Large Scale Application Model Potential of Health Technology under 5G Action Plan

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5G for Europe: An Action Plan

5G Action Plan

- Early stage 5G application projects in Europe
- Ideally one in each European member state (or clusters)
- Due to the fact of a distorted time frame (5G PPP Phase 3 will not start until summer / fall 2018 and tangible results may not be ready by 2020
- Early deployment still scheduled for 2020 (Verizon – USA, AT&T)
- 5G action plan to convey integration across different industries and to establish concrete pilots within the EU

European telecoms groups ask: what happened to the 5G manifesto?

Written by Scott Bicheno | 07 June 2017 @ 15:50

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- Dieses Positionspapier ist eine Initiative der Fokusgruppe „Mobilkommunikation“ der Informationstechnischen Gesellschaft im VDE (ITG).

- Led by Professor Gerhard Fettweis, TU-Dresden
- Input of relevant industries and academics (Germany)

5G PPP Phase 3

- Call likely to be out by October 2017
- Healthcare projects extremely important
- Ideally cross sectional projects together with
  - Healthcare providers (Hospitals, GP consortia)
  - Patient organizations
  - Regulators
  - Pharmaceutical industry (Smart Pharma)
  - Service providers (Siemens Healthineers, Agfa, Phillips, Google, MS, etc)
  - Telcos (Telecom Italia, Orange, Dt. Telecom, Vodafone, etc)
  - Vendors (Nokia, Ericsson, Huawei)
  - SMEs
  - Academia

IEEE 5G World Forum 2018 (5GWF'18)

9-11 July 2018

Santa Clara, California, USA

5G is not only Wave forms and last mile technology

Multi Domain orchestration on different levels and network slicing are essential

5G PPP Multi-Domain Orchestration (5G PPP White Paper on Architecture)

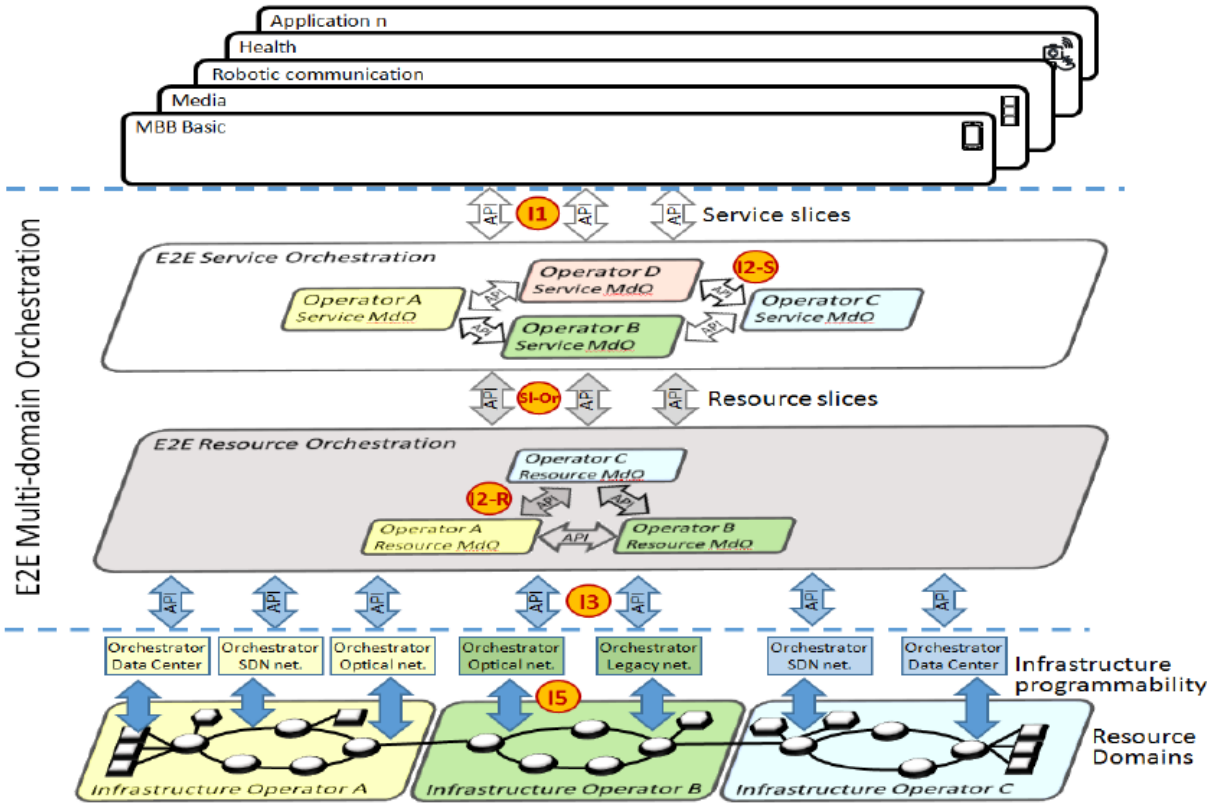


Figure 3-8 - E2E Multi-Domain Management and Orchestration of different infrastructure domains belonging to different operators

What is Hot?

