

Impact of exponential technology on health care. Change of mindset is needed?

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Economic realities are driving significant changes in Healthcare

volume

value

Clinical and economic outcomes are driving the 'consumerization' of healthcare

response

prevention

Move from treating illness to *maintaining wellness* shifts focus to avoidance of injuries, complications and readmissions

episodic

continuous

Connecting everyone unlocks value in the rich, but highly disconnected islands of information

fast

instantly

Readily available comprehensive data, largely collected by the patient, creates a viable source for prediction, risk stratification and diagnosis

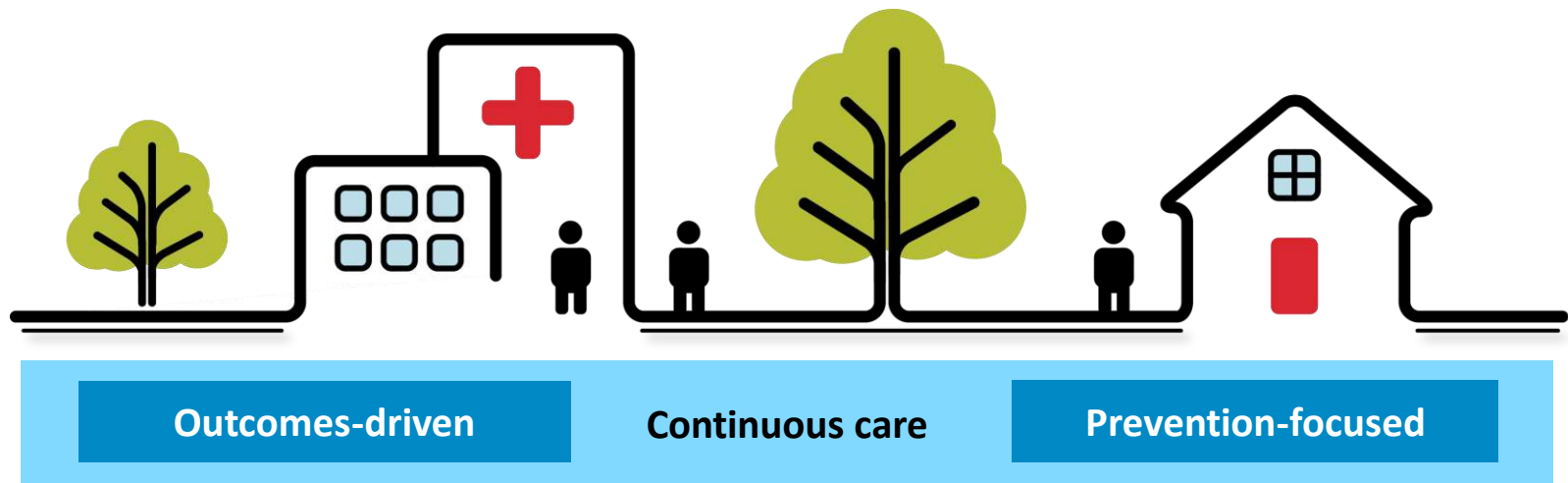
Let's start with the conclusions

- Hospitals will be smaller
 - Diagnostic and treatment 'satellites' connected electronically to hospitals
 - Self-diagnosis with more precision (sensors, artificial intelligence)
 - Physician will focus on severe cases and surgery
 - Ubiquitous IT will be the driver for change(s)
- Social networks, IoT and big data analytics are the foundation for deriving health patterns
- Patients want be in the driver seat
- Technological advances are essential to keep healthcare affordable
- Shift from disease care to health care

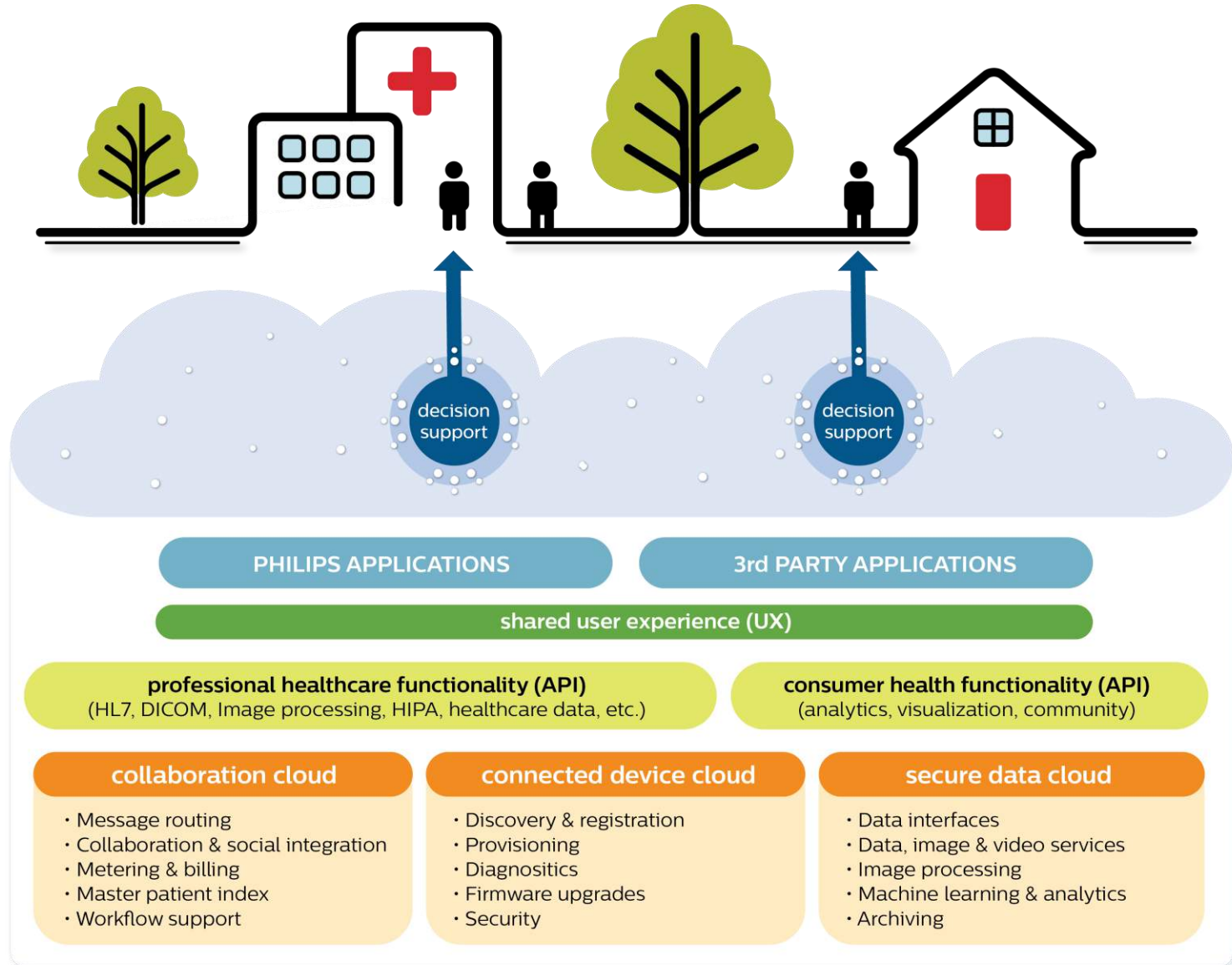
Transformation of healthcare

Professional healthcare delivery

Continuous personal health



Flexible, scalable and cost effective



Current directions

Exponential technology will (dramatically) impact the organization of healthcare

What does Exponential Technology mean?

Rapidly growing technological features which at the same time are becoming cheaper. Moore's law applies and when information is added to technique => law of acceleration returns applies

Are there examples?

