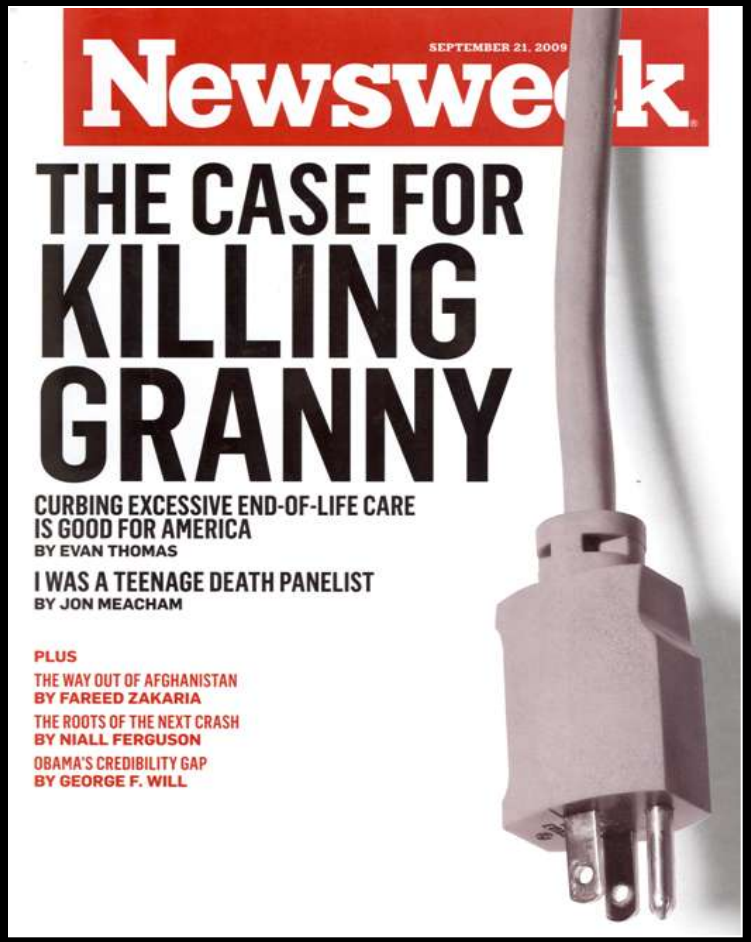


“We must acknowledge that the cost of drug discovery is becoming outrageous and, if it continues to grow at the present rate, new drugs will be unaffordable for any country in the world.”

Sir Michael Rawlins
Chairman,
UK National Institute for Health and Clinical Excellence (NICE)

Nature Rev. Drug Disc. (2009) 8, 692

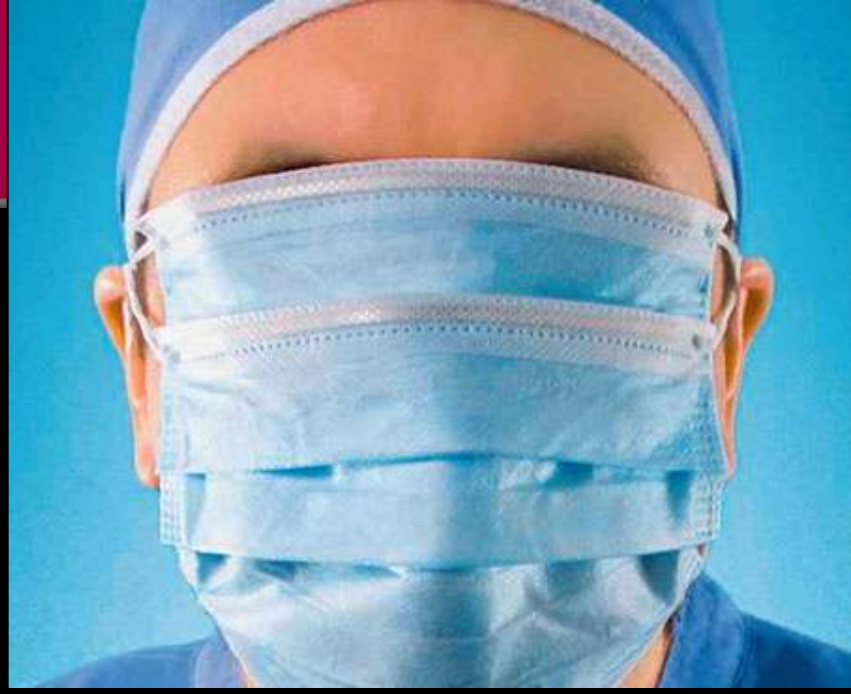
UK National Institute for Health and Clinical Excellence (NICE)



