# AI and Healthcare

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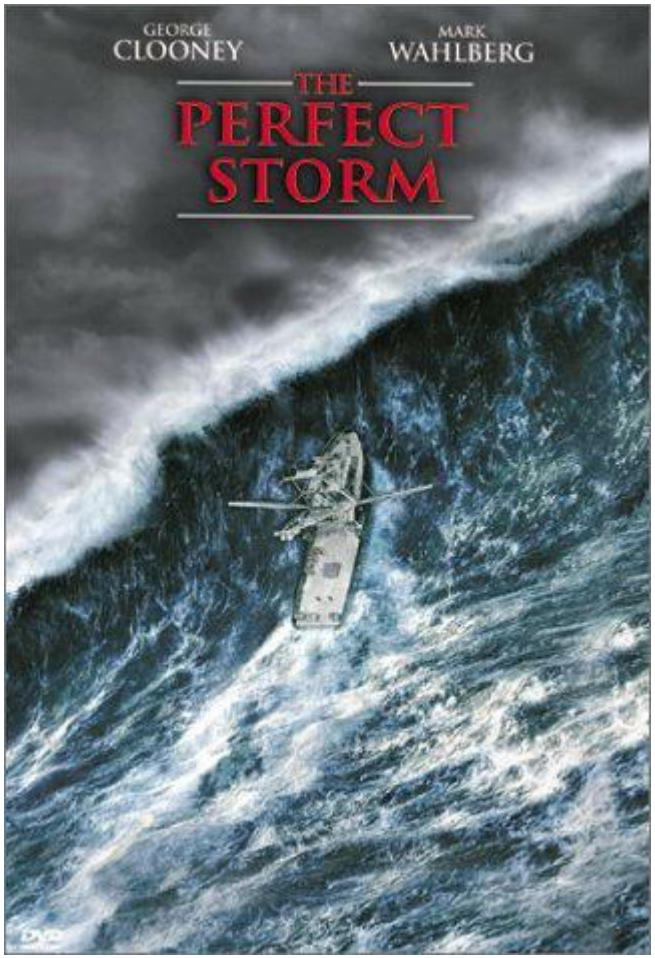
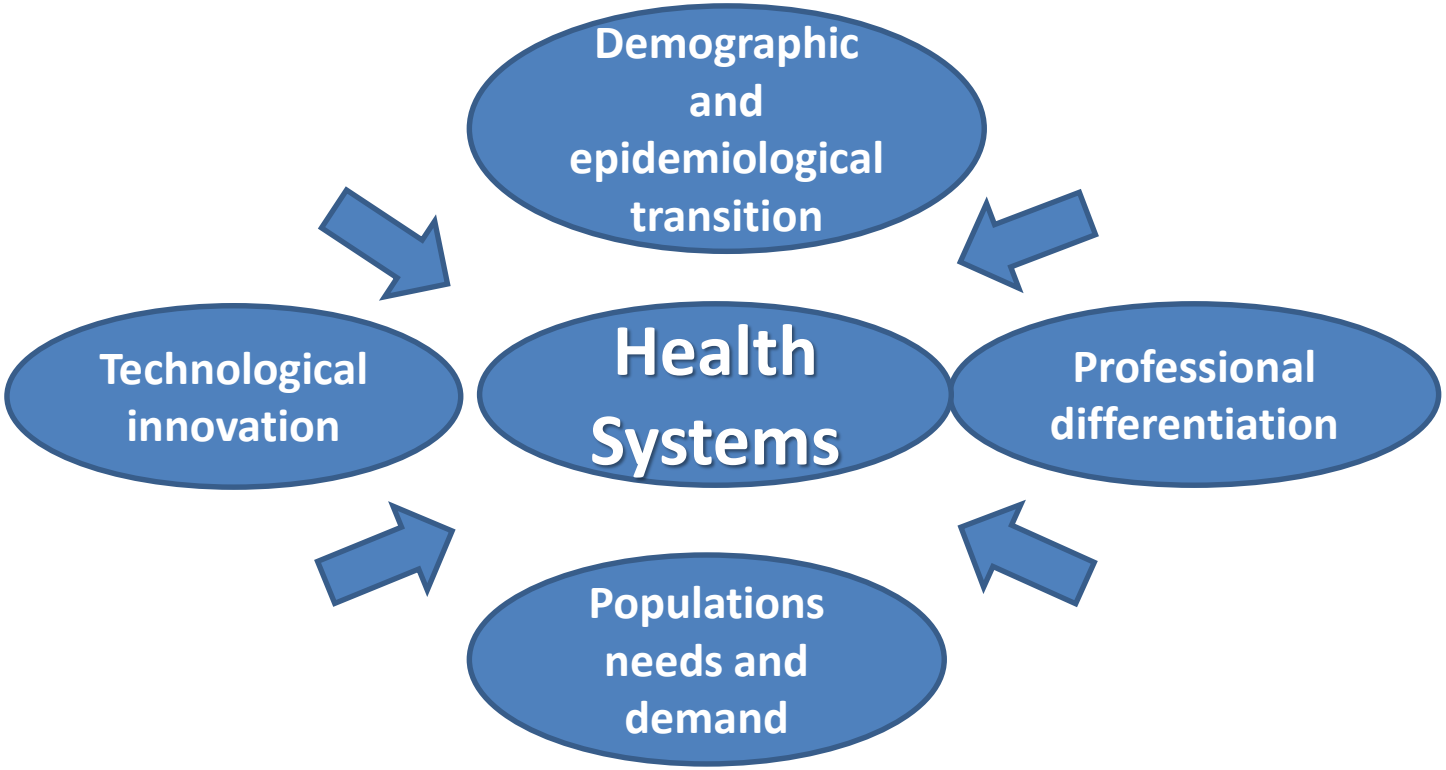
Roma, 27 February 2020

# Are world health systems facing the perfect storm?




**A "perfect storm" is an expression that describes an event where a rare combination of circumstances will aggravate a situation drastically.**

