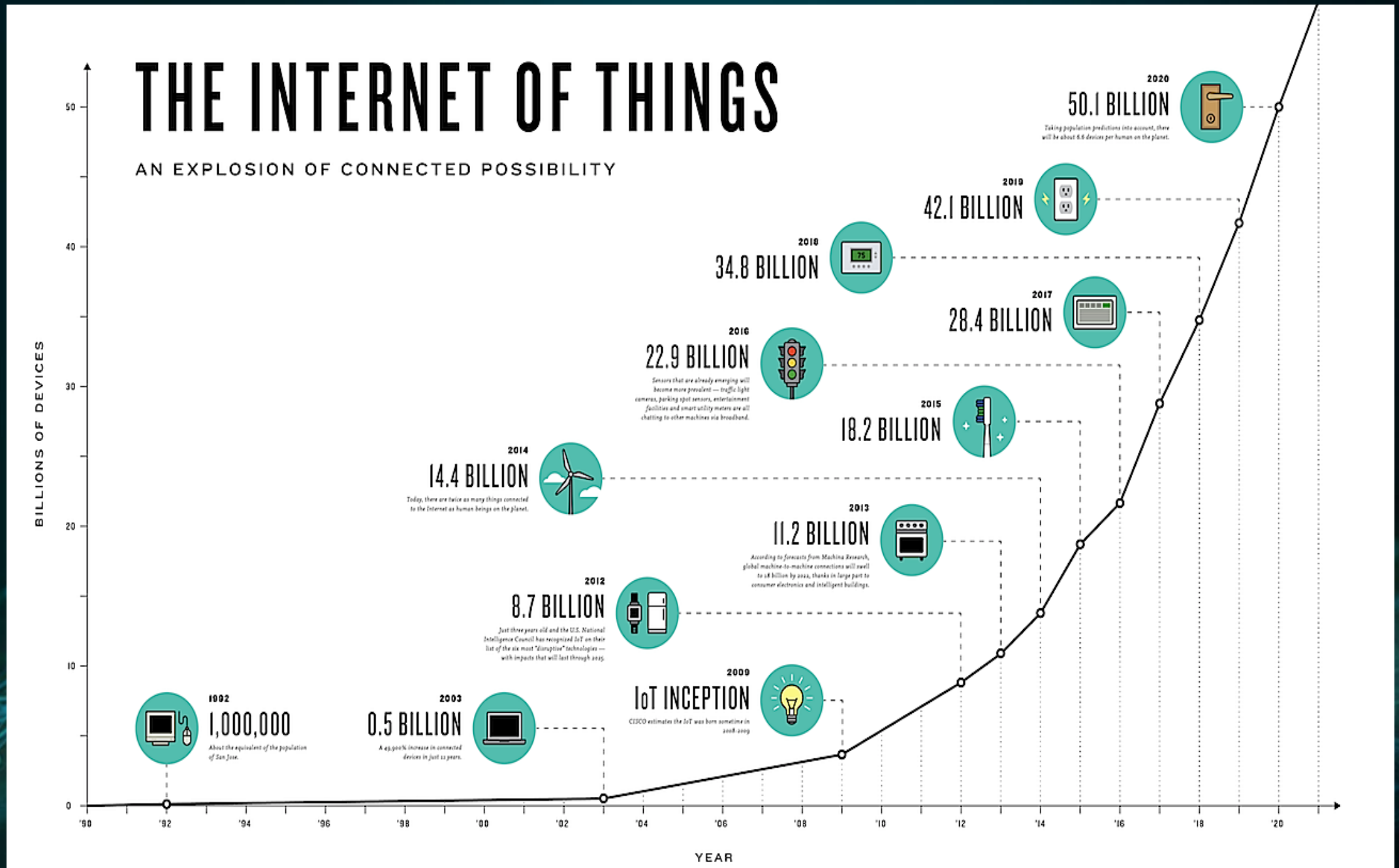
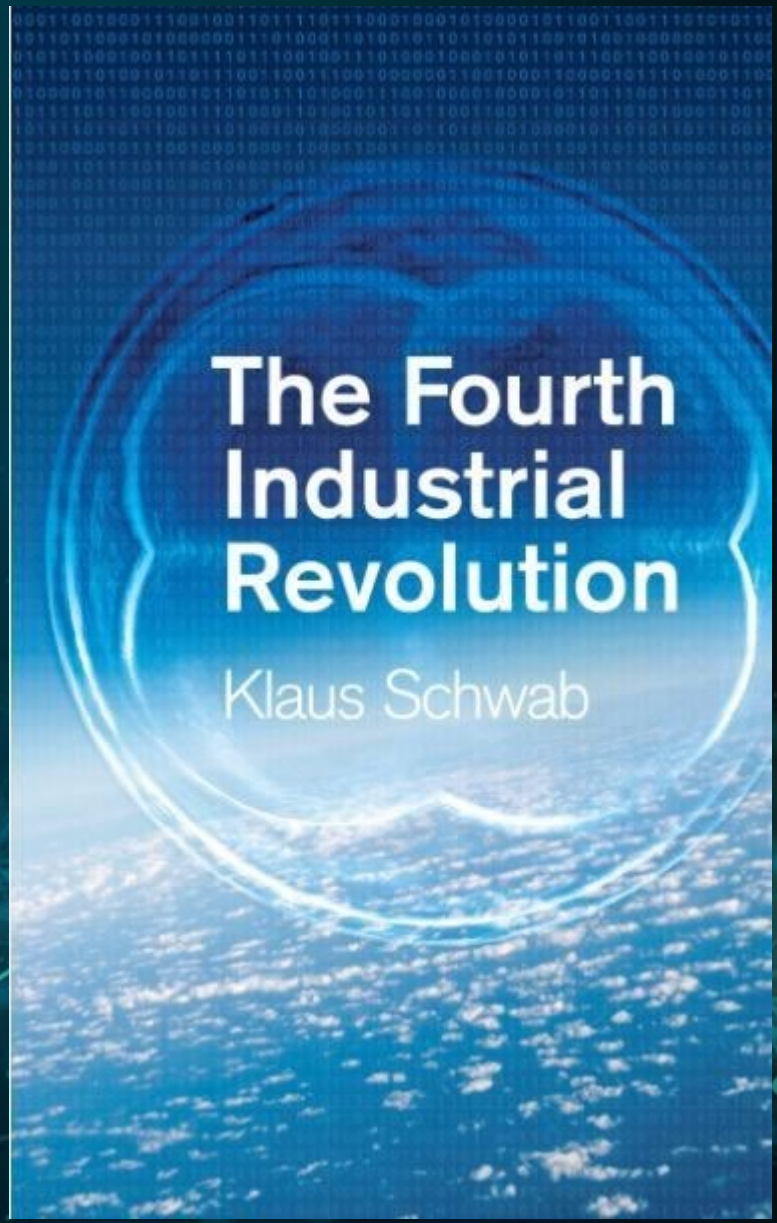