Nice Gets Nasty (or Rational?)

Knowing What Works (or Doesn't)

- Pervasive Inefficiencies and Errors in Healthcare Created by Empirical Care and Lack of Robust Outcomes and Performance Data



Comparative Effectiveness Research (CER)

- superficial appeal of rational policy belies the complexity of rigorous CER
  - endpoints/outcomes
  - methodological and reporting standardization
  - stringency of patient selection/treatment regimen/compliance
  - prospective versus retrospective data
- payor engagement and impact on reimbursement policies
  - predisposition to chose lower cost intervention(s)?
  - risk of abuse and rationing of care

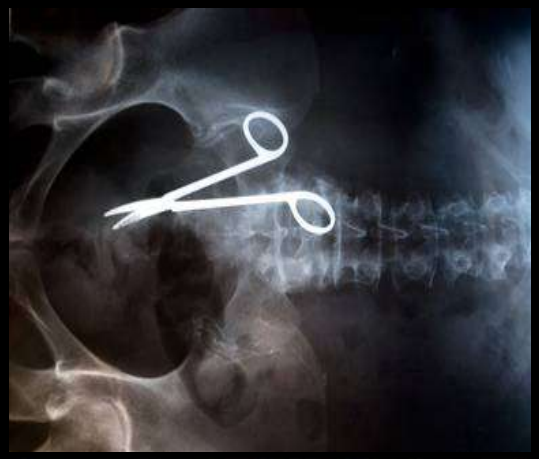
WHO SETS PRIORITIES AND EVALUATION CRITERIA?

Who Defines Best Practices?

- controversy over US Preventive Task Force (USPTF) recommendations on mammograms for women age 40-49
- endorsed by ACP
- opposed by ASCO and NCCN
- USPTF did not address cost but it dominated public debate
- “should policy makers set a price on saving a life?”

Patient Safety:
The Dimension of the Problem

Overt Error | **Non-Compliance** | **Adverse Rx Event**



Hospital-Acquired Infections | **Cost of Hospital Re-admissions** | **Inaccurate, Inaccessible or Ignored Information**

Wellness:

The Most Broad and Most Valuable Definition of Successful Healthcare

Consumers at the Center

Consumer Behavior and Healthcare Costs

“diabesity” $200 billion

smoking $190 billion
alcohol $20 billion

The Costs of Non-Compliance with Rx Regimens

- $177 billion projected cost
- 20 million workdays/year lost (IHPM)
- 40% of nursing home admissions
- projected 45-75% non-compliance (WHO)
- 50-60% depressed patients (IHPM)
- 50% chronic care Rx (WHO)

Health Status Monitoring and the Promotion of Wellness

On-Body: In-Body Sensors (OBIBs) and Remote Monitoring of Health Status

Personal Health Systems: On-Body: In-Body Sensors (OBIBs)

- wearable
- portable/mobile
- point-of-care
- implantable
- multi-parametric
- interoperability with electronic records

Mobile Health (mHealth)

Major Target Markets for Wireless Medicine

Disease	*Patients	Parameter
Alzheimer's	5 million	vital signs, location, activity, balance
Asthma	20 million	respiratory rate, FEV, air quality, oximetry, pollen count
Breast CA	3 million	ultrasound self-exam
COPD	10 million	respiratory rate, FEV, air quality, oximetry
Depression	19 million	medication compliance, communication
Diabetes	21 million	glucose, hemoglobin ATC
Heart Failure	5 million	cardiac pressures, weight, blood pressure fluid status
Hypertension	74 million	continuous blood pressure monitoring, medication compliance
Obesity	80 million	smart scales, caloric in/out, activity
Sleep Disorders	15 million	sleep phases, quality, apnea, vital signs

