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

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Economic realities are driving significant changes in Healthcare

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

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

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

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

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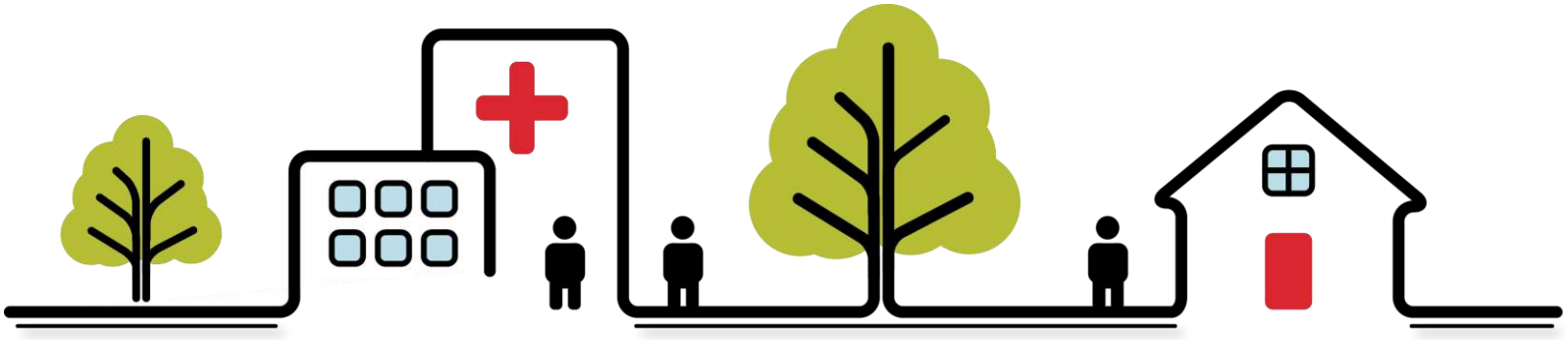
Transformation of healthcare

Professional healthcare delivery

Continuous personal health



Outcomes-driven | **Continuous care** | **Prevention-focused**

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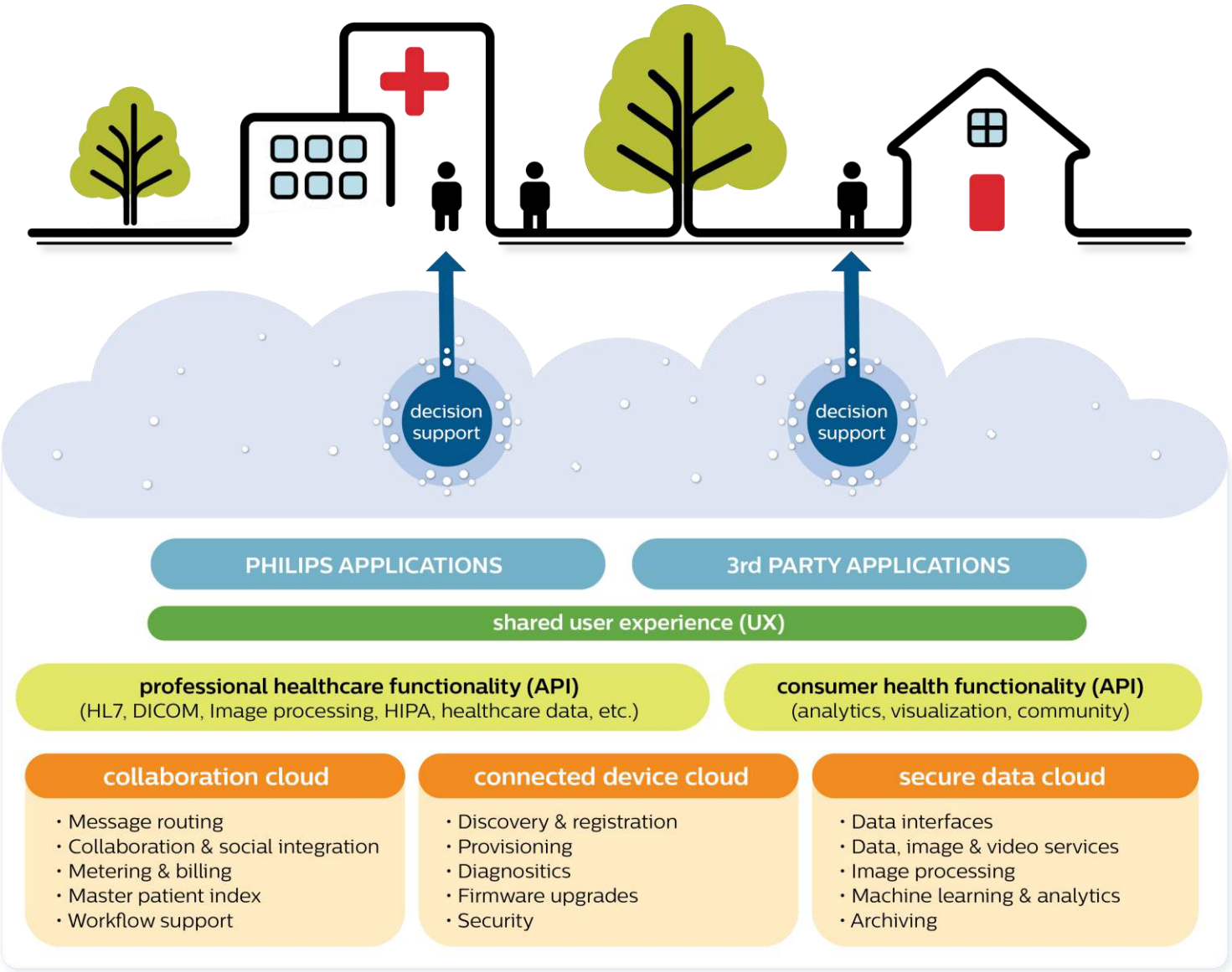
Flexible, scalable and cost effective



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

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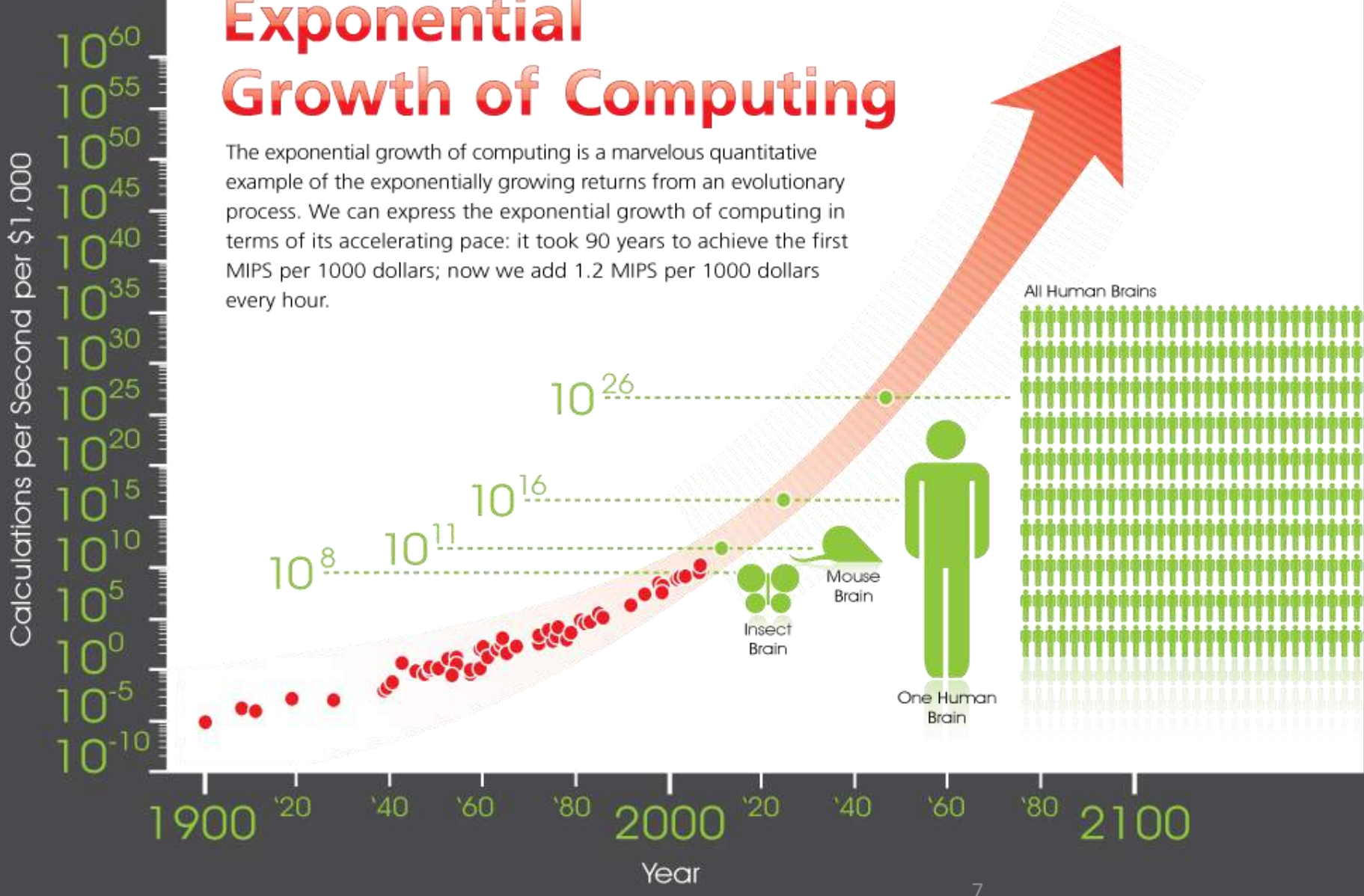
Exponential Growth of Computing

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.



