The Markets Now: 18 January, 2016
The Caledonian Club, 9 Halkin St, London SW1X 7DR

Digital transformation of our healthcare - and investment opportunities

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Quote from Michael Burry, star of The Big Short

Question:

"What, if anything, makes you hopeful about the future?"

Answer:

"Innovation, especially in America, is continuing at a breakneck pace,

even in areas facing substantial political or regulatory headwinds.

The advances in health care in particular are breathtaking — so many selfless souls are working to advance science, and this is heartening.

Long-term, this is good for humans in general."

December 28, 2015

Coming together of several digital technologies ➡ synergy

Coming together of several digital technologies ➡ synergy

Announcement of the sequencing of the human genome

June 26, 2000

Ceremony at the White House
to announce the first draft of the human genome.

President Bill Clinton said, “Today we are learning the language in which God created life. . . . It will revolutionize the diagnosis, prevention, and treatment of most, if not all human diseases.”

Over-hyped by politicians: most scientists were more realistic about timelines and potential.

Personal genome sequencing now below $1k

2003: 1st genome (actually a mix of several people, 13 years at cost of $2.7 billion.
2007: Craig Venter's genome, 4 years at cost of about $100 million.
2008: The Watson genome, 4 months at cost of $1.5 million.
2008: 1-2 weeks for less than $100,000.
2010: Illumina, offered whole-genome sequencing for $28,000
2011: Complete Genomics sequencing 1,000 whole human genomes per month, <$5000
2014: Illumina launched its HiSeq X Ten Sequencer; $1,000 genome at 30x coverage

2,700,00 cost reduction in 12 years. 225,000x improvement per year

"Gene-sequencing technology is advancing at a rate even faster than computer processing power." McKinsey 2013

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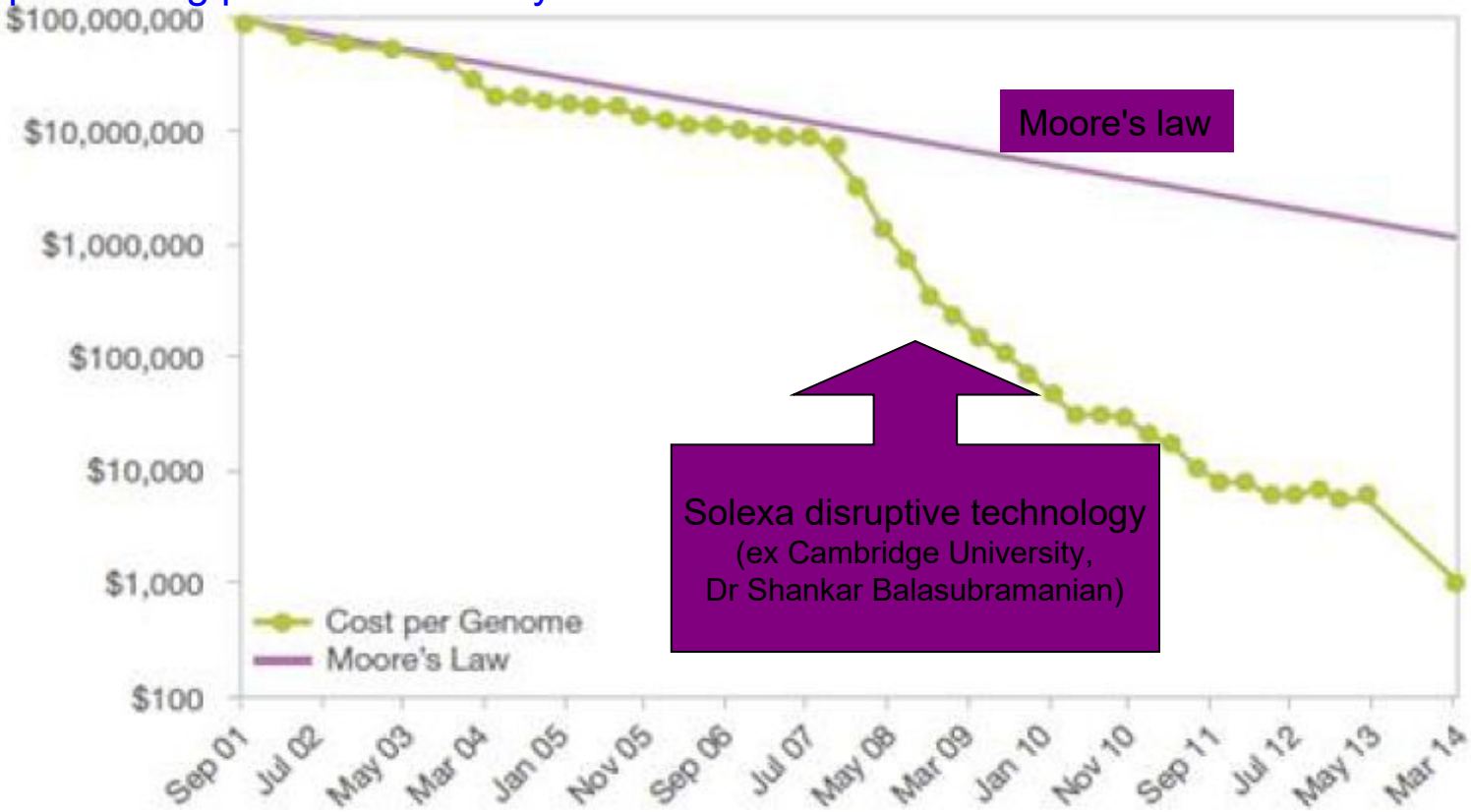


But, disillusion too

The New York Times

A Decade Later, Genetic Map Yields Few New Cures

By NICHOLAS WADE

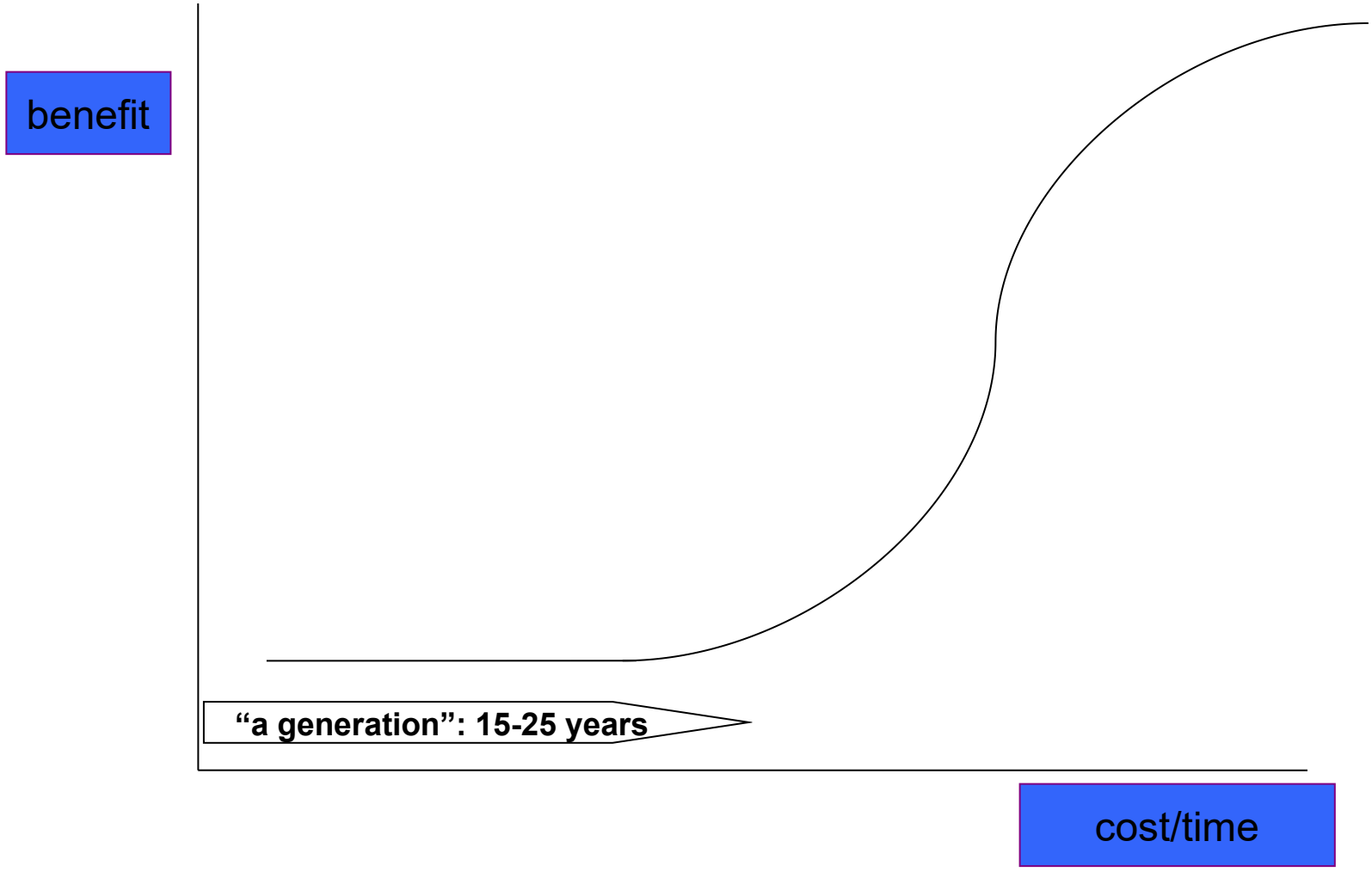
Published: June 12, 2010

Ten years after President Bill Clinton announced that the first draft of the human genome was complete, medicine has yet to see any large part of the promised benefits.

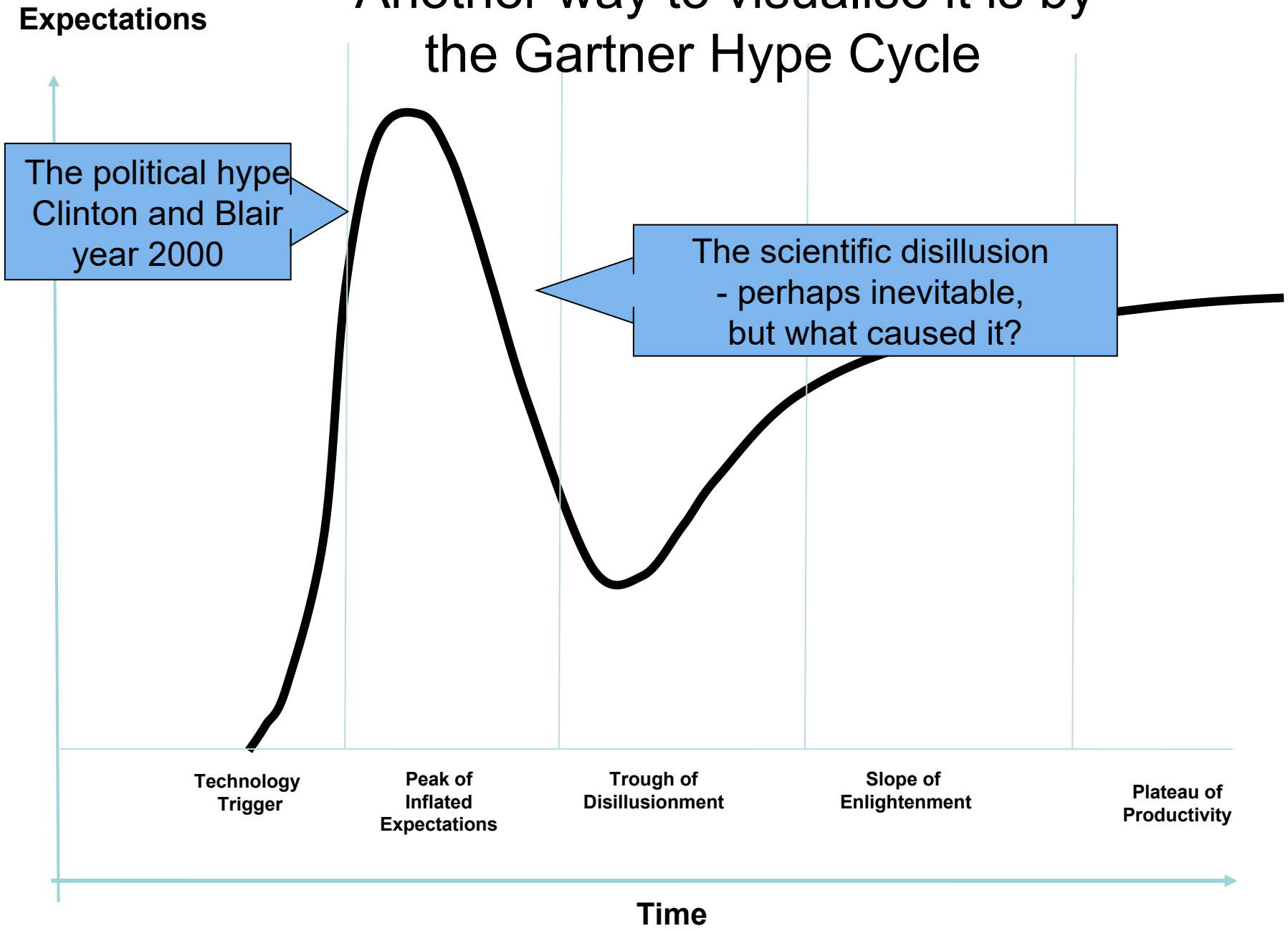
The Genome at 10

For biologists, the genome has yielded one insightful surprise after another. But the primary goal of the $3 billion Human Genome Project — to ferret out the genetic roots of common diseases like cancer and Alzheimer's and then generate treatments — remains largely elusive. Indeed, after 10 years of effort, geneticists are almost back to square one in knowing where to look for the roots of common disease.