Medical revolution driven by Artificial Intelligence (AI)
Sensors
3D-printing
Big data
Internet of Things (IoT)
Quantified Self
Genomics
Synthetic biology
Robotics
Stem cells

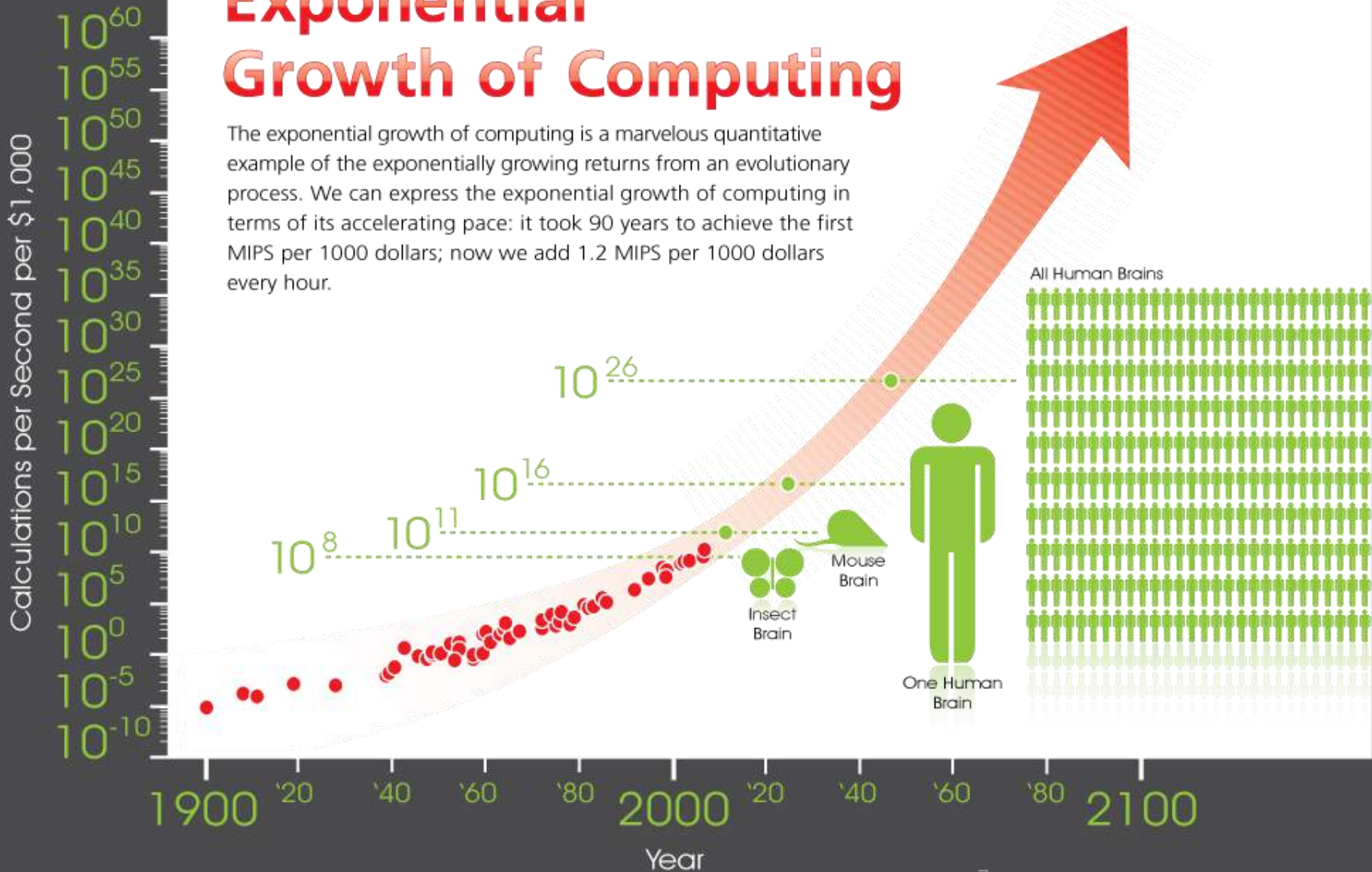
Who will be affected?

Healthcare providers
Healthcare consumers
Policy makers
Legal bodies
... *everyone*

Disruptive

Exponential Growth of Computing

The exponential growth of computing is a marvelous quantitative example of the exponentially growing returns from an evolutionary process. We can express the exponential growth of computing in terms of its accelerating pace: it took 90 years to achieve the first MIPS per 1000 dollars; now we add 1.2 MIPS per 1000 dollars every hour.



What does that mean: disruptive

The 6 D's according to P. Diamandis

Effect that we see, experience

1

Digitize

All technology that will digitize, add information to it

2

Deceptive

In the early stage small doublings => once it hits the knee you're 10 doublings away from a thousand, twenty doublings to reach a million; thirty doublings to get a billion

3

Disruptive

When this steep growth path is entered. Once disruptive it ...

4

Dematerialization

You don't have separated solutions (flashlight, GPS or camera,...)
Instead => apps on your smartphone

5

Demonetization

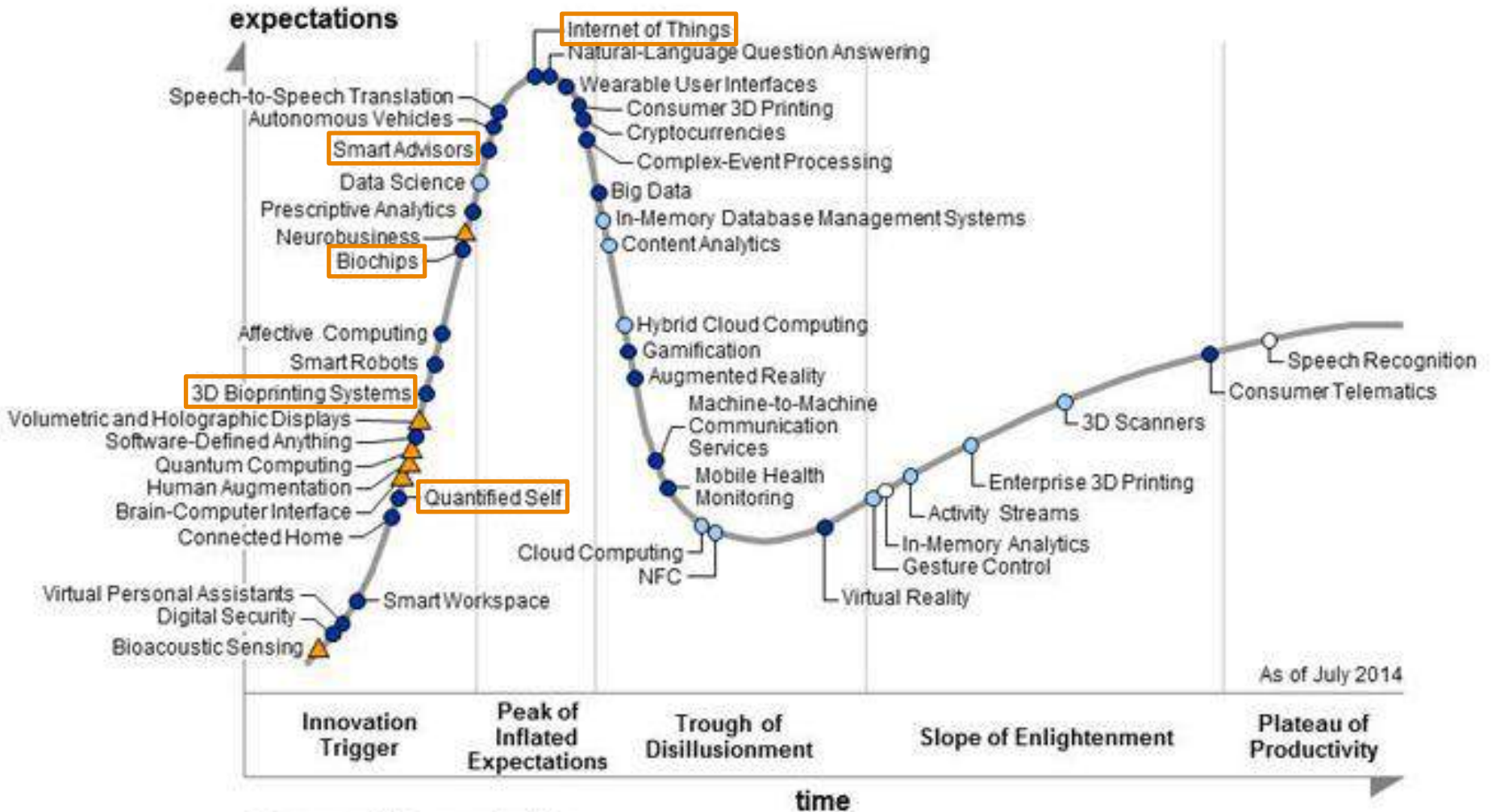
An existing product or service (Uber, Airbnb, Craigslist, etc)

