FACULTEIT INGENIEURSWETENSCHAPPEN EN ARCHITECTUUR

"EEN *INGENIEURSBLIK* OP DATAWETENSCHAPPEN EN GEZONDHEID"

Prof.dr. Ir. Pascal Verdonck

UNIVERSITEIT GENT

Belgische Vereniging van Ziekenhuisdirecteurs v

EUROPEAN ASSOCIAT OF HOSPITAL MANAG

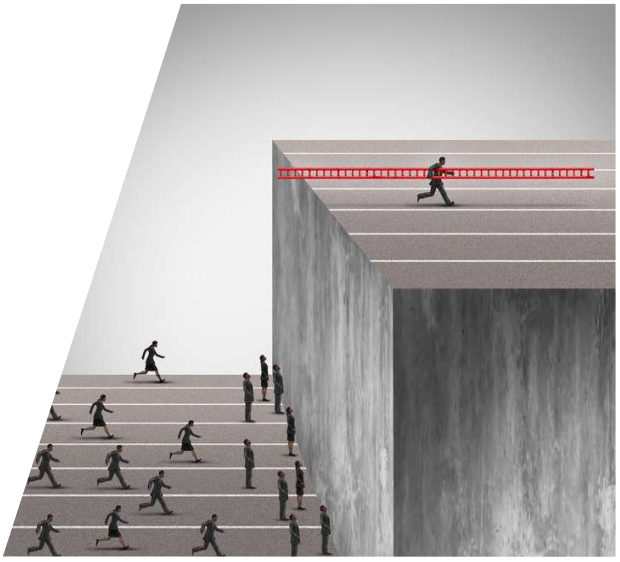
VAN "HOF" NAAR "FOH"

INNOVEREN IN DE GEZONDHEIDSZORG

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

INNOVEREN IN DE GEZONDHEIDSZORG

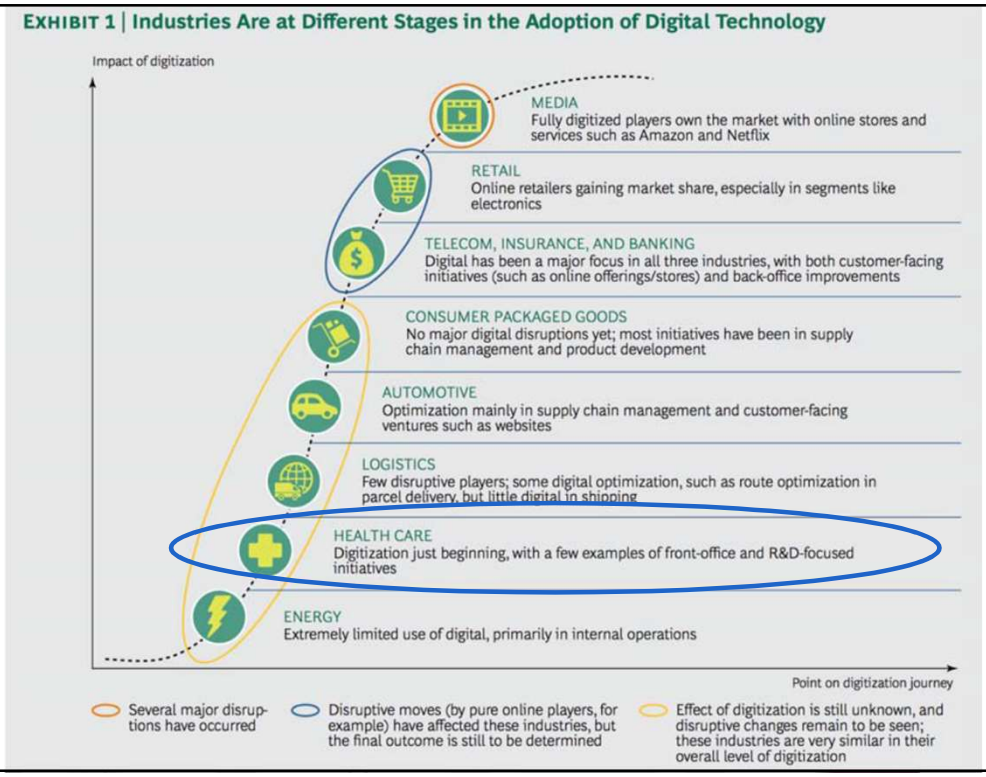
Uitvoering van een *nieuw* idee
als antwoord
op een uitdaging
met *toegevoegde waarde* voor
patiënt, organisatie
en samenleving



GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

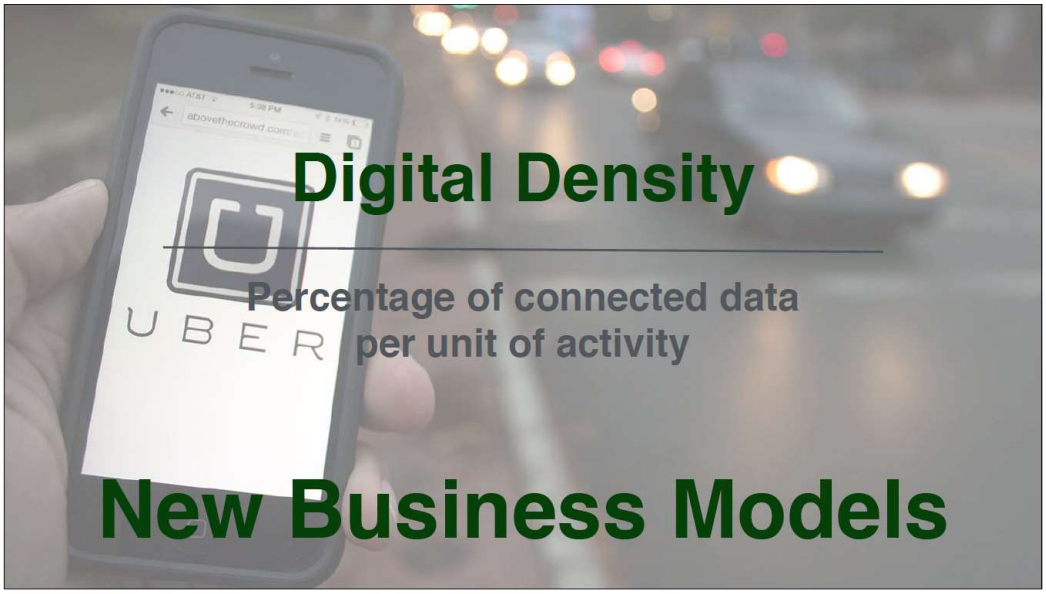
INNOVEREN IN DE GEZONDHEIDSZORG

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE



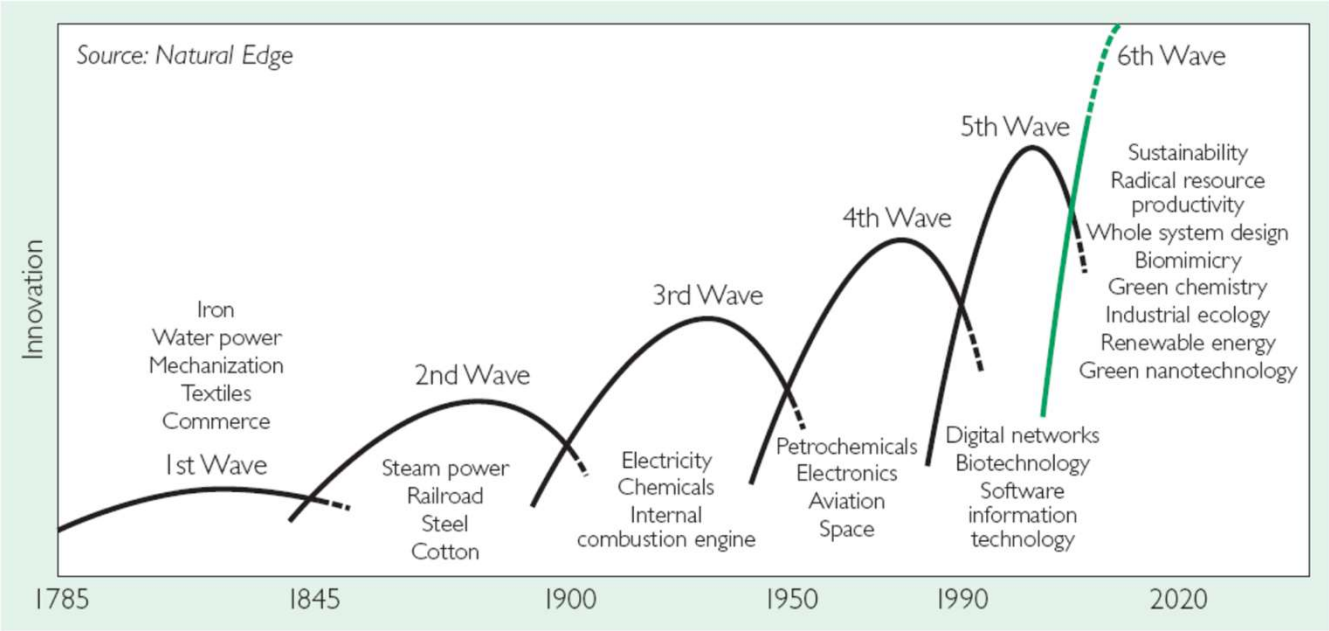
GHENT UNIVERSITY

Digitale dichtheid!