To understand why, consider the S-curve of technology development



Another way to visualise it is by the Gartner Hype Cycle



Causes of the disillusion (1): March 2014: Discrepencies in genome DNA sequences from different labs

- Independent team from Stanford found important differences in sequences from 2 main sequencing providers, Illumina and Complete Genomics.

- Also found that10–19% of genes known to be linked to disease were not adequately sequenced and might have missed finding harmful mutations in these genes.

- The two services also disagreed two-thirds of the time about the presence of a particularly worrisome type of mutation — the addition or deletion of parts of genes linked to disease.

- The study clinicians often disagreed about what patients should do in light of the findings about their genomes — for instance, whether a particular mutation meant that the patient should undergo further testing.

Causes of the disillusion (2): For most health and illness, how DNA is expressed to RNA ('the transcriptome') is more important than DNA alone

The Economist

Leaders

The RNA revolution

Biology's Big Bang

What physics was to the 20th century, biology will be to the 21st—and RNA will be a vital part of it

Jun 14th 2007

Bridgeman

NATURE is full of surprises. When a

Why?

- The earlier idea of 'coding DNA' (making proteins) and 'junk DNA' (doing nothing) was seriously wrong.
- The 'junk DNA' codes for RNA which controls the 'coding DNA'.
- RNA is the big story of the genome.
- And we are still deciphering what it all does.

- And more than that, YOU are important too...

Causes of the disillusion (3):
It is more than genes

'Don't blame your genes.
They may simply be getting bad instructions from you'.
The Economist. 3 September 2009

The Economist

World politics | Business & finance | Economics | Science & technology | Culture

The origin of diabetes

Don't blame your genes

They may simply be getting bad instructions—from you

Sep 3rd 2009 | From the print edition

GENES are acquired at conception and carried to the grave. But the same gene can be expressed differently in different people—or at different times during an individual's life. The differences are the result of what are known as epigenetic marks, chemicals such as methyl groups that are sometimes attached to a gene to tell it to turn out more of a vital protein, or to stop making that protein altogether.

Magnum Photos

Your lifestyle changes your DNA!!!

'Epigenetics' resolves the Nature vs Nurture debate

Genome - the DNA you inherited from your parents (and mutations acquired in your lifetime).

Transcriptome - DNA makes RNA which has many functions

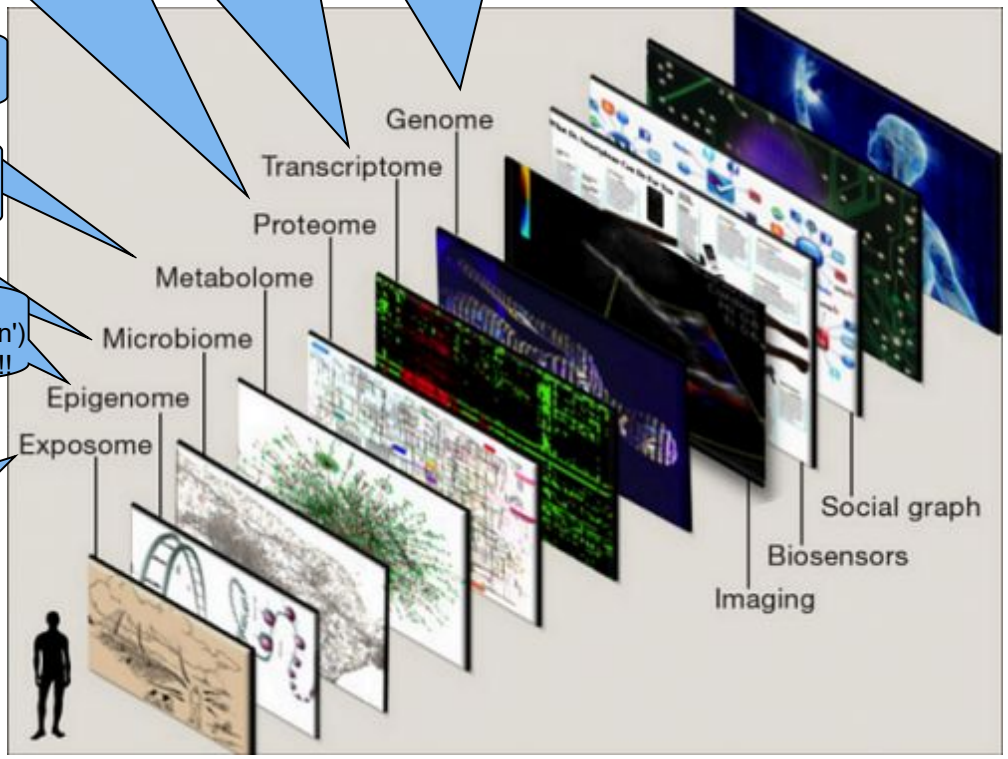
Proteome - the proteins coded by your DNA / RNA

Proteins get modified by other proteins (enzymes)

Bacteria in your gut contain 10x more DNA, and may be just as important

Chemical changes to your DNA and histone proteins. ('Methylation') Your lifestyle modifies your DNA!!!

And not only DNA is modified by the environment, proteins etc are too.



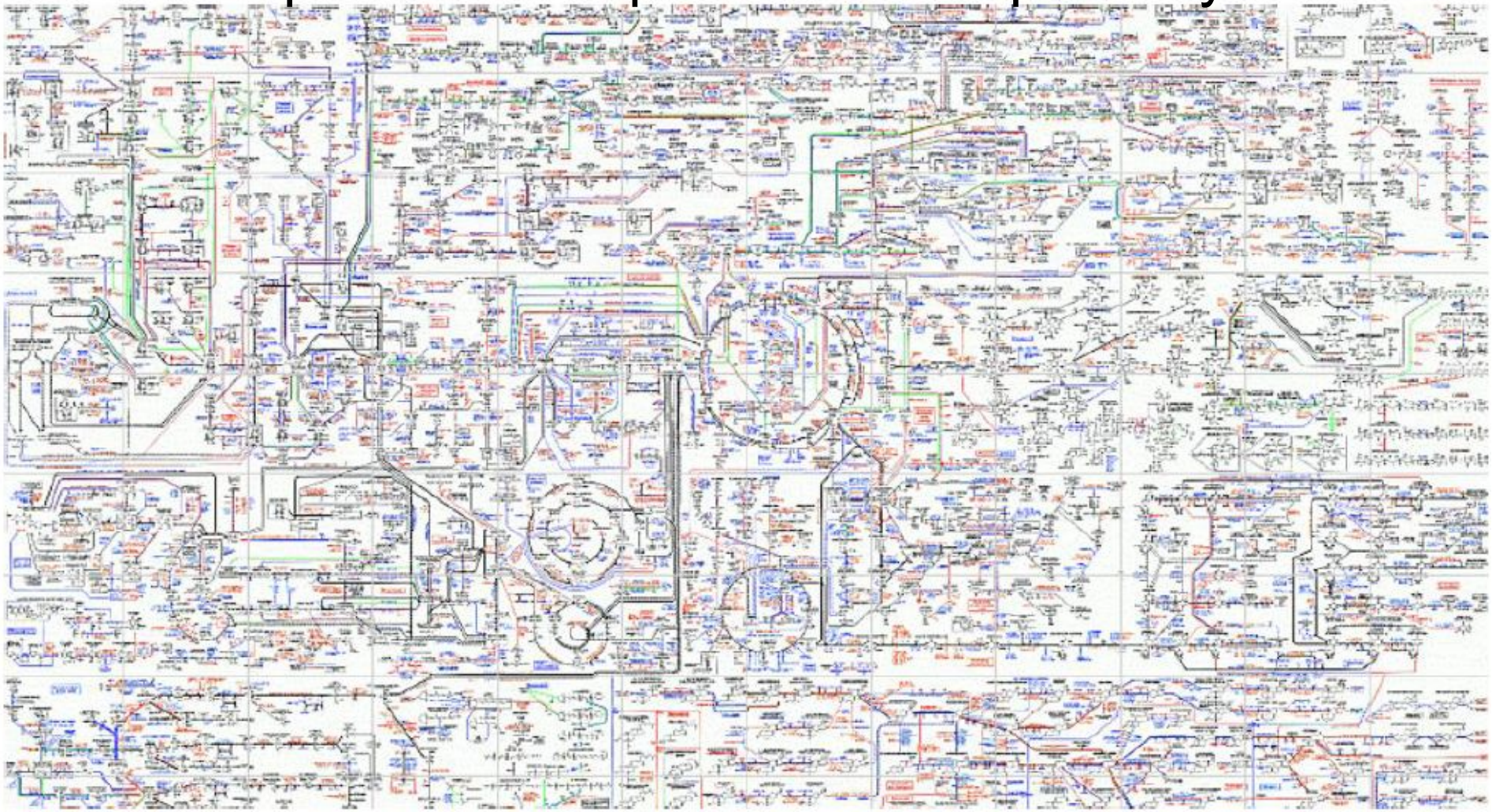
Causes of the disillusion (4):

The majority of disease causation is non-genetic.

Nature vs Nurture - genes vs environment - it is is blurred.

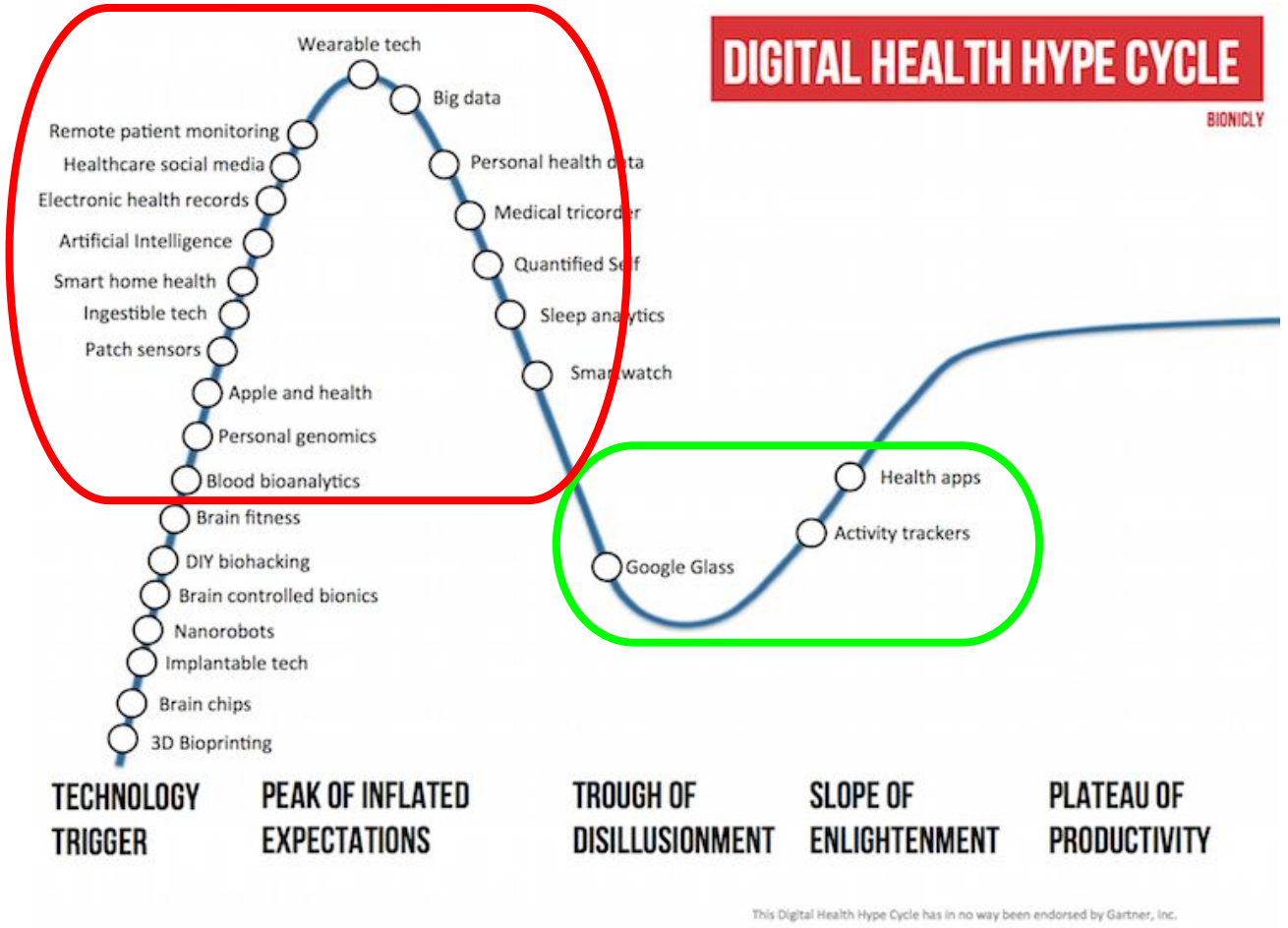
Environmental exposures cause permanent genetic changes via mutagenesis and also have long-term impact on gene expression through epigenetic mechanisms.