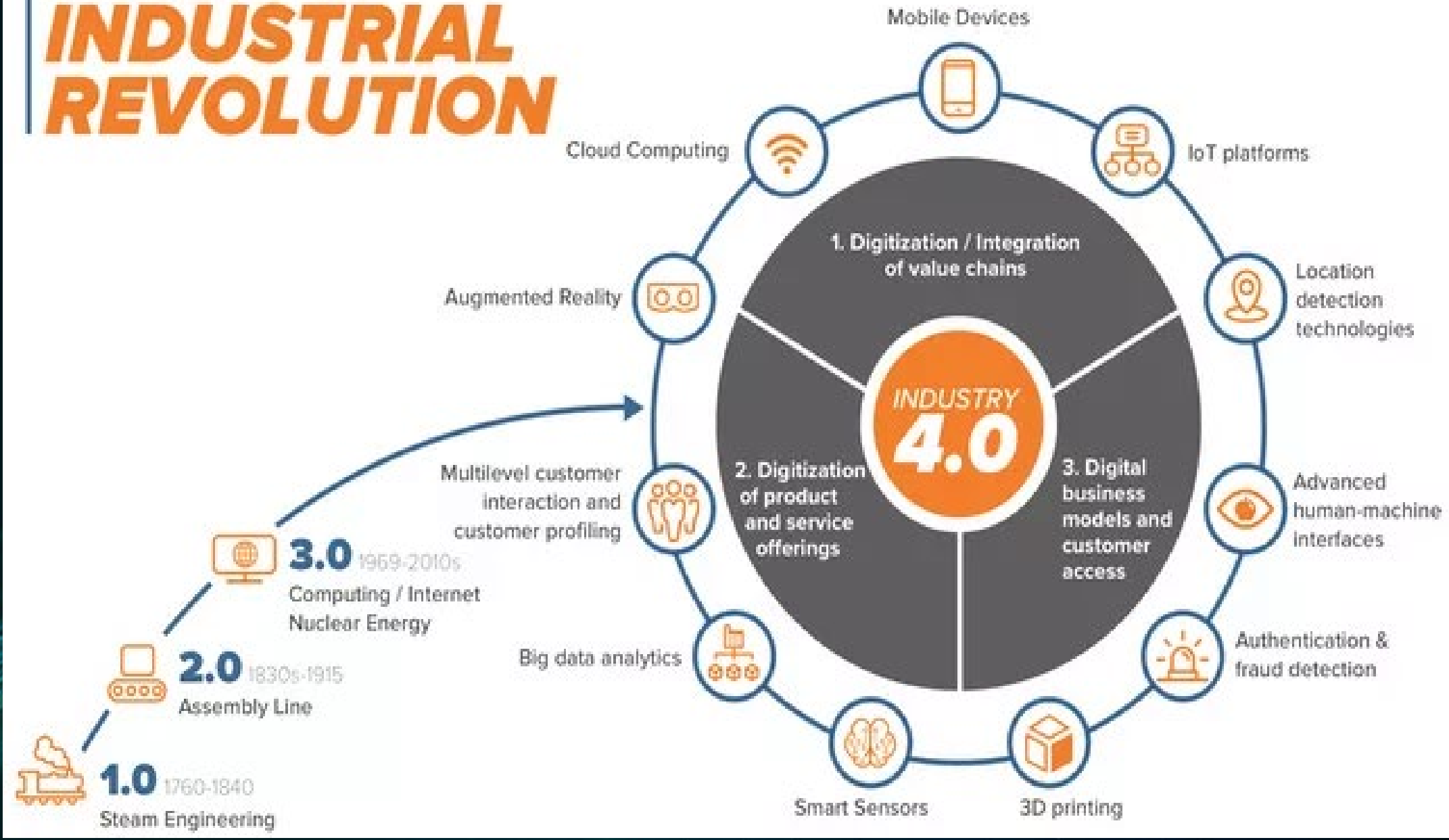
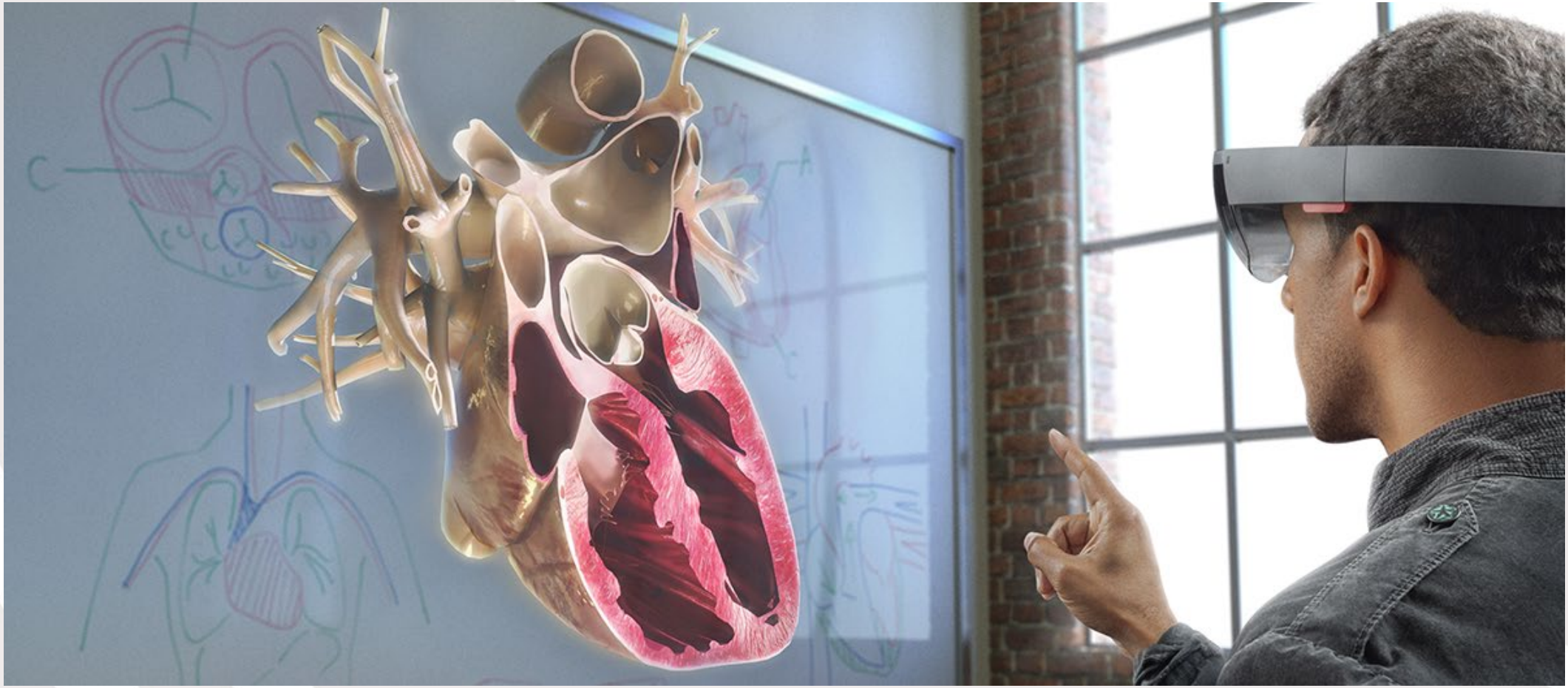