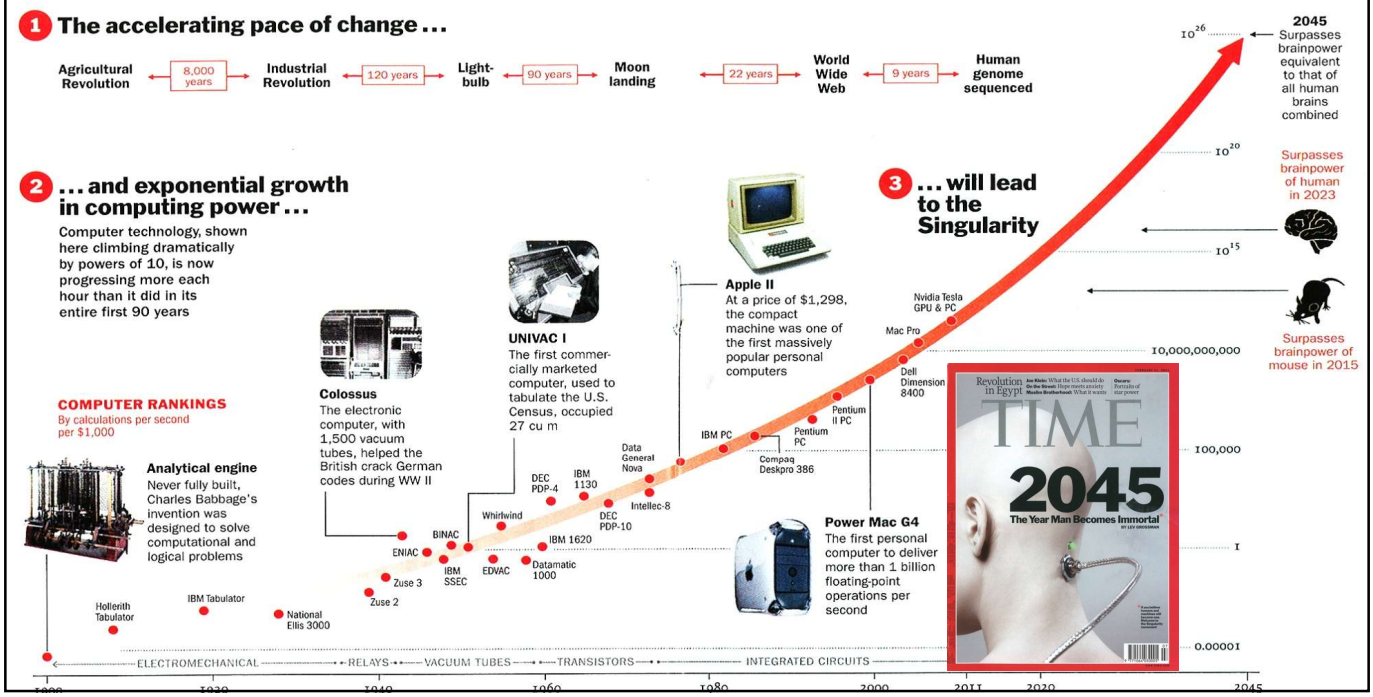


GHENT UNIVERSITY

IMPACT INNOVATIEGOLVEN



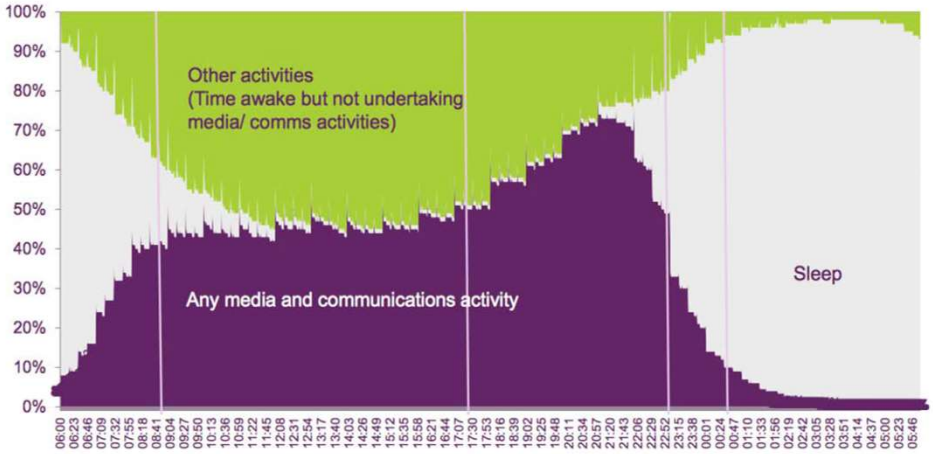
SINGULARITEITSPUNT 2045



"MORE THAN 9 BILLION CELL PHONES"

UNIVERSITEIT GENT

Figure 1.6 **Proportion of media and communications activities across the day**



Across all UK adults, on average:
Media and comms activity = 8hrs 41mins/ **Sleep** = 8hrs 21mins/ **Other activities (non-media)** = 6hrs 58mins

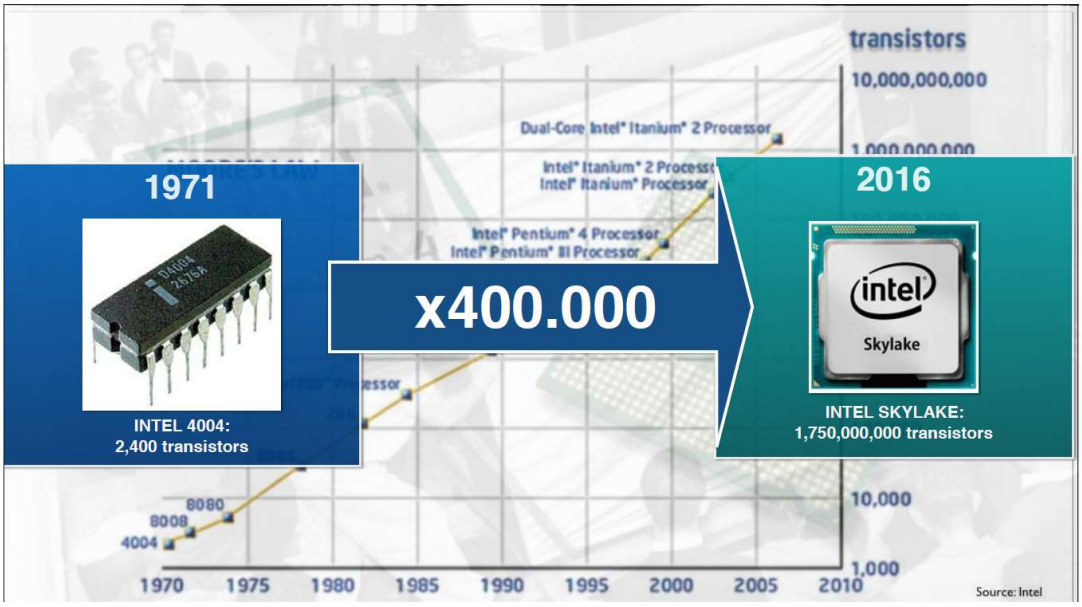
UNIVERSITEI GENT

Source: Digital Day 7-day diary
Base: All minutes (14021) for each day, all adults 16+ (1644)