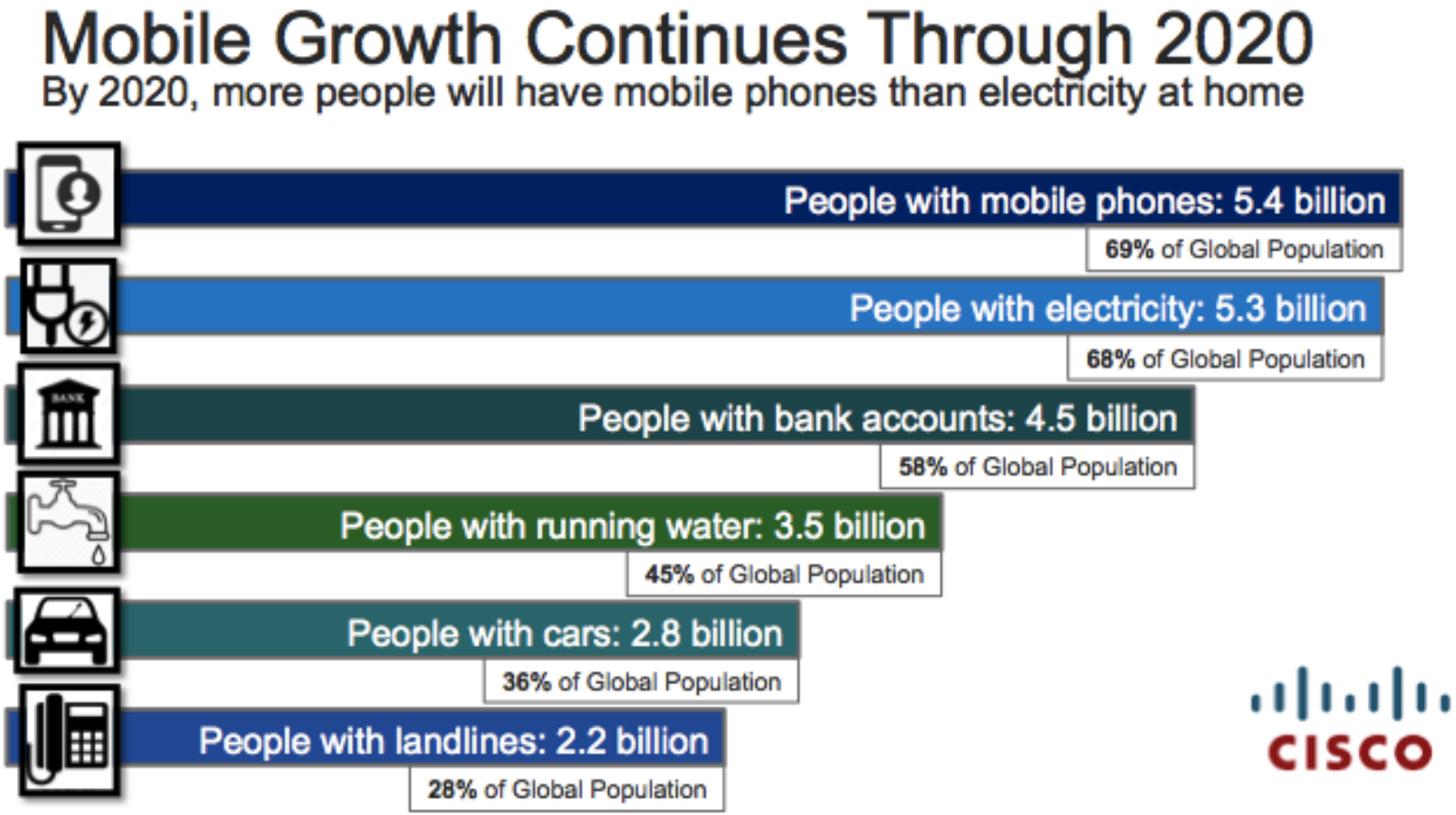
- Prophylaxis (scanning of barcodes, photographic identification, virtual reality support when looking at foods, pharmaceuticals, situations)
- Smart Pharmaceuticals (Insulin, asthma / COPD inhalers)
- Hospital @ Home (Home Dialysis, Feeding tubes, Infusions, CPAP-ventilators), fewer hospital admissions more deployed devices (
- AI supported management of chronic disease (for example Multiple Sclerosis, Depression, Gastro-esophageal reflux disease)
- Virtualized Rehabilitation (stereotactic cameras, holographic trainers)
- Population Health Management (for example viral outbreaks, resistance maps, analytics)
- Real time supply chain management inside and outside hospitals
- Device management inside and outside hospitals (NB-IOT, 4G LTE, 5G)
- Precision Medicine
- Health 4.0
- IIOT

IOT / IIOT
Emergence of the Hyper-Connected Society

Towards Virtualization and Cyber-physical Systems

Steve Jobs during the launch of the IPhone in 2007

Smart Phone Deployment



Machine to Machine (M2M) connections

Source: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016–2021

EU-CN White Paper on Internet of Things

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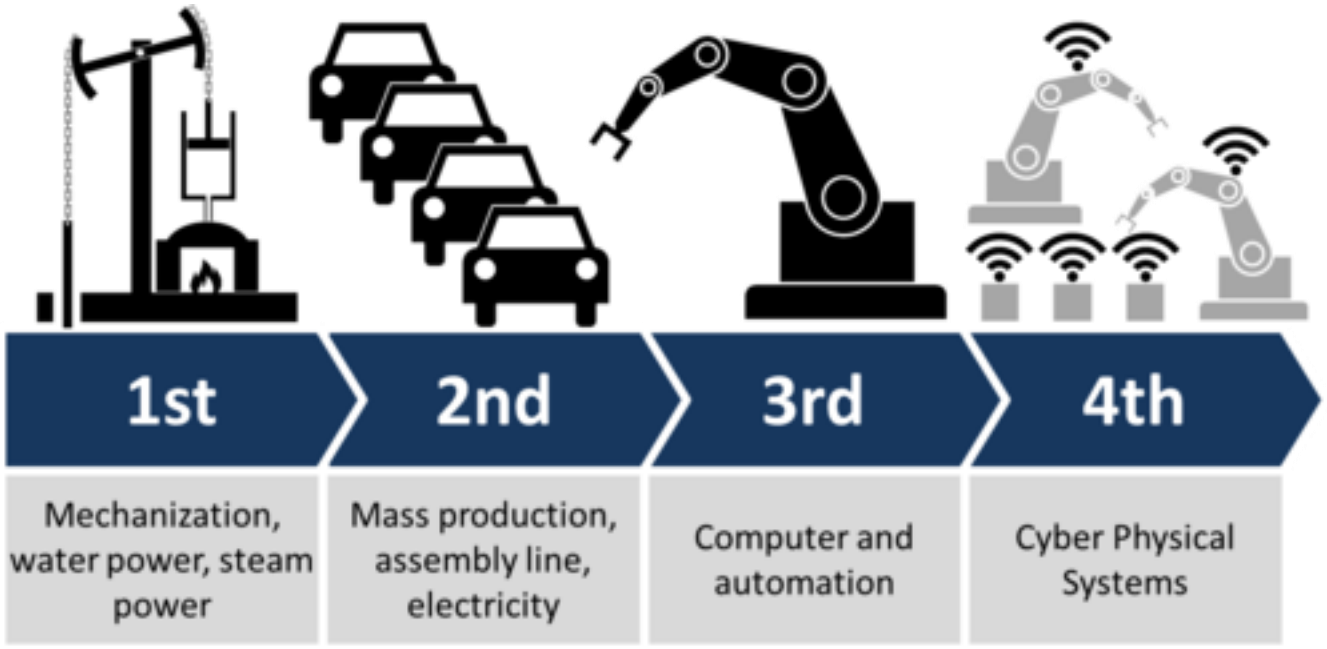
What does this mean in the context of Health and Care ?