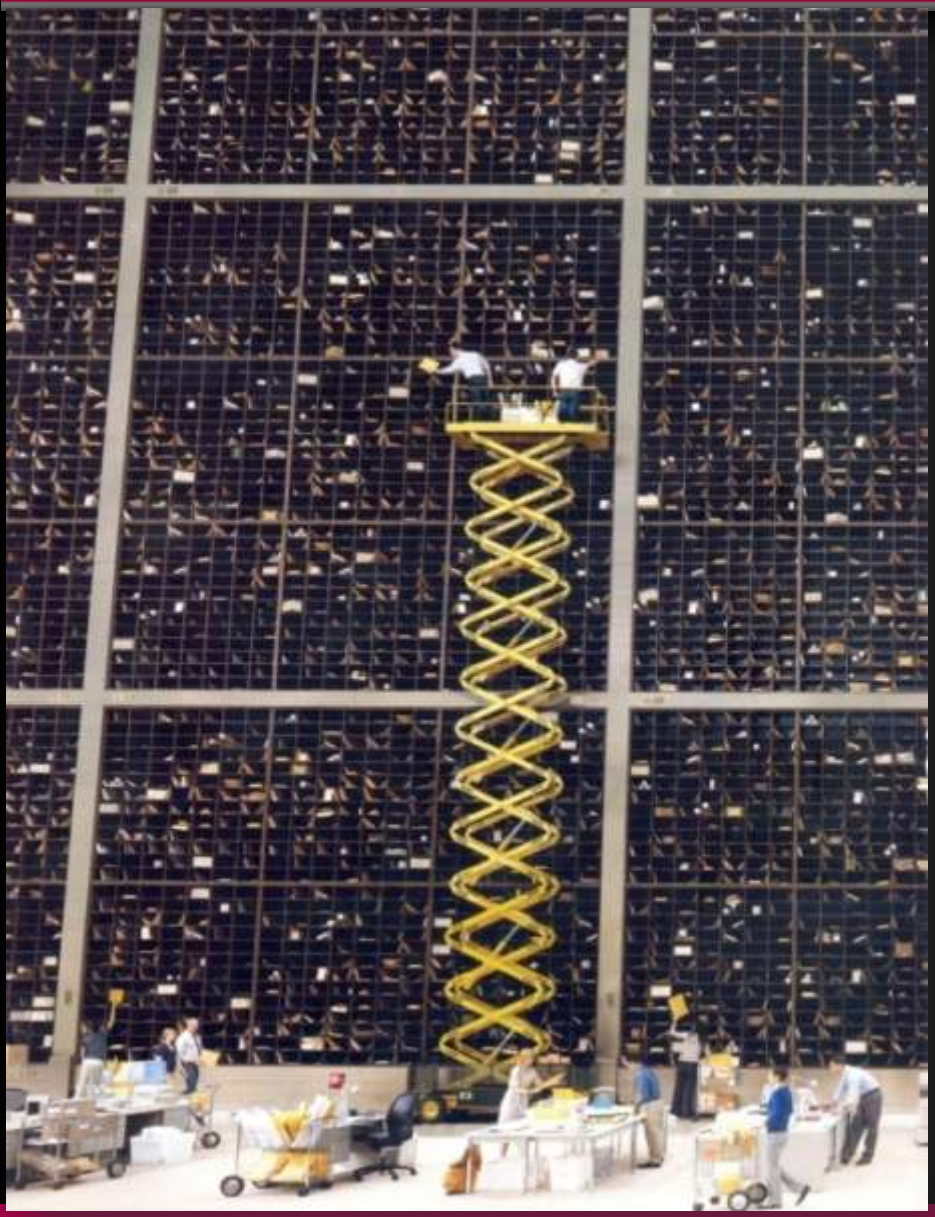
from: West Wireless Health Institute, Medtech Insight, August 2009