BELANG VAN TECHNOLOGIE

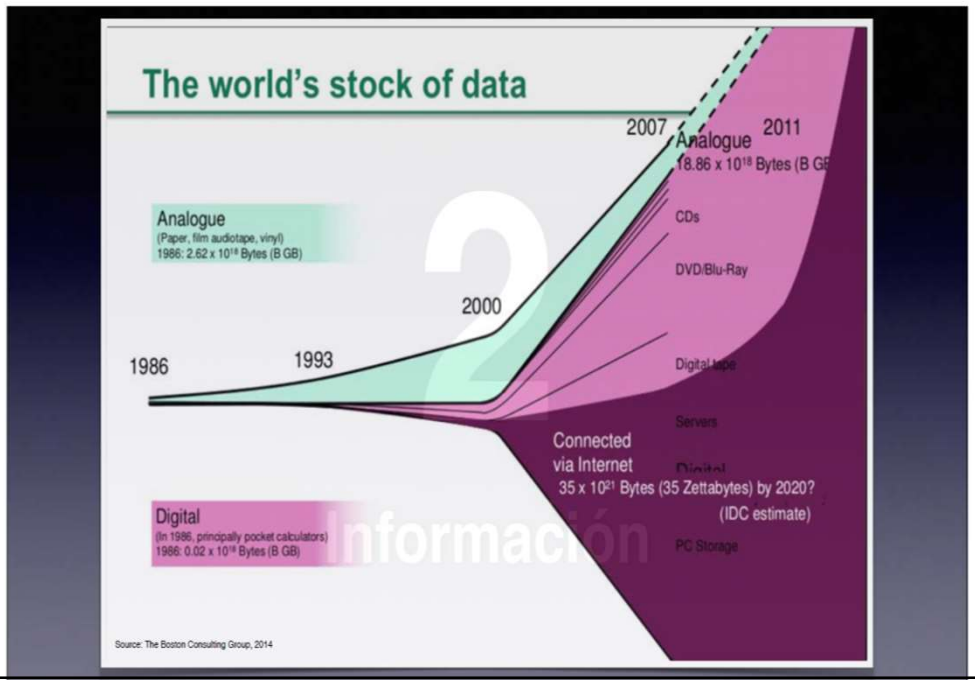
UNIVERSITEI GENT

(1) SNELHEID VAN COMPUTERS



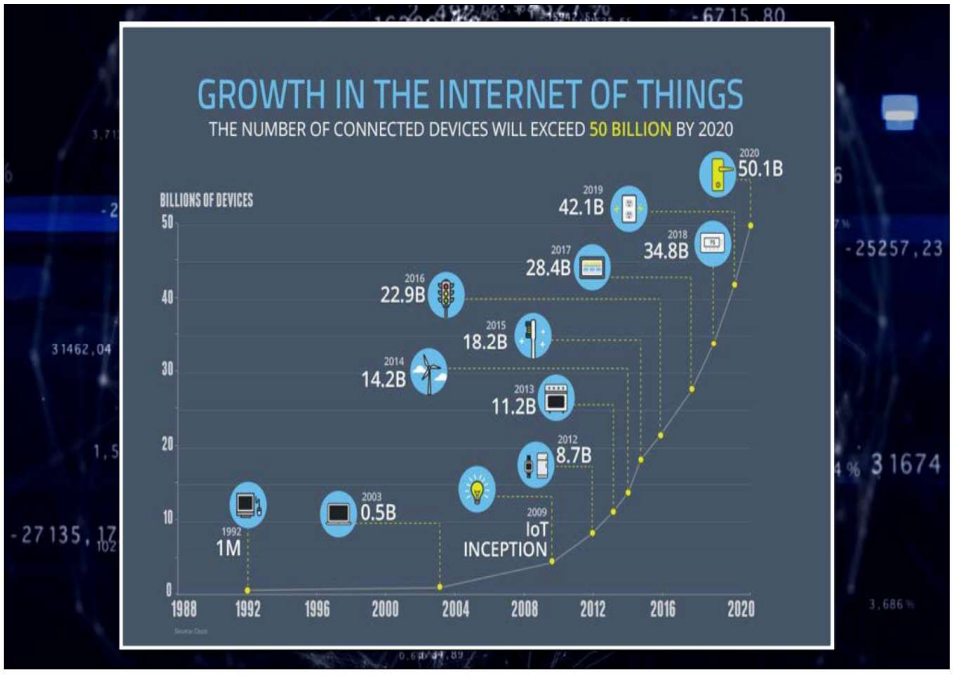
UNIVERSITEIT GENT

(2) GROEI VAN DATA OPSLAG



UNIVERSITEIT GENT

(3) DOORBRAAK VAN CONNECTIVITEIT



UNIVERSIT
GENT

(4) INTERACTIEF

UNIVERSITEIT
GENT

(5) TOEGANKELIJK EN BETAALBAAR

UNIVERSITEIT GENT

TECHNOLOGIE IS DE DRIJVENDE KRACHT

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

TECHNOLOGIE IS DE DRIJVENDE KRACHT

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

TECHNOLOGIE IS DE DRIJVENDE KRACHT

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

ZORGTOEKOMST: SENSOREN & DATA

A. Enables IoT to connect the dots & deliver value

Sensors *(source)*
Data Collection
(health, activity, location, emotions, temp, air...)

Data *(currency)*
Data is King!
(personal, population, environment...)

IoT | IoT

IoT | AI

Connectivity *(medium)*
Data Transmission
(Bluetooth, Wifi, Cellular (3G/4G/5G), LORA...)

Intelligence *(brain)*
Analysis, Insights & Actions
(timely, contextual & actionable insights)

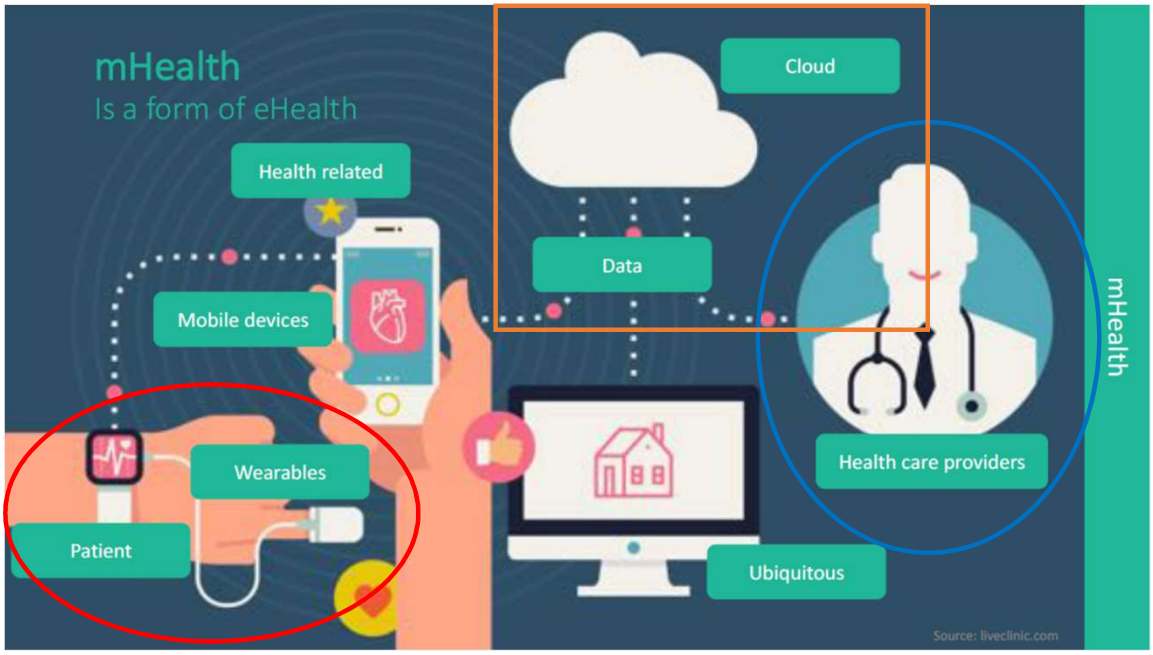
5G networks

- Superior: speed, bandwith, latency, power, reliability, ect.
- Intelligent: network slicing (separate custom network per application)