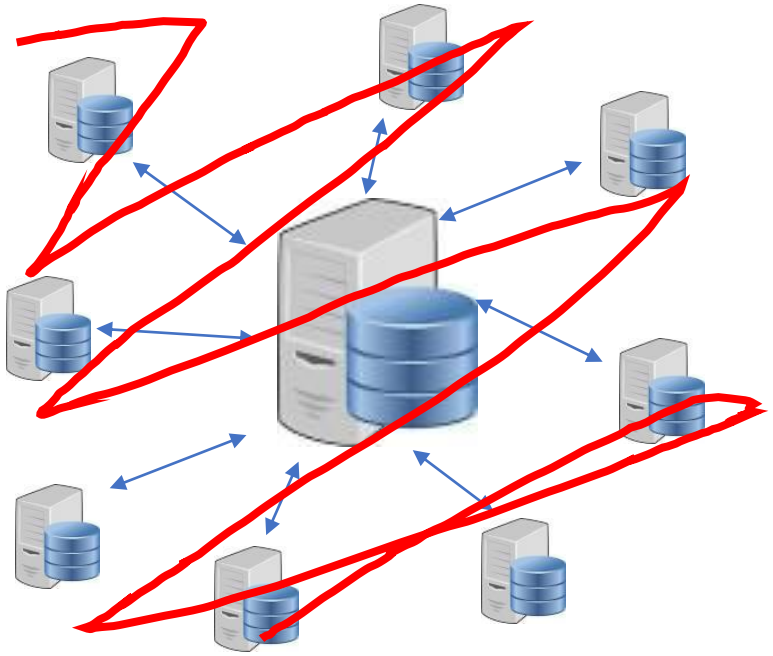
- People, their informal carers and lesser educated health care professionals will play a bigger role than ever in health care
- More people to be treated outside hospitals
- Need for highly improved connectivity - Availability of Data in almost real time
- Instant availability of services or customized service aggregates
- Sensors can be connected to algorithms and service platforms thus connecting the real world with the virtual world (Cyber-physical Systems)
- Treatments to move from ” based on empirical data” to “customized” = Precision Medicine
- Processing of increasing numbers of “case-episodes” through “robots” and “algorithms” (Population Health Management)

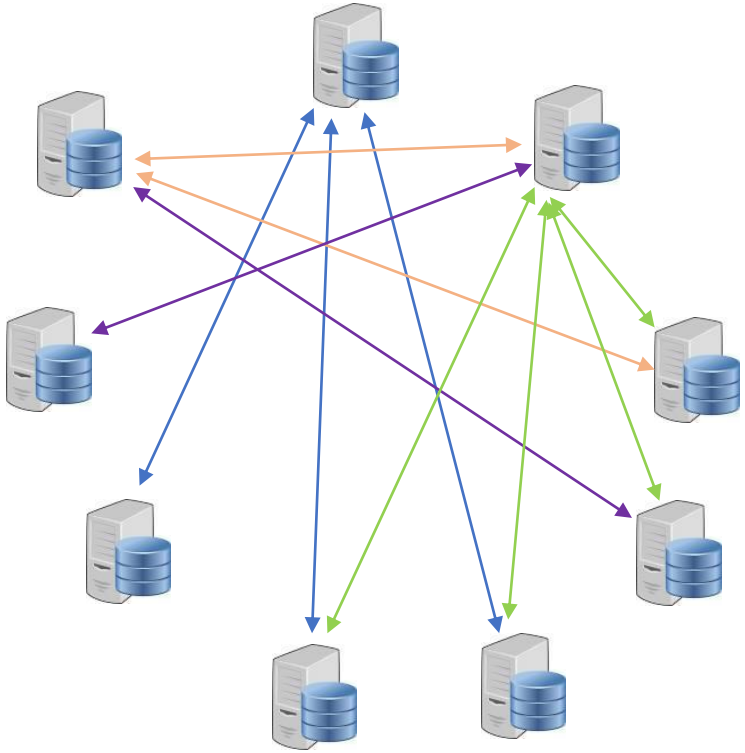
Health 4.0 is the application of Industry 4.0 principles in the health domain