Causes of the disillusion (5):
Diseases are very complex
- proteome map of a disease pathway



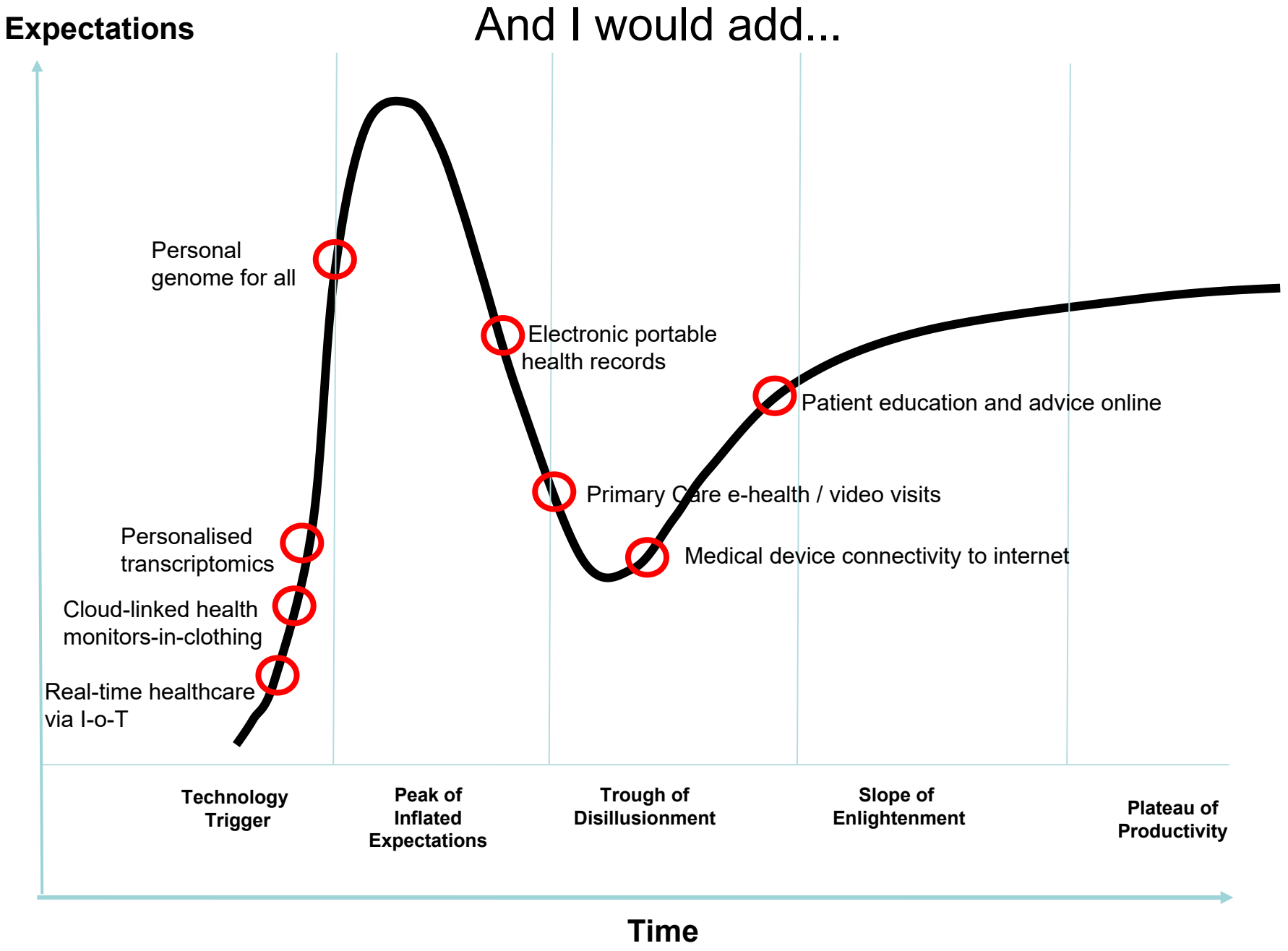
So where are we on the Gartner Hype cycle?

Here is a view from Stephen Davies and colleagues
(Published December 2014)



Reference: http://bionicly.com/digital-health-hype-cycle/
NB. The digital health hype cycle has not been approved by Gartner!

And I would add...



Actually, things are now beginning to move fast:
As an analogy, remember this:
Today you can access free on smartphones capabilities that recently cost $thousands

Dematerialization and Demonetization

'Abundance: The future is better than you think'. Diamandis and Kotler 2012

76 Dematerialization

"Positive deflation".

>$900,000 worth of applications in a smart phone today

	Application	$ (2011)	Original Device Name	Year*	MSRP	2011's $
1	Video conferencing	*free*	Compression Labs VC	1982	$250,000	$586,904
2	GPS	*free*	TI NAVSTAR	1982	$119,900	$279,366
3	Digital voice recorder	*free*	SONY PCM	1978	$2,500	$8,687
4	Digital watch	*free*	Seiko 35SQ Astron	1969	$1,250	$7,716
5	5 Mpixel camera	*free*	Canon RC-701	1986	$3,000	$6,201
6	Medical library	*free*	e.g. CONSULTANT	1987	Up to $2,000	$3,988
7	Video player	*free*	Toshiba V-8000	1981	$1,245	$3,103
8	Video camera	*free*	RCA CC010	1981	$1,050	$2,617
9	Music player	*free*	Sony CDP-101 CD player	1982	$900	$2,113
10	Encyclopedia	*free*	Compton's CD Encyclopedia	1989	$750	$1,370
11	Videogame console	*free*	Atari 2600	1977	$199	$744
	Total	**free**				**$902,065**

*Year of Launch

The same is beginning
to happen in healthcare.

Massive reductions in cost
and gains in quality are coming rapidly now

iPhone as stethoscope

iPhone to Measure Blood Pressure

Allows more realistic measurement of blood pressure, avoiding “white-coat hypertension” (falsely high readings at a doctor’s office).

Easy storage and retrieval of records - graph form, so easier to see trends in blood pressure.

Easy to send your record to whereever you wish, including to your doctor.

iPhone as otoscope

Also called the Remotoscope or Cellscope.

Can view the inner ear with magnification, take photos, to send to doctors, or specialists, from home or remote areas.

It is approved by the FDA.

iPhone as ECG

Attaches to the back of the iPhone to read and record heart ECG pattern via an app

Low cost - allows for mass screening in developing countries.

Wireless device provides direct transmission for in-the-field consultations with cardiologists.

iPhone as a Microscope

The iPhone as a Glucose metre

iPhone as a dermatoscope

20x magnification.
Highly useful for diagnosing skin problems.
Can analyze photos, match to similar ones through programmed algorithms.
Photos and medical analysis can be documented in detail for future reference, shared with others, allowing a rapid AI learning loop.

iPhone as an ultrasound device

Approved by the FDA

Attachable ultrasound device using iPhone as a display and record keeping device.

Costs $7,000 and $8,000; traditional machines cost from $10,000 to $200,000.

iPhone as eye scanner

iPhone as brain scanner

PubMed.gov
US National Library of Medicine
National Institutes of Health

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Full text links

PLOS ONE | PMC Free Full text

PLoS One. 2014 Feb 5;9(2):e86733. doi: 10.1371/journal.pone.0086733. eCollection 2014.

The smartphone brain scanner: a portable real-time neuroimaging system.

Stopczynski A[1], Stahlhut C[1], Larsen JE[1], Petersen MK[1], Hansen LK[1].

Author information

Erratum in
PLoS One. 2014;9(4):e96652.

Abstract

Combining low-cost wireless EEG sensors with smartphones offers novel opportunities for mobile brain imaging in an everyday context. Here we present the technical details and validation of a framework for building multi-platform, portable EEG applications with real-time 3D source reconstruction. The system--Smartphone Brain Scanner--combines an off-the-shelf neuroheadset or EEG cap with a smartphone or tablet, and as such represents the first fully portable system for real-time 3D EEG imaging. We discuss the benefits and challenges, including technical limitations as well as details of real-time reconstruction of 3D images of brain activity. We present examples of brain activity captured in a simple experiment involving imagined finger tapping, which shows that the acquired signal in a relevant brain region is similar to that obtained with standard EEG lab equipment. Although the quality of the signal in a mobile solution using an off-the-shelf consumer neuroheadset is lower than the signal obtained using high-density standard EEG equipment, we propose mobile application development may offset the disadvantages and provide completely new opportunities for neuroimaging in natural settings.

PMID: 24505263 [PubMed - indexed for MEDLINE] PMCID: PMC3914802 **Free PMC Article**

Images from this publication. See all images (9) Free text

iPhone as Spirometer and Breath Analyser

- early disease detection
- portable breathalyzer
- plugs into bottom of iPhone; displays blood alcohol content on the screen.

Google Glass

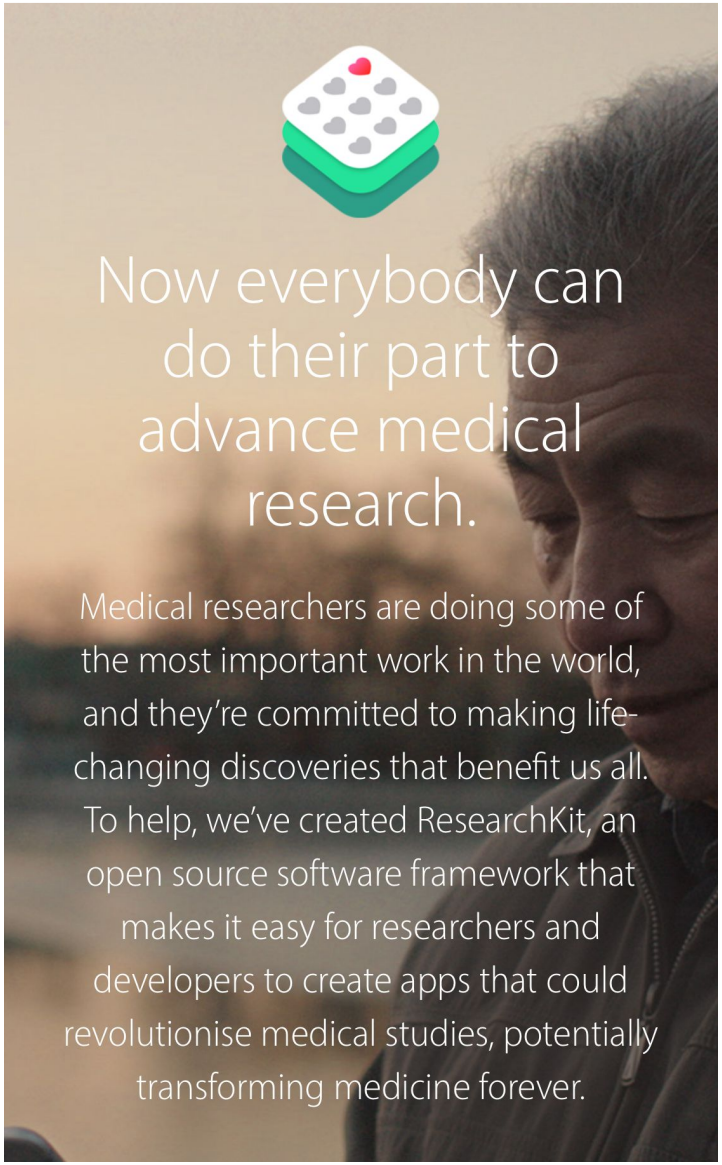
Measures glucose levels in the tears of diabetic patients continuously.
Eliminates daily pin pricks for blood sample.
The lens consists of a wireless chip and a miniaturized glucose sensor.
A wireless antenna thinner than a human's hair communicates information to a wireless device.
Human testing begins in 2016.
Eventually, likely to extend to other health measurements.