6

Democratization

You can reach very quickly very large groups of people

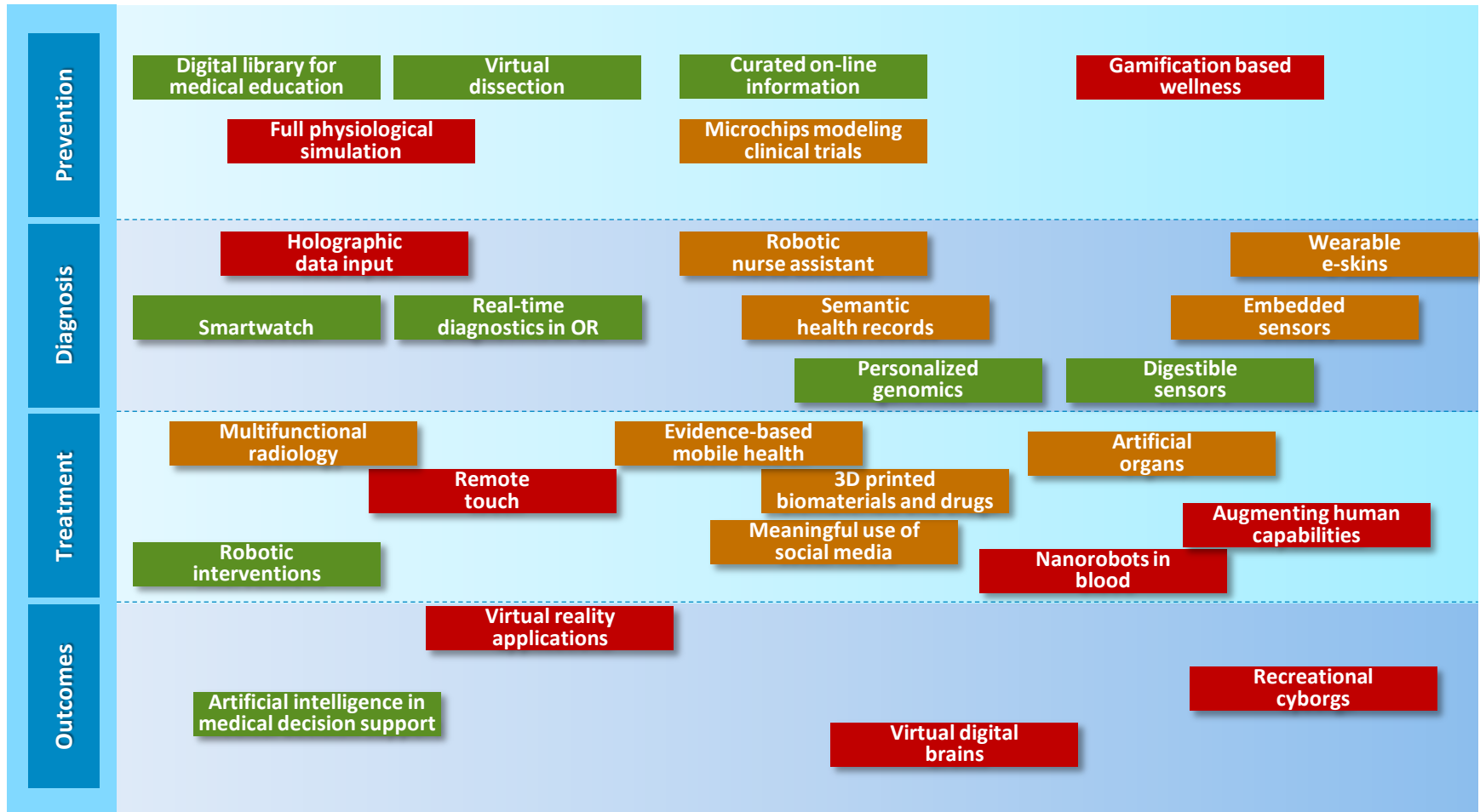
Hype cycle



Exponential growth

Professional healthcare delivery

Continuous personal health

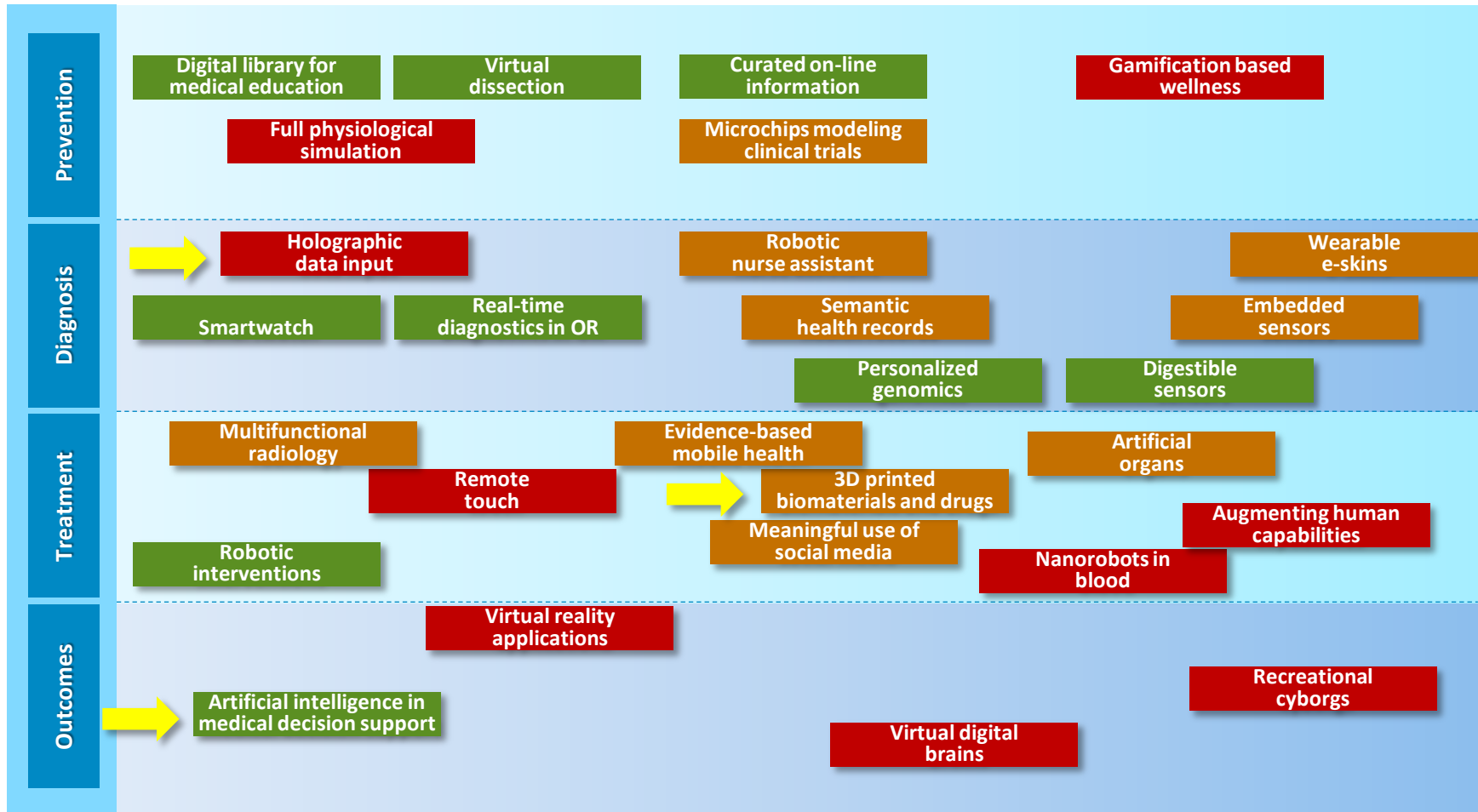


Already available
In progress
Still needs time

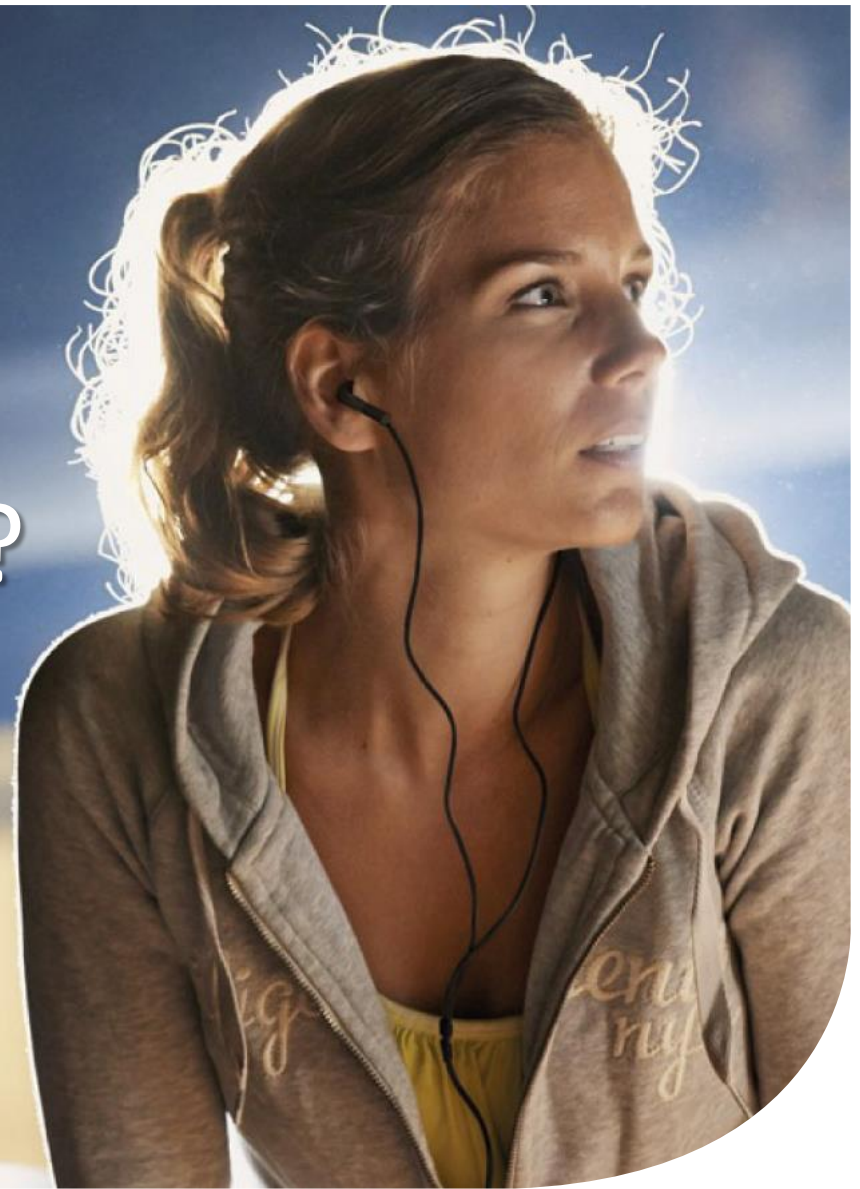