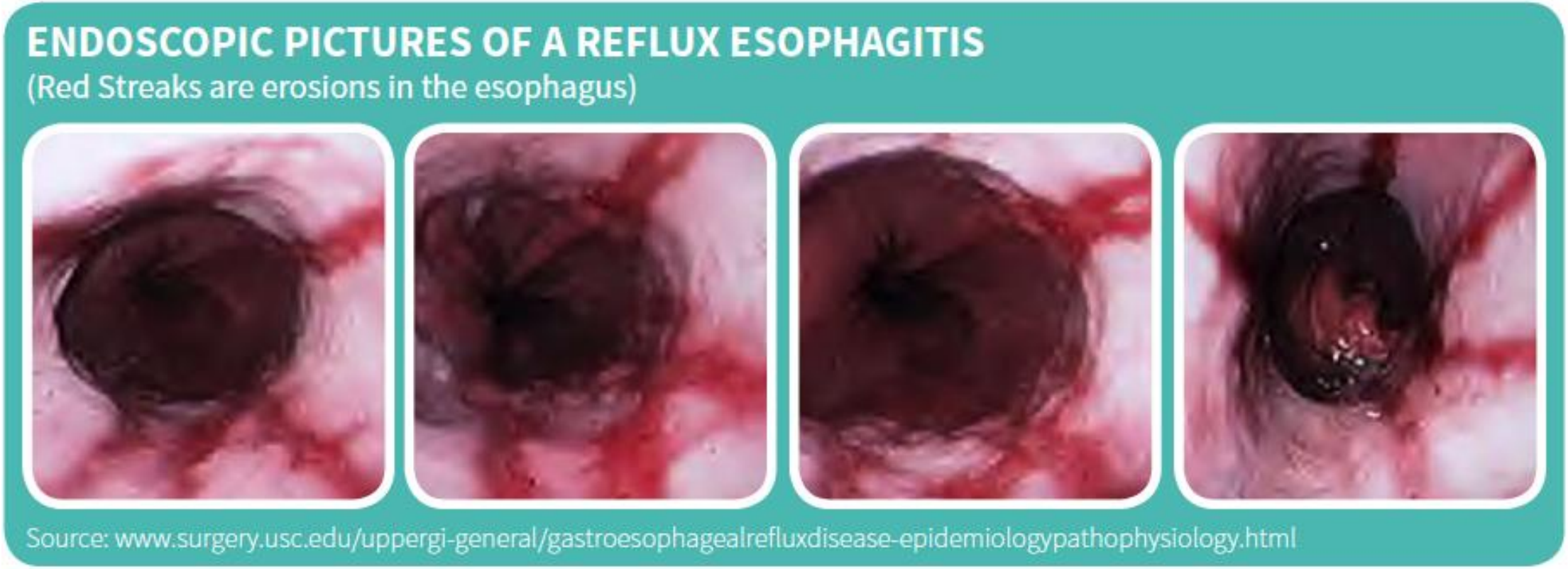
Industry 4.0 is the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of things and cloud computing.

Time to butcher the “Centralized Electronic Patient Record” sacred cow?



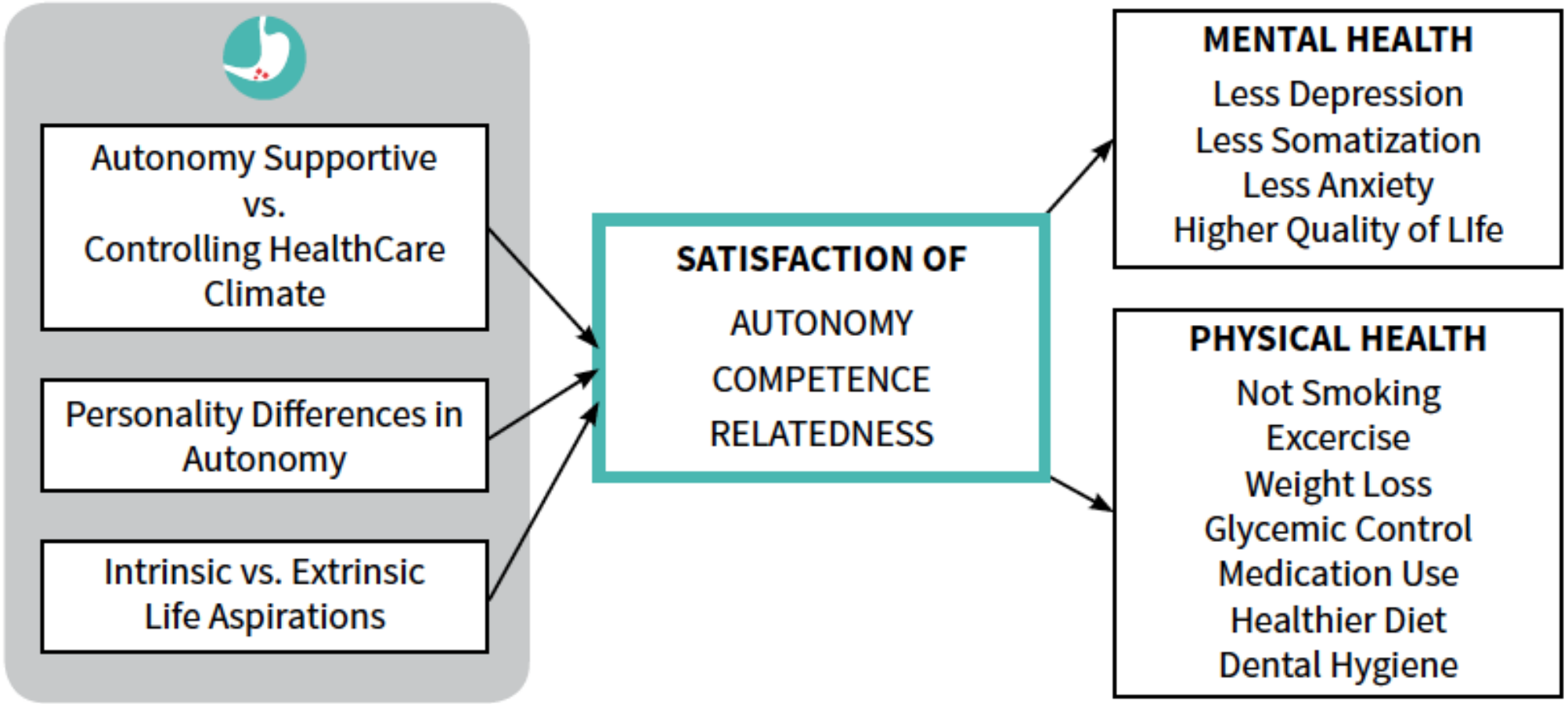


Influencing Behavior in Gastro-Esophageal Reflux Disease (ACID)



Behavior support through Algorithms ?