Source: Ray Kurzweil and KurzweilAI.net

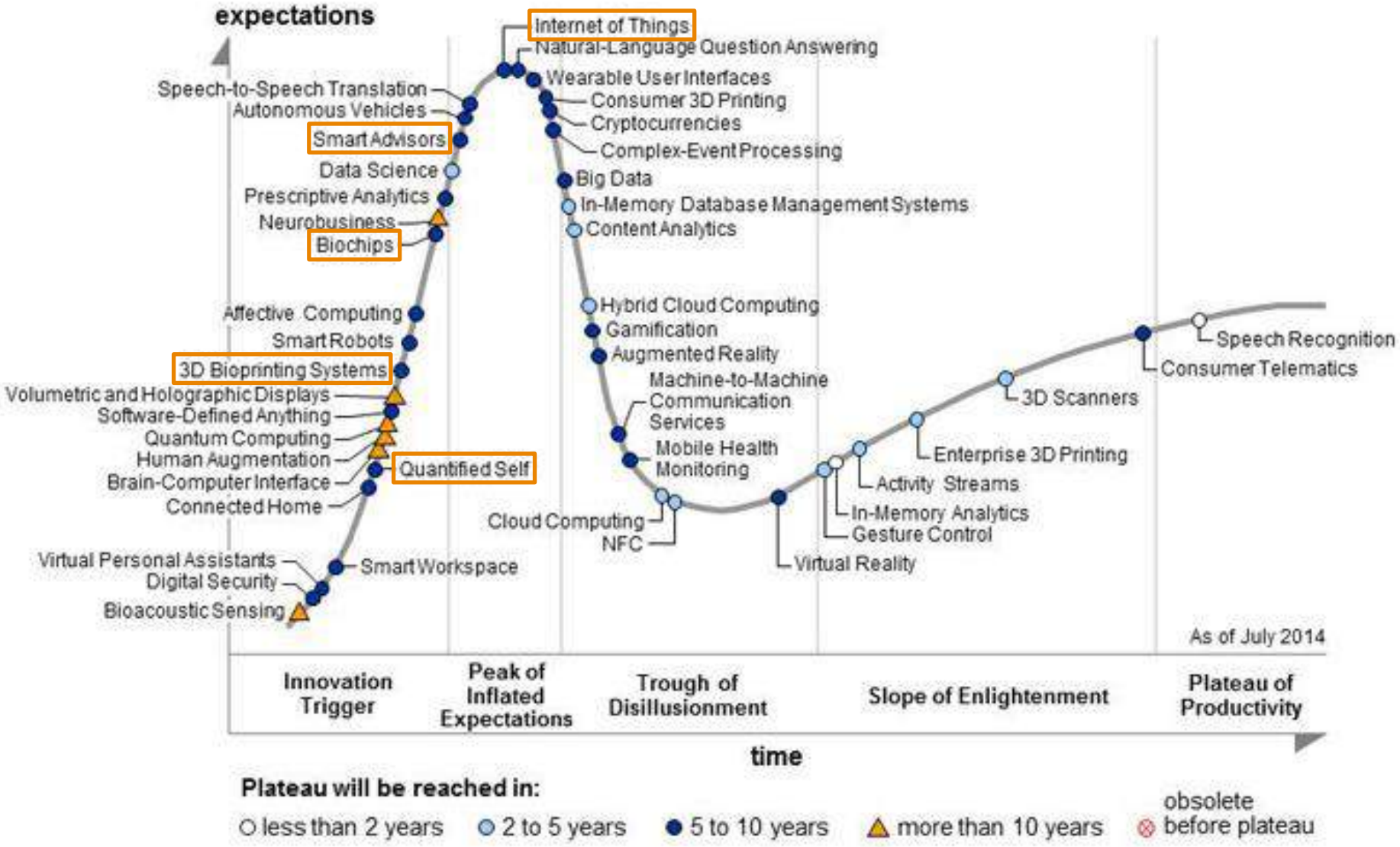
What does that mean: disruptive

The 6 D's according to P. Diamandis

Effect that we see, experience

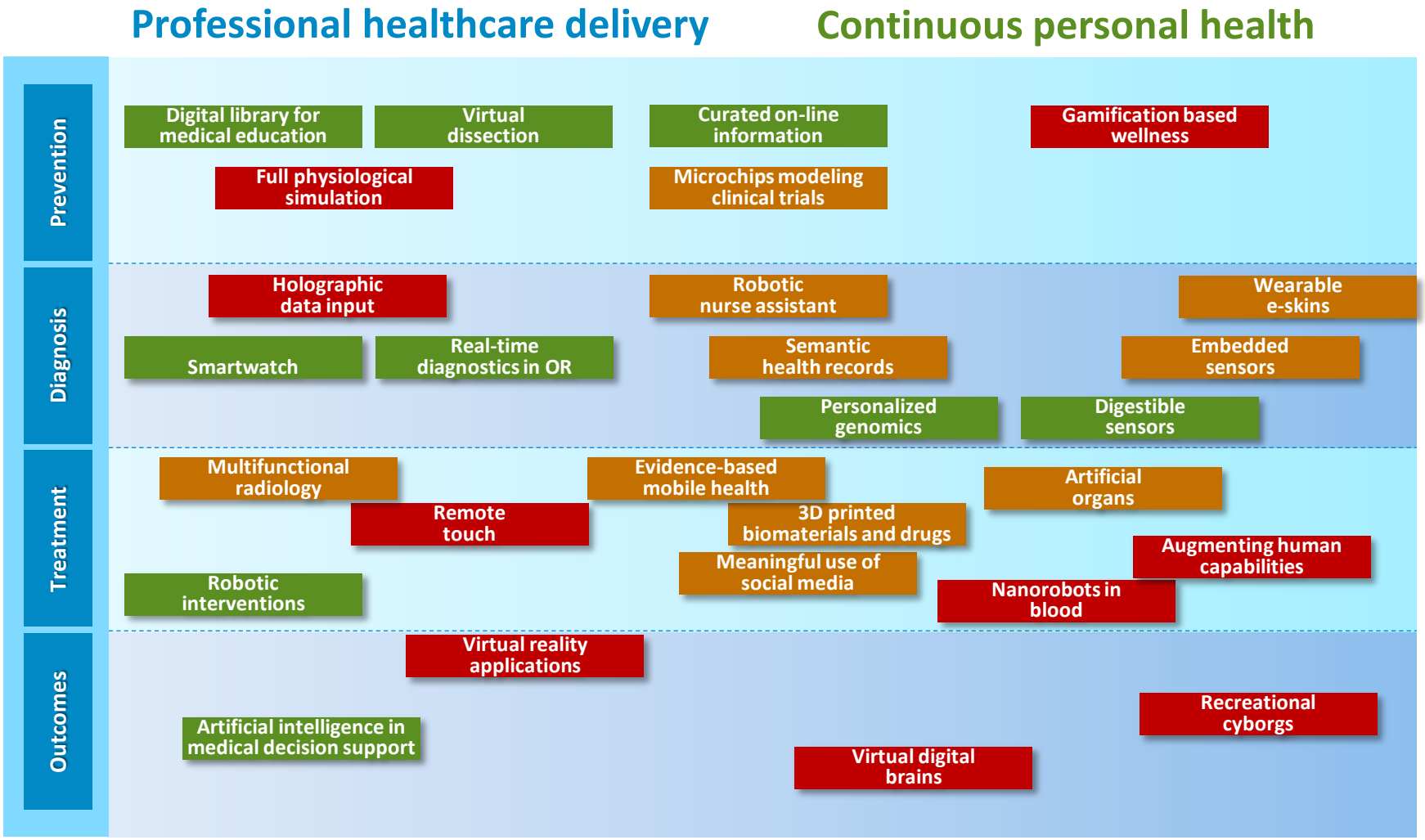
1 **Digitize**	All technology that will digitize, add information to it
2 **Deceptive**	In the early stage small doublings => once it hits the knee you're 10 doublings away from a thousand, twenty doublings to reach a million; thirty doublings to get a billion
3 **Disruptive**	When this steep growth 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, Craiglist, etc)
6 **Democratization**	You can reach very quickly very large groups of people