OBIBs: The Need for New Reimbursement and Regulatory Policies

- first generation remote health monitoring devices
- MD payment for analysis of data streams from remote monitoring
  - Cardionet, Medtronic
- White House Broadband Plan (3/16/10)
  - FDA and FCC to establish oversight process for e.health devices
  - HHS to develop reimbursement methods to accelerate adoption
  - FCC to allocate wireless spectrum for BANs

The Infocosm: Emerging Networks of Global Connectivity

Healthcare Records:
Proliferating Paper and Primitive Electronic Systems



“Meaningful Use”
EHR Incentive Programs Funded by ARRA 2009

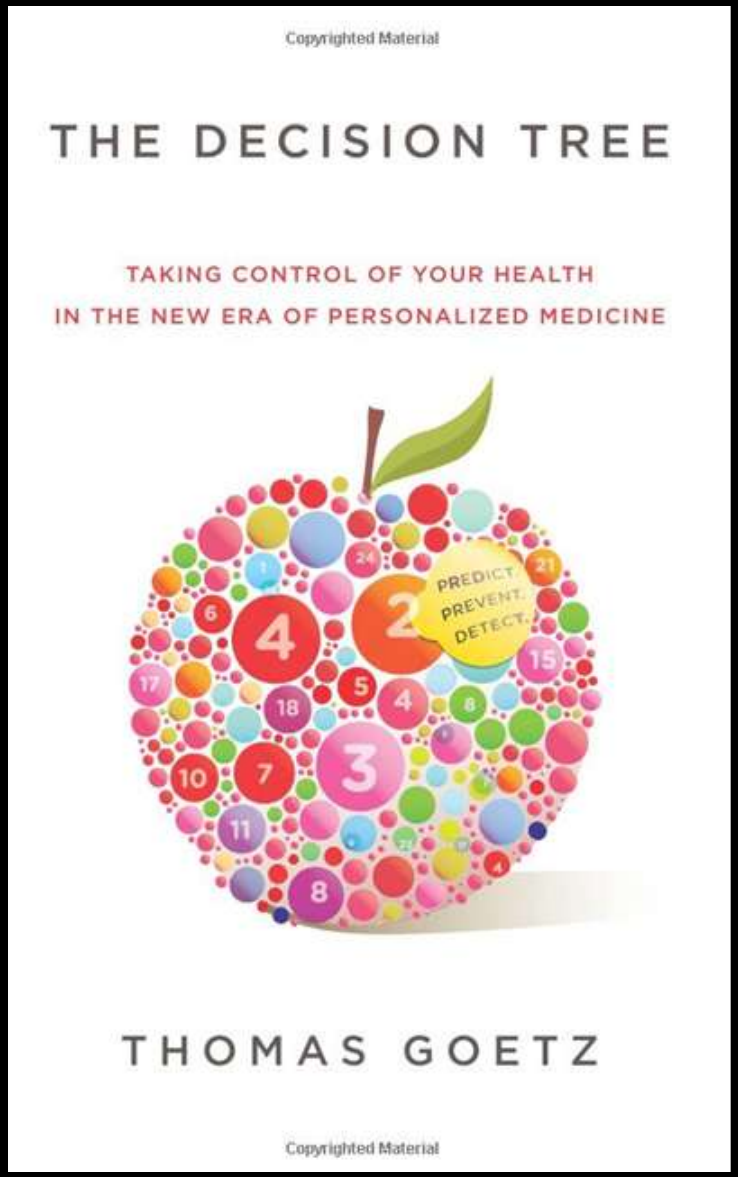
CMS Centers for Medicare & Medicaid Services

- **proposed rule and fact sheet comment deadline 2/28/10**
- **www.cms.hhs.gov/recovery/11-healthit.asp**

Health Information Technology
For the Future of Health and Care

- **interim final rule: comment deadline 2/28/10**
- http://healthit.hhs.gov/standardsandcertification

Telecommunications and Media Industry Convergence: Implications for Healthcare



"Real personalized medicine should begin long before we're faced with pharmacology"

"Our health information is too important to leave to an archaic, insular system.