THE INTERNET OF THINGS
AN EXPLOSION OF CONNECTED POSSIBILITY
BILLIONS OF DEVICES
YEAR
0
10
20
30
40
50
'90
'92
'94
'96
'98
'00
'02
'04
'06
'08
'10
'12
'14
'16
'18
'20
1992
1,000,000
About the equivalent of the population of San Jose.
2003
0.5 BILLION
A 49,900% increase in connected devices in just 12 years.
2009
IoT INCEPTION
CISCO estimates the IoT was born sometime in 2008-2009
2012
8.7 BILLION
Just three years old and the U.S. National Intelligence Council has recognized IoT on their list of the six most "disruptive" technologies — with impacts that will last through 2025.
2013
11.2 BILLION
According to forecasts from Machina Research, global machine-to-machine connections will swell to 18 billion by 2024, thanks in large part to consumer electronics and intelligent buildings.
2014
14.4 BILLION
Today, there are twice as many things connected to the Internet as human beings on the planet.
2015
18.2 BILLION
2016
22.9 BILLION
Sensors that are already emerging will become more prevalent — traffic light cameras, parking spot sensors, entertainment facilities and smart utility meters are all chatting to other machines via broadband.
2017
28.4 BILLION
2018
34.8 BILLION
2019
42.1 BILLION
2020
50.1 BILLION
Taking population predictions into account, there will be about 6.6 devices per human on the planet.