Hype cycle



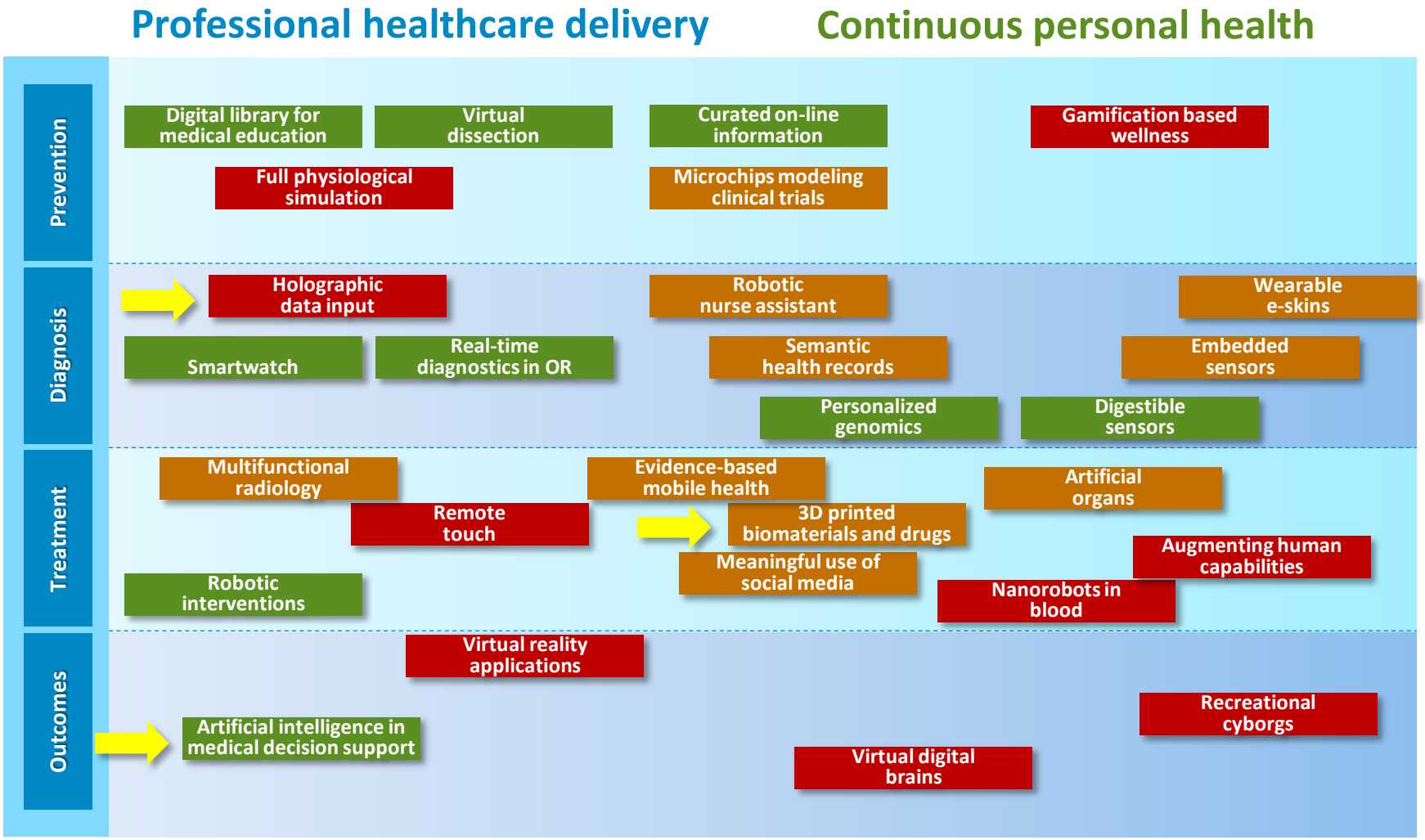
Source: Gartner, 2014

Exponential growth



Source: Instagram by Bertalan Meskó, MD, PhD

Exponential growth



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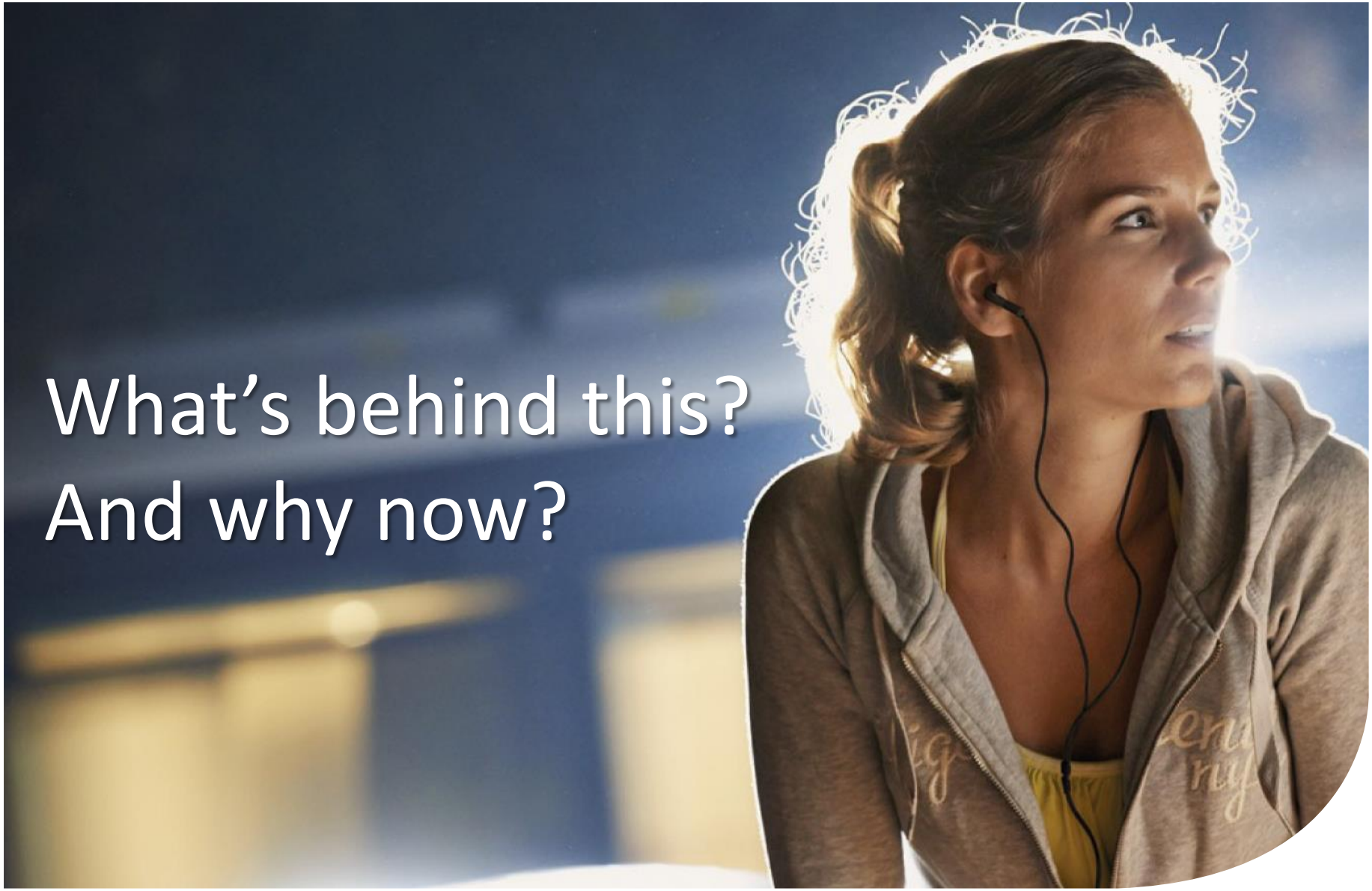