Exponential growth

Professional healthcare delivery

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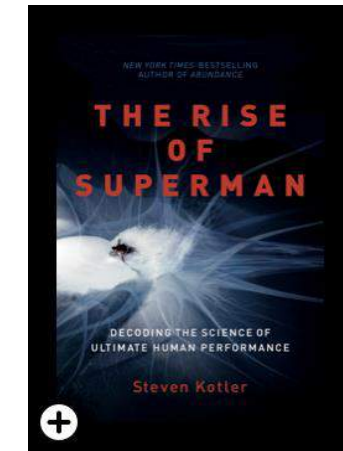
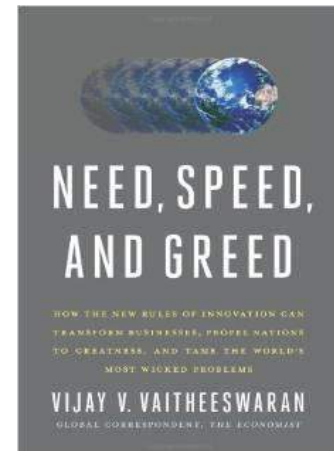
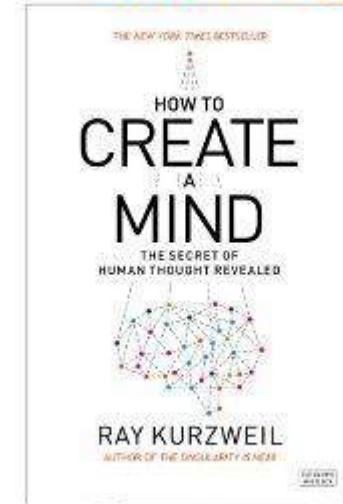
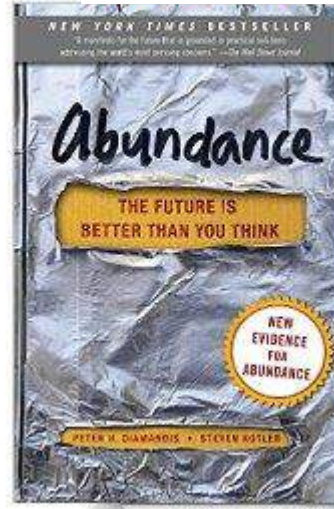
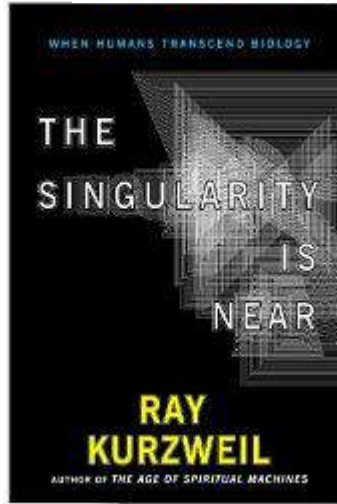


What's behind this?
And why now?