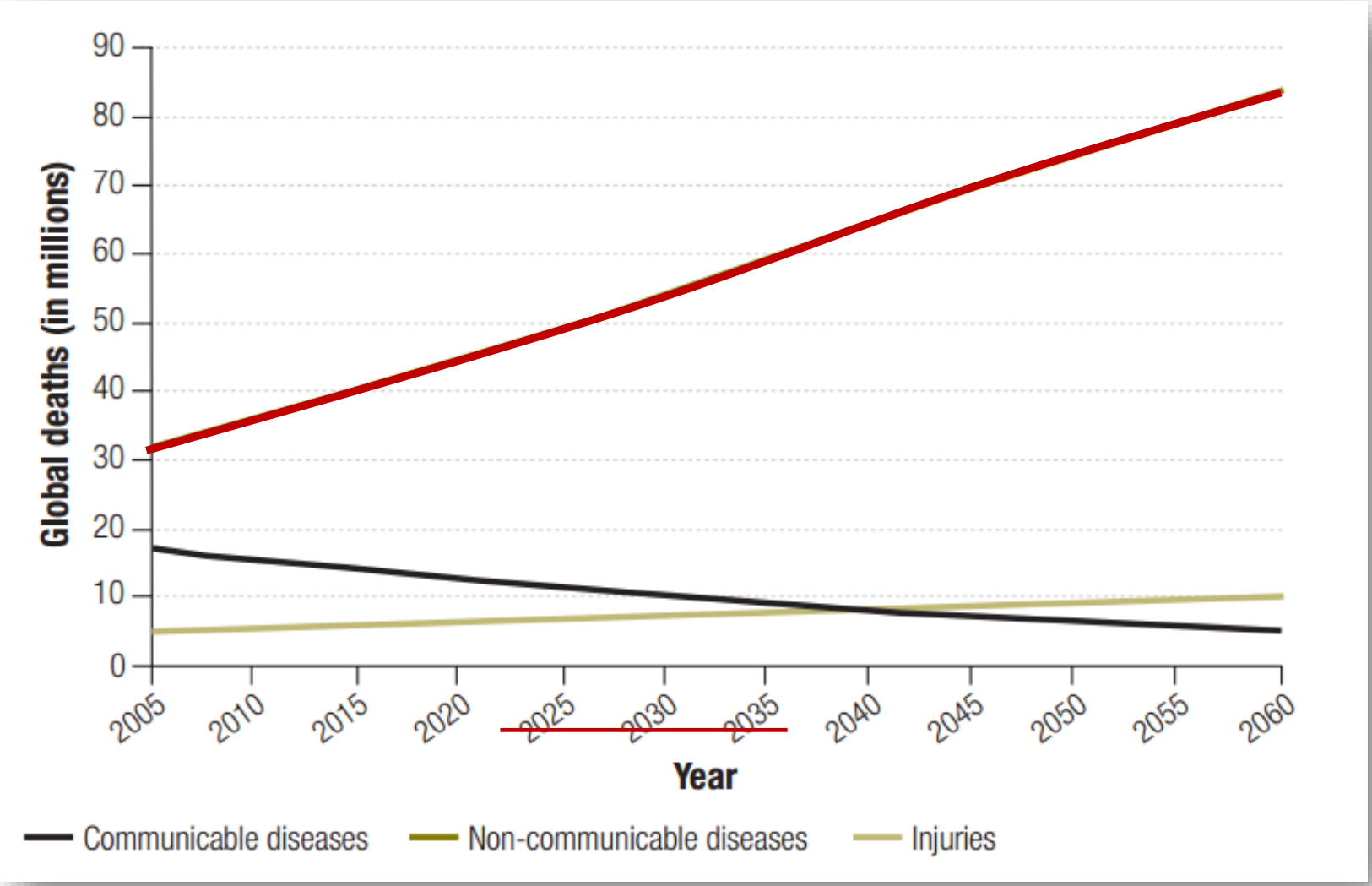
# The waves of demand and supply



70s

2020

# Chronic diseases

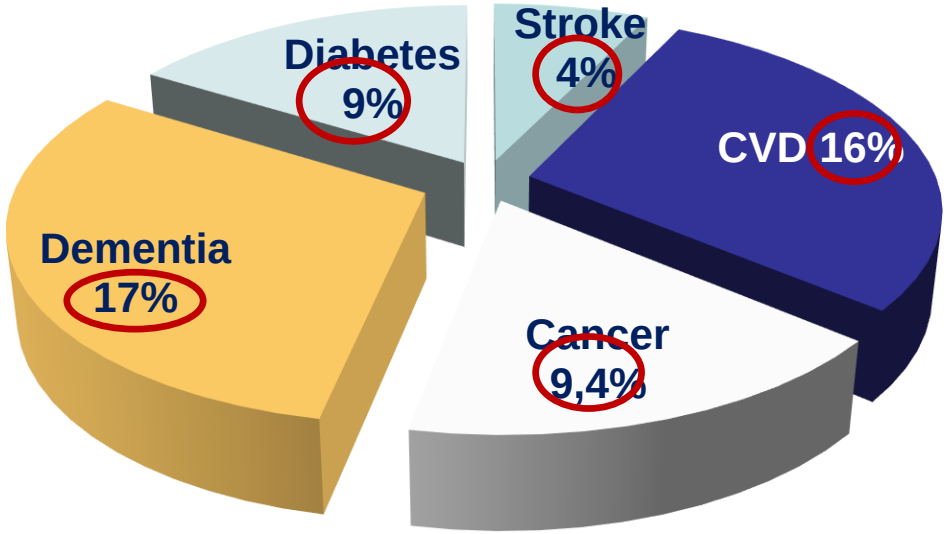



Source: Projections of global health outcomes from 2005 to 2060 using the International Futures integrated forecasting model. WHO bullettin 2011.

# Chronic conditions and economic burden

**It has been estimated that the commonest chronic conditions are costing the EU countries more than 1 trillion Euros per year, which is expected to increase to 6 trillion Euros by the middle of the century.**

**In UK the cost of chronic conditions such as stroke, heart diseases, diabetes, cancer and dementia pile up to over 50% of total healthcare expenditure.**