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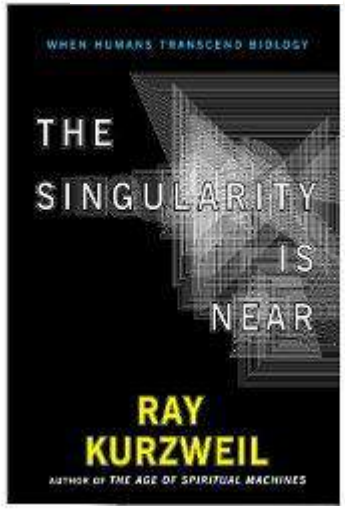
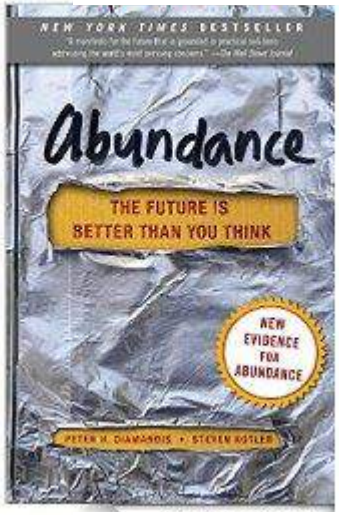
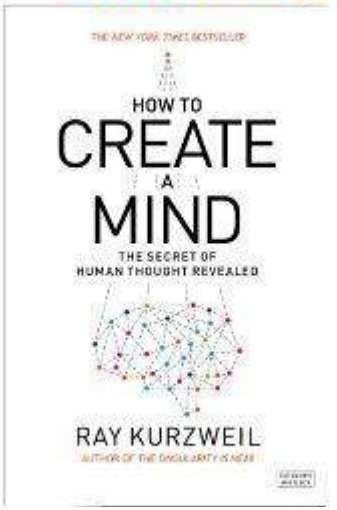
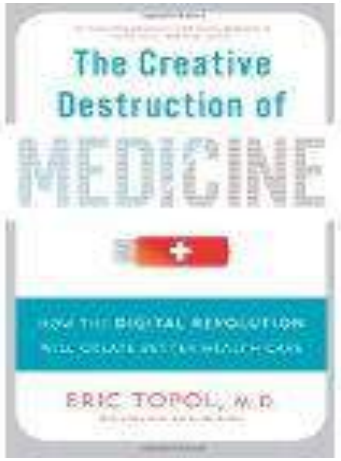
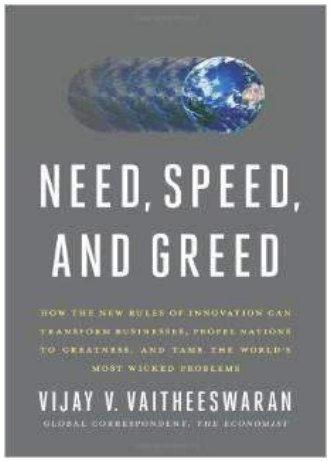
Influential books

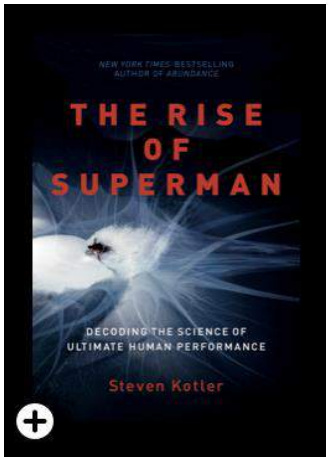












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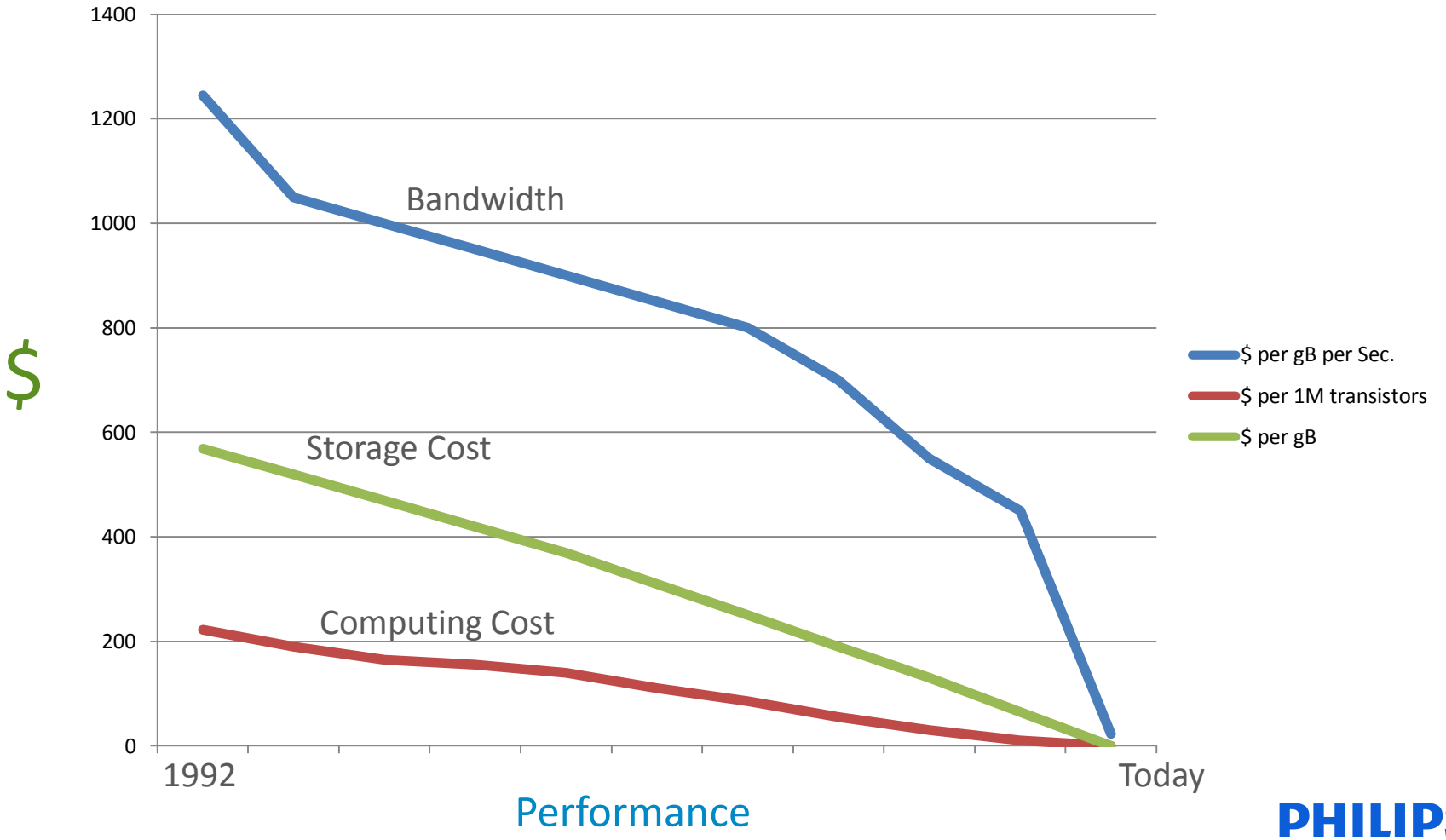
Exponential technological growth

at reduced cost for performance



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Quantified self.

A powerful way to change behavior.

Source: David Hargreaves, Quantified Self promoter

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You are just a number

Source: Tim Chester, Digital writer

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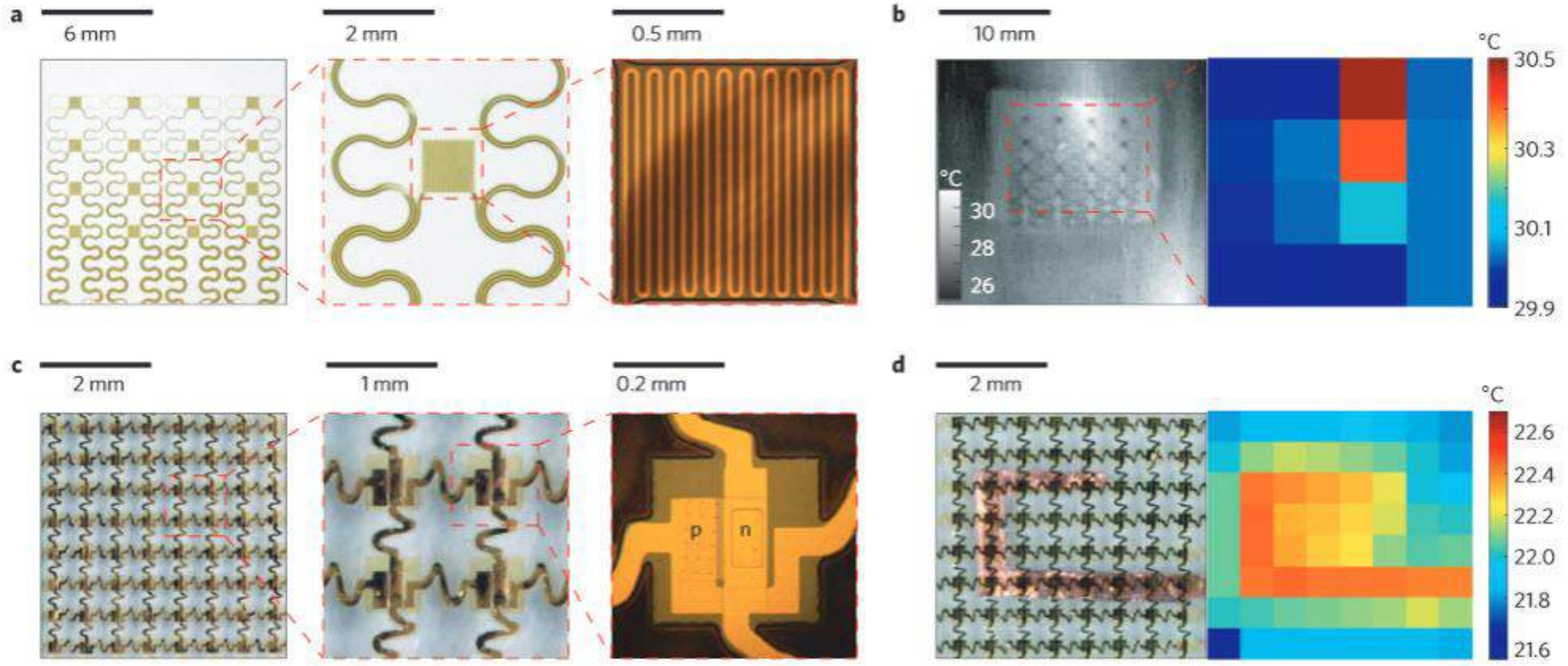
Ultrathin ‘diagnostic skin’