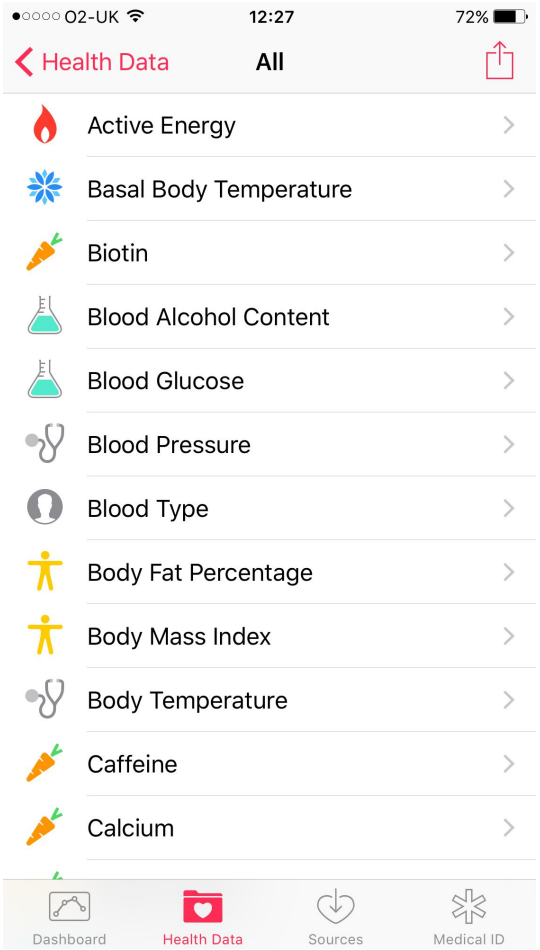
"The Star Trek-style 'Tricorder' that diagnoses disease in under 15 minutes"

(Headline in Daily Mail, 2 November 2015)

- Handheld device will analyse DNA to test for illnesses such as malaria,TB, STIs, Ebola etc with the accuracy of a state-of-the-art laboratory.
- University of Newcastle scientists aim is to launch the Q-POC device by the end of 2016

Apple ResearchKit

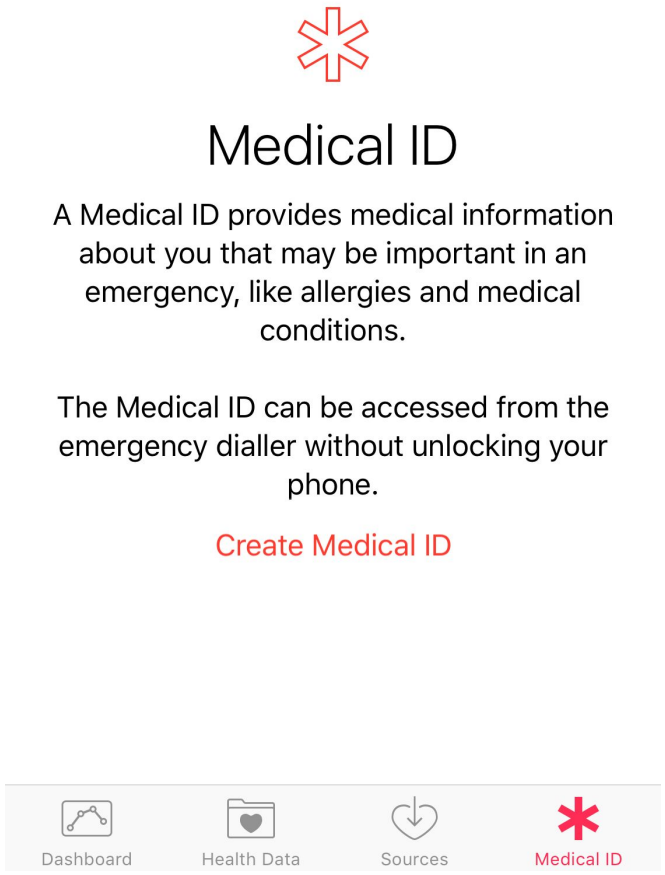



O2-UK
12:27
72%
Health Data
All
Active Energy
Basal Body Temperature
Biotin
Blood Alcohol Content
Blood Glucose
Blood Pressure
Blood Type
Body Fat Percentage
Body Mass Index
Body Temperature
Caffeine
Calcium
Dashboard
Health Data
Sources
Medical ID

iPhone activity monitor

Also useful for monitoring activity of elderly relatives

This could save your life - and it's free



It shows your vital medical information.

You create a list of medical conditions and current medication.

It can be accessed from the lock screen in the event of an emergency.

Useful website
with news on new medical apps

http://www.imedicalapps.com

The Centers for Disease Control and Prevention (CDC) now has 27 medical and health apps in the iOS App Store.

The CDC also has 21 medical and health apps in the Google Play Android store.

Technology’s biggest untapped market is elderly care

http://www.telegraph.co.uk/technology/news/12044446/Technologys-biggest-untapped-market-is-elderly-care.html

For the first time in history, 14pc of the world is over 65.

How can technology assist them cheaply and efficiently?

Robot carers like Obi, (pictured, from TV series Humans), will become more common as the world population ages

Emerald can visualise where you are through radio waves and detect falls anywhere in the home

Wi-Fi-router-sized box can sit on the side in an elderly person's home, and doesn't require any human operators. It uses radio waves to reflect off the person, so it can accurately track exactly where they are, and when they fall – even through walls and doors.

When it does detect a fall, it can alert family members and medical helpers.

Healthy ageing
Nutritional epigenetics

- During both early development and in adult life, environmental signals can activate intracellular pathways that directly remodel the epigenome, leading to changes in gene expression and function....'Epigenetics'

- Epigenetics: heritable traits resulting from changes in DNA or chromatin structure - without alterations in the DNA sequence

- Nutritional epigenetics is a way to prevent diseases and delay ageing.

- Your epigenetic profile is affected by diet, nutrients, and environmental factors such as chemical, psychological, and behavioral factors.

Recurring themes

Devices connected to (universal) smartphone.
Wireless cloud connection.
Instant measurement and analysis.
Potential for remote review by experts.
Easier storage of data for later analysis.
Accumulation of patient records for societal-level learning, AI etc.

Digital data and analytics via the cloud
is starting to transform healthcare

This could lead to changes larger than most people envisage

Now

Data gathering:
- point-in-time, sparse

Data feedback:
- point-in-time, sparse,

Advice:
- subjective ('medical opinion')

Actions:
- dependence, fixed, slow learning cycle

Records:
- hospitals/ doctors own/ control your medical records

2020-2030 onwards?

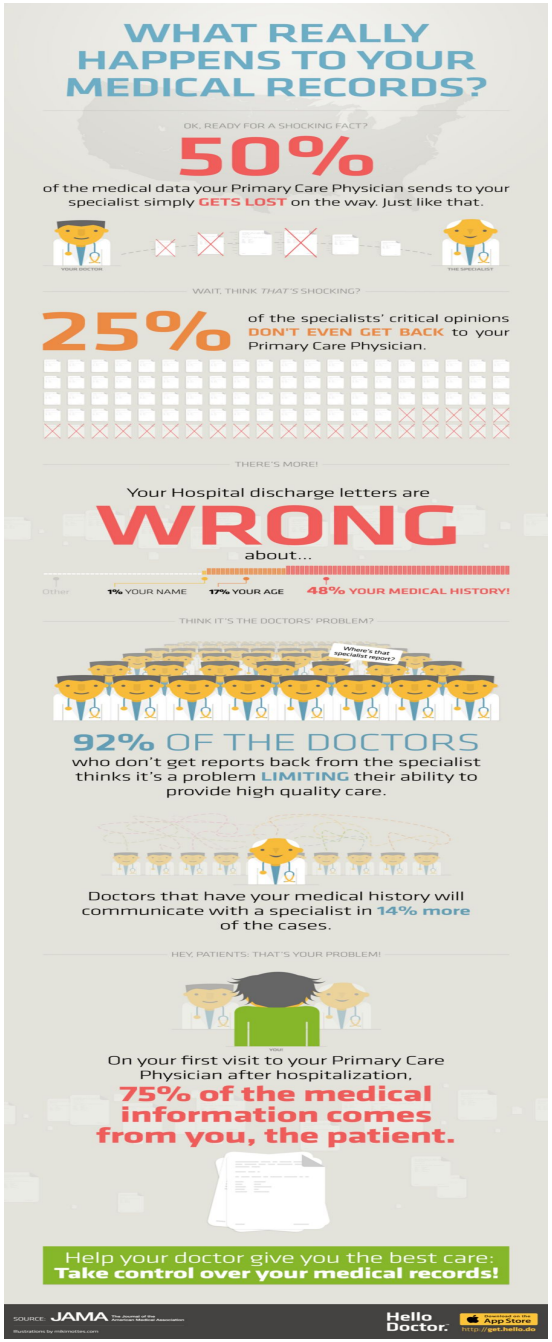
Data gathering:
- continuous, dense,

Data feedback:
- continuous, rich,

Advice:
- AI interpretation

Actions:
- independence, experimental, rapid learning cycle

Records:
- you own and control your medical records



We really do need change (1)...

This is where we are now.

JAMA on your medical record

Primary care → Specialist:
50% of data from primary care to specialist gets lost.

Specialist → Primary care:
25% specialist opinions do not get back to primary care.

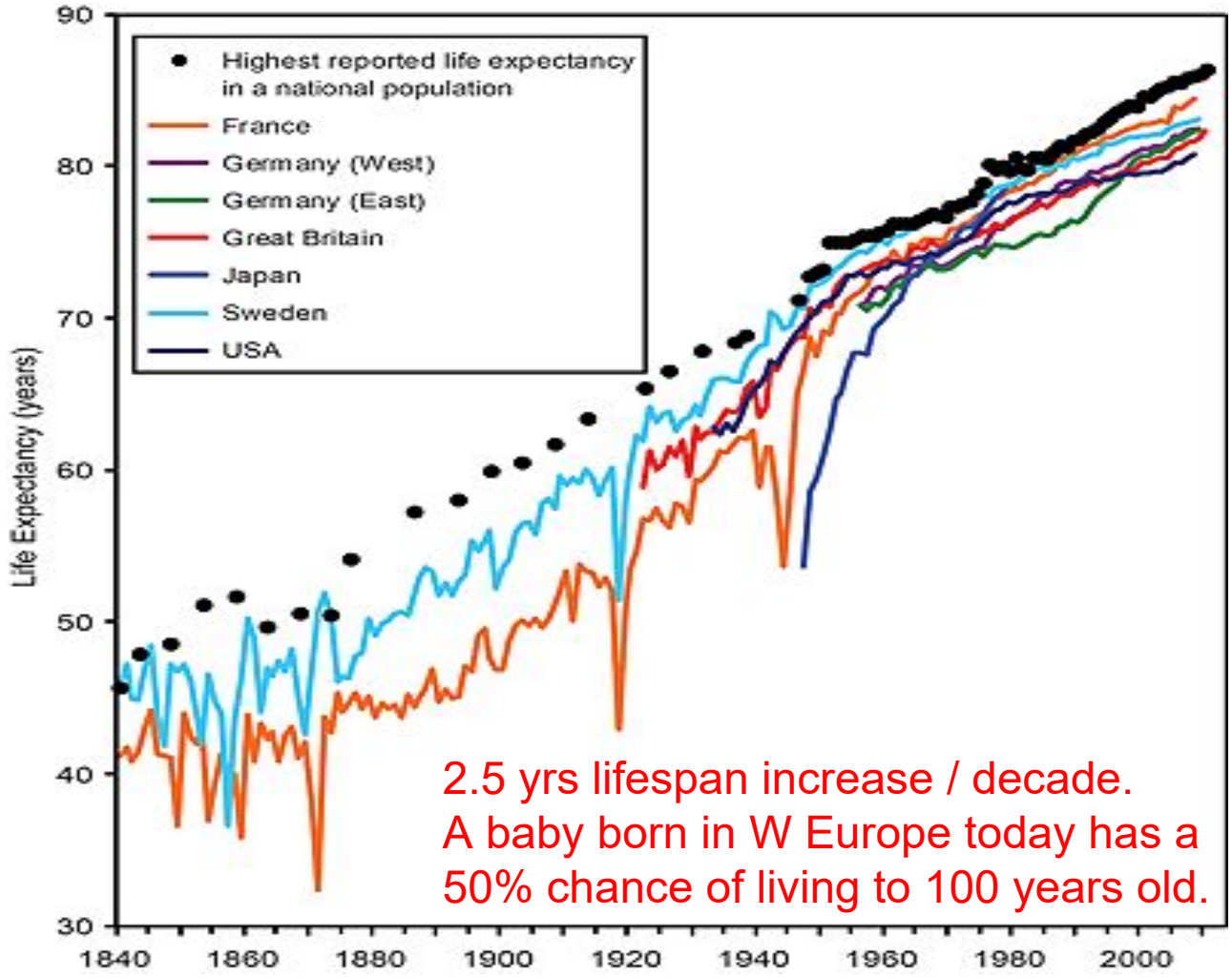
Hospital → Primary care
48% hospital discharge records are wrong on your medical history
75% of your medical information after hospitalisation comes from you personally on next visit primary care visit.

Source data from the Journal of American Medical Association (JAMA) in these two studies:
http://jama.jamanetwork.com/article.aspx?articleid=205790 and
http://archinte.jamanetwork.com/article.aspx?articleid=226367

We really do need change (2)...

Lifespan has increased linearly through both 1st and 2nd Industrial Revolutions, and looks likely to continue to do so.

But quality of life at 90-110?

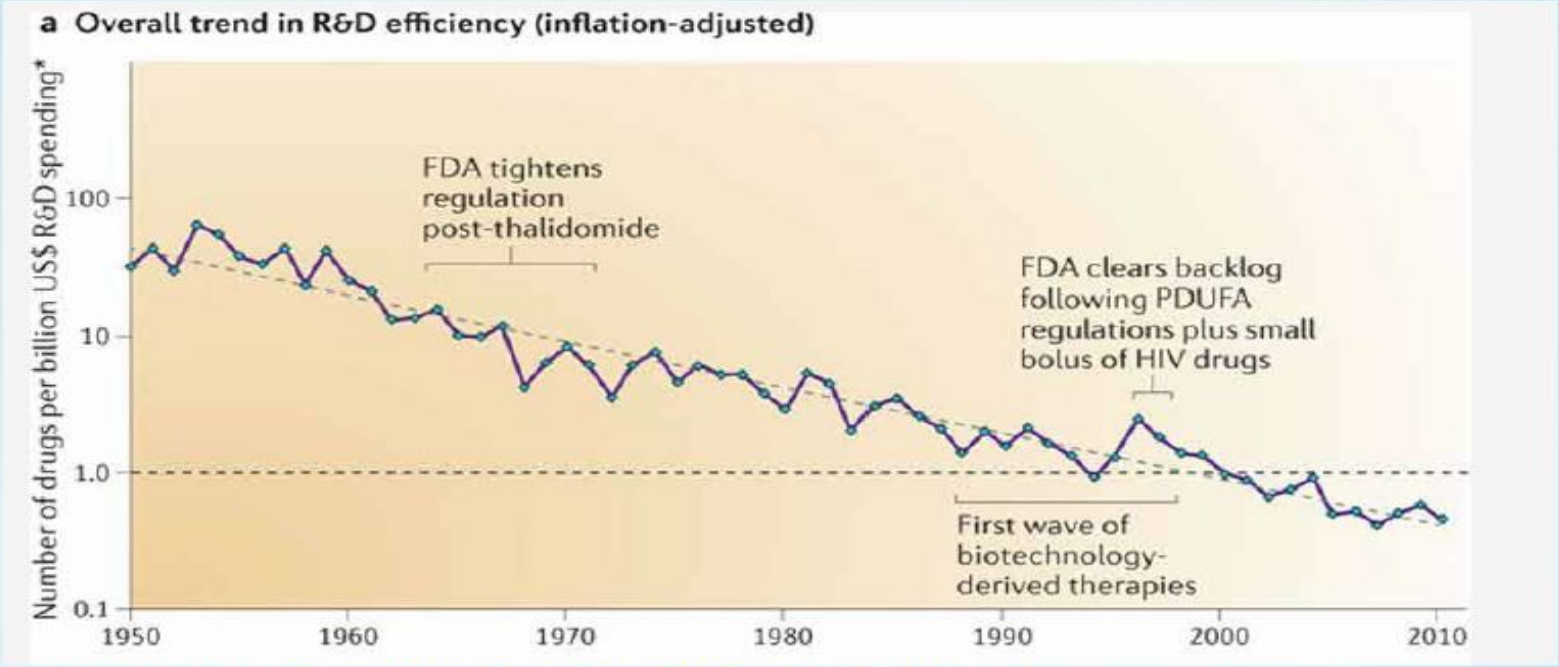


We really do need change (3)...