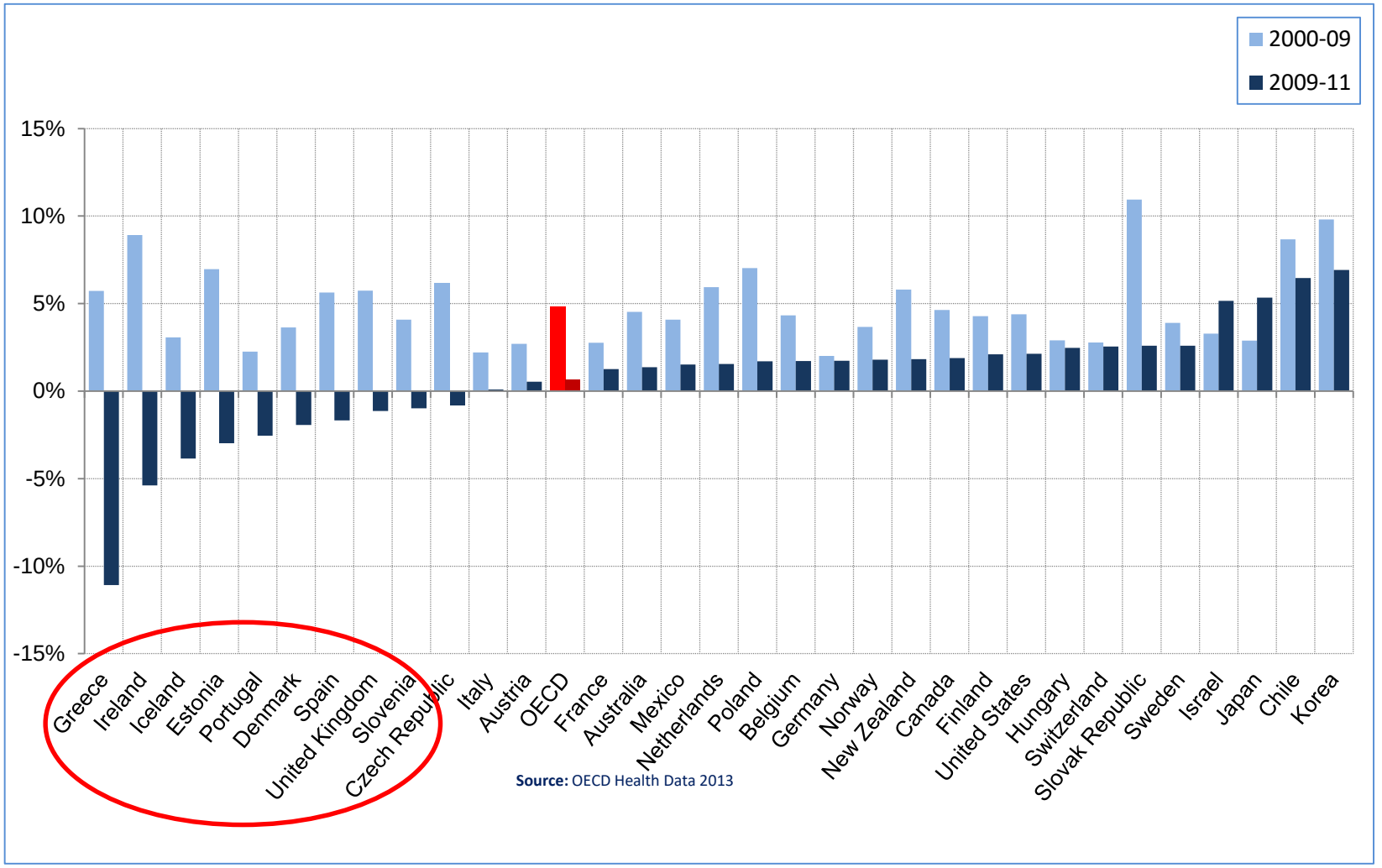

No country can afford this

1 trillion = 1.000.000.000.000.000.000

# Financial constraints

# Health spending

## Average annual growth in health spending in real terms




**Source:** OECD Health Data 2013

What can we do for our health systems?

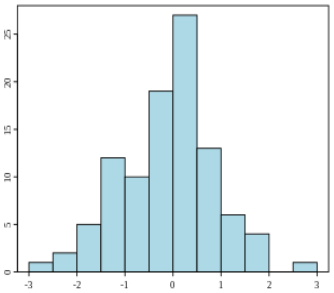
# Healthcare Sustainability

# What makes health services ineffective and inefficient

Delay in treatment

Same treatment for all

Undue variability in health conditions




Waiting for patients to arrive in our silo structures

Uncertainty on what really works

Frequent medical errors (not notified)


Irrational workflow

Patients ignore doctor's instructions

from Elias Mossialos, modified

# A complex challenge

As seen, health care providers are currently faced with an extremely complex challenge characterised by rising demand, increasing cost and insufficient funding.

Never as much as today have health care systems been interested and involved with the **potential benefits deriving from innovations**

**Innovation is a key feature that organisations have to incorporate as a condition to offer sustainable and efficient solutions**

# Innovation


The process of translating an idea or invention into a product/service that creates value or for which customers or society or insurance will pay

The application of better solutions that meet new requirements, unarticulated needs, or existing population needs

Something original and more effective and - as a consequence- new, which "breaks into" the market or society

# Innovation

| INVENTION | ≠ | IMPROVEMENT |
| --- | --- | --- |
| Innovation refers to the use of a better and, as a result, novel idea or method | | Innovation refers to the notion of doing something different |
| *whereas* | | *rather than* |
| invention refers more directly to the creation of the idea or method itself | | rather than doing the same thing better |

# Types of innovation

| | | |
|---|---|---|
| **SUSTAINING** | **An innovation that does not affect existing markets** | |
| | **Continuous** | An innovation that improves a product in an existing market in ways that customers are expecting. |
| | **Discontinuous** | An innovation that is unexpected, but nevertheless does not affect existing markets. |

| | | |
|---|---|---|
| **DISRUPTIVE** | **An innovation that creates a new market or expands an existing market by applying a different set of values, which ultimately (and unexpectedly) overtakes an existing market** | |
| | Main features are: | a) improved health outcomes<br>b) create new professional culture<br>c) serve new groups or have new products/services<br>(“create new markets”)<br>d) create new players<br>e) disorders old systems |

# Disruptive innovation in health care

The EXPH understands disruptive innovation in health care as:


**“a type of innovation that creates new networks and new organisations based on a new set of values, involving new players, which makes it possible to health improve outcomes and other valuable goals, such as equity and efficiency. This innovation displaces older systems and ways of doing things”.**

# Disruptive innovation in health care



The concept of disruption implies that not only does an innovation take place, but that the previous “market”, companies, employers or employees might change considerably.