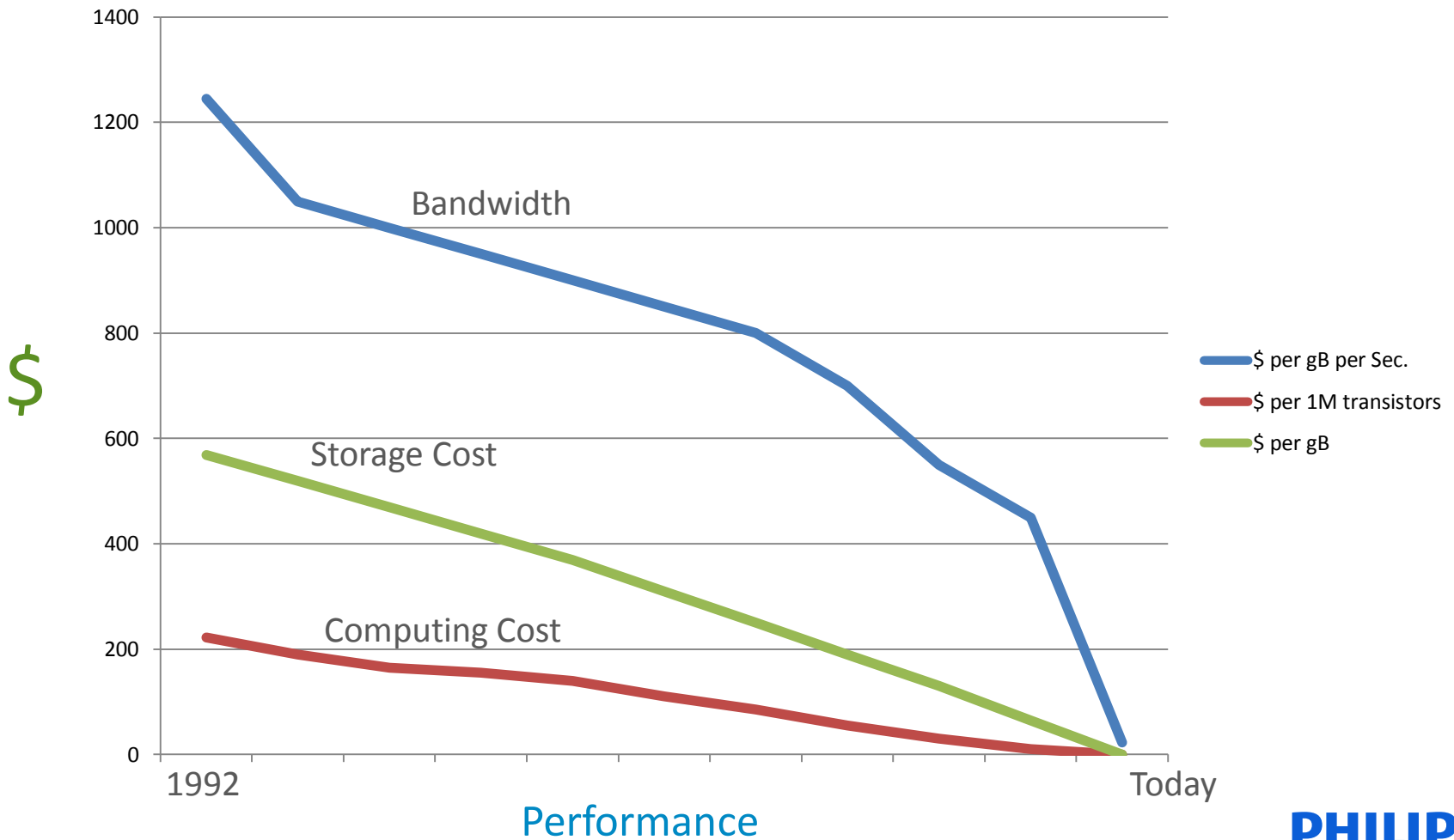


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Influential books



Exponential technological growth at reduced cost for performance



Quantified self.

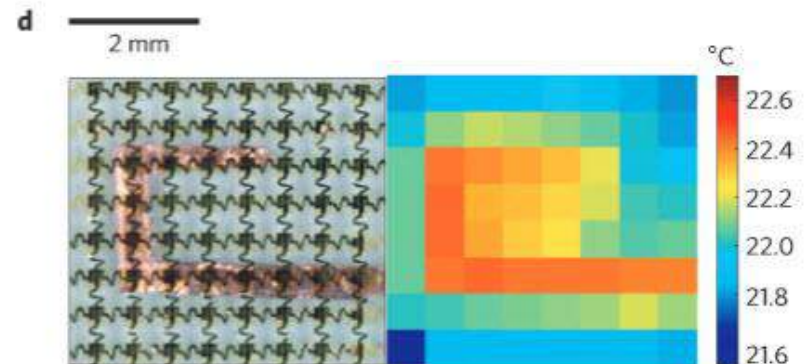
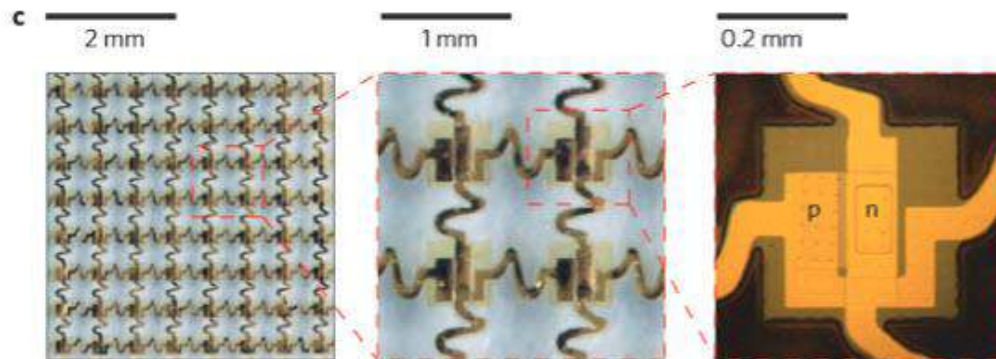
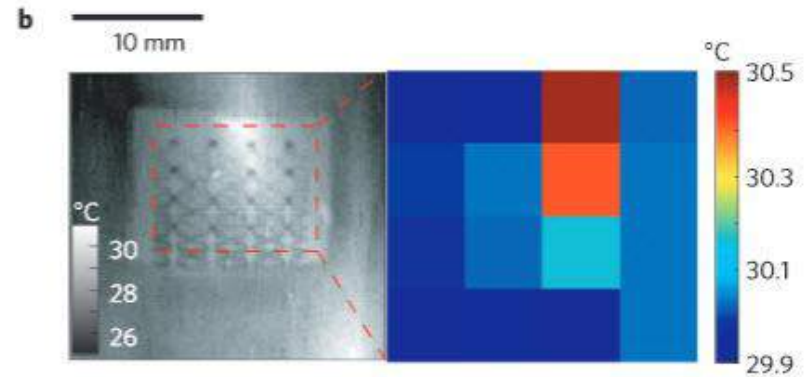
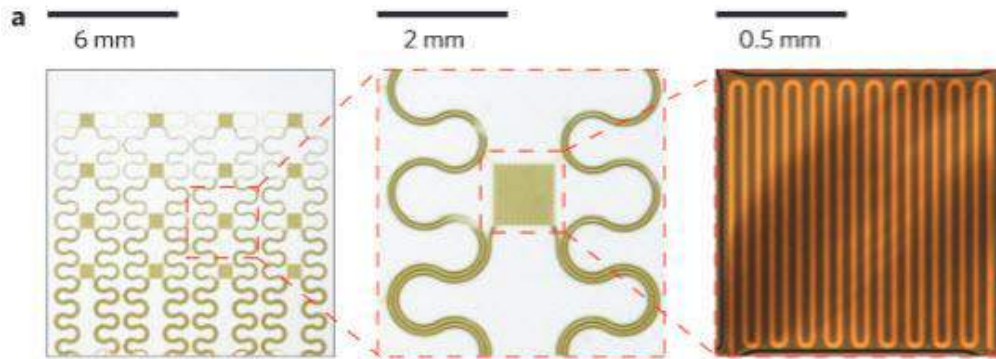
A powerful way to change behavior.