EROOM'S LAW
MOORE'S LAW

The Problem

Discovery of new medicines is declining continually. The old methods are not working.



Source: Nature Reviews, Diagnosing the decline in pharmaceutical R&D efficiency; Jack W. Scannell, et al.

- 29 drugs out of 30 tested fail: $5M - 10M in sunk cost each
- 2/3 of tested compounds never make it to human clinical trials

CYCLICA

We really do need change (4)...

The biggest failure in healthcare

"The biggest failure in healthcare is that no one has ever considered the consumer (aka the patient) the customer..."

"All stakeholders such as governments, private payers, medtech and pharma companies, and providers almost always ignore consumer-oriented value propositions, and instead focus on creating and delivering their value propositions to one another."

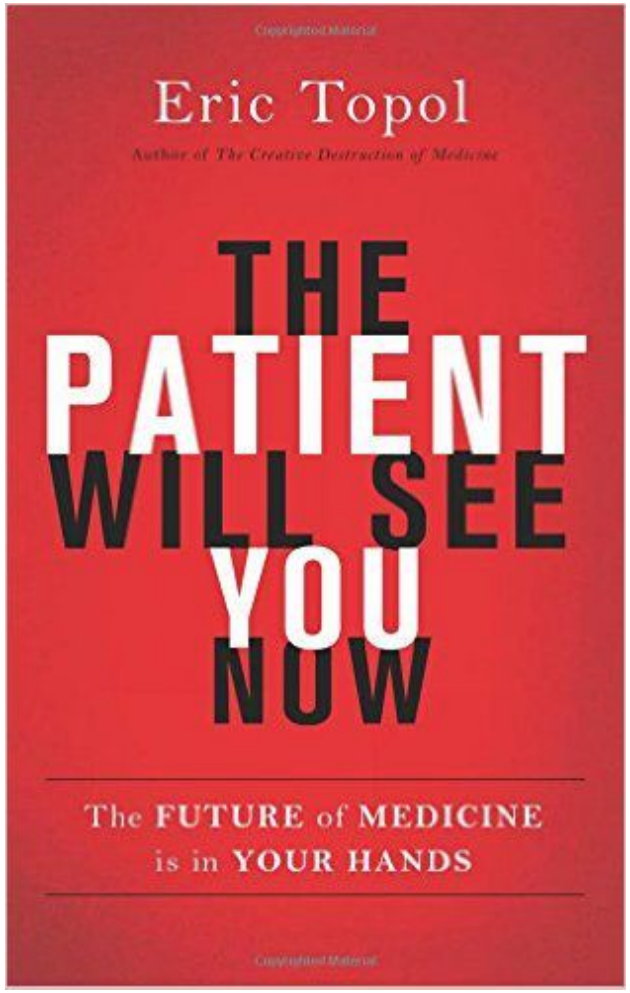
Chris Wasden December 2015

http://medtechviews.eu/article/ten-digital-health-tensions-driving-innovation-medtech

A view from a leading cardiac consultant and researcher

Dr. Eric Topol is a leading cardiologist and professor of genomics

" The future of medicine is in your hands."



Some quotes from his book

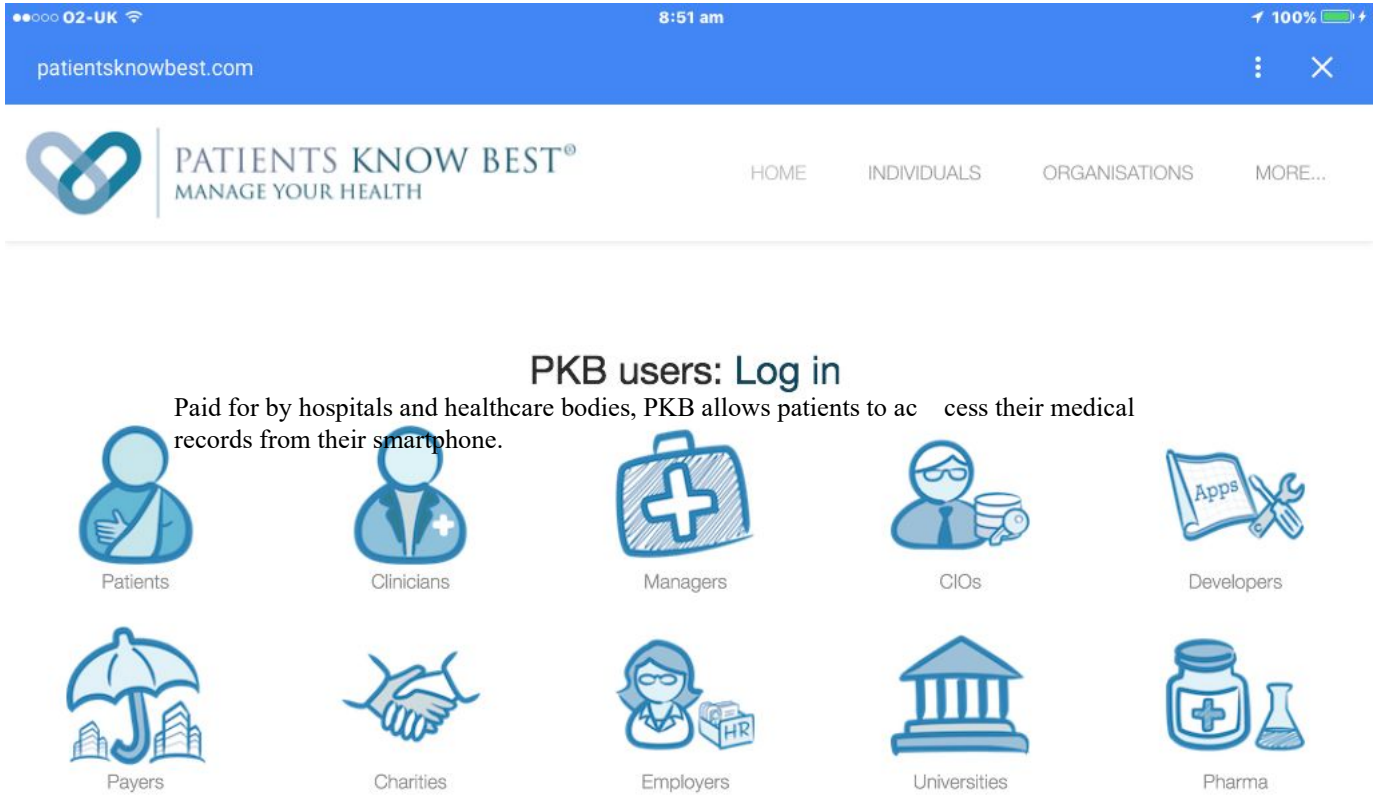
"Medicine is remarkably conservative to the point of being properly characterized as sclerotic, even ossified."

"Beyond the reluctance and resistance of physicians to change, the life science industry (companies that develop and commercialize drugs, devices, or diagnostic tests) and government regulatory agencies are in a near paralyzed state, unable to break out of a broken model."

"Without the active participation of consumers in this revolution, the process will be inexorably slowed. All the other forces that could come to bear—doctors, the life science industry, government, and health insurers—are incapable of catalyzing this transformation."

Eric Topol

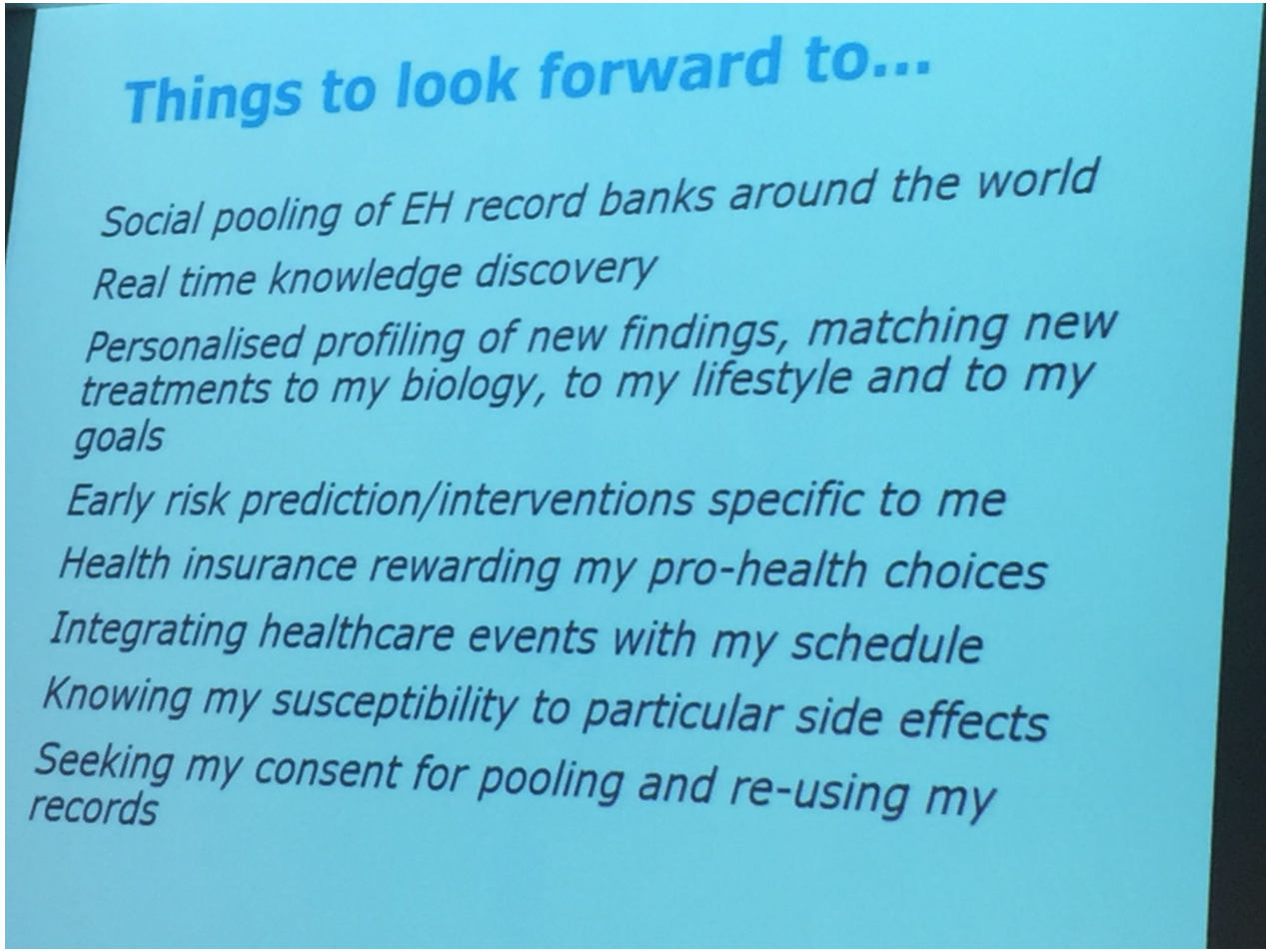
Change is happening:
Patients are now owning their health records



Patients Know Best. Founded: 2008, UK, by Mohammad Al-Ubaydli.
Gives patients anytime, anywhere access to their medical records.
Paid for by hospitals and healthcare bodies.
Allows patients to ac cess their medical records from their smartphone.
Allows sharing of records when required.