# Main characteristics of disruptive innovations

A disruptive innovation can often be characterised by some (or all) of the following elements:

**Provide improved health outcomes**

**Create new services and overcomes challenges regarding accessibility to existing or new services**

**Lead to cost-effective methodologies that improve access**

**Promote person-centred health delivery**

**Empower the patient/person**

**Create new professional roles and capacities**

**Create new sets of values for the health workforce, patients, citizens and community**

**Introduce transformative cultural change**

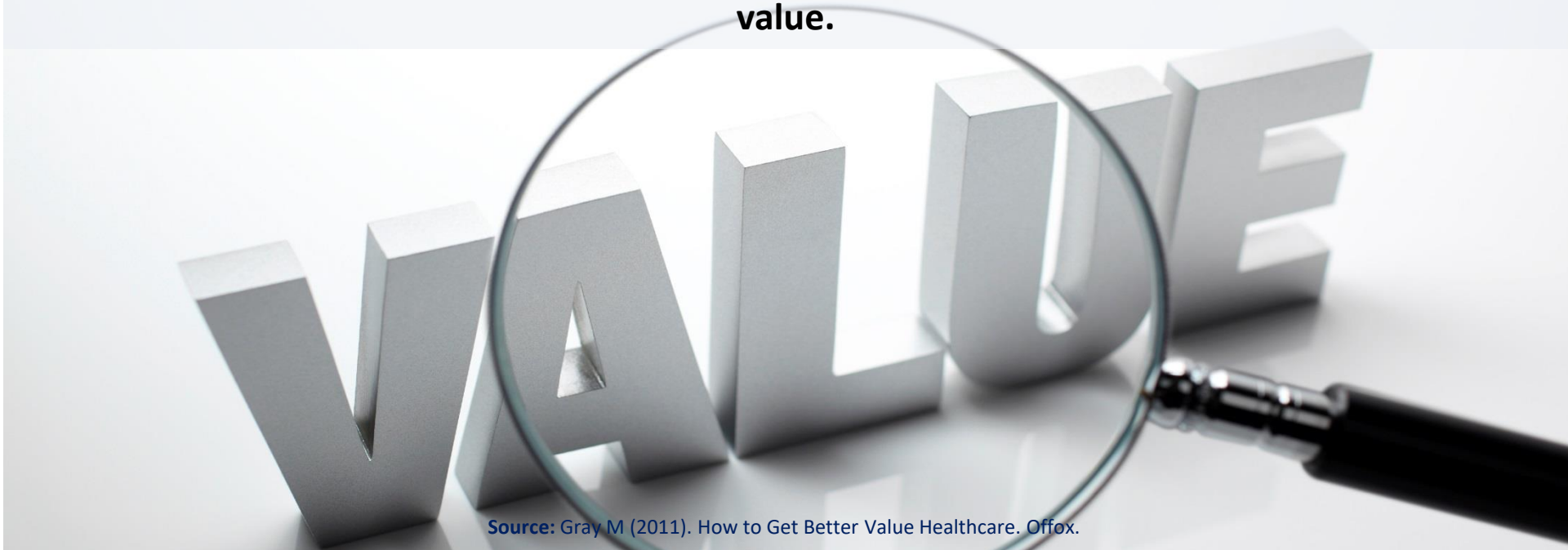
**Disorder old systems**

# High value in disruptive innovations

SOME DISRUPTIVE INNOVATIONS COULD BE CHARACTERIZED BY THE FACT THAT THEY ALSO PRESENT **HIGH VALUE**

In health care, high value can be defined as **meeting patient expectations at the level of the individual or providing the better outcomes in the most cost-effective way in the short or long-term at the population level**.

In an era in which resources often do not increase in step with increasing need and demand, when they increase at all, it is essential **to promote disruptive innovations that present high value.**