Figure 1.1: **ACID Self-Determination Theory**



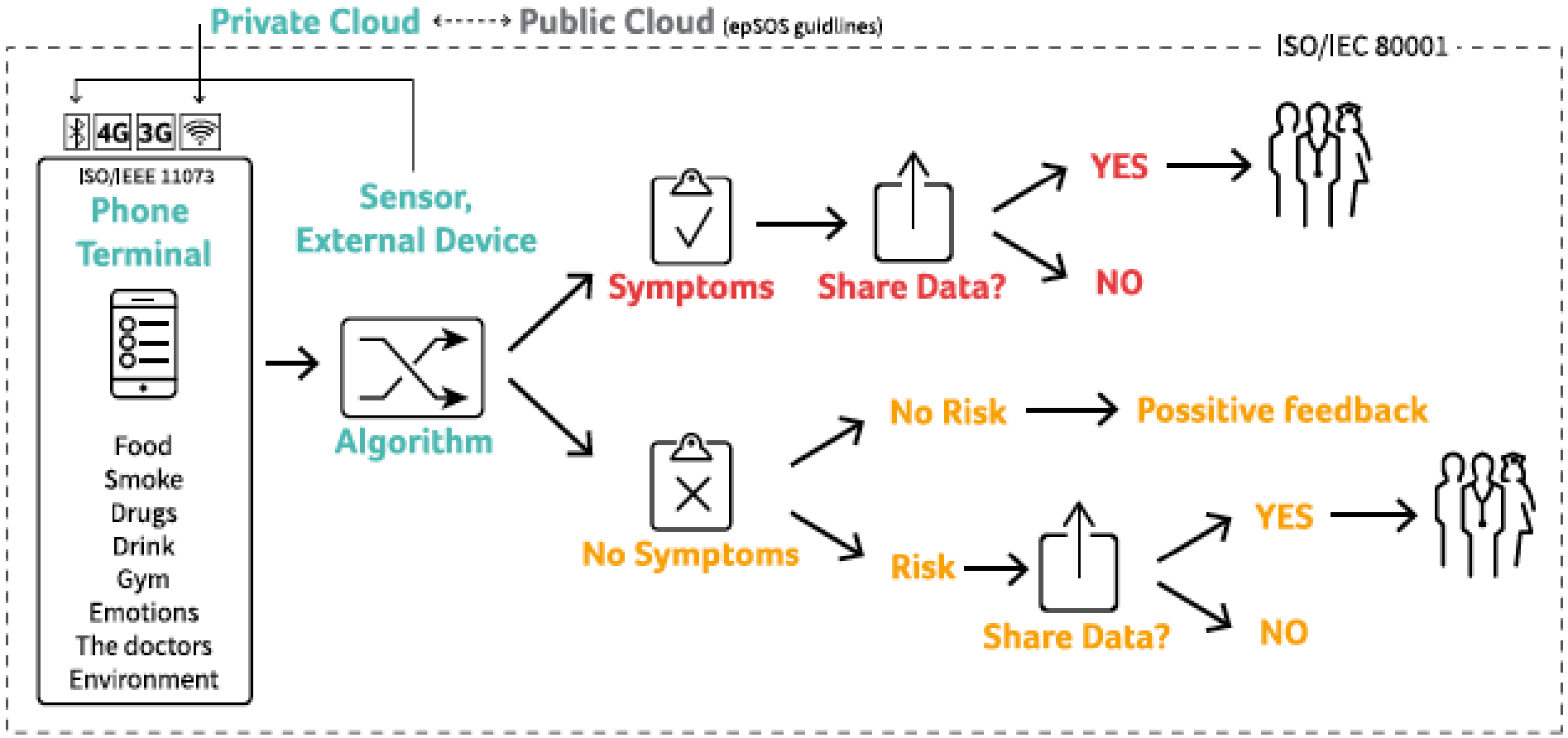
Source: Self-Determination Theory, Ryan et al 2008

Operationalization

Table 1.1: **ACID Self-Determination Theory Interface**

ACID FEATURE	OUTPUT	IMPACT
Predictive personal algorithm	Warning of risks and severe episodes	Avoidance of dependencies Autonomy
Information sharing facility	Personal health data	Relatedness, improved patient-health professional relationship
Social network	Access to information, information sharing	Competence
Diary function, Capture of environmental and social factors	Maps, timelines, analysis	Competence

Algorithm Flow Diagram Reflux Disease



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Salesforce Considers Takeover of Twitter