GHENT UNIVERSITY
FACULTY OF ENG AND ARCHITECT

21

MOBIELE GEZONDHEID



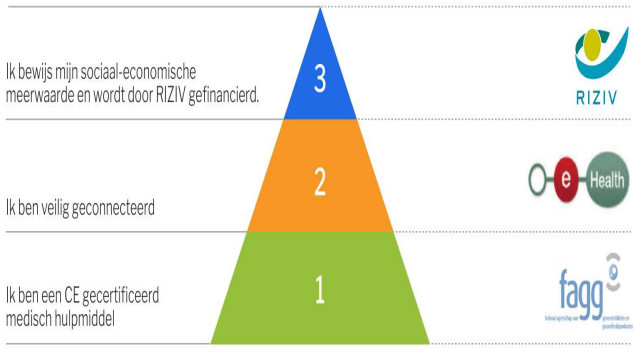
GHENT UNIVERSITY

MHEALTH BELGIUM

- 2015: 20 e-health acties gelanceerd in e-health roadmap
- 2016: 24 projecten geselecteerd uit 98 ingediende projecten
- 2018: start validatiepyramide
- 2019: mhealth Belgium platform gaat life
- 2023: nieuw systeem

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

MHEALTH BELGIUM



M1
- CE Markering
- Applicatie & moederbedrijf dienen in overeenstemming te zijn met GDPR
- Notificatie bij het FAGG

M2
- Interoperabel met andere mobiele applicaties & ICT-toepassingen binnen de gezondheidszorg en e-health platform (risicobeoordeling)

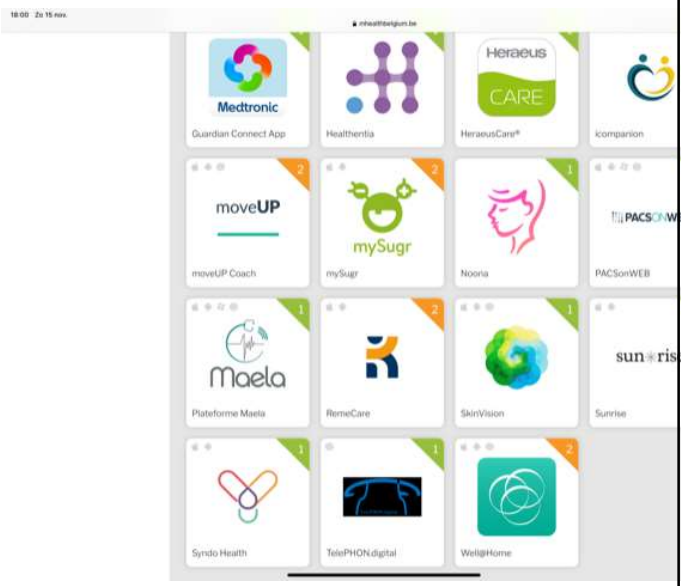
M3
- Sociaal-economische meerwaarde en positief advies Riziv

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

24

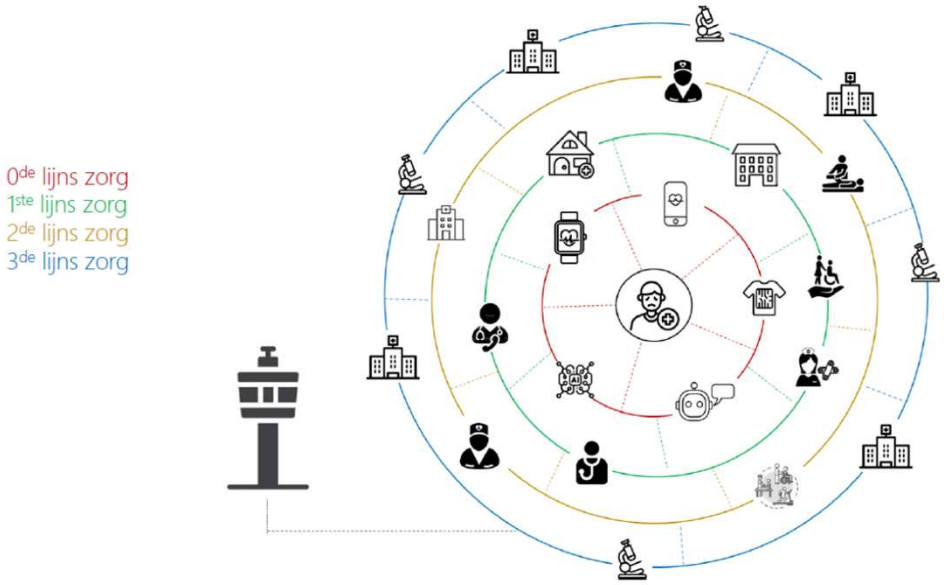
MHEALTH BELGIUM

- 23 gevalideerde toepassingen waarvan 6 met label M2
- Zorgverleners kunnen app's met M2-toepassing integreren in de dagelijkse zorgpraktijk
- Opstart M3-categorie o.a. MoveUp



GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

NULDE LIJNS ZORG ONTSTAAT EN CREËRT DATA



GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

26

G. Stevens, L. Hantson, P. Verdonck °2021

ACTOREN IN GECONNECTEERDE ZORG

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

EWS: "EARLY WARNING SCORE"

Ademfrequentie (RR)

Bloeddruk (BD)

Hartfrequentie (HR)

Temperatuur (T°)

Zuurstofsaturatie (SpO2)

Te automatiseren parameters

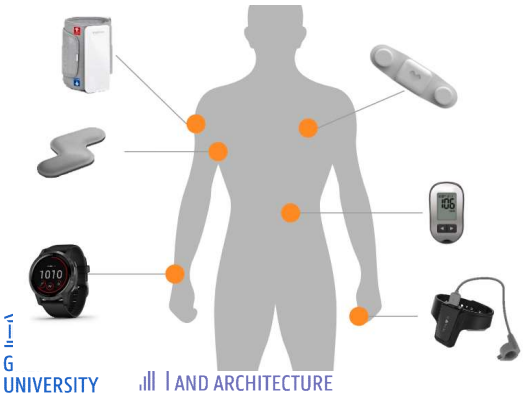
Physiological parameter	Score 3	2	1	0	1	2	3
Respiration rate (per minute)	≤8		9–11	12–20		21–24	≥25
SpO_2 Scale 1 (%)	≤91	92–93	94–95	≥96			
SpO_2 Scale 2 (%)	≤83	84–85	86–87	88–92 ≥93 on air	93–94 on oxygen	95–96 on oxygen	≥97 on oxygen
Air or oxygen?		Oxygen		Air			
Systolic blood pressure (mmHg)	≤90	91–100	101–110	111–219			≥220
Pulse (per minute)	≤40		41–50	51–90	91–110	111–130	≥131
Consciousness				Alert			CVPU
Temperature (°C)	≤35.0		35.1–36.0	36.1–38.0	38.1–39.0	≥39.1	

https://www.england.nhs.uk/ourwork/clinical-policy/sepsis/nationalearlywarningscore/

GHENT UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE

CONTINUE AUTOMATISCHE EWS METING

VIVALINK



Vital Parameters

Corsano

mindray

GHENT UNIVERSITY | FACULTY OF ENGINEERING AND ARCHITECTURE

UITDAGINGEN MOBIELE GEZONDHEID

- “Klinische nood” versus “vermarkten van een hype”
- Onderscheid tussen medische applicaties (gezondheidstoepassingen) en gadgets (welzijnstoepassingen)
- Vermijden van “overmedicalisering”
- Vermijden van een ongestructureerde data tsunami
- Bescherming van privacy en gegevensbescherming
- Nood aan charter met industrie (Agoria, beMedTech,…)
- Kloof overbruggen van digitale ongeletterdheid

Julie Hantson 2020

GHENT UNIVERSITY | FACULTY OF ENGINEERING AND ARCHITECTURE

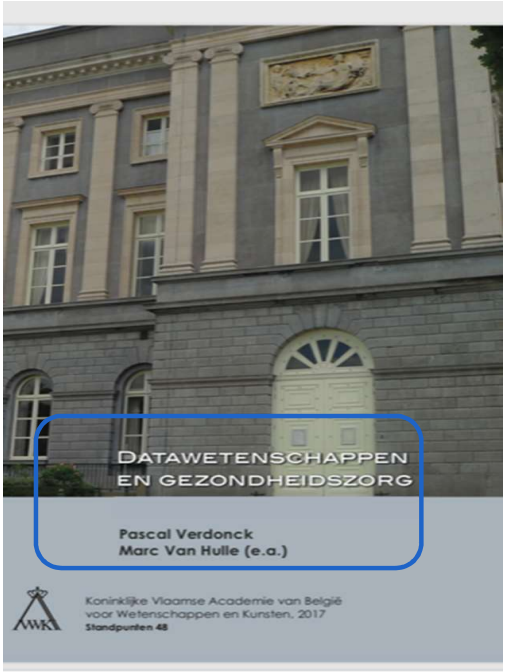
30

TECHNOLOGIE IS DE DRIJVENDE KRACHT

GHENT UNIVERSITY

FACULTY OF ENGINEERING AND ARCHITECTURE

STANDPUNT 48 VAN KVAB - 2017



UNIVERSITEIT GENT

DATAWETENSCHAPPEN

"Big Data is the capacity to search, aggregate and crossreference large data sets" (Boyd & Crawford).