Mechanization, steam and water power
INDUSTRY 1.0
Mass production and electricity
INDUSTRY 2.0
Electronic and IT systems, automation
INDUSTRY 3.0
Cyber physical systems
INDUSTRY 4.0


The Fourth Industrial Revolution
Klaus Schwab

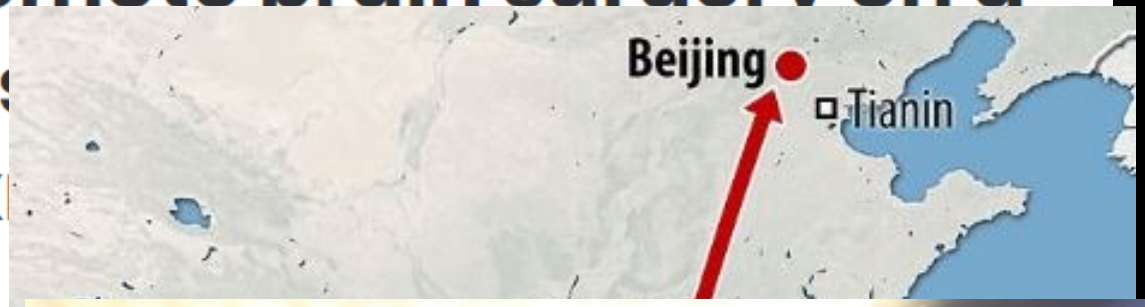
FOURTH INDUSTRIAL REVOLUTION





Chinese surgeon performs 'world first' remote brain surgery on a Parkin 3,000k

March 18, 2019



Hancock: NHS is world's biggest opportunity for saving lives through technology

By Sally Wardle, Press Association Health and Science Correspondent

PA Tech 6 September 2018

DH Department of Health

Saws and Scalpels to Lasers and Robots – Advances in Surgery

Clinical Case for Change: Report by

Professor Sir Ara Darzi, National Advisor on Surgery

How and where surgery is provided by the NHS must develop to follow the most modern clinical practices. This means we must localise surgical care where possible and centralise it where necessary.

2007

ABOUT THE COMMISSION

- Established by RCS autumn 2017
- Looked at what surgery & healthcare will look like in 5-20 years
- A lot of reports have reviewed specific innovations e.g. AI or robotics. The Commission brought all the changes together.