If there's no longer a need to rely solely on a doctors advice for treatment and care, why should we be expected to artificially limit our options."

Thomas Goetz

Deputy Editor of Wired

The Decision Tree: Taking Control of Your Health in the New Era of Personalized Medicine (Hardcover)
Thomas Goetz (Author) Image Source: Amazon.com

Wireless Technologies: Consumer and Clinical Markets Converge

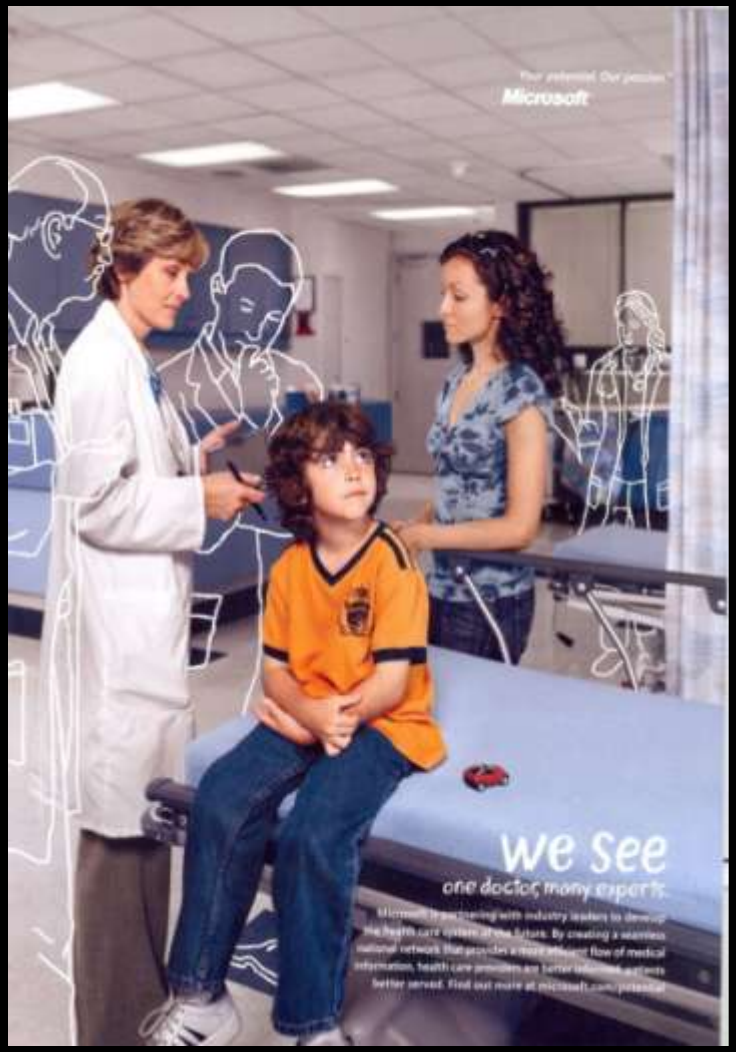
e-Patient Revolution

Pharma and Healthcare Social Media (Non-Brand Sponsored) Patient Communities

In-Home Health Connection: Engaging the Elderly

Wii Fit Plus

Virtual Medicine Networks: Increasingly Integrated Care and Continuity of Care



- rapid, real time access
- clinical specialties
- health records
- lab data
- drug interactions
- electronic Rx prescribing

The Doctor Will See You Online

- immediate access to care for patients
- patients submit medical records to company
- flexible engagement of MDs for additional income generation
- complementary tier of access
- billing and insurance services
- liability issues