Things to look forward to

(Credit: Laurent Probst, PwC Luxembourg)

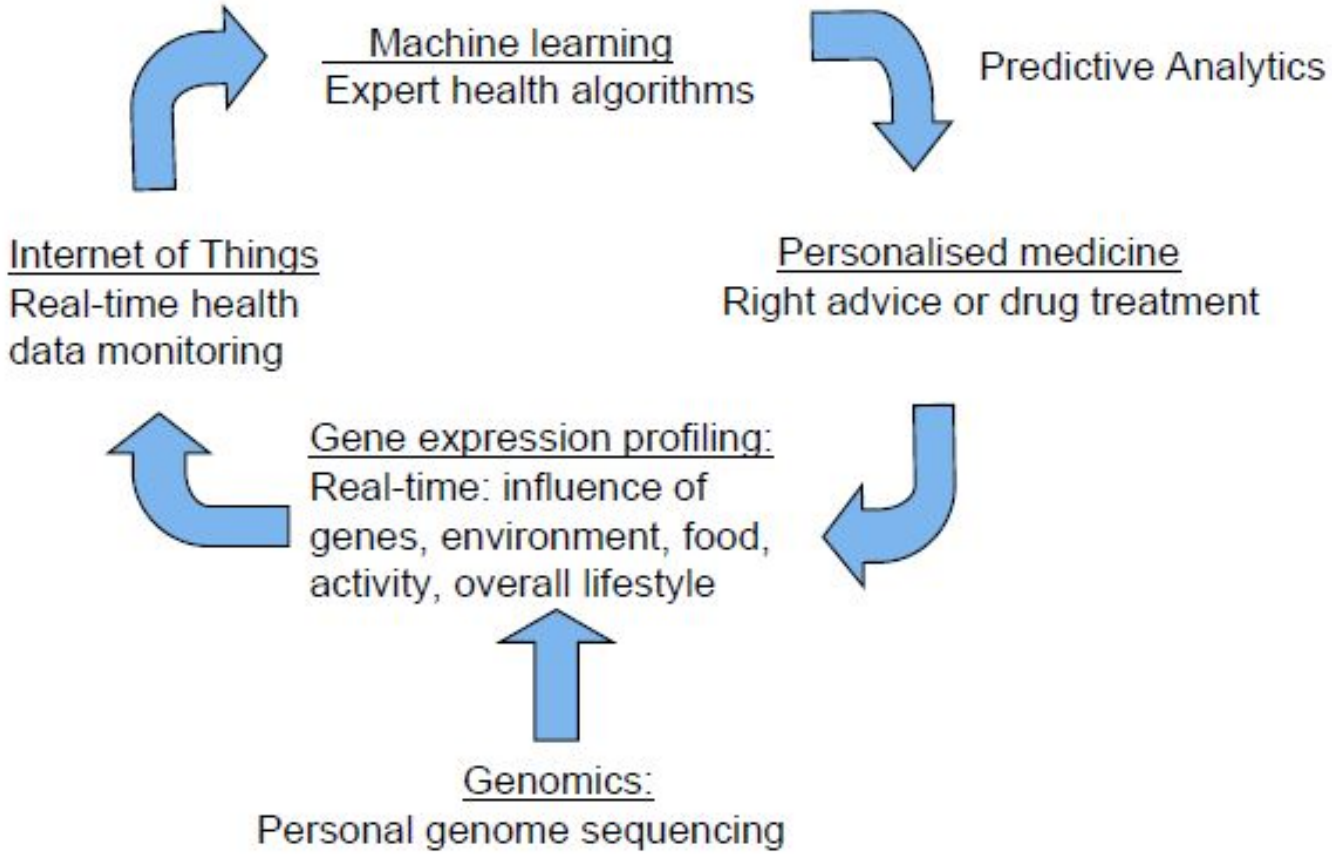


Conference: Big Data in Healthcare, Luxembourg, 28-29 October 2015.

I-o-T in Healthcare

- Fed by sensors (wearables, clothing etc)
- 'Intelligent' apps
- Real time data collection and analysis
- Massive data storage and analysis requirements
- Will drive new consumer goods and business opportunities
- Trillion dollar market
- Reorganisation of healthcare industry

The health learning circle



Progress requires the following

- Information security
- Seamless public and private cloud computing
- Agreement on standards
- Next- generation analytics
- New storage management technologies
- New data access tools and processes
- Automatic tagging
- Ability to deal with real-time data

Do you doubt this is possible?

30 years

30 years?

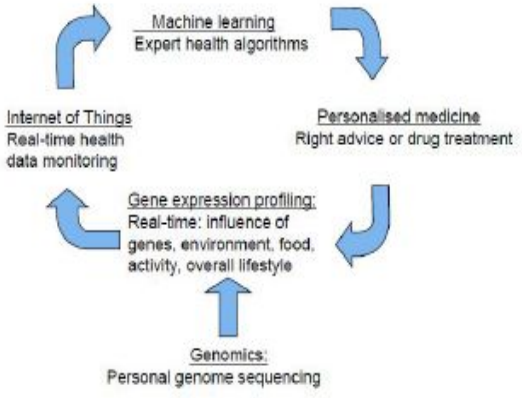
blackbox

1984:
64k memory.
Home hobbyist

More computing power than whole USA 50 yrs ago

More computing power than whole world today

30 years?



The winners in digital healthcare may not be the current dominant healthcare players

Business Model Innovation is

More Powerful than Technology Innovation.

Those Without a Legacy Have

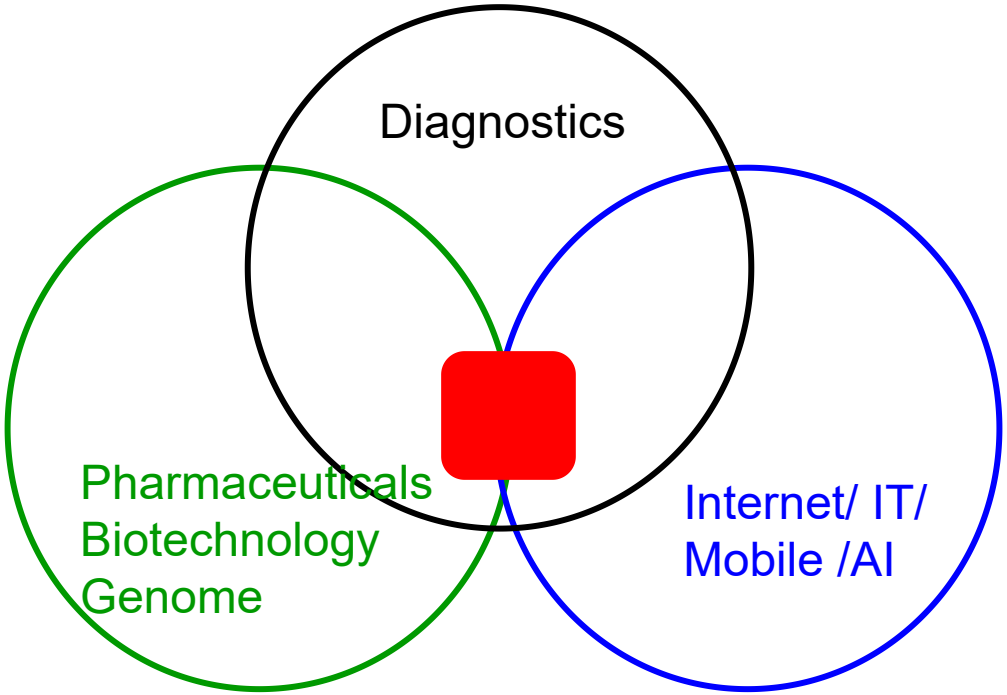
Fewer Barriers to Adopting Radical Innovations

Three business models will merge:

- Pharma/biotechnology
- Diagnostics
- Internet

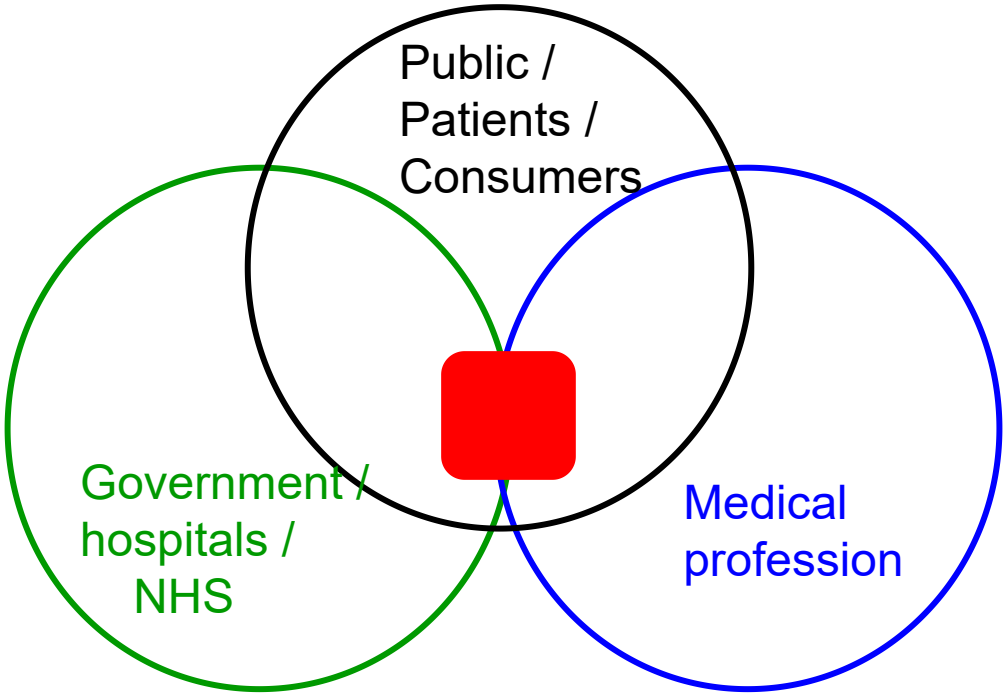
...creating a totally new business model

The new healthcare - businesses



New business models.
Current businesses will be challenged and over-taken.

The new healthcare - people



Things will change massively for all three sectors

Investing

The least-risky investment winners may be service providers (picks and shovels) not drug development companies

1. Big Data / cloud service providers
2. Genomics, proteomics etc providers
3. General scientific servicers companies
4. Connectivity providers: Internet of Things
5. Diagnostics providers
6. Platforms that integrate all 3 (connectivity + diagnostics + treatments)
7. Finally, Pharma/Biotech companies that can make the transition

Whatever the future business model,
massive data storage will be required.

Big Data

Refers to things we can do at a large scale
that are not possible at small scale

extract new insights, correlations, predictions

Infering probabilities from huge sets of data

So what is the future scale of big data in healthcare?

Stephens ZD, Lee SY, Faghri F, Campbell, RH, Zhai C, Efron MJ, et al. (2015) Big Data: Astronomical or Genomical?. PLoS Biol 13(7): e1002195. doi:10.1371/journal.pbio.1002195

Compared genomics with three other major generators of Big Data: astronomy, YouTube, and Twitter.

YouTube: 300 hours of video being uploaded every minute

- could grow to 1,000–1,700 hours per minute (1–2 exabytes of video data per year)

Show that genomics is either on par with or the most demanding for data acquisition, storage, distribution, and analysis.

Scale of genomics data

Year 2015

> 2,500 high-throughput instruments, in 1,000 sequencing centers in 55 countries in universities, hospitals and other research laboratories

e.g. Sequence Read Archive (SRA) USA

3.6 petabases of raw sequence data from ~32,000 microbial genomes, ~5,000 plant and animal genomes, and ~250,000 individual human genomes that have been sequenced to date

Genomics sequence data is doubling approximately every seven months

Genomics data storage size could far exceed all other domains

Stephens ZD, Lee SY, Faghri F, Campbell, RH, Zhai C, Efron MJ, et al. (2015)
Big Data: Astronomical or Genomical?
PLoS Biol13(7):e1002195.doi:10.1371/journal.pbio.1002195

We therefore estimate between 100 million and as many as 2 billion human genomes could be sequenced by 2025, representing four to five orders of magnitude growth in ten years and far exceeding the growth for the three other Big Data domains. Indeed, this number could grow even larger, especially since new single-cell genome sequencing technologies are starting to reveal previously unimagined levels of variation, especially in cancers, necessitating sequencing the genomes of thousands of separate cells in a single tumor [10].

My view: The figures on previous slides may be a massive under-estimate. Why?

- Genomes sequenced to date have been whole exome. Future focus will be whole genome.

- More than genome will be needed, much more!

  Phenotype data also required. Gene expression data, physiological changes, real time diagnostics and prognostics, feedback etc

- And eventually live data collection and analysis will be in demand for most humans via Internet-of-Things
  - Data from embedded systems, the signals from which are a major component of the Internet of Things, will grow from 2% of the digital universe in 2013 to 10% in 2020. Healthcare will push it much higher in the 2020s.

1. Big Data / cloud service providers

Some enterprises inherently capture a mass of data

- Retail: Amazon etc
- Software providers: Microsoft etc
- Search engines: Google
- Card issuers:Mastercard and Visa
- Social networks: Facebook etc

Some of these were first into Big Data storage and analytics

Healthcare could if more organised

- *or will the above companies segue into Healthcare?*
- *they already are, and they are storing data on a massive scale*

Types of cloud services

Amazon, Microsoft, Google etc

1. Infrastructure as a Service ("IaaS") - virtual servers / storage

2. Platform as a Service ("PaaS") a set of tools and services for developers to build apps

3. Software as a Service ("SaaS") - software is hosted by the service provider and made available to customers over the Internet

Big Data companies

Gartner's list of the top 10 cloud storage providers

Amazon Web Services
Microsoft
Google Cloud Storage
AT&T Synaptic cloud storage service
HP
IBM SmartCloud
Internap
Rackspace
Nirvanix
Softlayer

Amazon Web Services (AWS)

Market leader - more computing capacity than the next 14 players in the market, combined. (Gartner)

Got in early (2006)

Simple Storage Service (S3) is the basic storage
Elastic Block Storage is for storage volumes.
Glacier, a long-term, low-cost archival service
Redshift, cloud-based data warehousing

AWS is a key driver of Amazon growth

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Technology | Fri Jul 24, 2015 0:31pm EDT Related: TECH, MONEY

Cloud services seen growth driver for Amazon

BY EILEEN SORENG

Amazon.com Inc's shares surged more than 20 percent in early trading on Friday, adding more than $46 billion to the company's market value, after strong growth in the e-commerce giant's cloud business drove a surprise quarterly profit.