Doubts Rise About Digital Ads

Oculus Founder Says He Gave Money to Pro-Trump Group

Yah
Detecte
to Russi

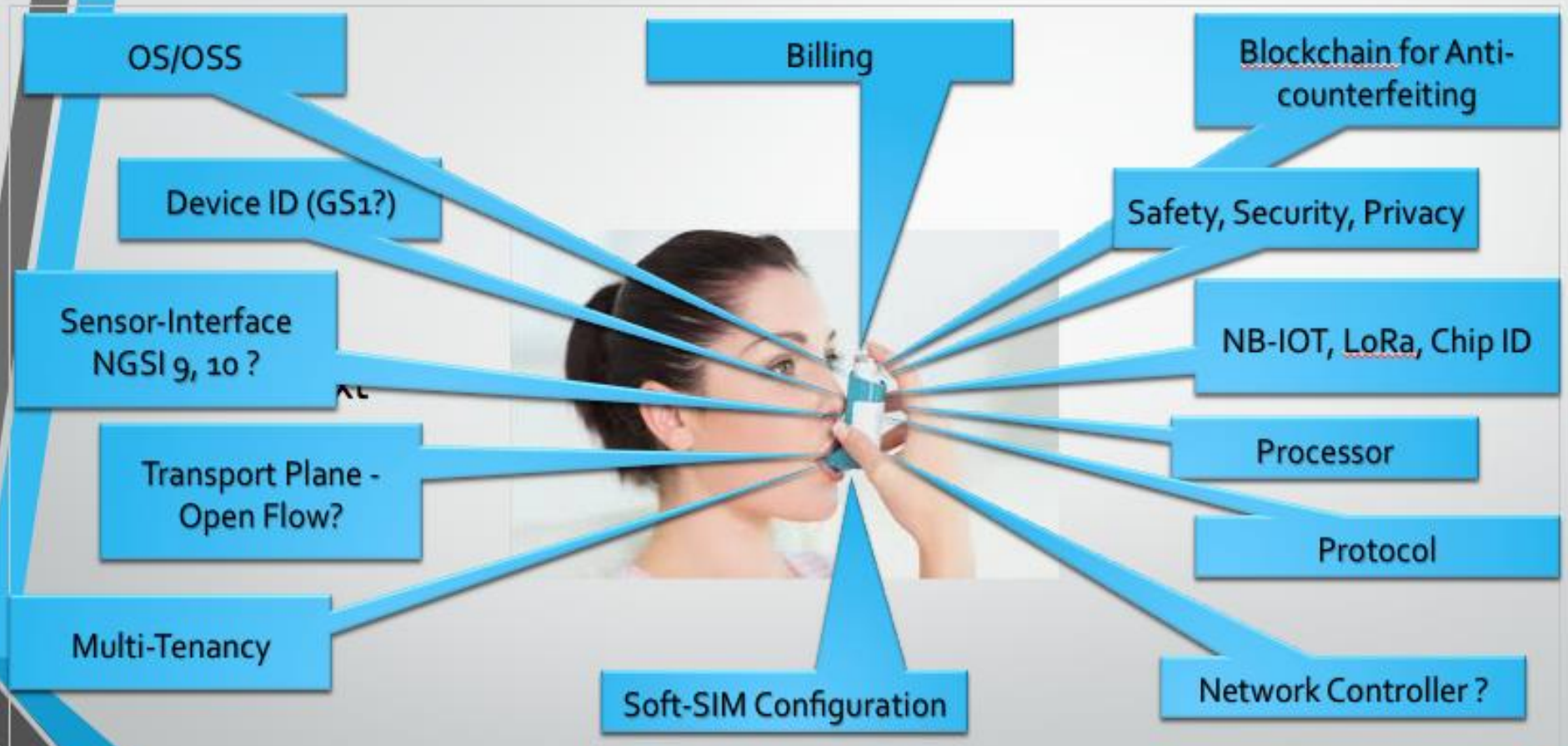
TECH

Google Parent and Sanofi Name Diabetes Joint Venture Onduo

Joint venture will develop tools for managing the disease expected to affect 592 million people world-wide by 2035

Joshua Riff, who was a senior executive at UnitedHealth Group's Optum, will be chief executive of the new unit. *PHOTO: EUROPEAN*

Smart Pharma Challenge



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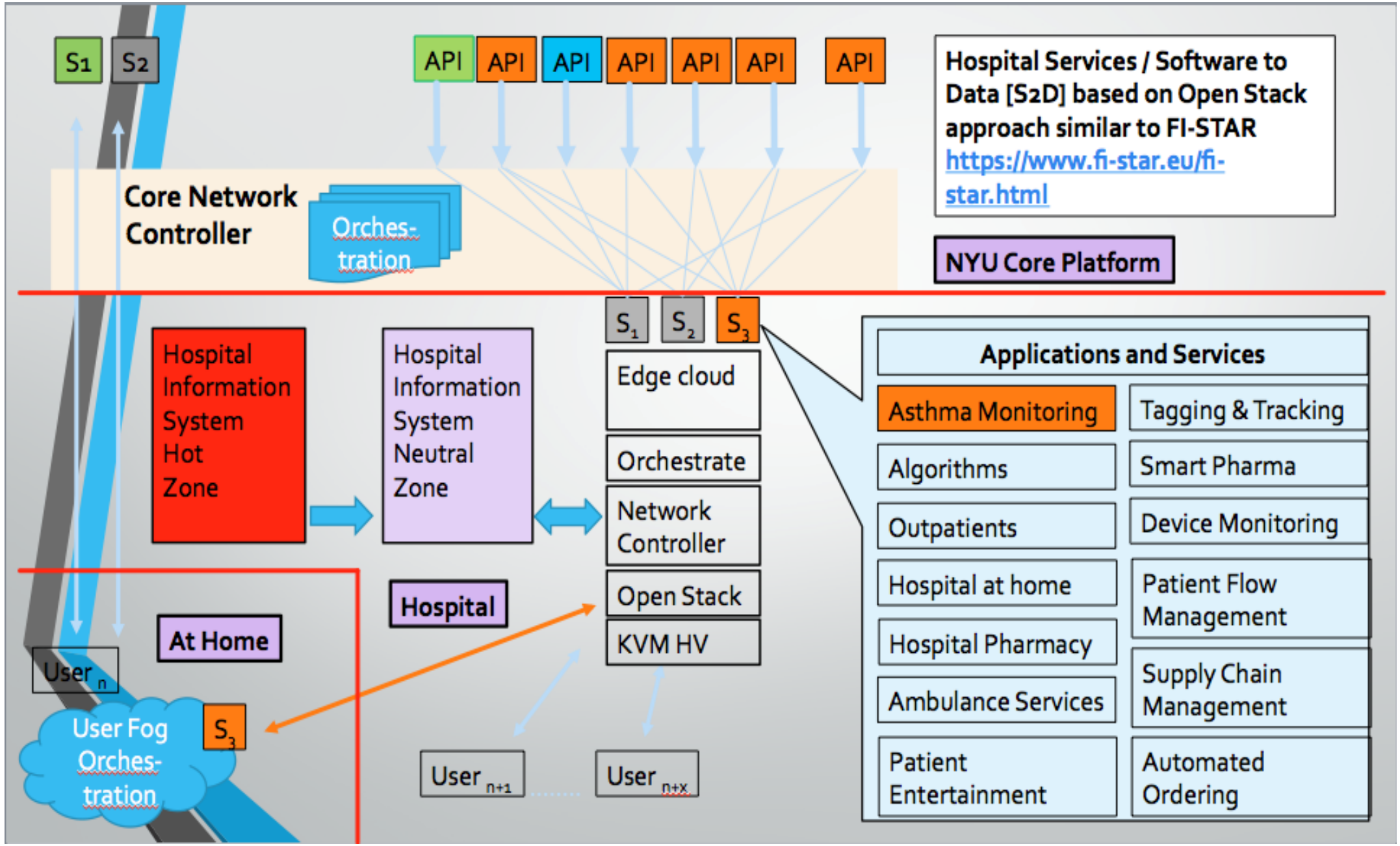
Smart Pharmaceuticals will not require Smart Phones as gateways in the future