Het "Big Data"-ecosysteem bestaat uit vijf componenten:
(1) Gegevenscreatie
(2) Gegevensvergaring en –beheer
(3) Analyse en informatie-extractie
(4) Hypothese en experiment
(5) Besluitvorming en actie

"Big Data" is onmiskenbaar een proces!

UNIVERSITEIT GENT

33

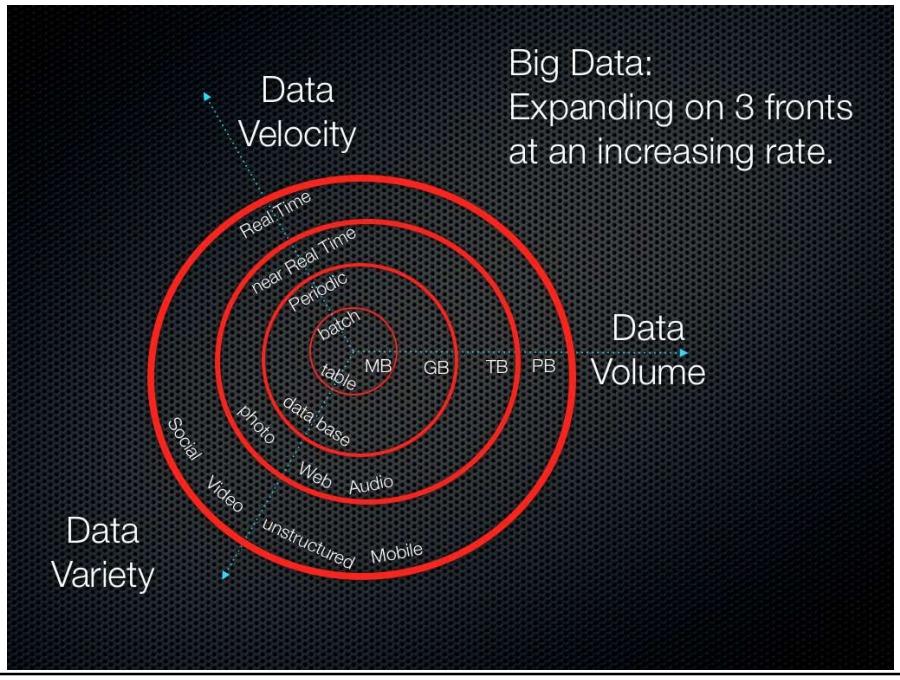
5 SOORTEN INFORMATIESTROMEN

1. Internet en sociale media
2. "Machine, hulpmiddelen" gegeneerde data uit sensoren (IoT..)
3. "Transactie data": gegevens uit de financiële & administratieve informatiestromen in de gezondheidszorg.
4. "Biometrische data": medische beelden, genetische informatie, irisscans,…
5. "Mens-gegenereerde" data: ingevoerde gegevens uit elektronische patiënten dossiers (EPD), aantekeningen, e-mails en papieren documenten,…

UNIVERSITEIT GENT

34

DATAWETENSCHAPPEN



° Soubra

UNIVERSITEIT GENT

DE V'S VAN BIG DATA

Big data slaat op de grote hoeveelheid aan, de verscheidenheid van en de complexiteit van data

De eigenschappen van big data wordt omschreven aan de hand van **6 V's**:

- **V**olume: de grote hoeveelheid van data.
- **V**ariety: verschillende bronnen waaruit de data afkomstig is.
- **V**elocity: de snelheid waarmee de data wordt ingezameld en verwerkt.
- **V**eracity: de accuraatheid van de data.
- **V**alue: waarde van de inzichten en de kennis die big data-analyses creëert
- **V**ariability: data waarvan de betekenis steeds wijzigt

UNIVERSITEIT GENT

FAIR DATA

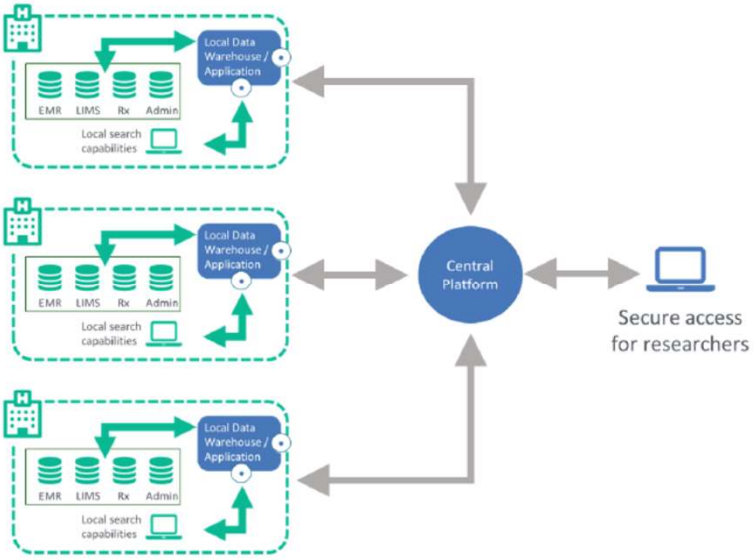
Een essentiële voorwaarde voor het doeltreffend (her)gebruik van verschillende soorten klinische gegevens voor de ondersteuning van besluitvorming, het opvolgen van patiënten en klinisch onderzoek, is dat de data FAIR is:

vindbaar (Findable), *toegankelijk* (Accessible), *interoperabel* (Interoperable) en *herbruikbaar* (Reusable)

UNIVERSITEIT GENT

37

NIEUWE SAMENWERKINGSMODELLEN



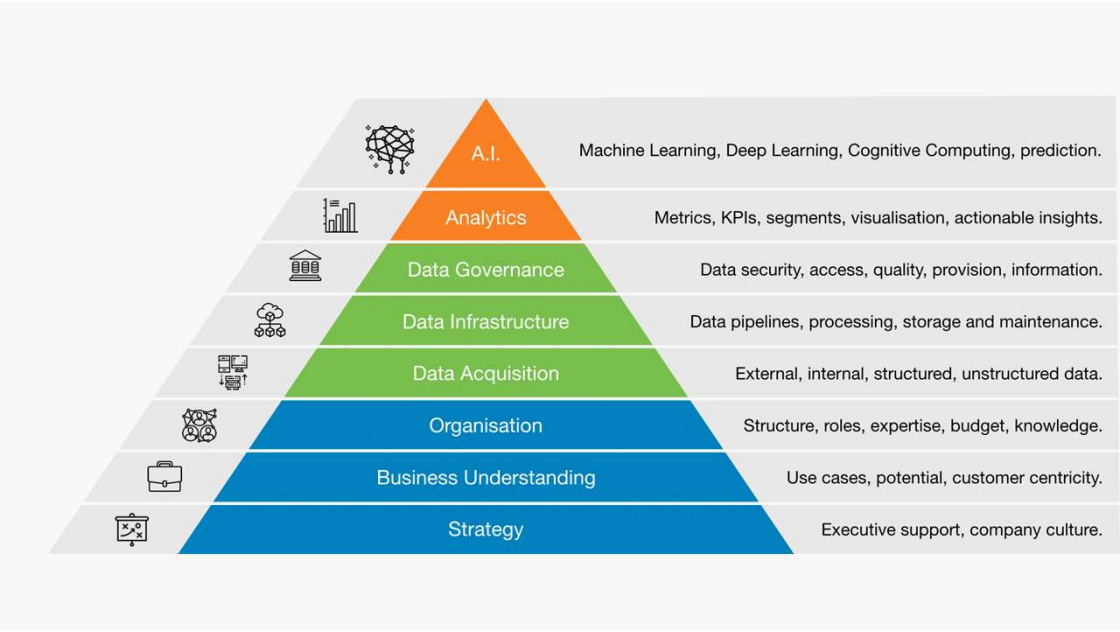
Benefits of federated networks

- Data remains under the control of the data owner
- Locally required legal and ethical approvals apply
- No patient level data leaves the owner's site, only aggregated counts, thereby ensuring patient privacy
- GDPR – *'Privacy by Design'*
- Analysis is "brought to the data" rather than creating central data repository
- Use of common data model allows for efficient search / analysis across multiple data sets
- Requires close collaboration with data owners which builds trust