Mr Richard Kerr
Chair


Ms Nadine Hachach-Haram


Dr Liam O'Toole


Professor Guang-Zhong Yang


Professor Sir Nick Black


Professor Dion Morton


Professor Sue Clark


Dr Will Cavendish


Professor Rajesh Chopra


Dr Gill Gaskin


Professor Tony Young


Ms Ros Levenson

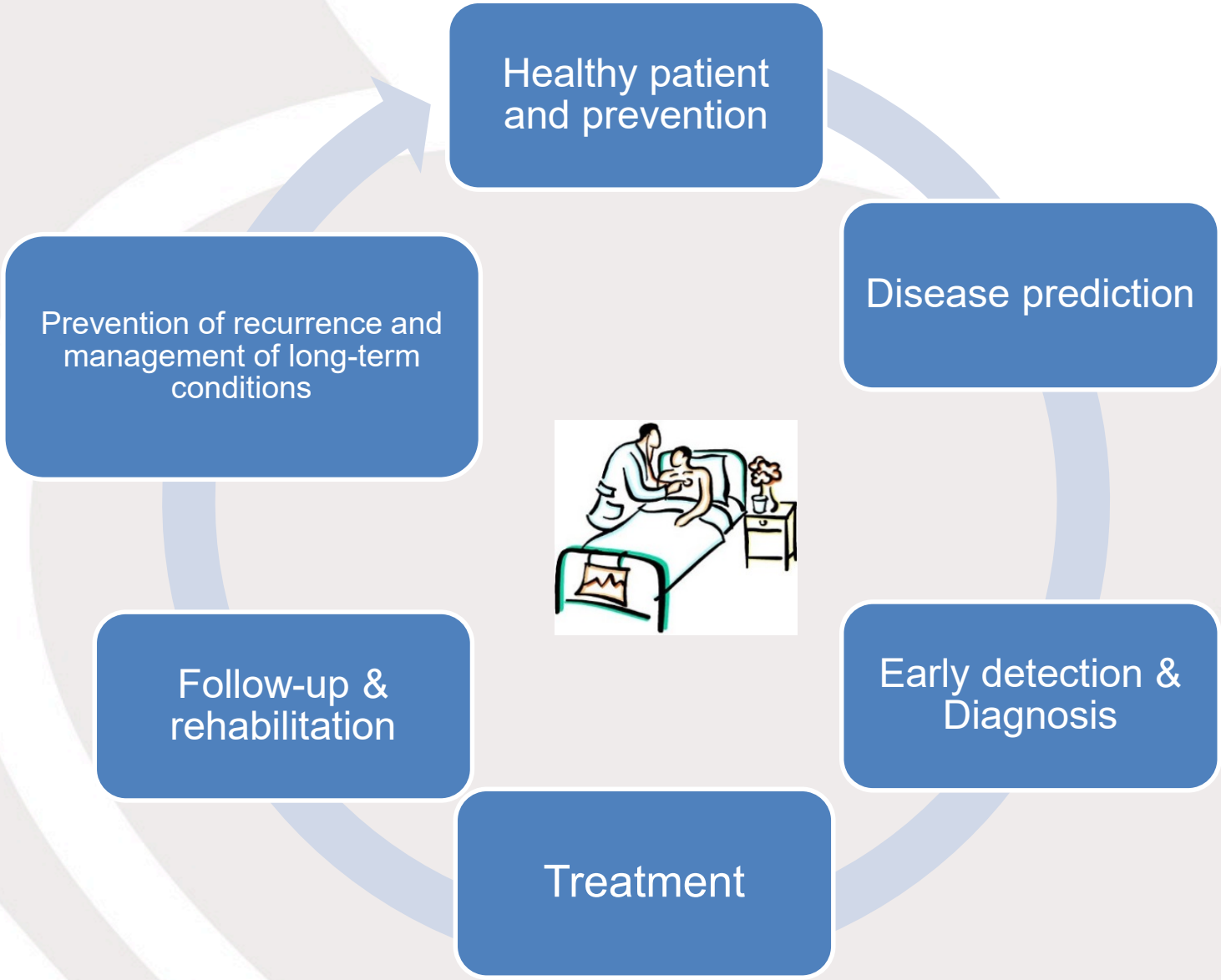

Mr Adrian Sugar

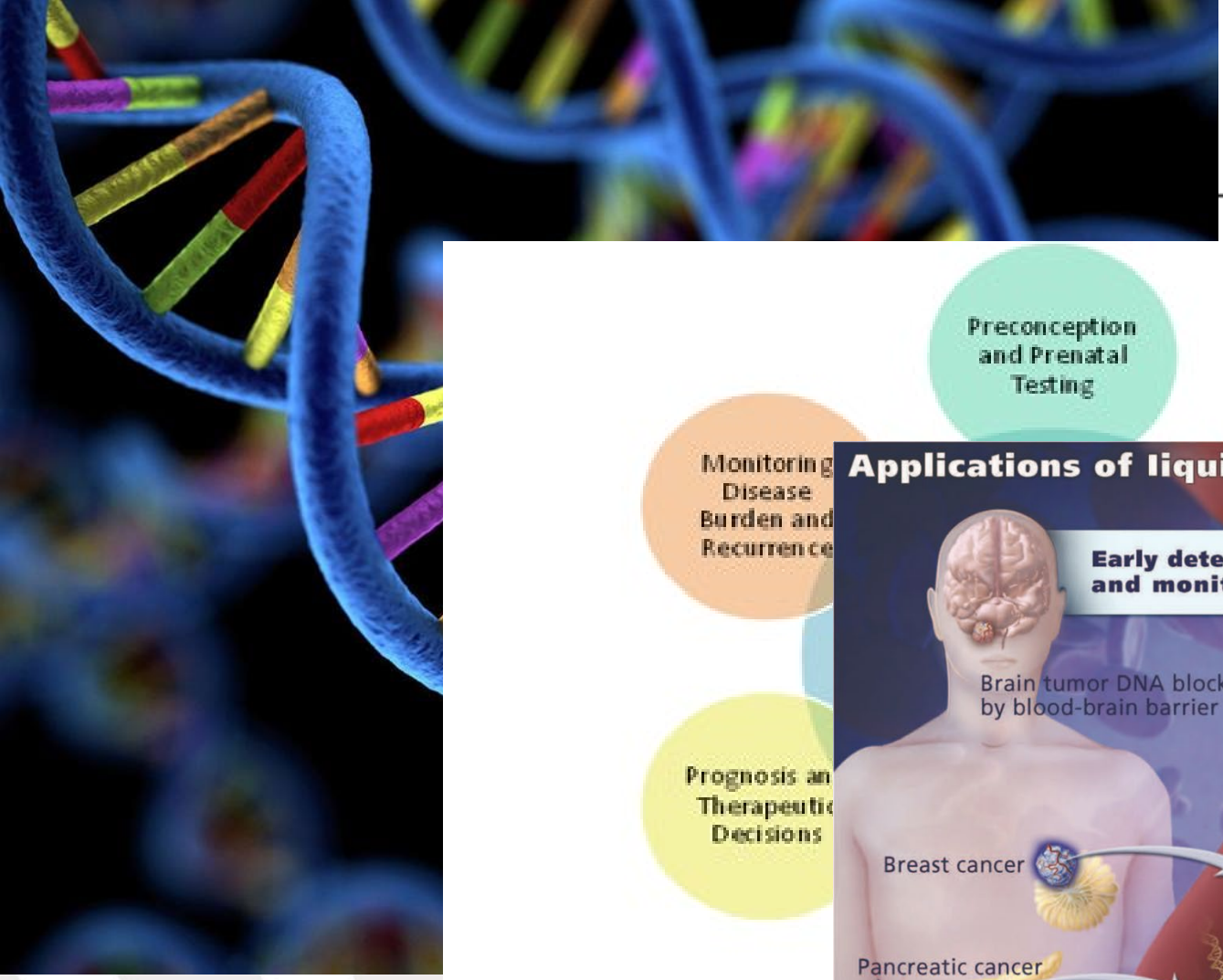

Miss Lorna Marson

MAIN FINDING: HOW SURGERY WILL CHANGE

- Next phase of medicine/surgery driven by rapid advances in **digital technology** and **biological understanding & treatments**
- Will affect every type of surgery, training, and the delivery of care
- Surgery will become even safer & less invasive with surgical teams using a wider range of interventions
- Commission has identified four key technologies:
  - Genomics & big data
  - Imaging, simulation, AR, and VR
  - Robot assisted and minimally-invasive surgery
  - Specialised interventions