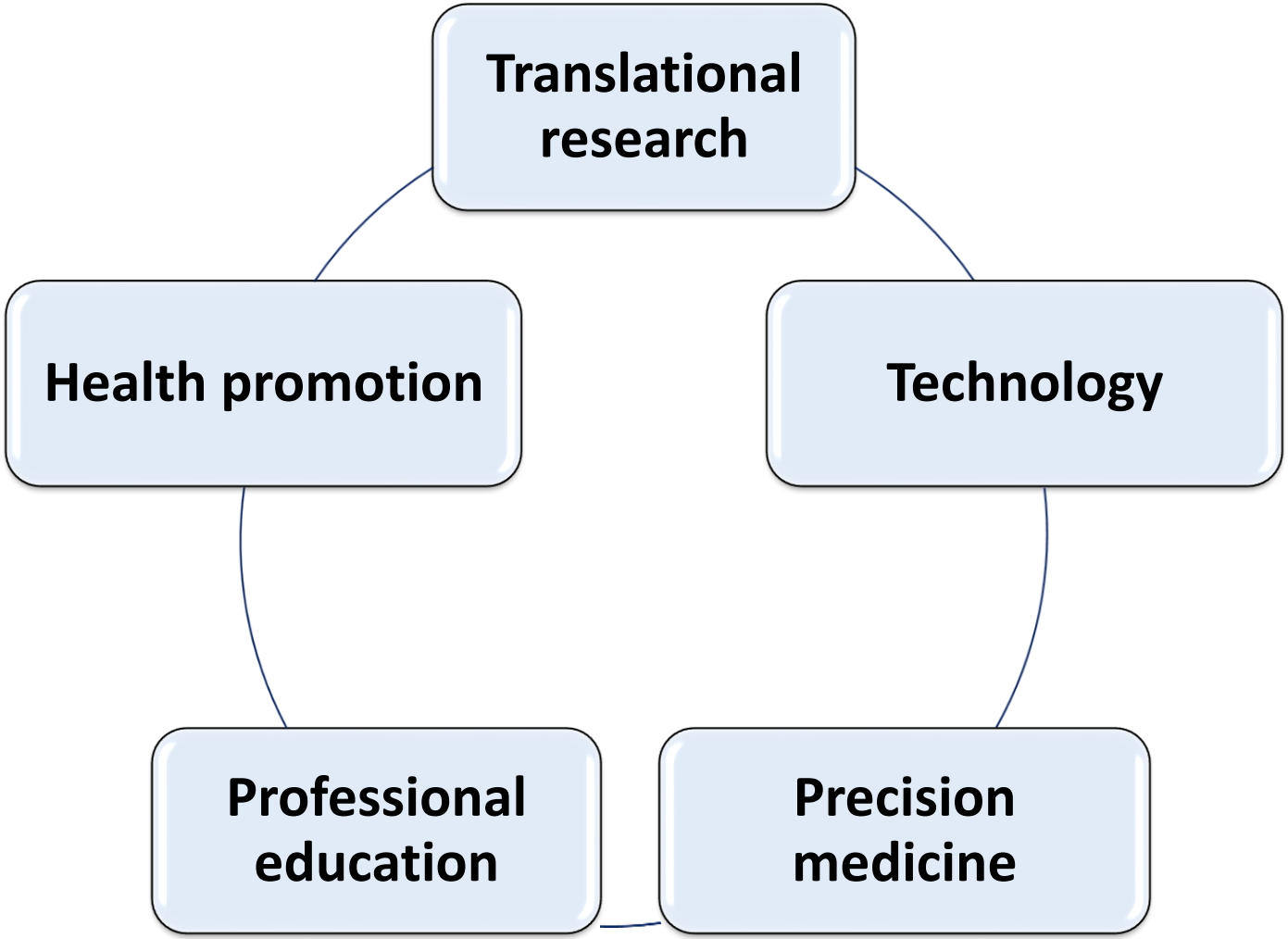


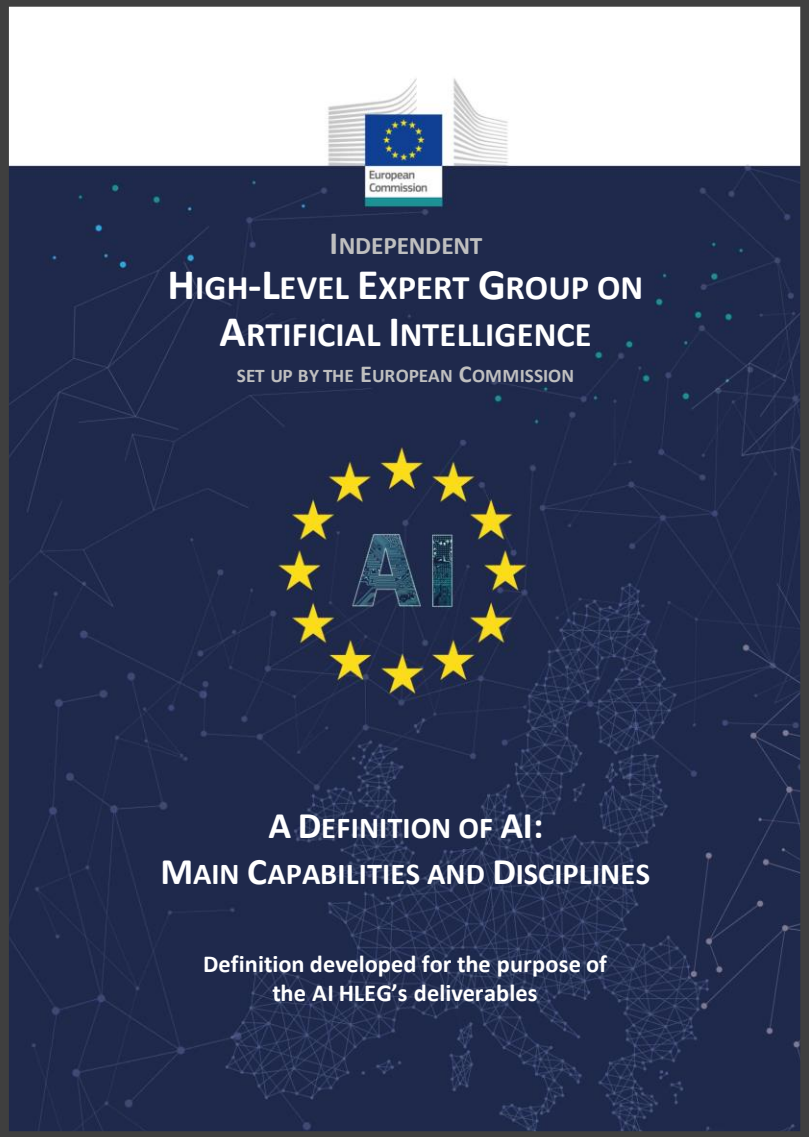

**Source:** Gray M (2011). How to Get Better Value Healthcare. Offox.

# Examples illustrating the taxonomy

| TECHNOLOGICAL | ORGANISATIONAL |
| --- | --- |
| • Antibiotic development<br>• Anti-ulcer drugs<br>• Minimal invasive surgery<br>• New and more effective treatment for HCV | • Community-based mental health<br>• Population based accountable organisations<br>• Integrated care |
| **PRODUCT AND SERVICES** | **HUMAN RESOURCES** |
| • Development of palliative care<br>• Patient-centred care | • Diabetic patient self-management |

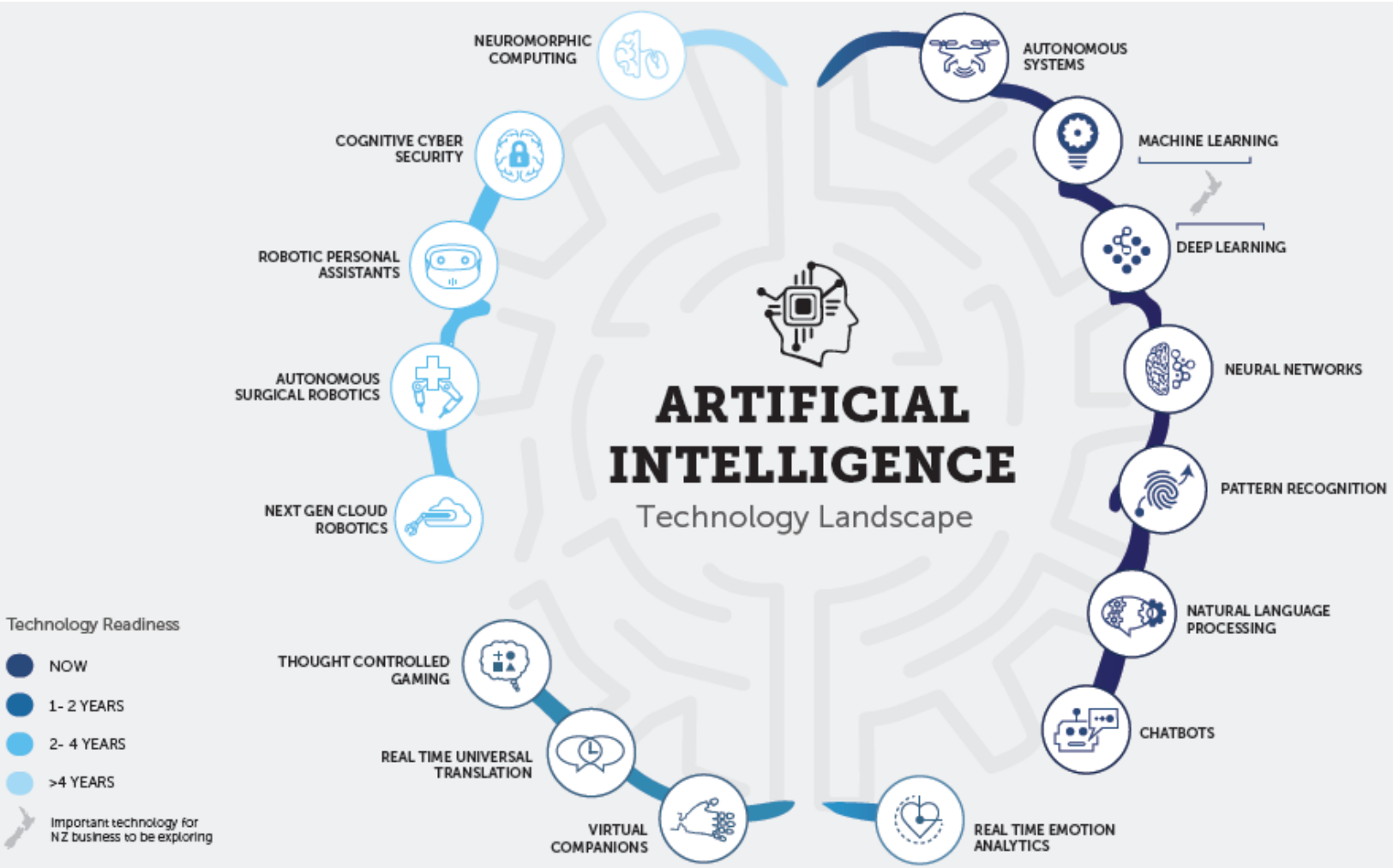
# 5 strategic areas for disruptive innovations