GENT

Bart Vannieuwenhuyse EAHM 2019

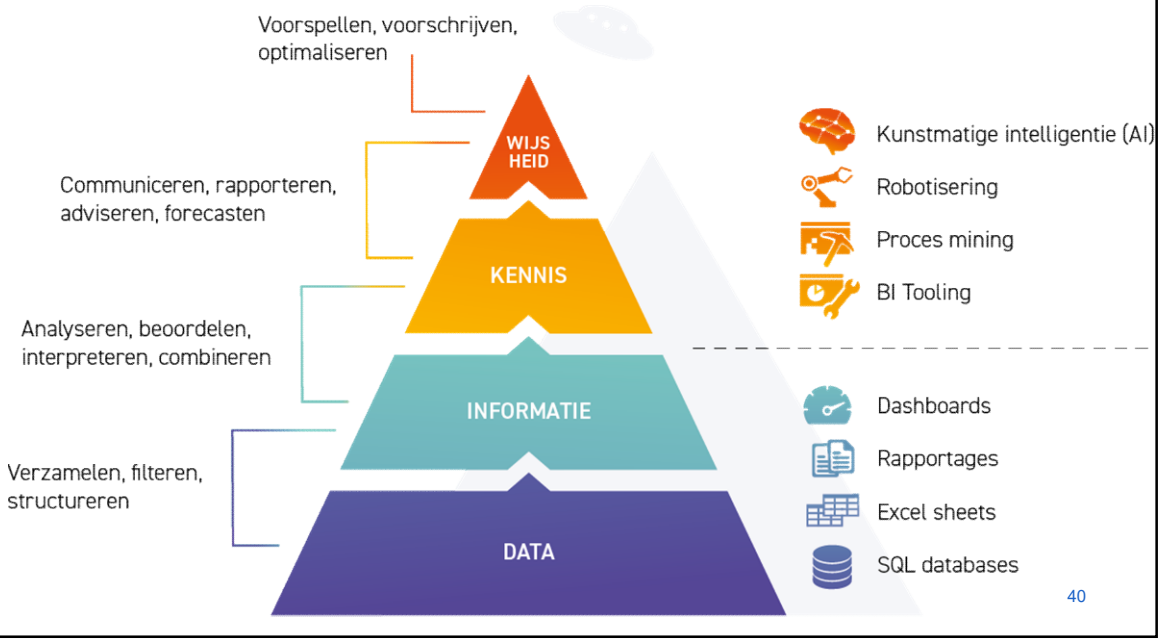
MATURITEIT VAN DATA GEDREVEN ONDERNEMING



UNIVERSITEIT GENT

The data-driven company needs pyramid was developed by foryouandyourcustomers

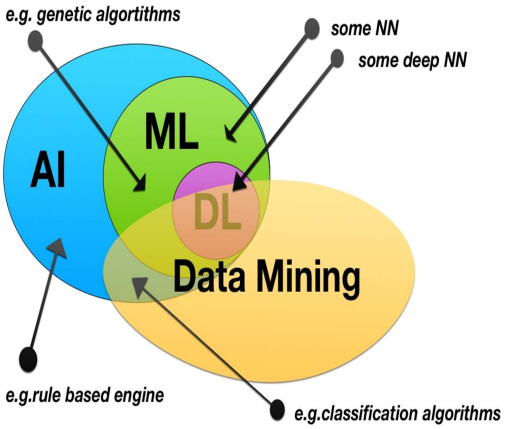
KENNISPIRAMIDE



UNIVERSITEIT GENT

40

KENNIS VERSUS DATAGEDREVEN AI



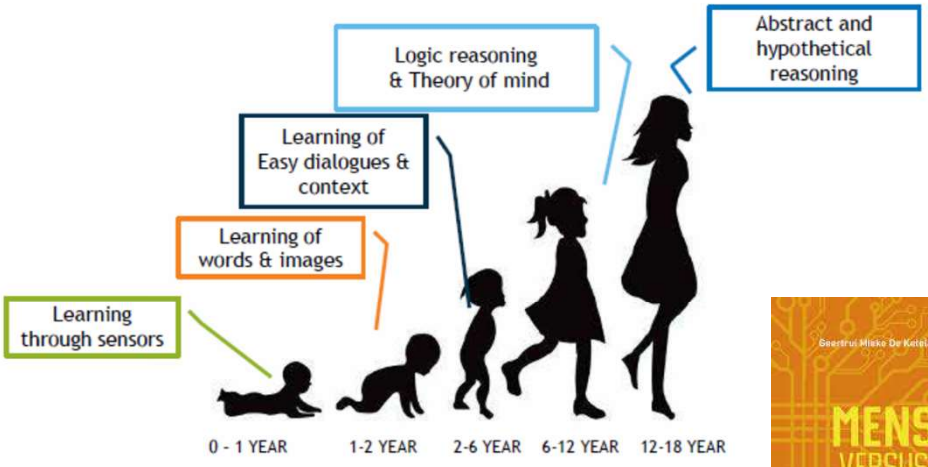
- **"Kennis-gebaseerd" AI-systeem** tracht de kennis van een menselijke expert zo goed mogelijk in kaart te brengen door middel van observaties en door gesprekken met de expert (medische literatuur, richtlijnen,…) , waarna die kennis vervolgens wordt omgevormd regels en zoekstrategieën die het gedrag van de expert benaderen

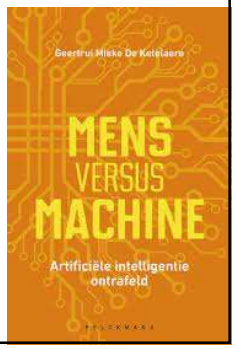
- Bij "**Datagedreven" AI-systeem** vertrekt het systeem van data over het gedrag van mensen, over de beslissingen die mensen hebben genomen of over verschijnselen die via sensoren zijn waargenomen, waarna het systeem statistische technieken aanwendt om in die data patronen te ontdekken en met die patronen nieuwe problemen op te lossen

Visie: maar algoritmes hebben geen inlevingsvermogen en "common sense" daarom gaan voor **hybride AI** waarbij "*datagedreven AI* "gekoppeld wordt met *menselijke kennis* leidend naar verhoogde menselijke intelligentie

41

GEBREK AAN "GEZOND VERSTAND"