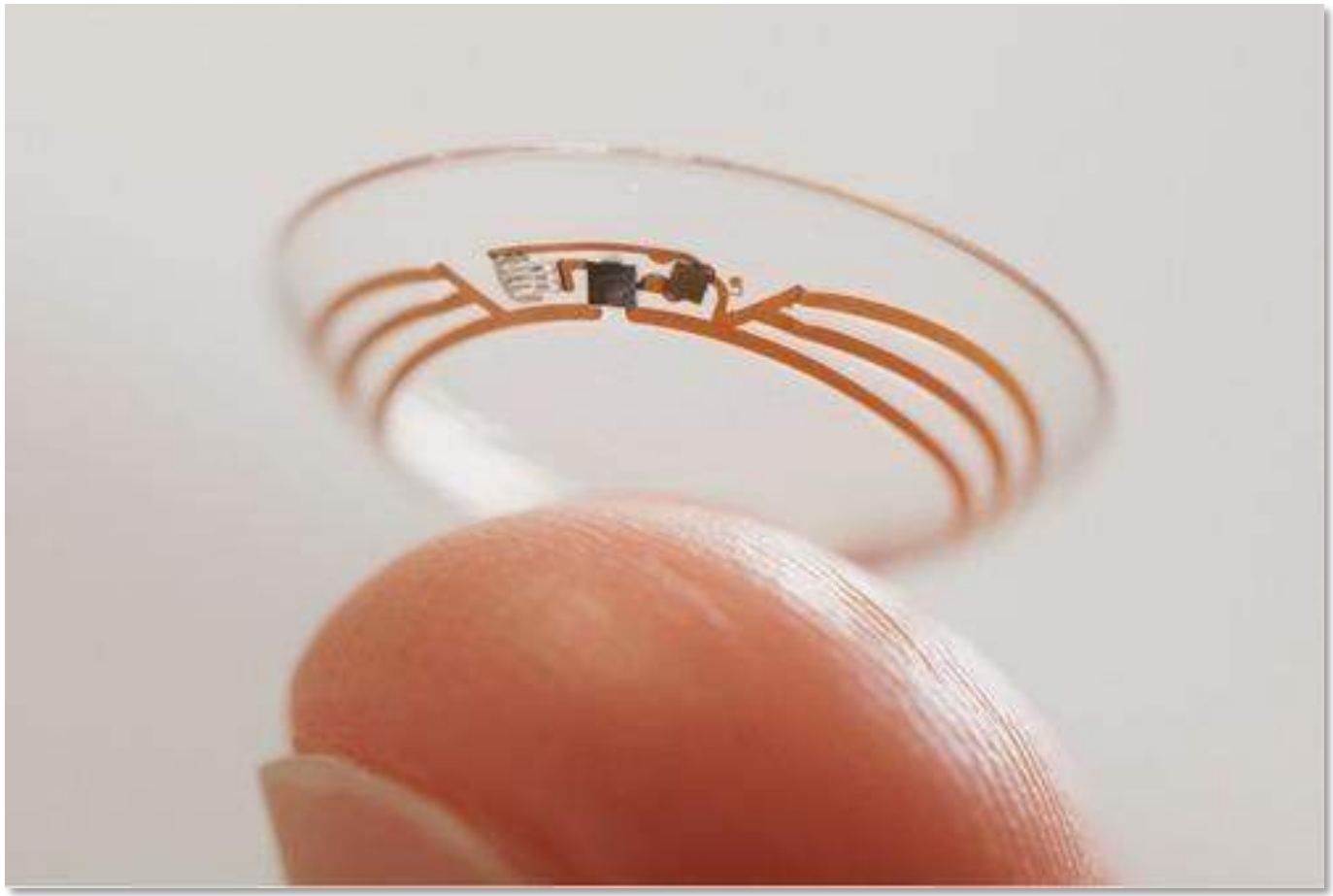
allows continuous monitoring



Source: R. Chad Webb et al., Natural Materials

“Smart Contact Lens”