- AI refers to systems that display intelligent behaviour by analysing their environment and taking actions

- with some degree of autonomy
- to achieve specific goals




Sources:
Frost & Sullivan "Artificial Intelligence - R&D and Applications Road Map" (Dec 2016), Harvard Business Review - The competitive landscape for Machine Intelligence (Nov 2016), Shivon Zilis and James Chan "The State of Machine Intelligence, 2016" (2016), Stanford University. "Artificial Intelligence and Life in 2030" (2016), https://en.wikipedia.org/wiki/Artificial_intelligence (2017)

CallaghanInnovation

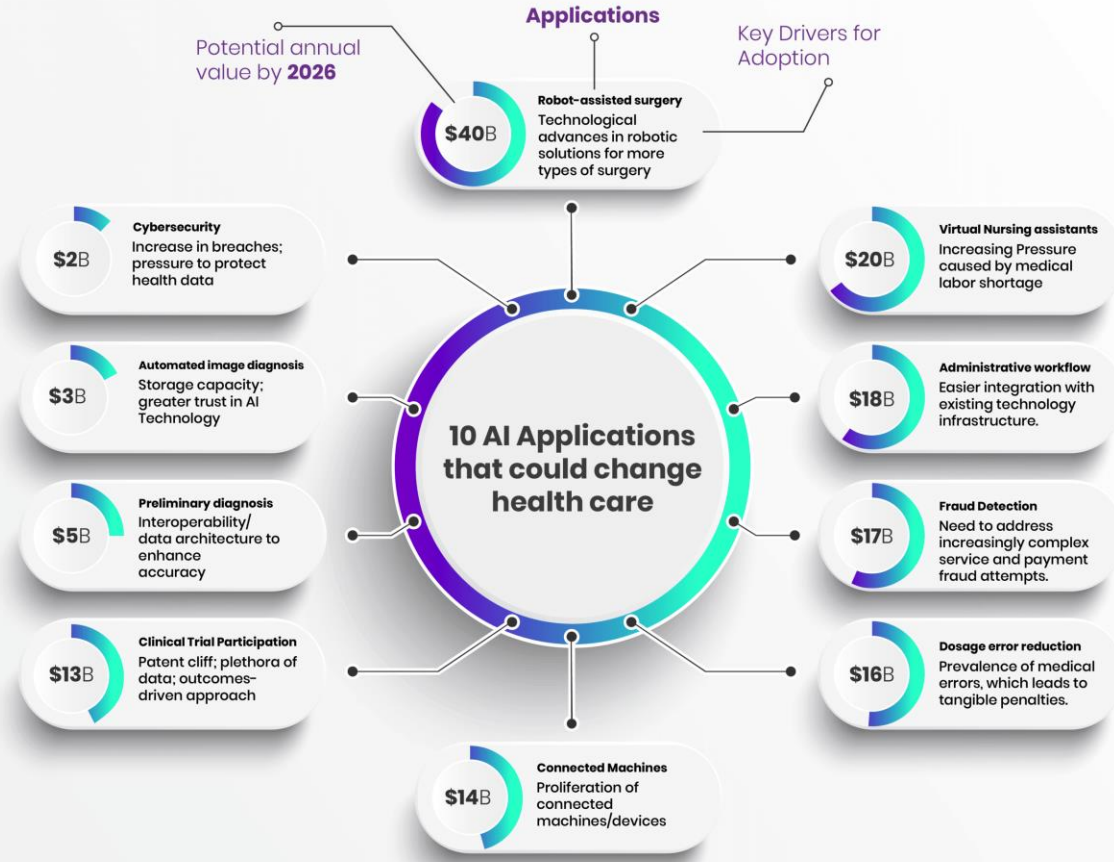
# Artificial Intelligence in Healthcare

Studies by **accenture** predict that growth in the AI healthcare space is expected to touch $6.6 billion by 2021 with a CAGR of **40%**

*The new technology aims to enhance interactions between patients and caregivers to both improve the consumer experience and reduce physician burnout.*

**AI** also holds promise for **helping** the healthcare industry **manage costly back-office problems** and **inefficiencies**. Activities that have nothing to do with patient care consume over **51%** of a **nurse's workload** and nearly **16%** of **physician activities**.

**AI-based technologies**, such as **voice-to-text transcription**, can **improve administrative workflows** and **eliminate time-consuming non-patient-care activities**, such as writing chart notes, filling prescriptions, and ordering tests. It is estimated that these **applications** could **save** the industry **$18 billion annually.**



# Artificial Intelligence in Healthcare can be deployed across these use cases

- Virtual Assistants for Staff
- Robot-Assisted Surgery
- Automated Image Diagnosis with AI/ML
- AI in Pathology
- Personal Health Companions Powered by AI
- Rare Diseases Detection with AI
- Oncology – Detecting Cancer with AI
- Cybersecurity Applications of AI in Healthcare
- AI-Powered Chatbots
- Medication Management with AI and ML
- Robots for Explaining Lab Results
- Health Monitoring with AI and Wearables

> **AI chatbots** in **healthcare** will be a **crawl-walk-run endeavor**, where the easier tasks will move to chatbots while **awaiting the technology** to **evolve** enough to **handle more complex tasks**

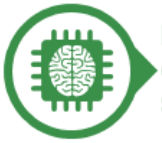
MARUTI TECHLABS

# Artificial Intelligence in healthcare: promising future, but barriers remain

## The future looks promising for AI-based automation …

New job creation

Opportunity to build advanced AI capabilities



Emergence of general AI to create a synthetic system as sophisticated as the human