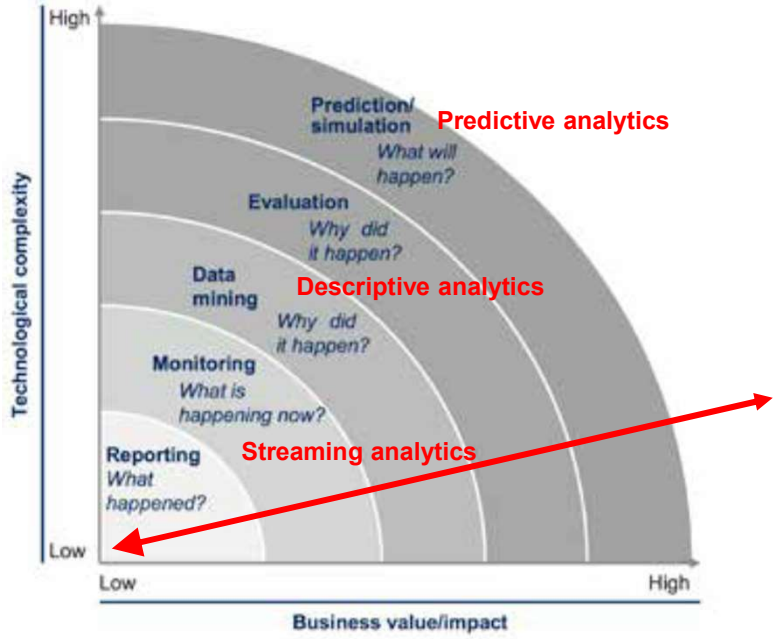




° Mieke de Ketelaere 2023

OPPORTUNITEIT VAN DATAWETENSCHAPPEN

Personalized Health Care is P4/Systems Medicine

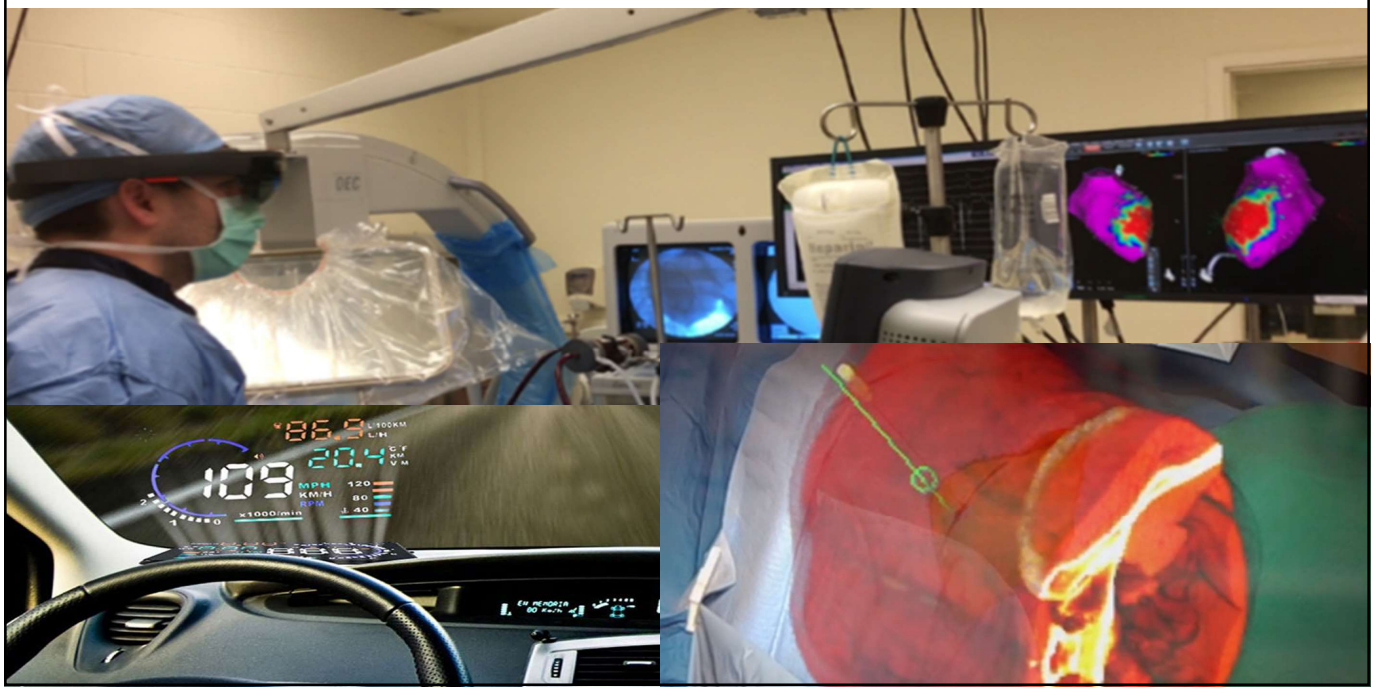


UNIVERSITEIT GENT

43

°Mc Kinsey Business >Technology°2013

VIRTUELE & AANGEVULDE REALITEIT (VR &AR)



UITDAGINGEN AI

- Data: veiligheid, kwaliteit (volledigheid) en interoperabiliteit
  - Dataset dient representatief te zijn voor de beoogde patiëntengroep
  - Inzicht in de “black box” is nodig voor geneeskundige toepassingen
  - De verwerkingsverantwoordelijke waken over de herkomst van de persoonsgegevens die worden gebruikt om de op “data-gebaseerde” AI-systemen te trainen en te laten werken, waarbij enkel opgeschoonde datasets worden gebruikt
- Legaal kader (EU: MDR, GDPR,AI-act… versus nationaal gezondheidssystemen)
- Maatschappelijk aanvaarding
  - Patiëntgerichtheid & betrokkenheid
  - Van zorg naar “vroeg”-detectie , preventie
  - Digitale geletterdheid
  - Deugdelijk bestuur & ethiek (charter, data access comittee, data protection board,…)
  - Privacy & security

UNIVERSITEIT GENT

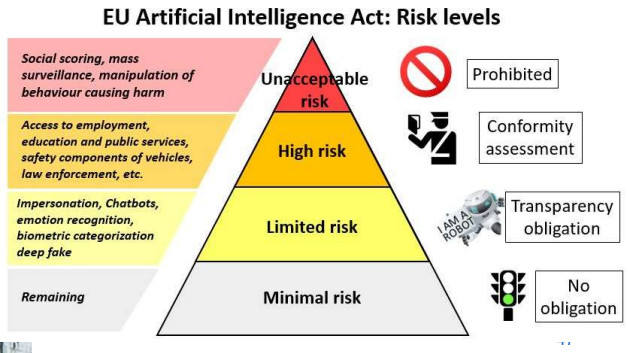
45

EU AI-ACT VANAF 2026

Het doel van de AI Act is dat personen en bedrijven in de EU kunnen rekenen op *veilige, transparante, traceerbare, niet-discriminerende en milieuvriendelijke* AI-systemen die onder toezicht staan van personen!

EU AI-ACT VANAF 2026

De hoeksteen van de AI-wet is een **classificatiesysteem** dat bepaalt hoeveel risico een AI-technologie kan opleveren voor de gezondheid en veiligheid of fundamentele rechten van een persoon. Het raamwerk kent vier risiconiveaus: *onaanvaardbaar, hoog, beperkt en minimaal.*



EU AI-ACT VANAF 2026

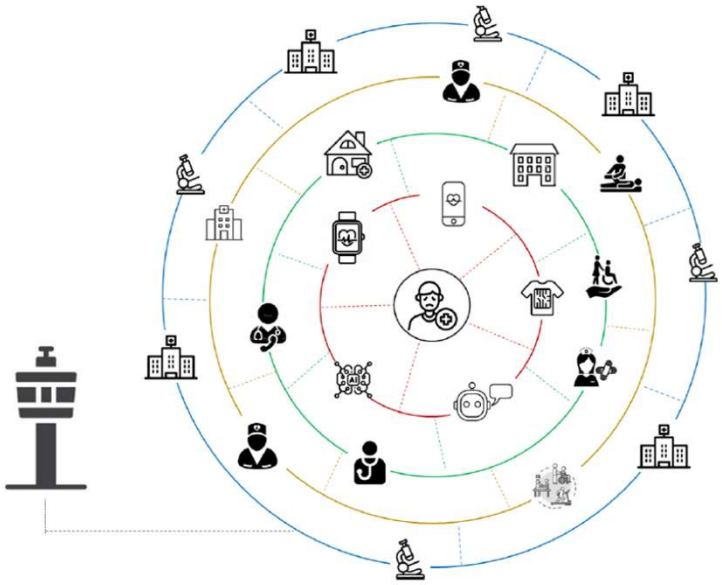
Verbod realtime biometrische identificatiesystemen in openbare ruimtes op uitzonderingen na (terrorisme, et al)

"Trust is a must, not a nice to have !"

EU

NULDE LIJNS ZORG ONTSTAAT EN CREËRT DATA

0de lijns zorg
1ste lijns zorg
2de lijns zorg
3de lijns zorg



UNIVERSITEIT GENT

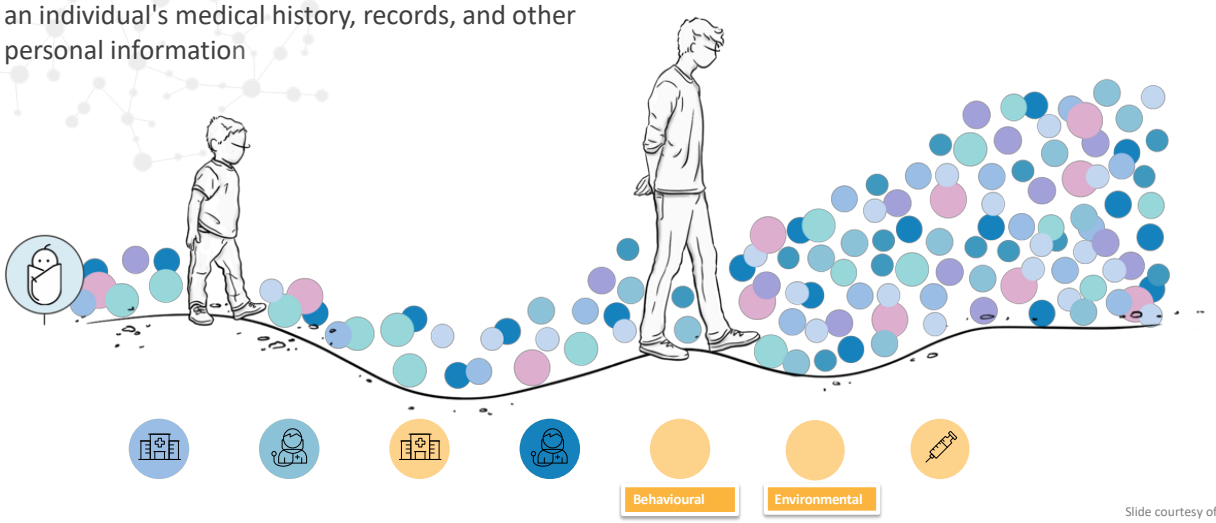
49

G. Stevens, L. Hantson, P. Verdonck °2021

INOVIGATE achieving outcomes

Definitions - Health data

Health data implies any and all information pertaining to an individual's medical history, records, and other personal information