You are just a number

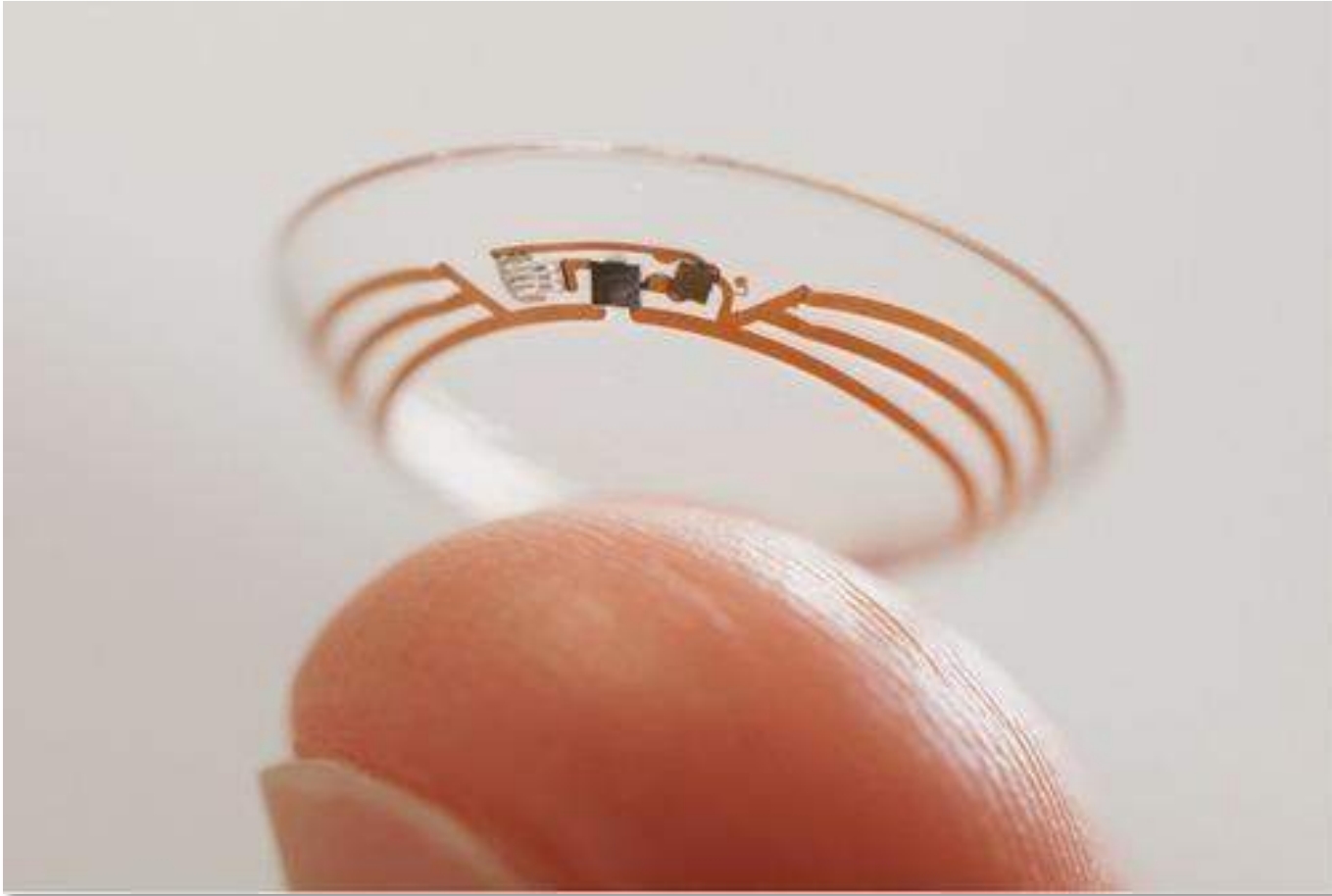


Ultrathin 'diagnostic skin' *allows continuous monitoring*



“Smart Contact Lens”

acquires all sorts of physiologic data

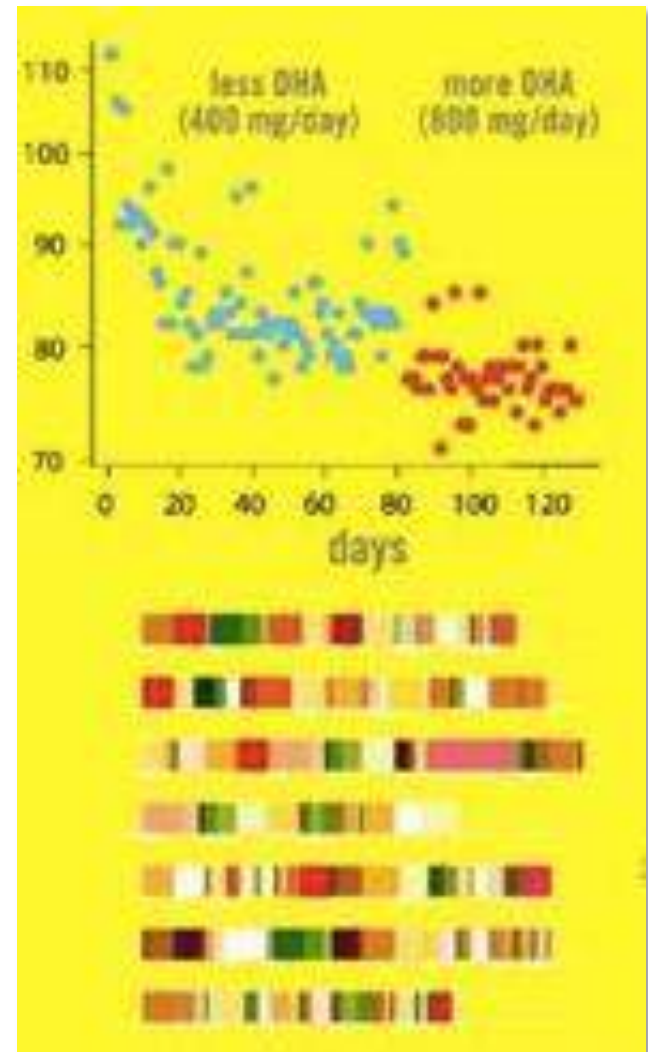


Data, data, data

- Collect data
- Share data
(we are our social network)
- Analyze data
- Find patterns
- Feed it to the “new” physician

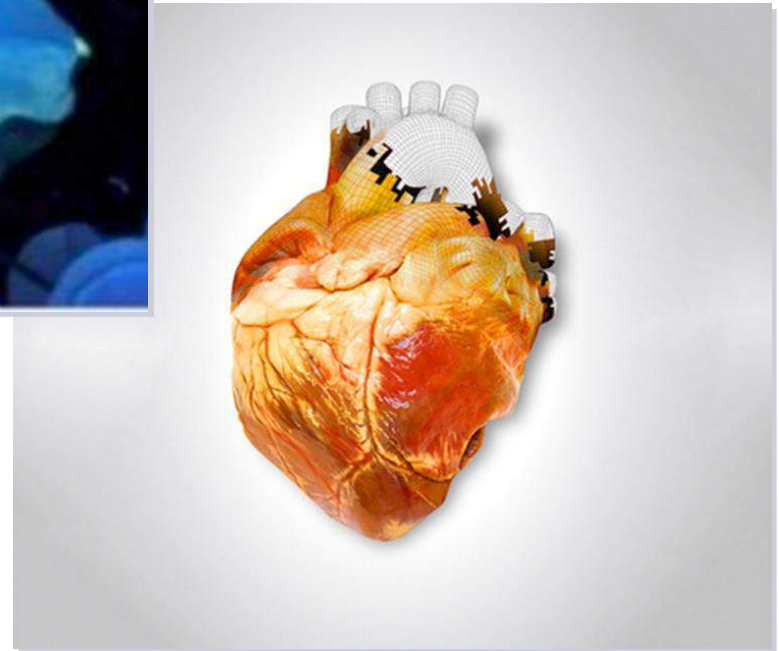
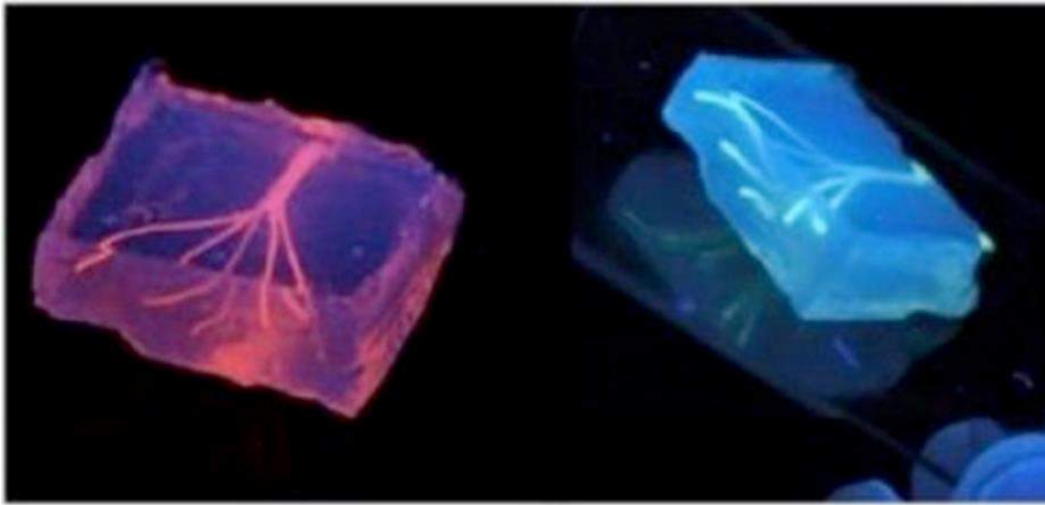
*People will contribute
their own private data*