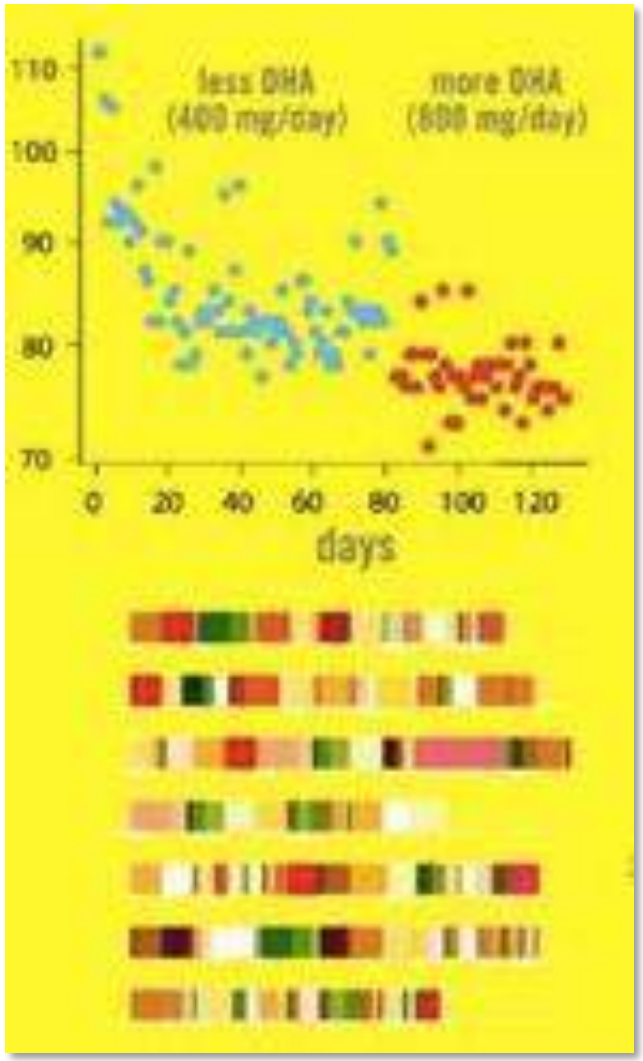
acquires all sorts of physiologic data



Google

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

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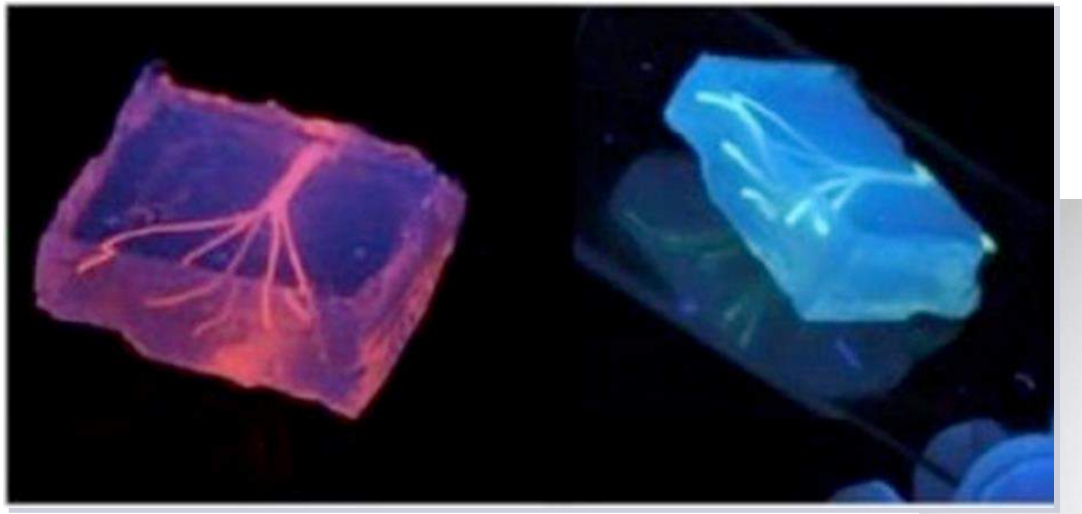
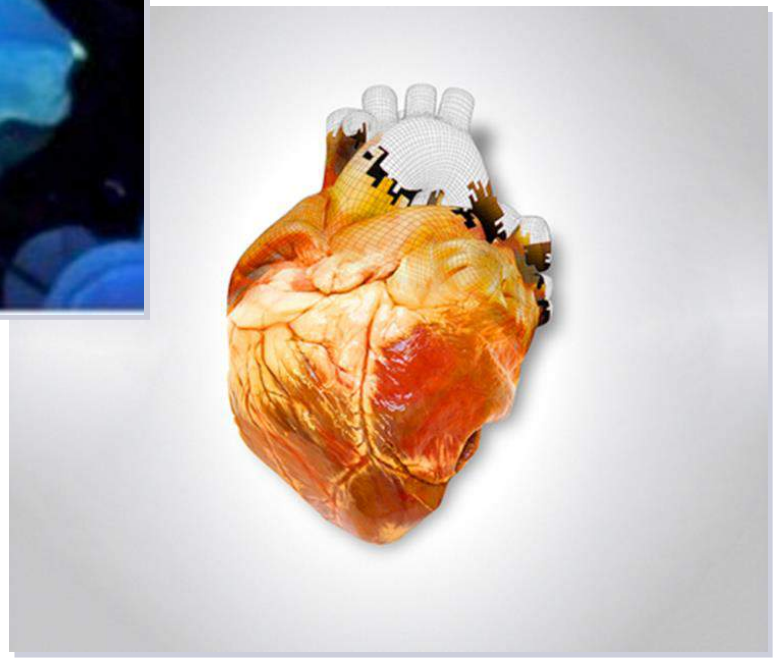
Waiting for a donor?

Let's (3-D) print it!





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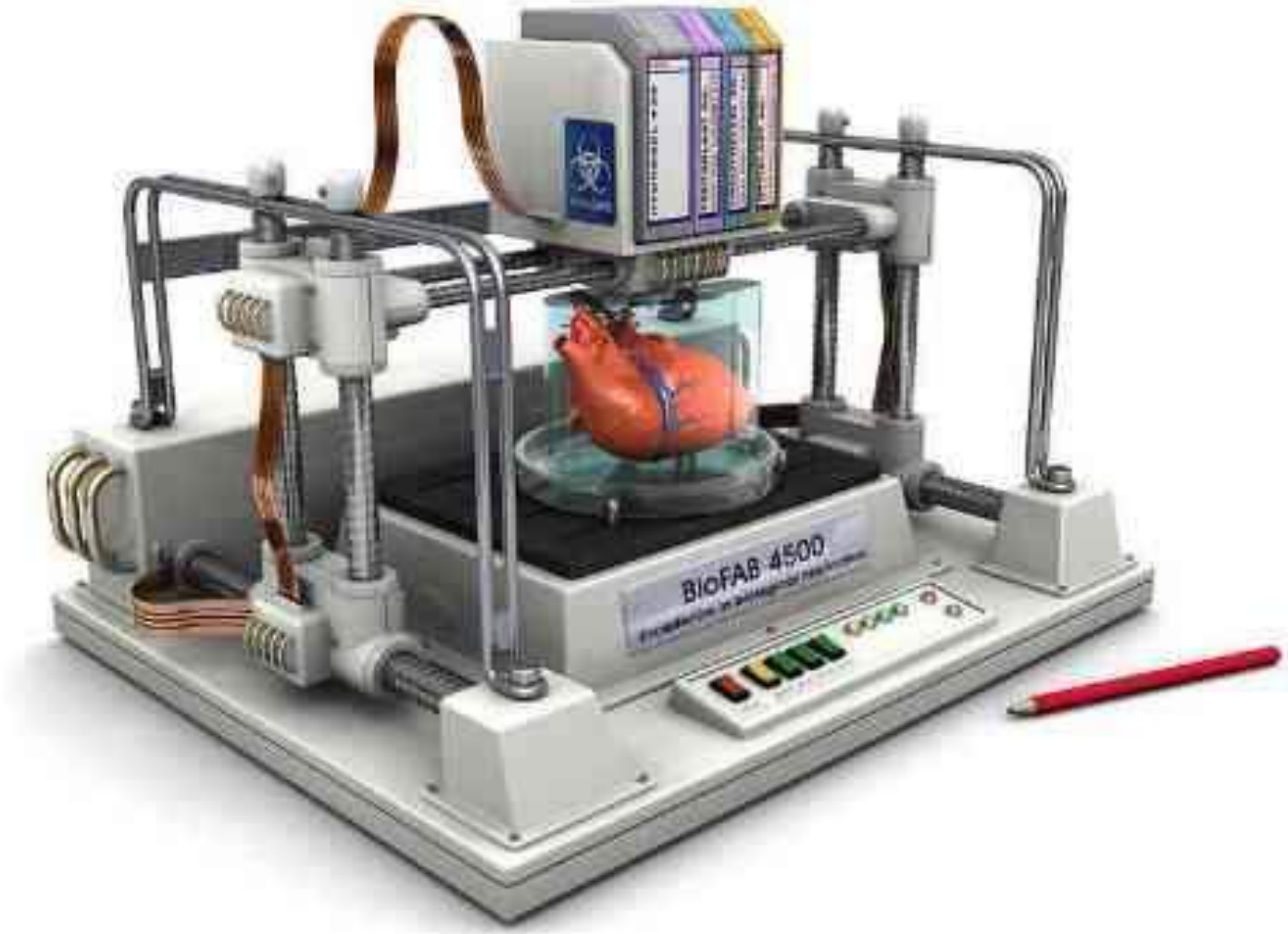
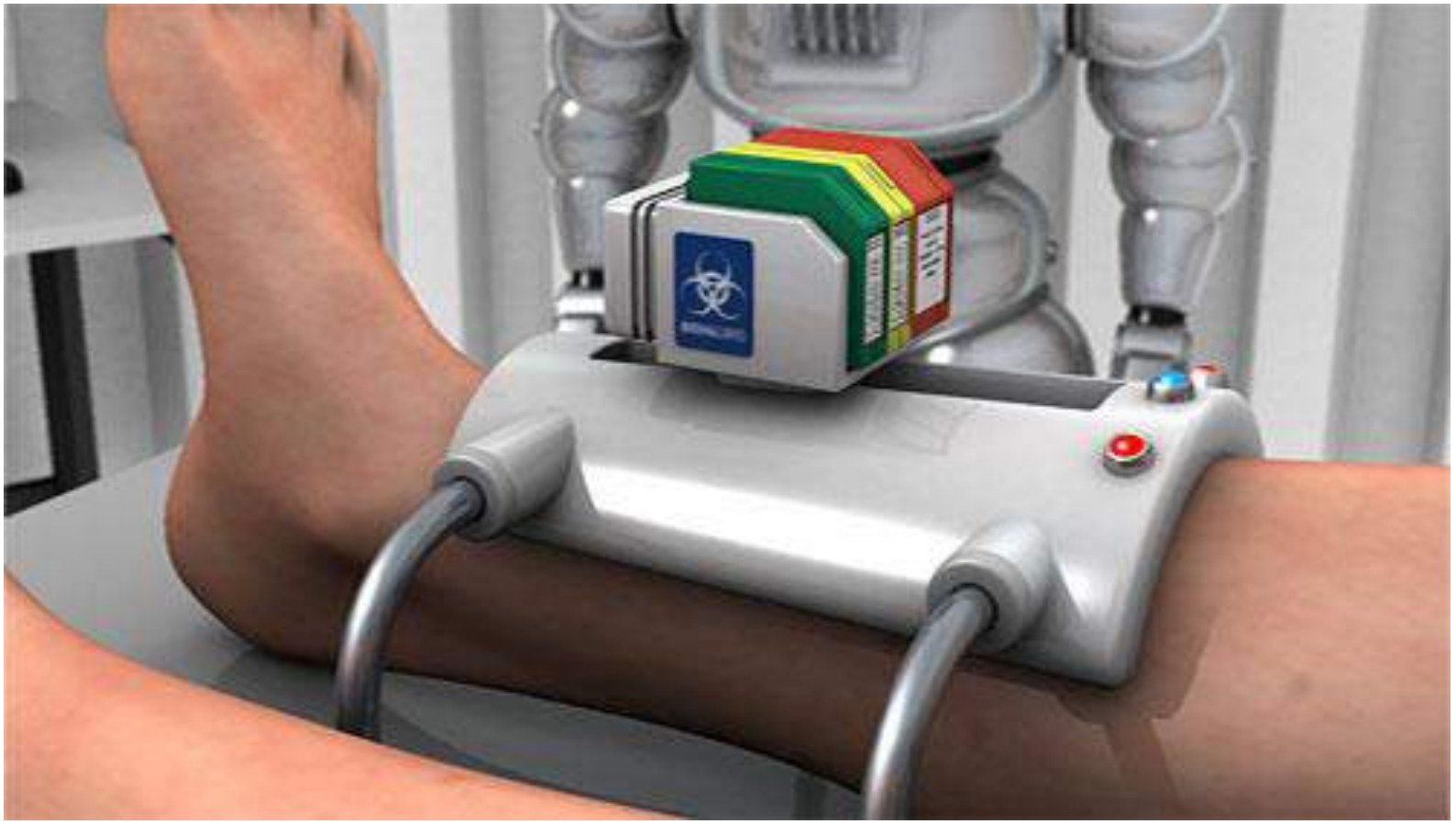
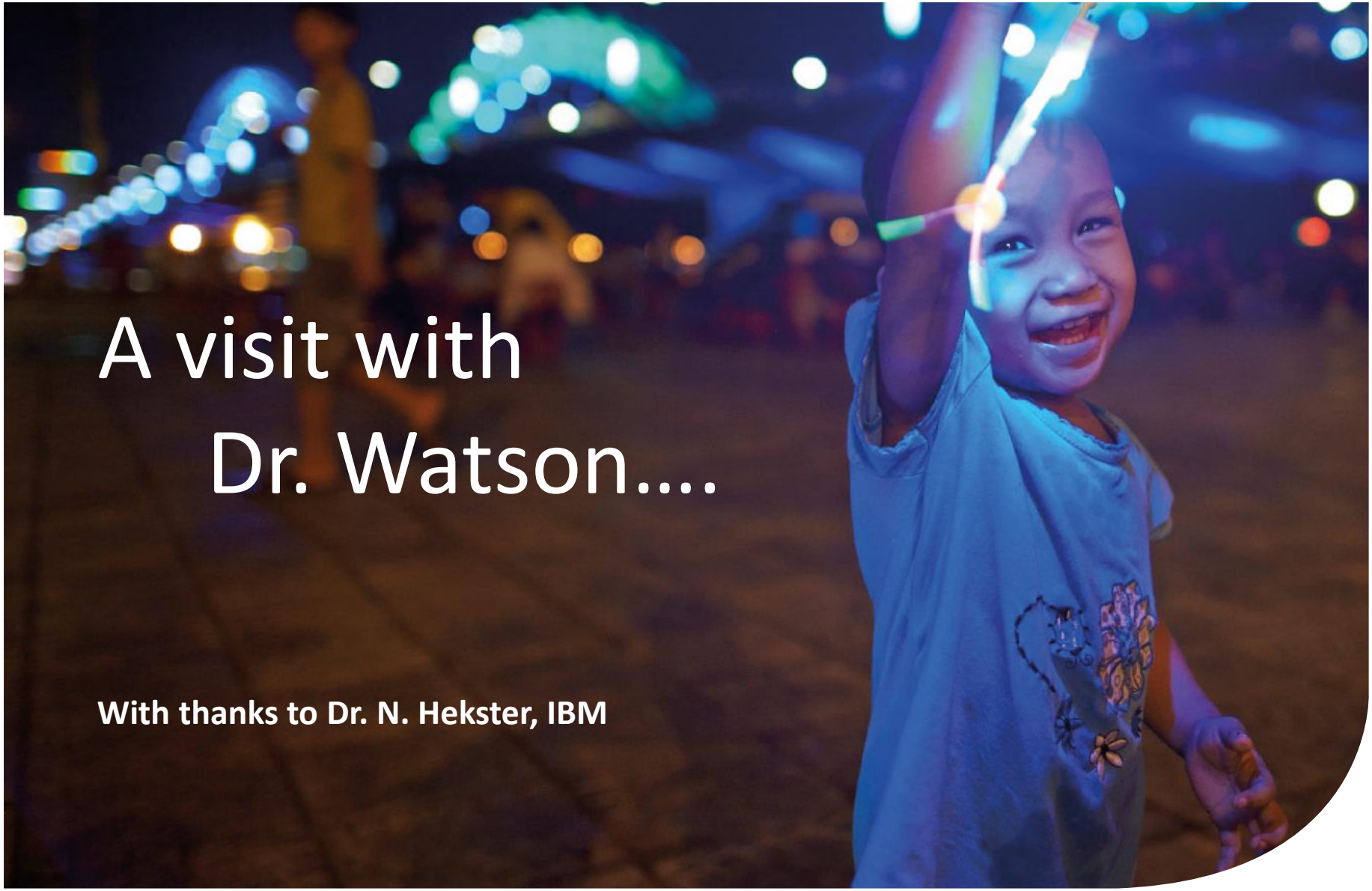