Changing patient's journey



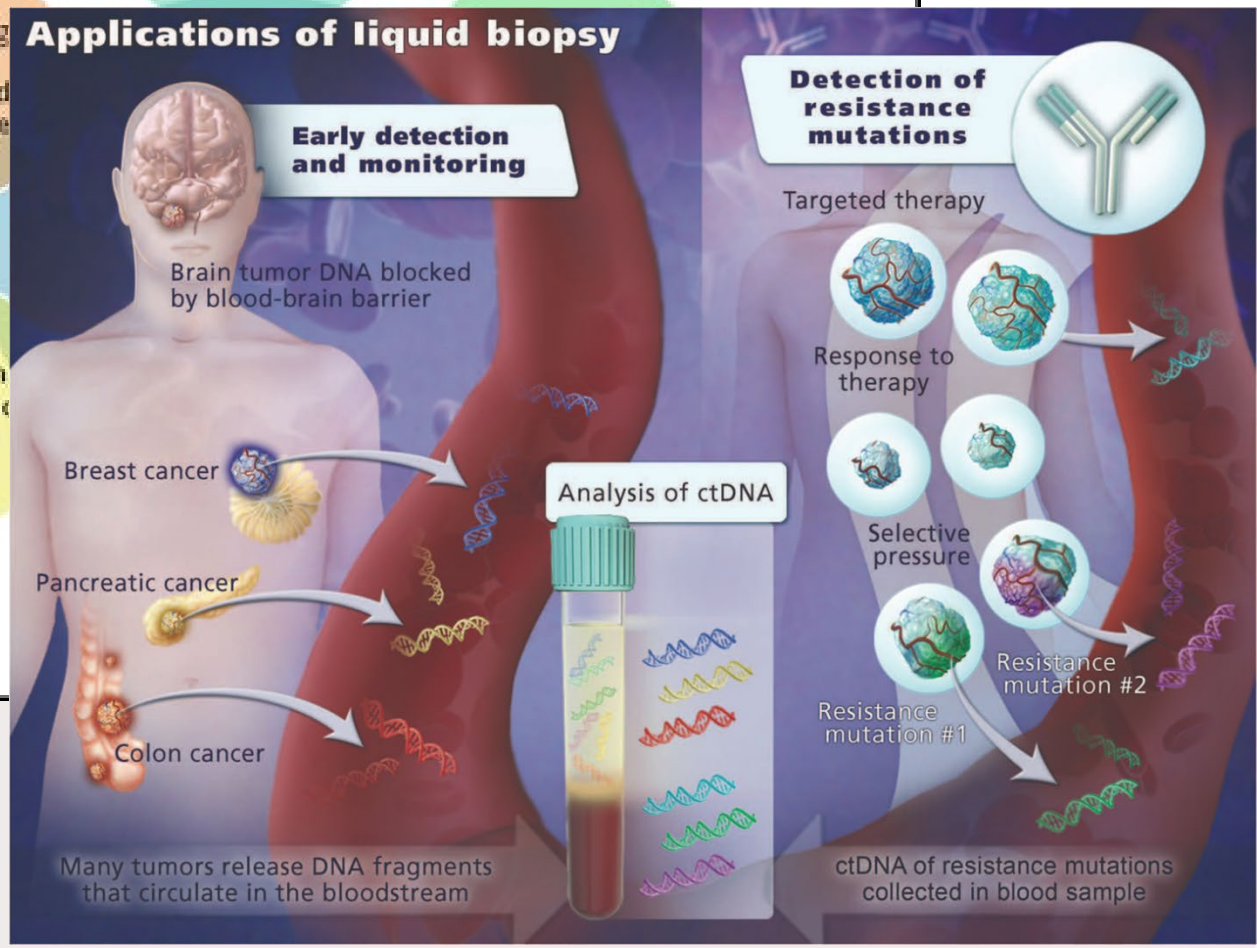


RCS

Preconception and Prenatal Testing

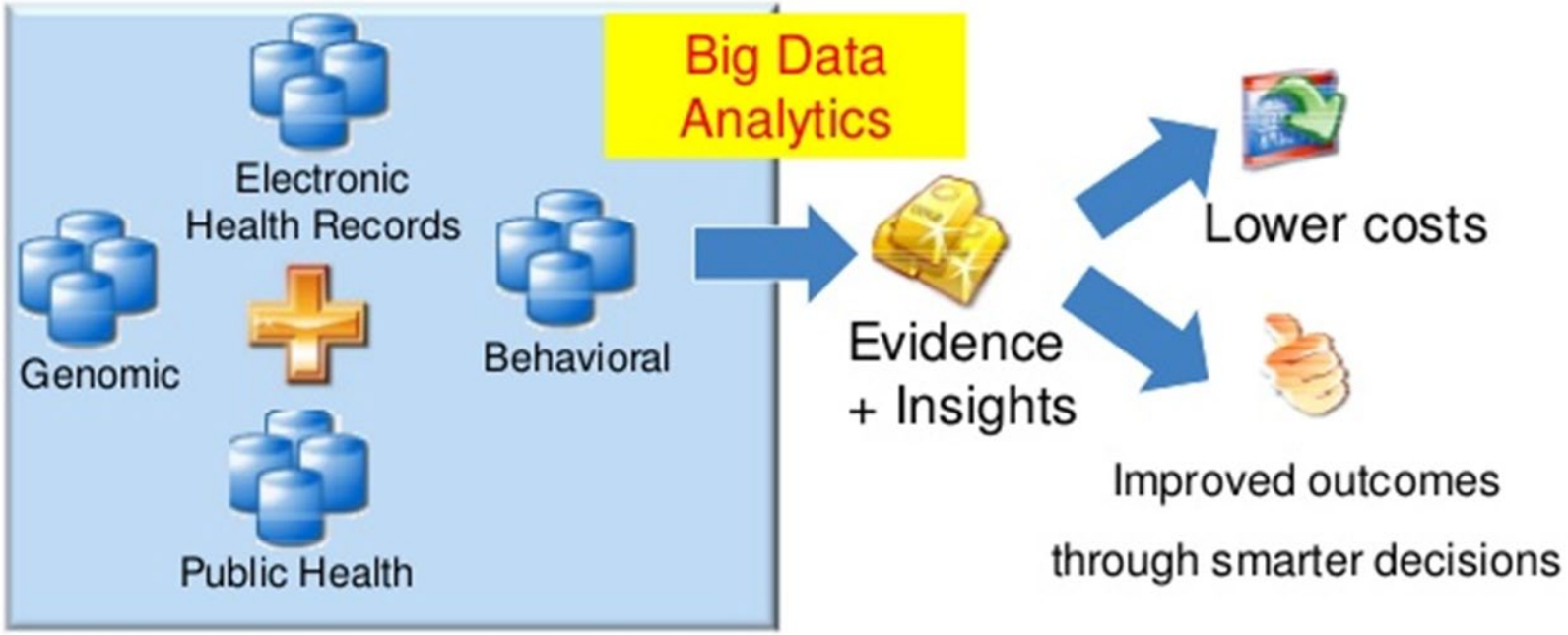
Monitoring Disease Burden and Recurrence

Prognosis an Therapeutic Decisions



Genomics england

Overall Goals of Big Data Analytics in Healthcare



GOAL: Provide Personalized care through right intervention to the right patient at the right time.

What are the benefits/ risks of RAS?

- A
- A
- V
  r
- F
- T
- F
- L
- LESS VARIATION in outcome

se

ted

SPECIALISED INTERVENTIONS

- Certain novel interventions may reach clinical application.
    - E.g. some stem-cell therapies, 3D-bioprinting of tissues and organs, & neural prosthetics
- Artificial organs: e.g. bile ducts (easier to replicate). Plus potential for animal-human transplants.
- Novel treatments are likely to become increasingly dependent on collaborative highly specialised teams
    - More diverse teams – e.g. engineers, chemists, bioinformaticians

Open Bionic

Most common procedures over 5 years

Procedures	Volume
Cataract	2 million
Femoral Fracture	510k
LSCS	500k
Arthoscopy	422k
Cholecystectomy	400k
Hernia	392k
TKR	390k
Spinal surgery	287k

5 year and 10-20 year changes in Cataract Surgery

5 year changes

- Increasing demand given population demographics
- AI diagnosis increasing
- Improved lens design – Smart lenses