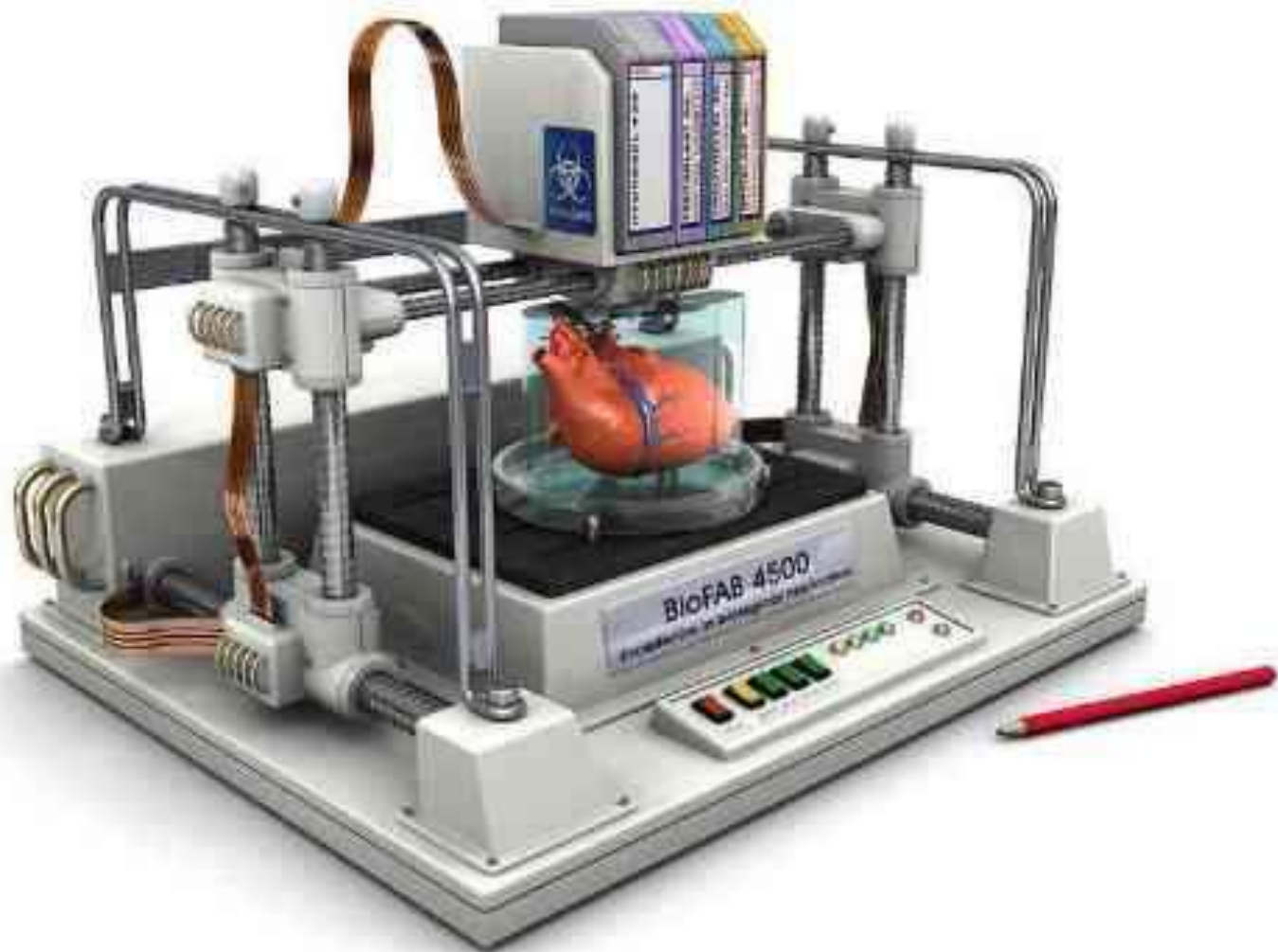
as long as they get value back

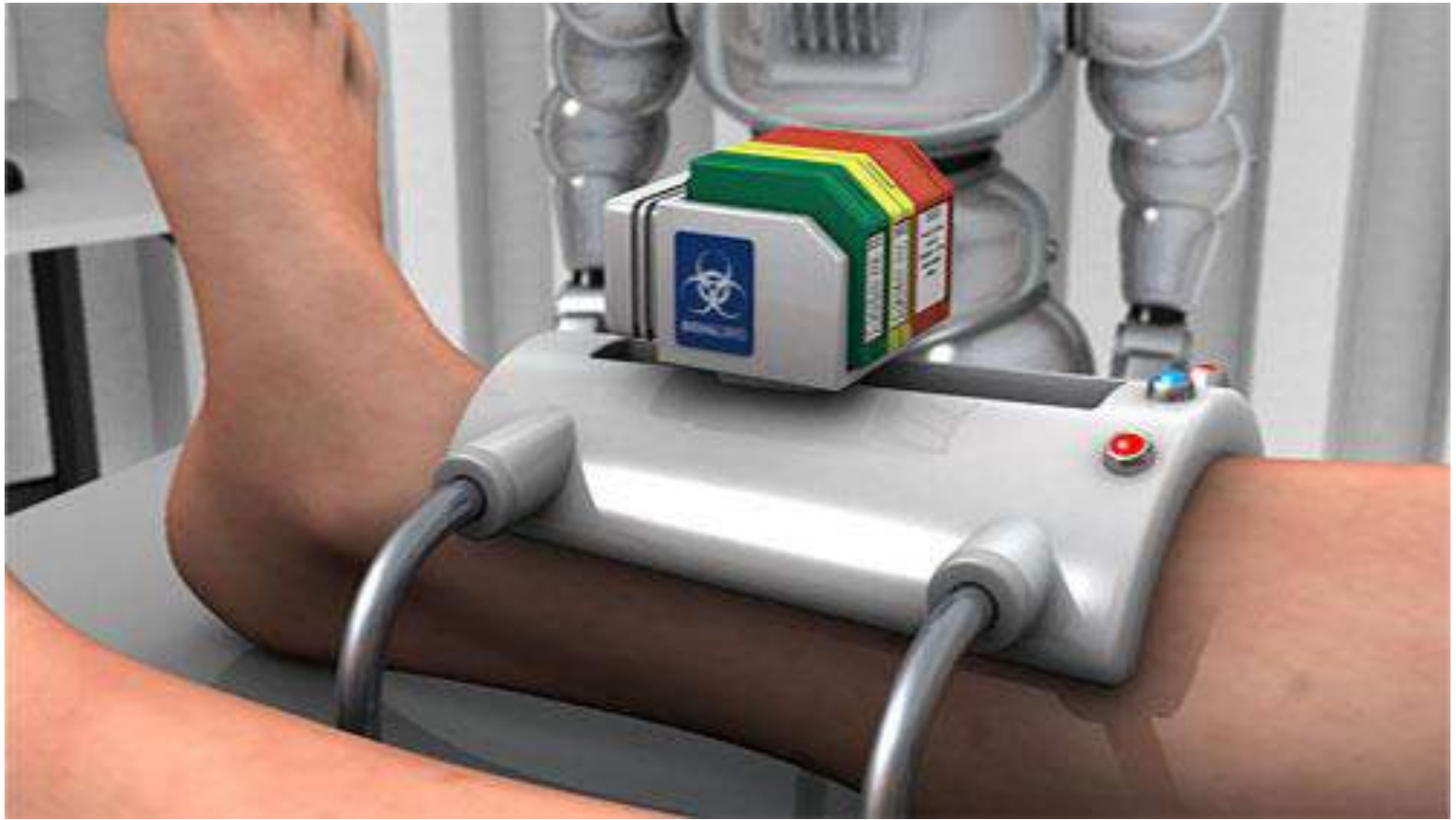


Waiting for a donor?

Let's (3-D) print it!









A young child, likely of South Asian descent, is the central focus of the image. They are wearing a light blue t-shirt with a colorful graphic on the front. The child is holding a glowing, multi-colored light stick high in their right hand, and their face is lit up with a joyful smile. The background is a dark night scene filled with out-of-focus bokeh lights in various colors, including blue, green, and yellow, suggesting a festive or fair setting. The overall mood is happy and celebratory.

A visit with Dr. Watson....