BioFAB 4500





A visit with Dr. Watson….

With thanks to Dr. N. Hekster, IBM

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Dr. Watson supports healthcare with:

Education

Clinical Practice

Research

Payment

What is Dr. Watson doing?

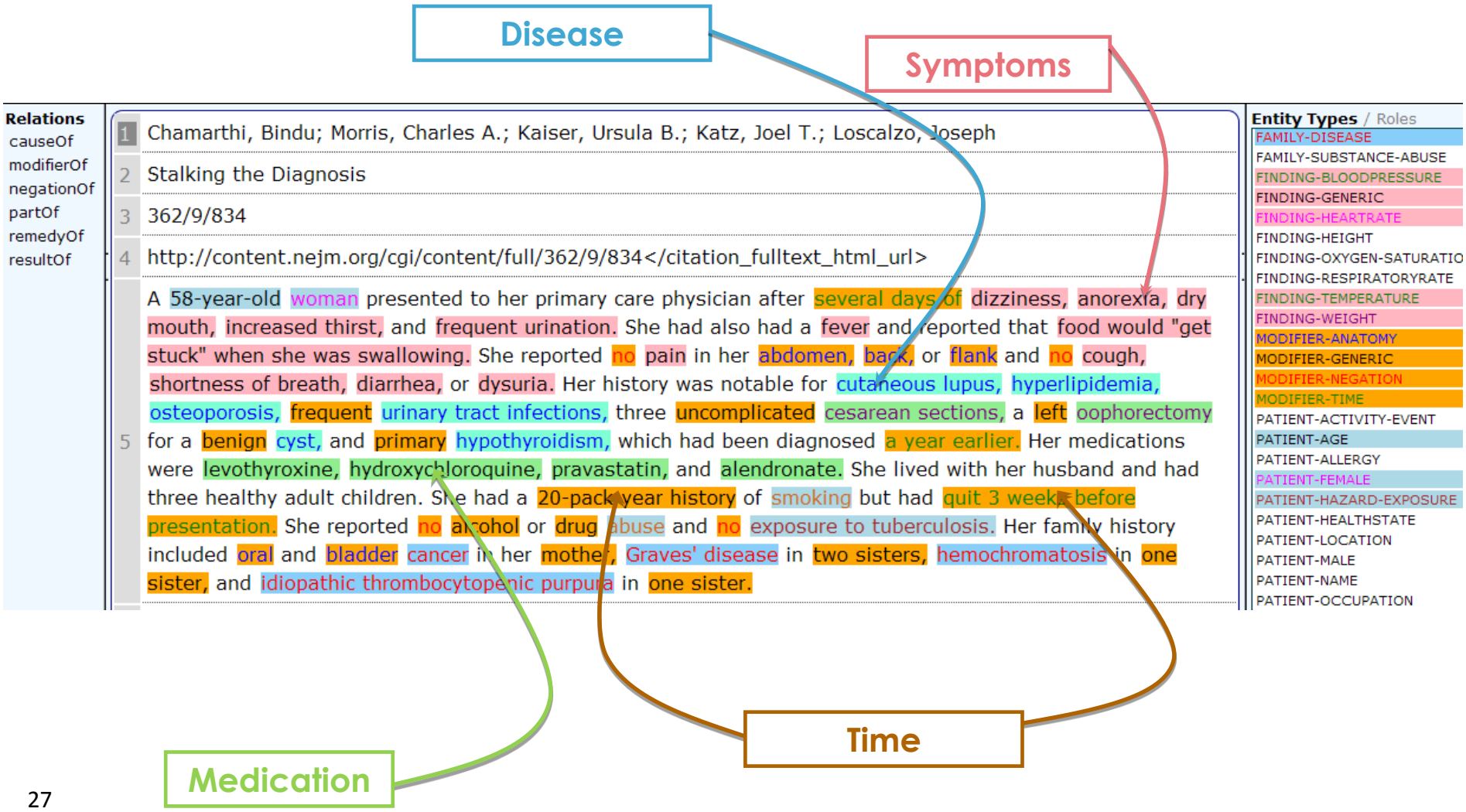
Understands **natural language** and human communication