- AR platforms for training
- Specialisation of surgeons

10 – 20 year changes

- Continuing increase in demand
- AI diagnosis routine
- Robot assisted surgery
- Remote surgery / AR
- Stem cell therapy for lens replacement

MAIN BENEFIT TO PATIENTS

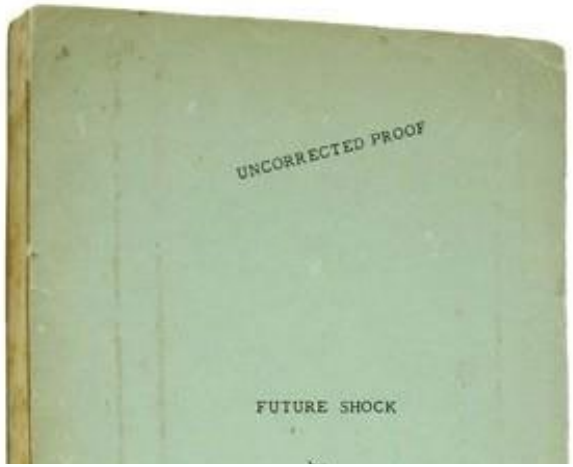
- Less invasive, and even more accurate surgery
  - Faster recovery times & lower risk of harm (organ sparing surgery)
  - Smaller difference in performance between surgeons
- Treatments driven by access to data & personal choice
- Alternative interventions may mean fewer operations for e.g. some types of cancer
  - Better integrated stages of treatment for patients
- Easier to operate on older, frail patients
  - Wider access to surgical treatments
- Move towards earlier diagnosis and preventive surgery on the ‘well’
  - Surgery will potentially prevent, not just treat, illness
  - Organ sparing surgery rather than organ removing

HOW THE SURGEON WILL CHANGE

- Surgical career may become less distinct & more flexible
- Surgeons will need to become ‘multi-linguists’, offering multiple treatment options – surgery or non-surgery (or both)
- Team-working (training) even more important in future
- Greater role for non-surgeons
  - Advanced robotics may allow non-surgeons with appropriate expertise to conduct operations with surgeon oversight