3M Inhalers with display to be market ready by 2019


S1
S2
API
API
API
API
API
API
API
Hospital Services / Software to Data [S2D] based on Open Stack approach similar to FI-STAR
https://www.fi-star.eu/fi-star.html
Core Network Controller
Orches-tration
NYU Core Platform
S1
S2
S3
Hospital Information System Hot Zone
Hospital Information System Neutral Zone
Edge cloud
Orchestrate
Network Controller
Open Stack
KVM HV
Hospital
At Home
User n
User Fog Orches-tration
S3
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Patient Flow Management
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Supply Chain Management
Ambulance Services
Patient Entertainment
Automated Ordering

Surgical Robots

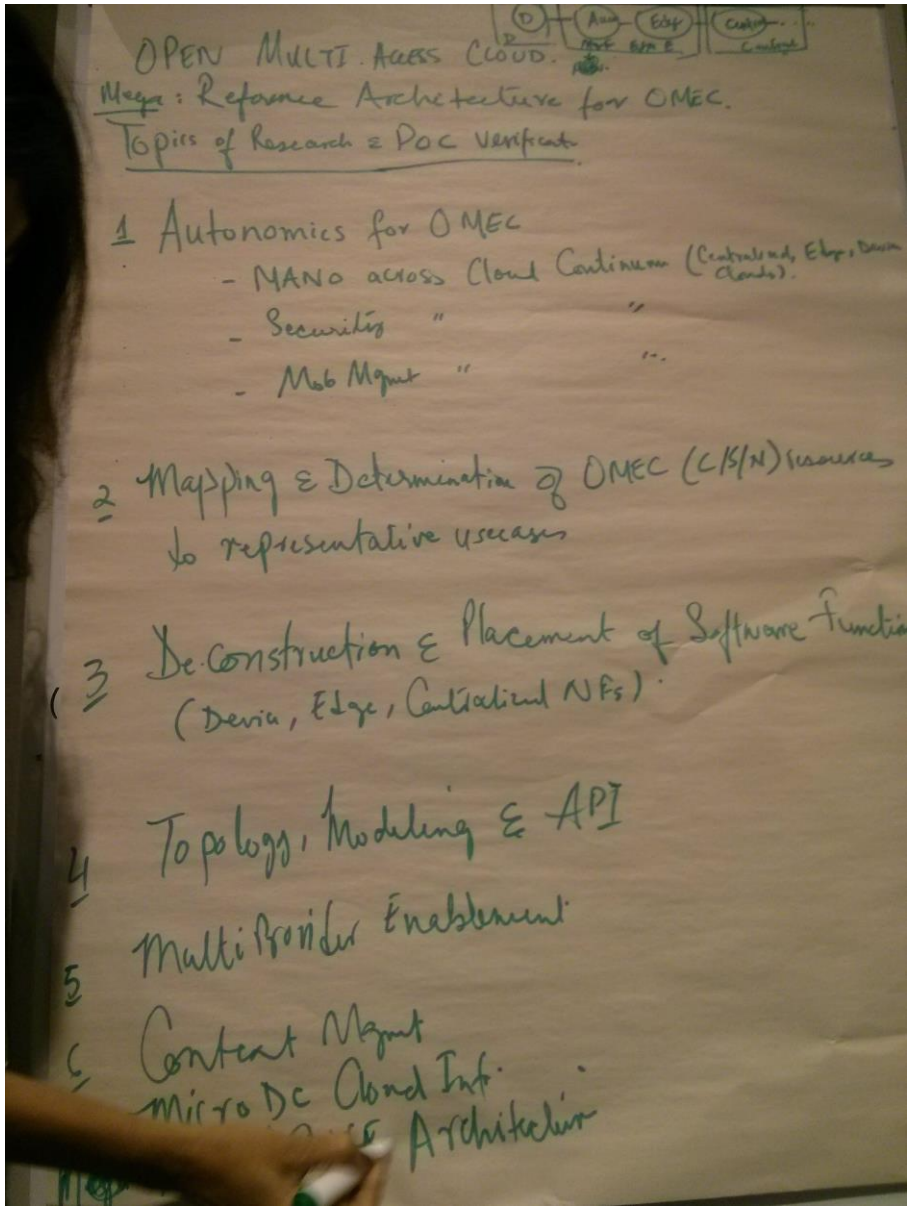
Social Robots

Multi Edge Cloud and Private 5G network supporting arguments

- Multi Edge Cloud / Private 5G Networks likely to pick up in health due to value of the business (in China around 6% of GDP, Europe 10% of GDP, in the US 18.5% of GDP)
- Healthcare providers, pharmaceutical industry and policy makers unlikely to leave such a relevant industry to digital service providers such as IBM, Google or Microsoft to develop OTT XaaS business model (especially outside the US)
- General Data Protection Regulations
- Parallel processing and distributed computing are extremely strong trends
- Managing local problems locally might safe energy, bandwidth and cost, especially as global 5G coverage is unlikely to happen within 25 years from now

Open Multi Access Edge-Cloud [OMEC]