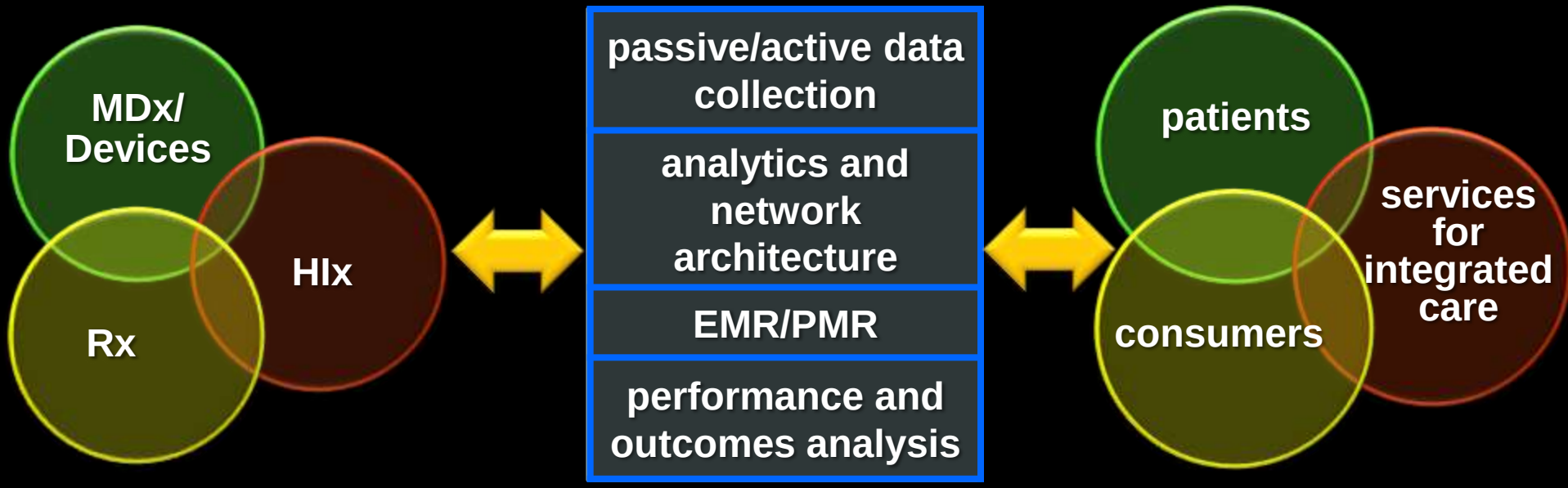
The Dominant Future Element in Primary Healthcare Delivery???

Walgreens
As far as you want to go.™

CVS CAREMARK

WAL★MART®
Save money. Live better.™

A New Healthcare Ecosystem Arising From Technology and Market Convergence



Integrated Technology Platforms

Data Mining and Integration Services

Increasingly Targeted Care and Efficient Use of Finite Resources

Sustaining Innovation: Research, Reimbursement and Regulation

Research

- national resources network for biomedical R&D
- expanded private: public partnerships
- reform of academic funding model to promote interdisciplinary research

Reimbursement

- value-based pricing
- new coding for molecular medicine
- new models for HTA and CER

Regulation

- rebalancing benefit: risk evaluation and abandonment of ‘zero-risk’ delusion
- validation standards for Dx-Rx and high complexity Rx

Genes and Intellectual Property


14 March 2000

SACGHS

5 February 2010 Report

MYRIAD

ACLU

AMERICAN CIVIL LIBERTIES UNION

29 March 2010 SDNY Court Decision


16 April 2010 WSJ Editorial

The Coming Convergence in Healthcare Delivery

Technologies

- biotechnology, medicine, engineering, computing, telecommunications and social media

Clinical Practice

- molecular medicine and increasingly customized care
- diagnostic, drug and device combinations
- POC testing and remote monitoring
- reduced error and improved compliance
- improved outcomes

Realigned Incentives

- integrated care for complex chronic diseases
- earlier disease detection and risk reduction
- wellness versus illness
- remote health status monitoring

The Coming Convergence in Healthcare Delivery

Consumers

- increased personal responsibility for health
- new incentives for wellness/compliance
- remote health status monitoring

Connectivity

- integrated care networks for chronic disease
- social media networks and informed consumers
- new supplier networks of specialized turnkey expertise
- value added ‘content’ services for clinical data mining
- clinical decision-support systems