The company's market capitalization soared to more than $270 billion, overtaking that of Wal-Mart Stores, the world's biggest retailer.

Revenue from Amazon's cloud operations - Amazon Web Services (AWS) - nearly doubled in the second quarter, indicating that the business was poised to drive sustainable earnings for the online retailer, Wall Street analysts said.

Operating margins at the unit jumped to 21.4 pct from 7.7 percent.

Share price not much bothered by 2015 market blues!

Microsoft Azure

Late entrant - resisted cloud for years

Introduced Azure, competitor to AWS, in 2010

Cloud computing is now a major driver of Microsoft's revenue growth

Satya Nadella, when head of Microsoft's infrastructure business developed Azure, then became CEO in 2014

Microsoft has now made Azure a top priority

Azure is growing faster than Amazon Web Services (Gartner)

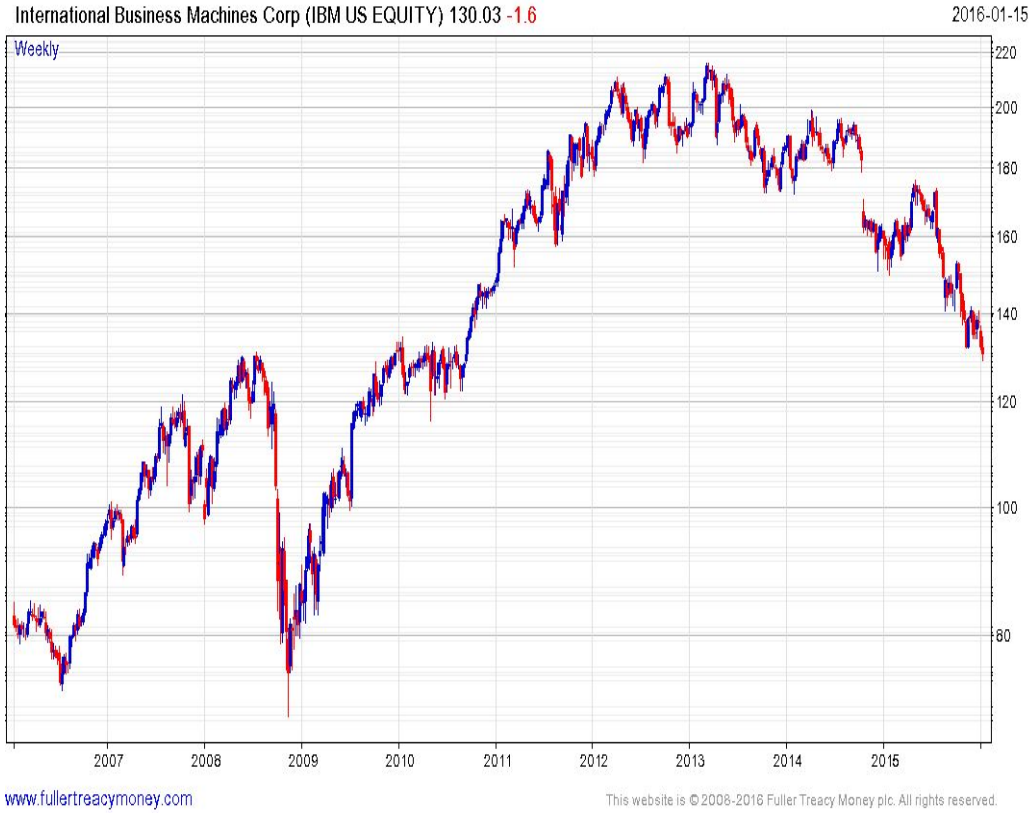
CEO Satya Nadella says the cloud is a "Seattle race" between Amazon and Microsoft, with most others irrelevant.

IBM

Invested heavily in technology (IBM Bluemix and IBM Watson).

These enable developers to build apps in the cloud.

But movement to the cloud damaged IBM's legacy business in hardware.



Share price pattern almost inverse of MSFT.
But will the Gartner curve apply eventually after this 'disillussion phase?

IBM's Watson supercomputer to speed up cancer care

6 May 2015 | Technology

Watson can sift through medical data in minutes, compared to the weeks it would take a human

IBM's supercomputer Watson will be used to make decisions about cancer care in 14 hospitals in the US and Canada, it has been announced.

Using computers to trawl through vast amounts of medical data speeds up the diagnosis process.

The system will help assess individual tumours and suggest which drug should be used to target them.

Why IBM Just Bought Billions of Medical Images for Watson to Look At

IBM seeks to transform image-based diagnostics by combining its cognitive computing technology with a massive collection of medical images.

By Mike Orcutt on August 11, 2015

IBM says that Watson, its artificial-intelligence technology, can use advanced computer vision to process huge volumes of medical images. Now Watson has its sights set on using this ability to help doctors diagnose diseases faster and more accurately.

Last week IBM announced it would buy Merge Healthcare for a billion dollars. If the deal is finalized, this would be the third health-care data company IBM has bought this year (see "Meet the Health-Care Company IBM Needed to Make Watson More Insightful"). Merge specializes in handling all kinds of medical images, and its service is used by more than 7,500 hospitals and clinics in the United States, as well as clinical research organizations and pharmaceutical companies. Shahram Ebadollahi, vice president of innovation and chief science officer for IBM's Watson Health Group, says the acquisition is part of an effort to draw on many different data sources, including anonymized, text-based medical records, to help physicians make treatment decisions.

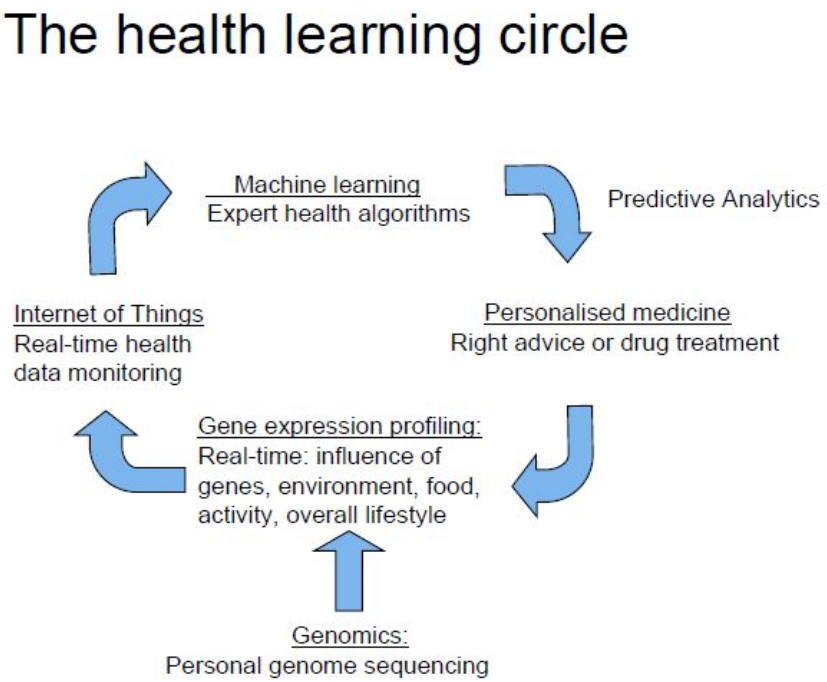
Merge's data set contains some 30 billion images, which is crucial to IBM because its plans for Watson rely on a technology, called deep learning, that trains a computer by feeding it large amounts of data.

http://www.technologyreview.com/news/540141/why-ibm-just-bought-billions-of-medical-images-for-watson-to-look-at/

IBM

Could IBM - Watson be a game-changer?

Potential to deliver the 'Healthcare Learning Circle' described earlier?



Announcement 7 Jan 2016:
IBM Watson and Pathway Genomics announce app which combines Watson's cognitive computing capabilities with precision medicine and genetics information to give users a more personal, in depth look at their health.

- assesses user's individual genetic traits, current health habits, data from health wearables and GPS, as well as information from the user's Apple HealthKit account.
- the app helps build a diet plan for users, it takes a look at the genetic variants that determine how the user burns fat, or how quickly he or she will feel full after eating etc.

Oracle, InterNAP, HP, Rackspace

Oracle cloud business is growing via existing customers, but struggling to attract new?

InterNAP AgileFiles cloud storage

HP Helion public cloud shut down in January 2016.

Rackspace Hosting gave up competing with AWS and now provides support services.

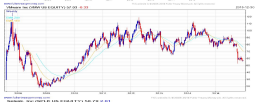
Big Data needs analysing:

MANY smaller companies focused on data curation and analytics

Public

Teradata 

SAP 

VMware 

Splunk 

MemSQL

Palantir Technologies

Trifacta

Datameer

Tamr

Neo Technology

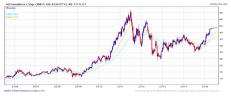
DataStax

Private

Infobright

Fractal Analytics (India)

Metric Insights

Informatica 

Syntasa

Comscore 

Chartio

Thoughtworks

Platfora

YarcData (Cray)

SiSense

ZettaSet

ClearStory Data

Hortonworks

MapR

MongoDB

Databricks

Premise

Cloudera

Pivotal

Concurrent

The Hive

WibiData

Aerospike

Ayasdi

Sight Machine

Segment.io

DataPad

Paxata

Interana

Wise.io

Sentinal Labs

Sift Science

Automatic

etc etc etc

Top Ten Holdings

	Holdings	% of Total Assets
1	Amazon.com	9.8
2	Illumina	7.8
3	Baidu	6.2
4	Inditex	5.6
5	Tencent	4.4
6	Tesla Motors	4.4
7	Alibaba	4.1
8	Facebook	3.9
9	Alphabet	3.7
10	Fiat Chrysler Automobiles	2.3
		52.1

Total may not sum due to rounding.

Investing in 'Big Data' via funds is less risky than single companies.

UK Investment Trust:
More than double its 2008 peak.

Security	Weight
Apple	16.37%
Microsoft Corp.	9.72%
Alphabet Class A	5.54%
Alphabet Class C	5.36%
Facebook Class A	4.60%
Intel Corp.	4.11%
Cisco Systems	3.44%
International Business Machines Corp.	3.35%
Oracle Corp.	3.20%
Taiwan Semiconductor Manufacturing	2.53%

Holdings

Stock	Stock Weighting
Apple Inc.	15.97
Microsoft Corporation	8.23
Alphabet Inc.	4.35
Facebook Inc.	4.28
Alphabet Inc. Class A	4.27
International Business Machines Corp.	3.44
Visa Inc.	3.35
Cisco Systems, Inc.	3.28
Oracle Corporation	3.17
Intel Corporation	3.10
QUALCOMM Incorporated	2.40

UK IT Fund: More than double its 2008 peak.

Top 10 holdings

Apple
Google A
Google C
Facebook
Microsoft
Intel
Samsung
Baidu
Splunk Inc
Qualcomm

2. Genomics, proteomics etc providers
Illumina

Pacific Biosciences

3. General scientific services companies

Thermo Fisher Scientific (acquired Life Technologies)