Formulation of an AI regulatory framework

## … but barriers that restrict its universal acceptance remain

Absence of interoperability

Regulatory implications

Moral/ethical implications

Concerns about data privacy

Shortage of relevant and sufficient talent

Everest Group® Dr. Robot Will See You Now: Unpacking the State of Artificial Intelligence in Healthcare – 2019

The market will be **ACCELERATING** growing at a **CAGR** over **28%**

**INCREMENTAL GROWTH**

**$5.16 bn**


The year-over-year growth rate for **2019** is estimated at

**25.19%**

The market is **MODERATELY CONCENTRATED** with a few players occupying the market share

**49%** of the growth will come from **NORTH AMERICA**

One of the **KEY DRIVERS** for this market will be the **PUSH FOR DIGITALIZATION IN HEALTHCARE**

**READ THE REPORT:**

GLOBAL ARTIFICIAL INTELLIGENCE (AI) MARKET IN HEALTHCARE SECTOR

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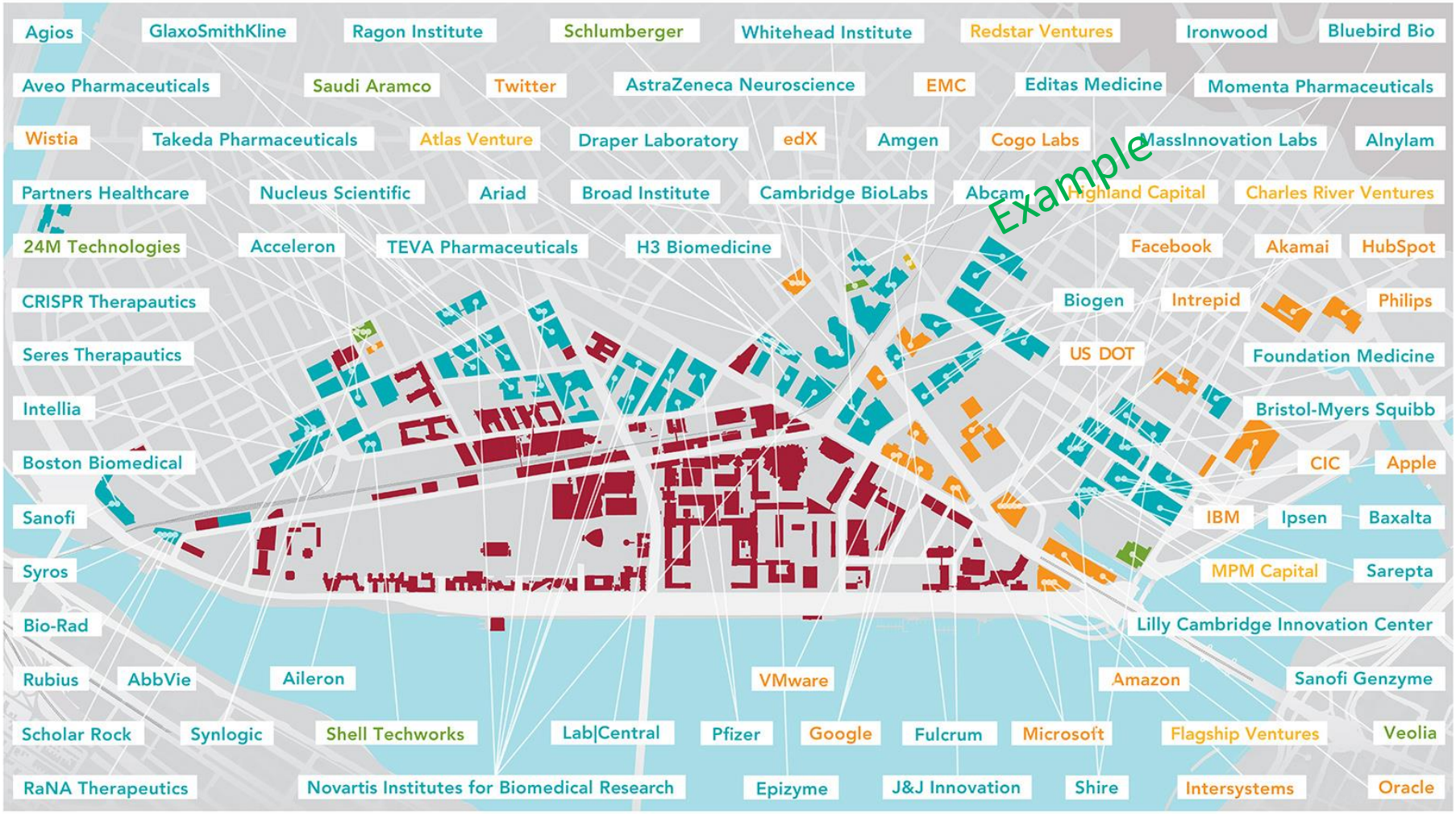
# The Kendall Square Technology and Innovation Cluster



# 90+ Healthcare AI Startups To Watch

## Imaging & Diagnostics

ablacon, aidence, aidoc, Healthy.io, PathAI, RadiomicsAI, Aillis, EXO, 深睿医疗 deepwise, 推想科技 infervision, sight, enlitic, EKAWIZARDS, freenome, JLK INSPECTION, zebra, BUTTERFLY Network, Inc., IBEX, IDx, SIGTUPLE, 数坤科技, ULTROMICS, PAIGE, VUNO, VoxelCloud, Lunit, VIZ

## Drug Discovery

Accutar Biotech, BenevolentAI, DIP 深度智耀, FINCH THERAPEUTICS, APEIRON, BlackThorn THERAPEUTICS, Frontier MEDICINES, insitro, Atomwise Better medicines faster., Exscientia DRIVEN BY KNOWLEDGE, engine BIOSCIENCES, JUVENESCENCE, Notable Labs, OWKIN, RECURSION pharmaceuticals, 药研社, Standigm, XtalPi, twoXAR, SPRING DISCOVERY

## Predictive Analytics & Risk Scoring

BenchSci, lu, 森亿智能 SYNYI·AI, saama, GNS HEALTHCARE, Medial EarlySign, TEMPUS, ikioo, medopad, Welltok, nference

## Genomics

DECIPHER BIOSCIENCES, SOPHIA GENETICS, Syntekabio, WuXiNextCODE

## Fitness

FINC, Vi

## Virtual Assistant

babylon, Curai, mfine, notable, buoy, K, Suki

## Hospital Decision Support

binaryfountain, Cardinal Analytx Solutions, Qventus, gauss, Olive, OM1, KenSci, NextHealth TECHNOLOGIES, LeanTaaS, Medical INFORMATICS

## Clinical Trials

deep lens, HEALTH[at]SCALE TECHNOLOGIES, teckro.