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



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**

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Google Glass in the Operating Room

Presents vital signs & EMR data to the surgeon directly

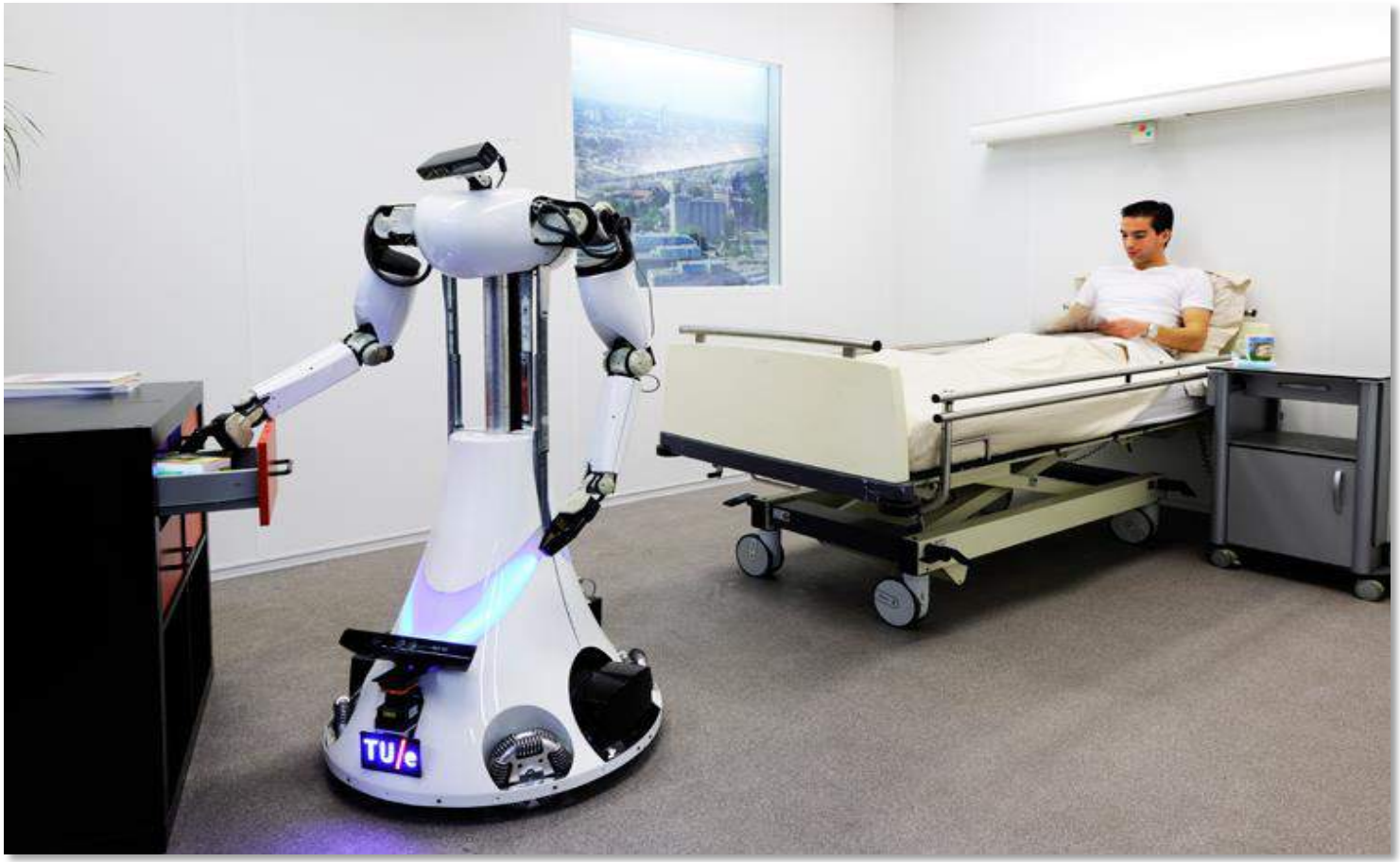
UMC-St. Radboud

Already a commodity?

Source: Paul Szotek [Google]

Robotic healthcare provider

Technology closer to the patient

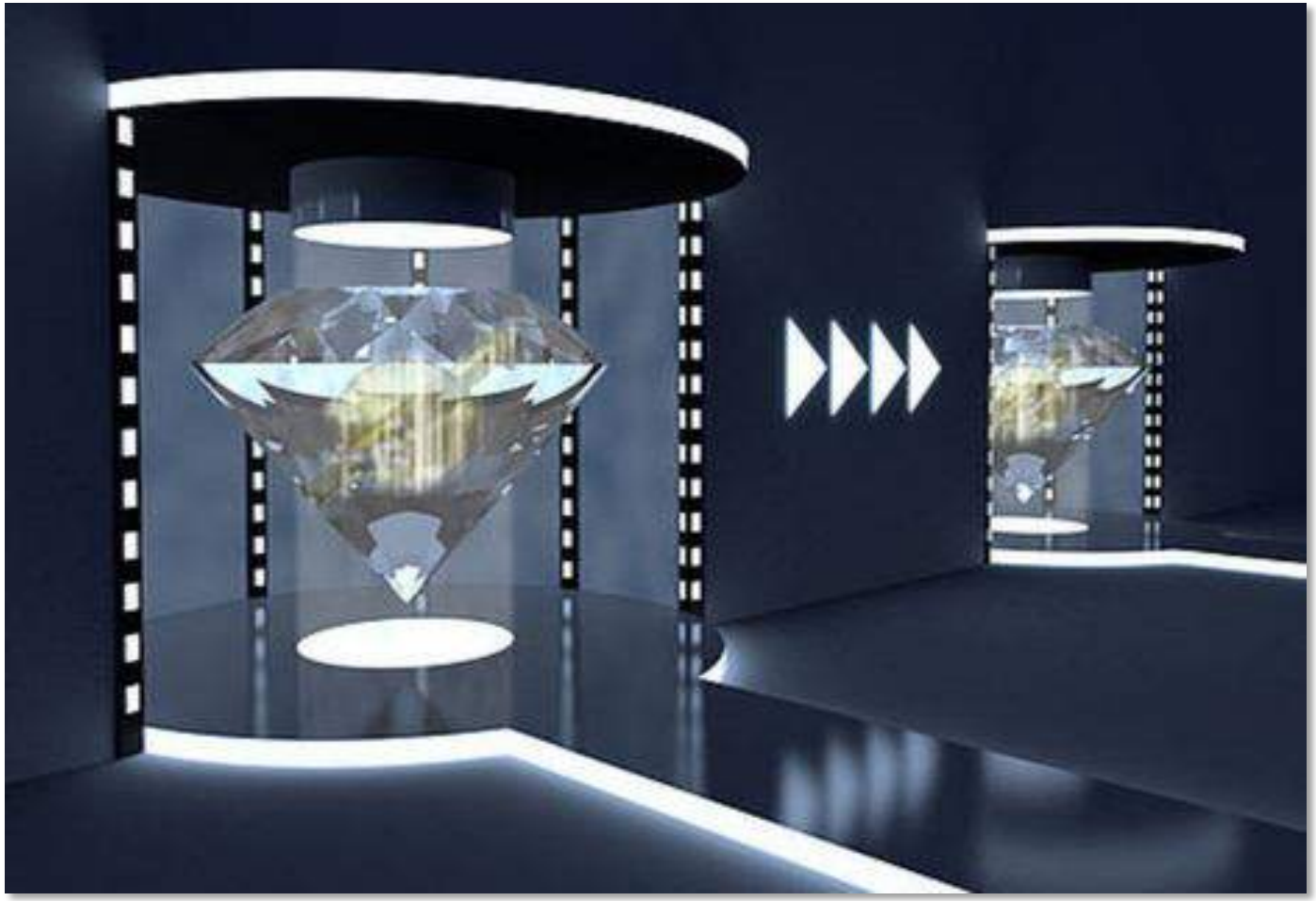


TU – Eindhoven

the new physician, nurse ...?

“Beam me up”

Experiments with teleporting of experts



TU - Delft

The new OR advisor?

Conclusions

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Shift from **disease** care to **health** care


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