With thanks to Dr. N. Hekster, IBM

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Dr. Watson supports healthcare with:

Education

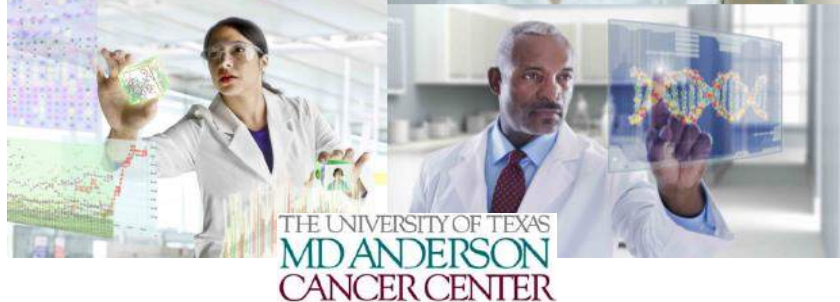


Payment

Clinical Practice



Research



What is Dr. Watson doing?

Understands **natural language** and human communication

Adapts and learns from choices and answers of his users

Generates and evaluates **founded hypotheses**



Based on unstructured information management architecture (UIMA), deep natural language processing (NLP), deep Quality Assurance (QA) of the data, hundreds of annotators, neural networks, and massively parallel processing (MPP)

Dr. Watson uses the *New England Journal of Medicine* for annotations of medical concepts

Disease

Symptoms

Time

Medication

Relations	Text	Entity Types / Roles
causeOf	1 Chamarthi, Bindu; Morris, Charles A.; Kaiser, Ursula B.; Katz, Joel T.; Loscalzo, Joseph	FAMILY-DISEASE
modifierOf	2 Stalking the Diagnosis	FAMILY-SUBSTANCE-ABUSE
negationOf	3 362/9/834	FINDING-BLOODPRESSURE
partOf	4 http://content.nejm.org/cgi/content/full/362/9/834	FINDING-GENERIC
remedyOf	<p>5 A 58-year-old woman presented to her primary care physician after several days of dizziness, anorexia, dry mouth, increased thirst, and frequent urination. She had also had a fever and reported that food would "get stuck" when she was swallowing. She reported no pain in her abdomen, back, or flank and no cough, shortness of breath, diarrhea, or dysuria. Her history was notable for cutaneous lupus, hyperlipidemia, osteoporosis, frequent urinary tract infections, three uncomplicated cesarean sections, a left oophorectomy for a benign cyst, and primary hypothyroidism, which had been diagnosed a year earlier. Her medications were levothyroxine, hydroxychloroquine, pravastatin, and alendronate. She lived with her husband and had three healthy adult children. She had a 20-pack year history of smoking but had quit 3 weeks before presentation. She reported no alcohol or drug abuse and no exposure to tuberculosis. Her family history included oral and bladder cancer in her mother, Graves' disease in two sisters, hemochromatosis in one sister, and idiopathic thrombocytopenic purpura in one sister.</p>	FINDING-HEARTRATE
resultOf		FINDING-HEIGHT
		FINDING-OXYGEN-SATURATIO
		FINDING-RESPIRATORYRATE
		FINDING-TEMPERATURE
	FINDING-WEIGHT	
	MODIFIER-ANATOMY	
	MODIFIER-GENERIC	
	MODIFIER-NEGATION	
	MODIFIER-TIME	
	PATIENT-ACTIVITY-EVENT	
	PATIENT-AGE	
	PATIENT-ALLERGY	
	PATIENT-FEMALE	
	PATIENT-HAZARD-EXPOSURE	
	PATIENT-HEALTHSTATE	
	PATIENT-LOCATION	
	PATIENT-MALE	
	PATIENT-NAME	
	PATIENT-OCCUPATION	

IBM's Oncology Diagnosis & Treatment Advisor

Shows how Watson assists an oncologist when:

- **Correlates scattered data**
EMR's, summaries, test results, pathology reports, etc.
- **Suggests additional diagnostics**
- **Provides evidence-based treatment options**



A photograph of two surgeons in a blue sterile environment, wearing blue scrubs and surgical masks. They are looking at a large monitor displaying a 3D anatomical model of a patient's internal organs. The text "Augmented reality?" is overlaid in white on the image. In the foreground, a control panel with a touch screen is visible, showing various buttons and a small display. The background shows other medical equipment and a patient lying on a table.

Augmented reality?

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Google Glass in the Operating Room

Presents vital signs & EMR data to the surgeon directly



UMC-St. Radboud

Already a commodity?

Robotic healthcare provider

Technology closer to the patient

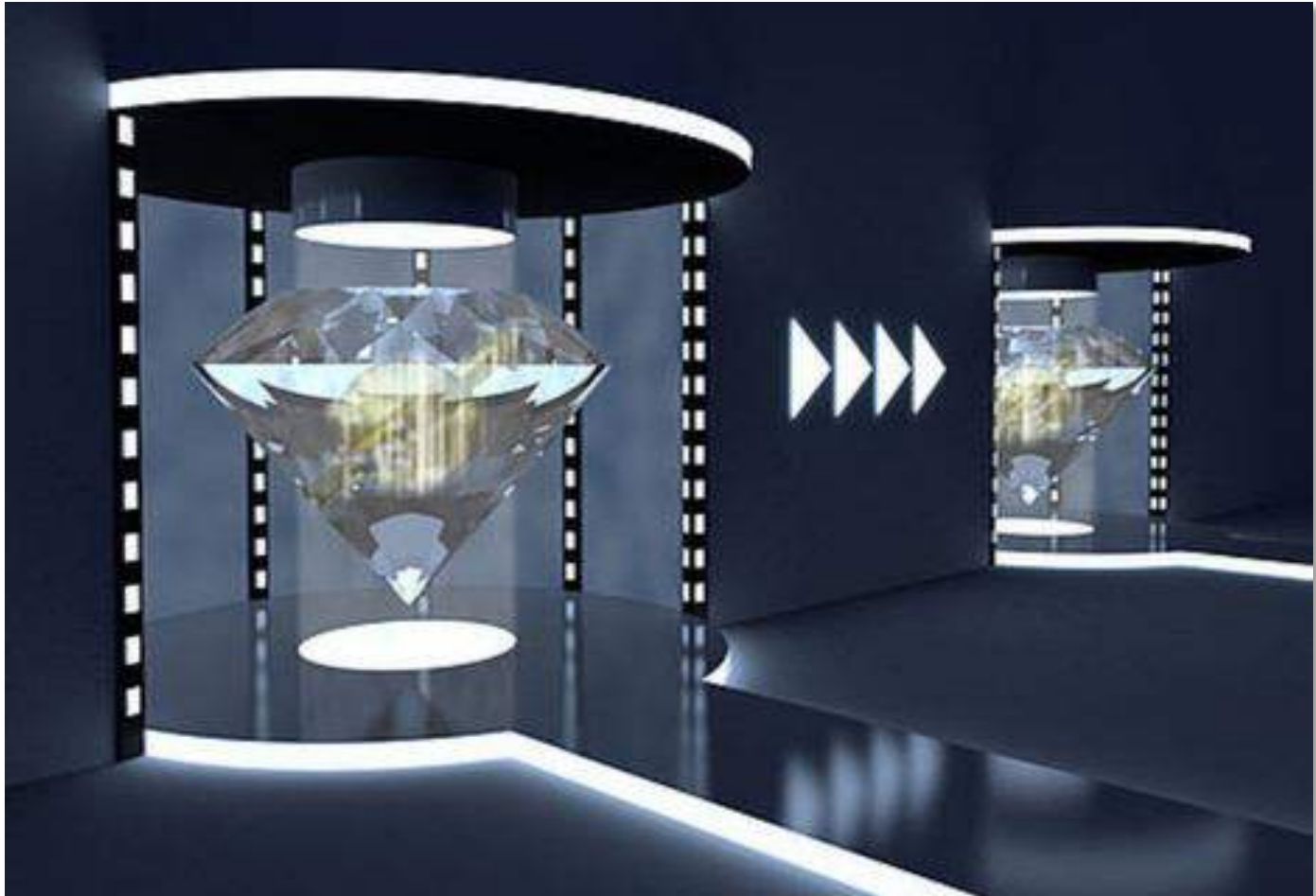


TU – Eindhoven

the new physician, nurse ...?

“Beam me up”

Experiments with teleporting of experts



TU - Delft

The new OR advisor?

Conclusions

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