- OMEC discussion during 5G Roadmap meeting in Paris on 25.May 2017

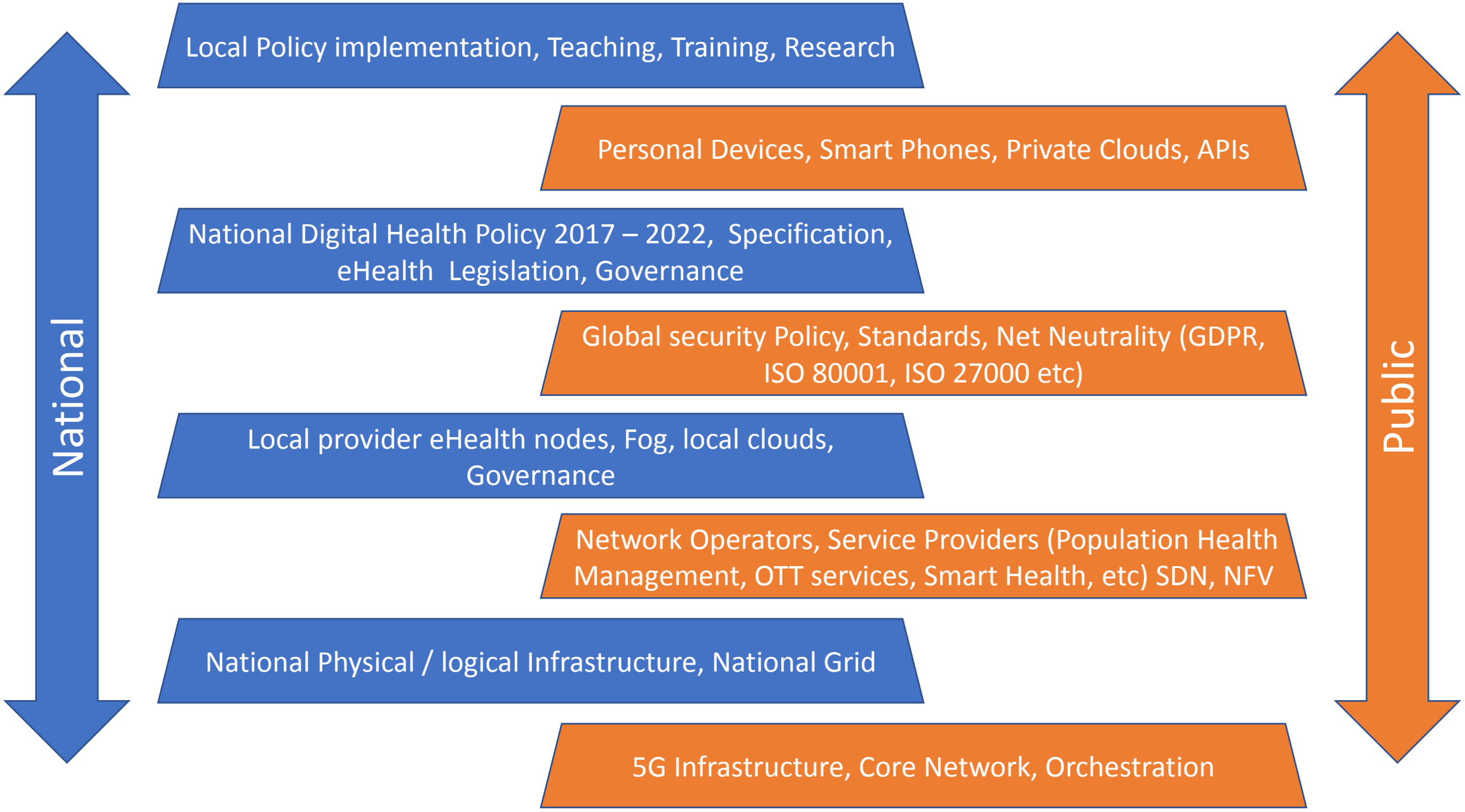


Driver Condition Monitoring

- Autonomous driving will require the presence of a fit driver
- Regulators are likely to require monitoring in order to proof fitness
- Captured health data have different privacy requirements from technical data
- Health data is a valuable commodity but will require data owner authorization for processing
- Multi-provider orchestration will be required to create more valuable individual health information (which might even replace routine check-ups to a certain extend)

Hospital @ Home

- Clear shift from hospital care to hospital at home
- More devices will be deployed into the home environment
- Device monitoring will be required to manage maintenance, QoS, QoE and governance in an environment which will not be monitored by a nurse on a regular basis
- NFV might be instrumental in the future to shift virtualised functions (settings of infusion pumps, monitoring devices, etc) between clouds (hospital to home)
- NB-IOT to enable device status monitoring



Social-Technological Alignment, National / Global eHealth Grid 2020

Billions of People will benefit from Health 4.0

- Asthma around 334 million people (Global asthma report 2014)
- COPD: 384 million people in 2010 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4693508/
- Diabetes: around 420 million people (WHO 2014)
- Gastro-Esophageal Reflux Disease GERD prevalence estimates was 18.1%-27.8% in North America, 8.8%-25.9% in Europe, 2.5%-7.8% in East Asia, 8.7%-33.1% in the Middle East, 11.6% in Australia and 23.0% in South America (El-Serag HB, Sweet S, Winchester CC, Dent J (2013), Gut. 2014 Jun;63(6):871-80. doi: 10.1136/gutjnl-2012-304269. Epub 2013 Jul 13
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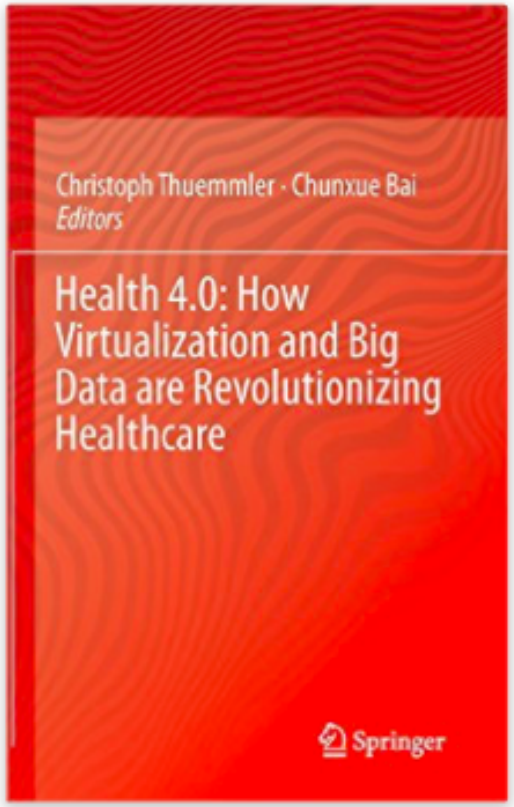

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Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare Hardcover – 11 Jan 2017

by Christoph Thuemmler (Editor), Chunxue Bai (Editor)

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This book describes how the creation of new digital services—through vertical and horizontal integration of data coming from sensors on top of existing legacy systems—that has already had a major impact on industry is now extending to healthcare. The book describes the fourth industrial revolution (i.e. Health 4.0), which is based on virtualization and service aggregation. It shows how sensors, embedded systems, and cyber-physical systems are fundamentally changing the way industrial processes work, their business models, and how we

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