Boston Scientific Corp

Charles River

Abcam, Cambridge UK

Antibody reagent supply

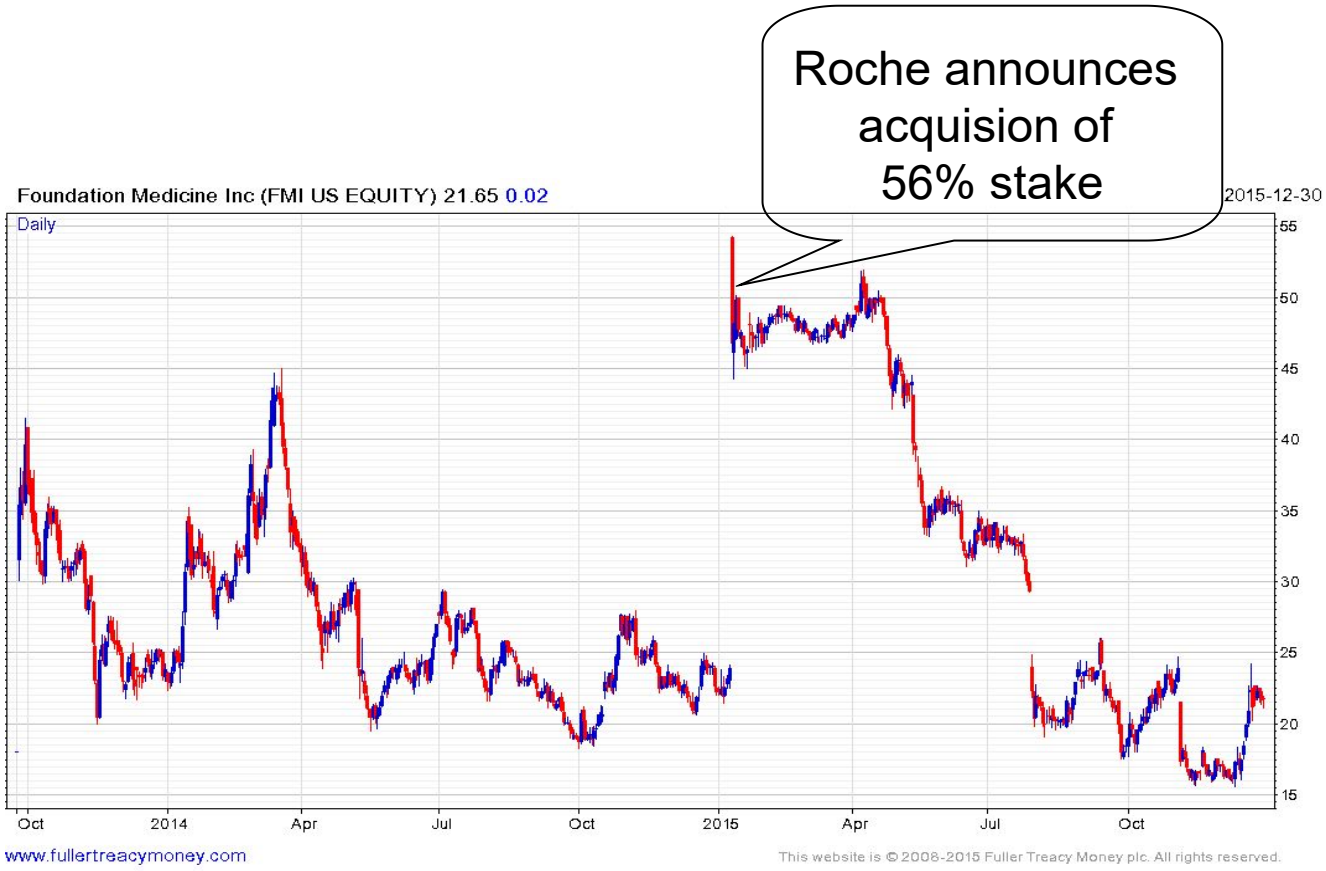
4. Connectivity providers: Internet of Things

ARM (Cambridge UK) has components essential to I-o-T, especially for healthcare (chips and sensors).

CDNS: Electronic Design Automation.
Creates software and hardware that assists semiconductor companies in designing chips.

5. Diagnostics providers

Foundation Medicine (cancer genomic testing)



Diagnostics providers

Start-ups in healthcare genomics and beyond

Invitiae - Genetic testing for hereditary disorders

Flatiron (oncology) - Google lead investor

Nant Health (oncology) - genomic AND proteomic information for cancer patients

6. Platforms that integrate all 3
connectivity + diagnostics + treatments

None yet. Will they emerge from 'wearables'?

Wearables: very early stage.
But potential to integrate many functions of the 'Healthcare Learning Cycle'

Apple Watch - when it grows up

Fitbit (FIT)

Google, Android Wear OS.
And eventually Magic Leap.

Pebble, fitness tracking, and Snowy voice command app.
Works with both iOS and Android phones

Facebook Occulus Rift could segue into healthcare

Others likely to appear.

7. Pharma/Biotech companies that can make the transition

Individual pharmaceutical and biotechnology companies are high risk.

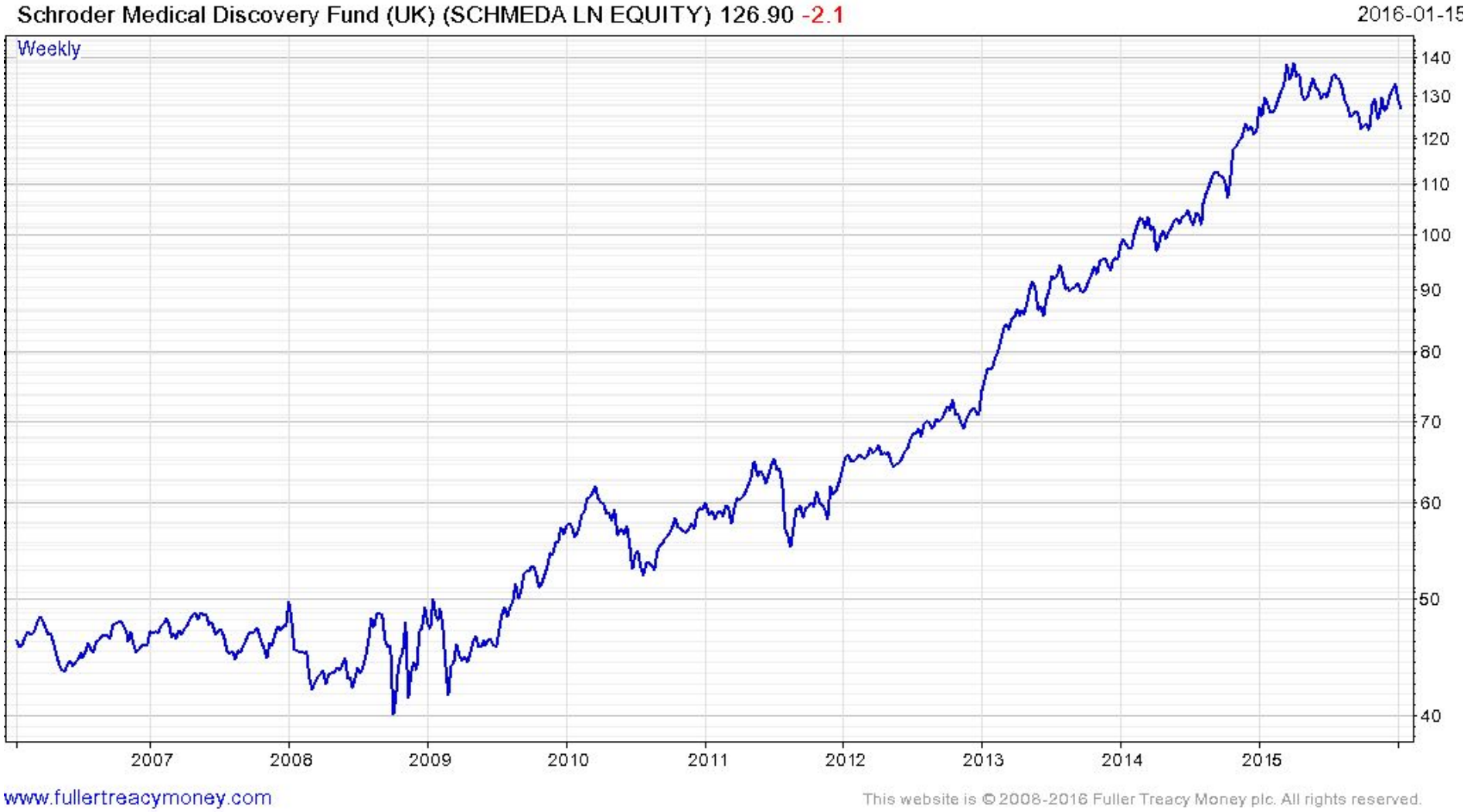
Success or failure can depend on a single clinical trial result.

Investment via funds speads the risk and uses the expertise of the managers to select the winners

ETF: Major pharma companies - sales force strength

Top 10 Holdings (54.33% of Total Assets)

Company	% Assets
Johnson & Johnson Common Stock	10.41
Pfizer, Inc. Common Stock	7.50
Gilead Sciences, Inc.	5.77
Merck & Company, Inc. Common St	5.54
Allergan plc Ordinary Shares	4.84
Amgen Inc.	4.54
Bristol-Myers Squibb Company Co	4.17
UnitedHealth Group Incorporated	4.02
Medtronic plc. Ordinary Shares	3.97
AbbVie Inc. Common Stock	3.57



Portfolio of larger established companies

Managed by OrbiMed.

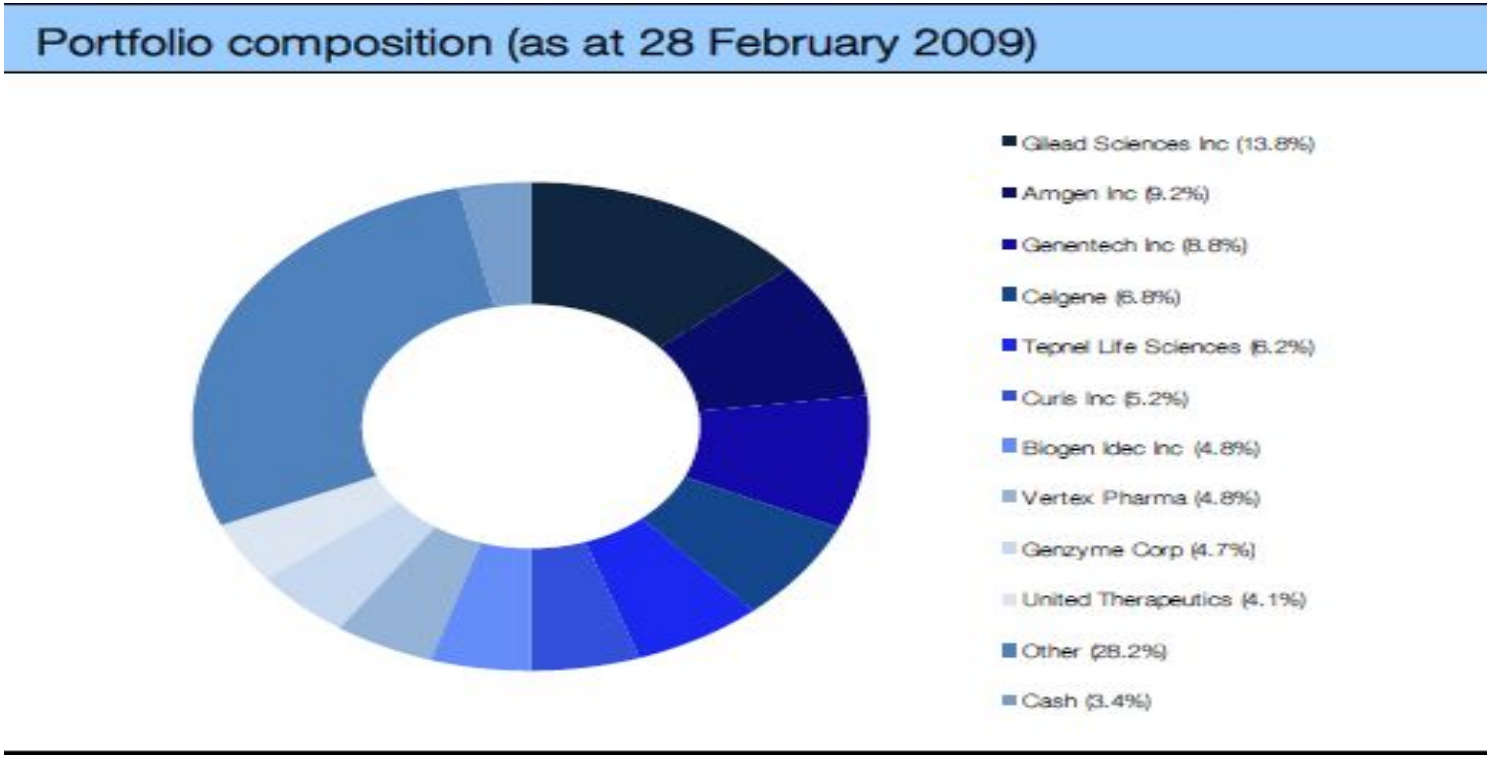
Broad healthcare remit:
- pharma
- medical devices
- services
- biotech.

Security	Weight
Novartis CHF50	6.49%
Bristol Myers Squibb	6.32%
HCA Holdings Inc / USD0.01	6.18%
Abbvie Inc Ordinary Shares USD 0.01	4.33%
Swaps	4.03%
Regeneron Pharmaceuticals Inc Common Stock	3.68%
Amgen Inc Ordinary US $ 0.01	3.54%
Biogen Inc USD	3.43%
Actelion Ltd CHF 0.50	3.25%
Boston Scientific Com Stk US $0.01	3.22%

Biotech Growth Fund (BIOG)
Focused on high-growth biotechs

Security	Weight
Biogen Inc USD	11.66%
Amgen Inc Ordinary US $ 0.01	10.59%
Gilead Sciences Inc Common Stock USD0.001	8.33%
Regeneron Pharmaceuticals Inc Common Stock	8.07%
Incyte Corp Com Stk USD0.001	8.03%
Alexion Pharmaceuticals USD0.0001	7.69%
Celgene Corp NPV	6.43%
GW Pharmaceuticals ADS Repr 12 Shares	5.38%
Illumina Inc Com Stk Usd0.01	5.18%
Bluebird Bio Inc USD0.01	3.75%

BIOG holdings that brought it through 2008 crash



IBT: Overlapping holdings with BIOG

Managed by SV Life Sciences

Security	Weight
Amgen Inc Ordinary US $ 0.01	7.32%
Celgene Corp NPV	7.25%
Biogen Inc USD	7.25%
Gilead Sciences Inc Common Stock USD0.001	7.12%
Aptiv Solutions	6.43%
Regeneron	5.09%
Alexion Pharmaceuticals USD0.0001	4.18%
Ophthotech	3.38%
Incyte Corp Com Stk USD0.001	3.35%
Onyx	3.34%

The Markets Now: 18 January, 2016
The Caledonian Club, 9 Halkin St, London SW1X 7DR

Digital transformation of our healthcare - and investment opportunities

Dr David Brown, PhD, FRSChem, FRSMed

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