THE FUTURE SURGICAL TEAM

- Complex, specialised interventions will require specialist teams
- Continuing need for a large surgical workforce to meet demand
- Competency based treatment delivery

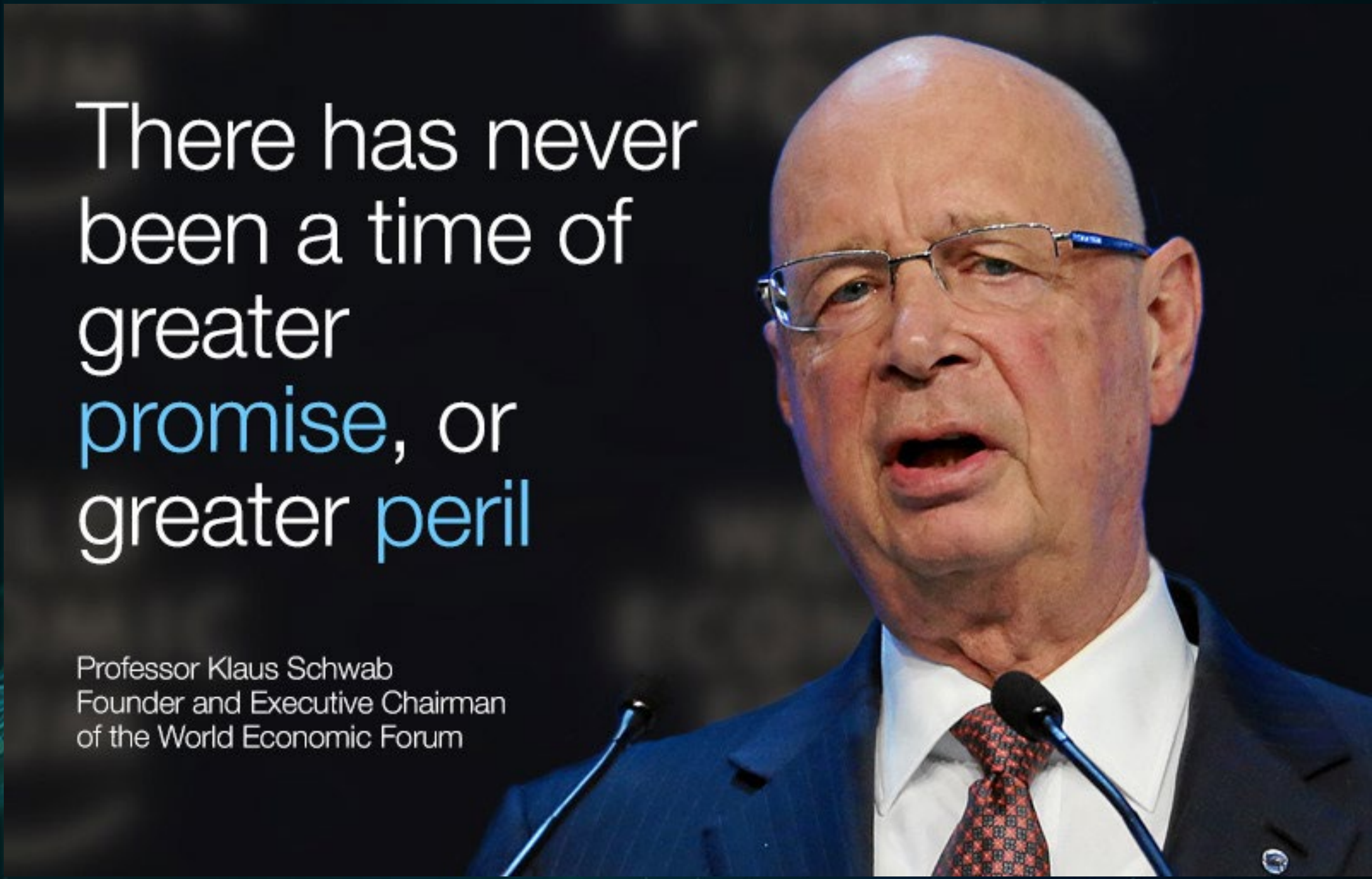


> *Alvin Toffler in his book Future Shock (1970) posited that "The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn".*

Education and Training

Royal College of Surgeons
ADVANCING SURGICAL CARE

- Surgical Curriculum – review / agility of change
- Knowledge of IT, data, engineering, genomics, team working, human factors etc
- Acceptance of training / career flexibility
- Importance of mentoring / proctoring
- Whole workforce
- Time allocated for change in training
- Entrance to med school – diversity of backgrounds


There has never been a time of greater promise, or greater peril
Professor Klaus Schwab
Founder and Executive Chairman
of the World Economic Forum

RCS Future of Surgery Commission:
A College perspective shaped by research

- Teaching and Training
  - Curriculum change, Methods of learning, Teams
- Standards
  - New devices, New techniques
- Patterns of care
  - Drive to early / preventative / organ sparing surgery
- Regulation and review
  - IRM, NICE, GMC, CQC
- Research and data collection / analysis
  - Forefront of driving future advances in surgical care


Az Damiaan

J. Weizenbaum. Computer Power and Human Reason. San Francisco: W.H. Freeman, 1976

'DECIDING AND CHOOSING'

There are some things people come to know only as a consequence of having been treated as human beings by other human beings.[11]

Compassion, empathy and the human touch.....