## Nutrition

NURITAS LIFE-CHANGING INGREDIENTS, WHOLE BIOME

## Remote Monitoring

biofourmis, ContinUse Biometrics, DENTAL MONITORING Connected orthodontics

## Compliance

DATAVANT, PROTENUS

## Mental Health

mindstrong

Created by You. Powered by CBINSIGHTS

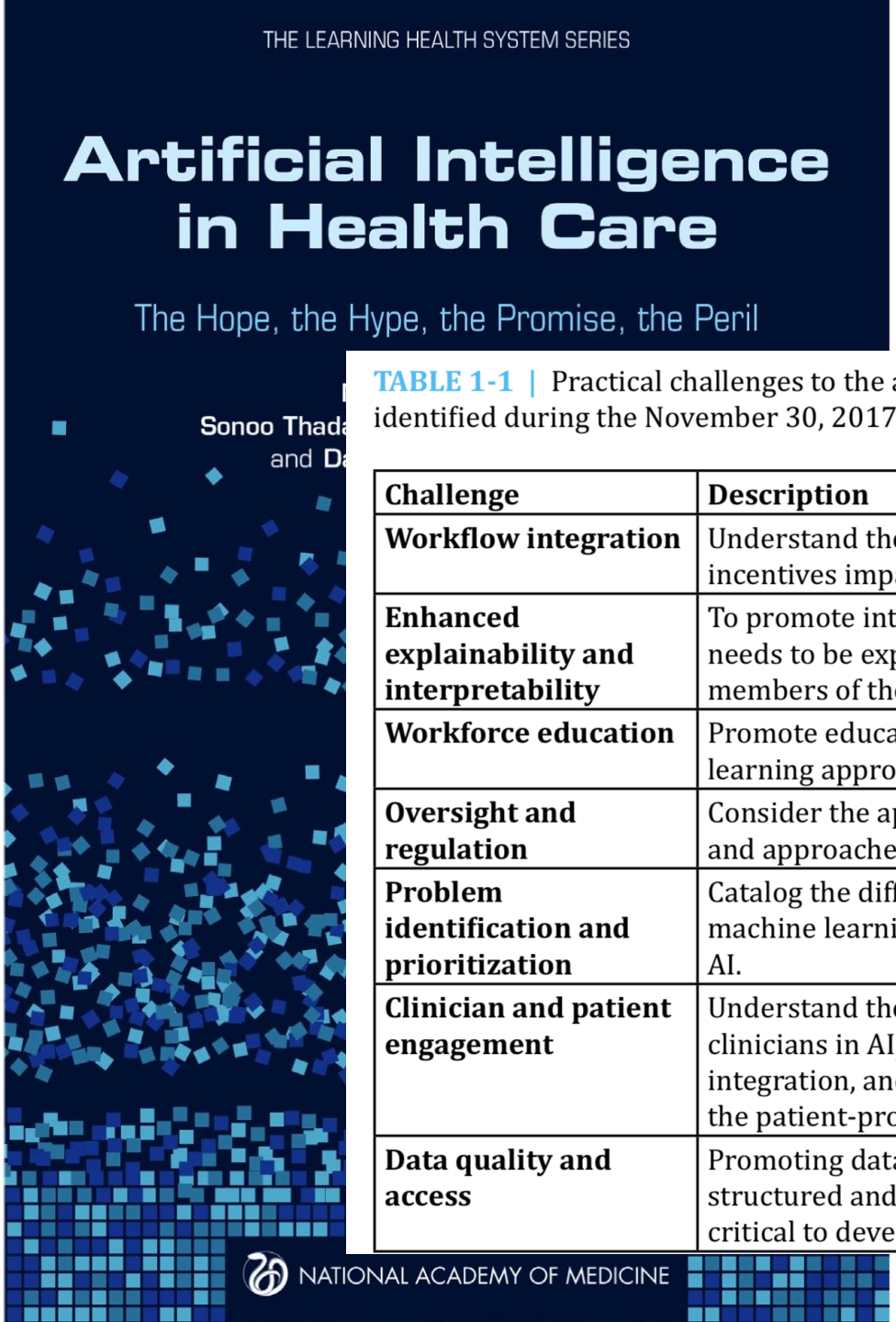



**TABLE 1-1** | Practical challenges to the advancement and application of AI tools in clinical settings identified during the November 30, 2017 Digital Health Learning Collaborative Meeting

| Challenge | Description |
|---|---|
| **Workflow integration** | Understand the technical, cognitive, social, and political factors in play and incentives impacting integration of AI into health care workflows. |
| **Enhanced explainability and interpretability** | To promote integration of AI into health care workflows, consider what needs to be explained and approaches for ensuring understanding by all members of the health care team. |
| **Workforce education** | Promote educational programs to inform clinicians about AI/machine learning approaches and to develop an adequate workforce. |
| **Oversight and regulation** | Consider the appropriate regulatory mechanism for AI/machine learning and approaches for evaluating algorithms and their impact. |
| **Problem identification and prioritization** | Catalog the different areas of health care and public health where AI/machine learning could make a difference, focusing on intervention-driven AI. |
| **Clinician and patient engagement** | Understand the appropriate approaches for involving consumers and clinicians in AI/machine learning prioritization, development, and integration, and the potential impact of AI/machine learning algorithms on the patient-provider relationship. |
| **Data quality and access** | Promoting data quality, access, and sharing, as well as the use of both structured and unstructured data and the integration of non-clinical data is critical to developing effective AI tools. |


NYU
Hea
gone

# A road-map for transformation: The NYU Langone Story

| KPI | 2007 | 2019 |
|---|---|---|
| QUALITY & SAFETY RANKING ON 90 HOSPITALS | # 60 | # 2 |
| MEDICAL SCHOOL RANKING | # 34 | TOP 10 |
| PROFIT PERFORMANCE | LOSS 150 Mio $ | GAIN 240 Mio $ |

Gemelli

Fondazione Policlinico Universitario Agostino Gemelli IRCCS
Università Cattolica del Sacro Cuore

PROGETTO DIREZIONE

DIGITAL INNOVATION & CHANGING PROCESS

# Conclusions

**Artificial intelligence**

**can be an important instrument**

**can provide a new and different perspective that tends to reduce complexity in favour of the empowerment of the citizen/patient**

**should be seen by policy makers as possible new methods of dealing with old issues**

**Health systems should be responsive to innovations and allow promising disruptive innovations to be tested, evaluated, and implemented. This requires the presence of responsive and open-minded systems**

**There may not be a “one size fits all” solution for monitoring, managing and stimulating the adoption of disruptive innovations**

Thank you for your attention