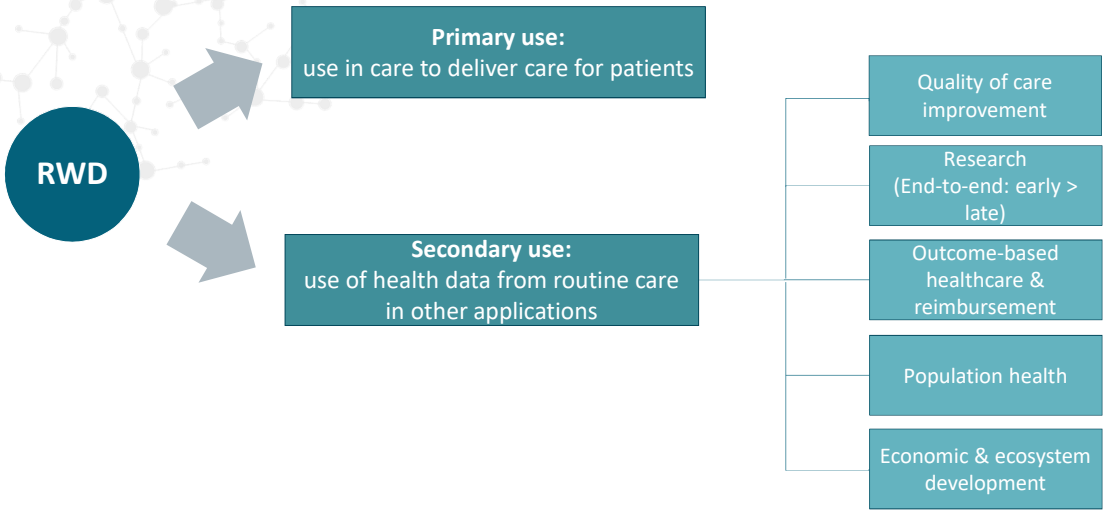
Slide courtesy of IMEC

50

WWW.INOVIGATE.COM

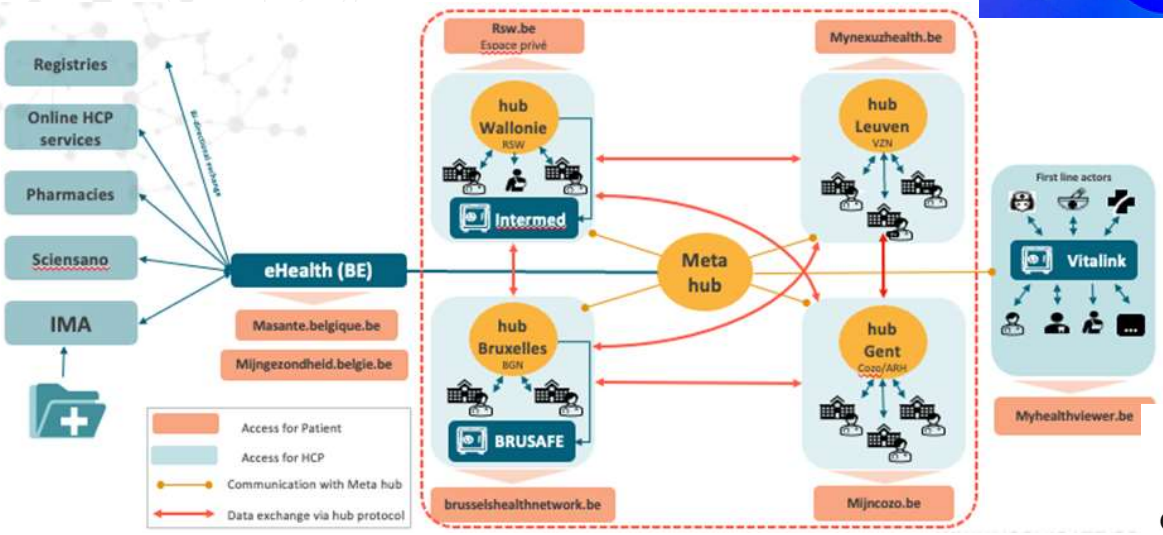
Primary and secondary use of health data

INOVIGATE achieving outcomes



www.inovigate.com

Health data space



.be

What is the EHDS?

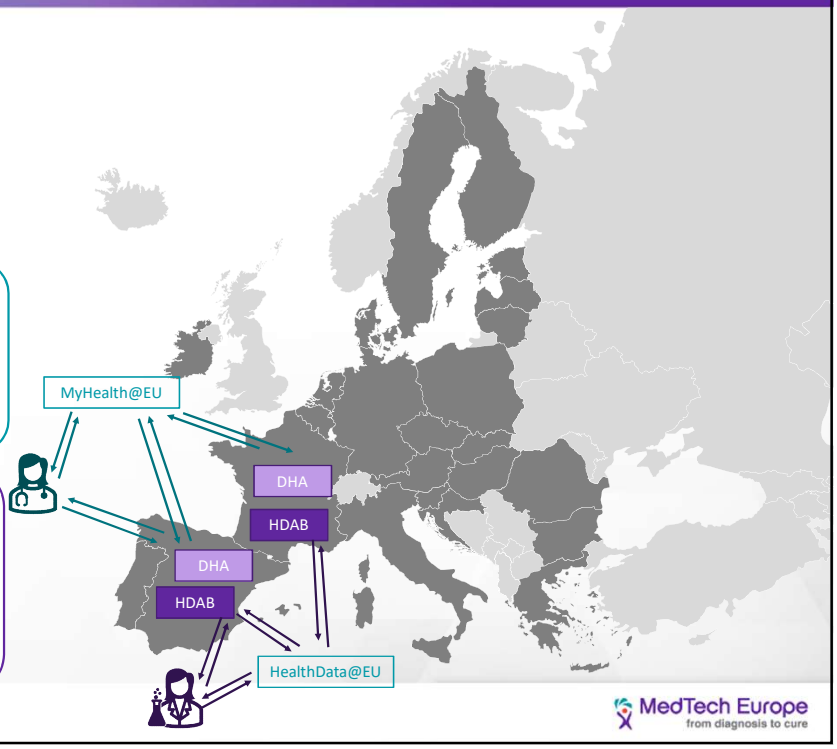
- Federated Data Ecosystem
- EU Infrastructures and authorities in the EU Member States

Primary use of electronic health data

- MyHealth@EU (EHDS1)
- Digital Health authorities (DHA)
- Enhanced rights for citizens and patients

Secondary use of electronic health data:

- HealthData@EU (EHDS2)
- Health Data Access Bodies (HDAB)
- Policy-making, research, and development



53

MedTech Europe
from diagnosis to cure

EHDS Objectives

- **Empower individuals** to control their health data
- Foster a **single market for digital health** services and products
- Ensure **interoperability and security** of health data
- Unleash the **power of the health data economy**
- Ensure a **consistent and efficient framework for the reuse of health data** for research, innovation & policies

54

MedTech Europe
from diagnosis to cure

Patient empowerment through opt-in or opt-out?

	European Commission proposal	European Parliament proposal	Amendments to European Parliament proposal
MyHealth@EU sharing data with your healthcare providers across the EU	Opt-in	Opt-in	Opt-in
HealthData@EU secondary use for research, innovation and education	Data as common good	Opt-out	Opt-in

°Griet Verhenneman 2023

HDA.be

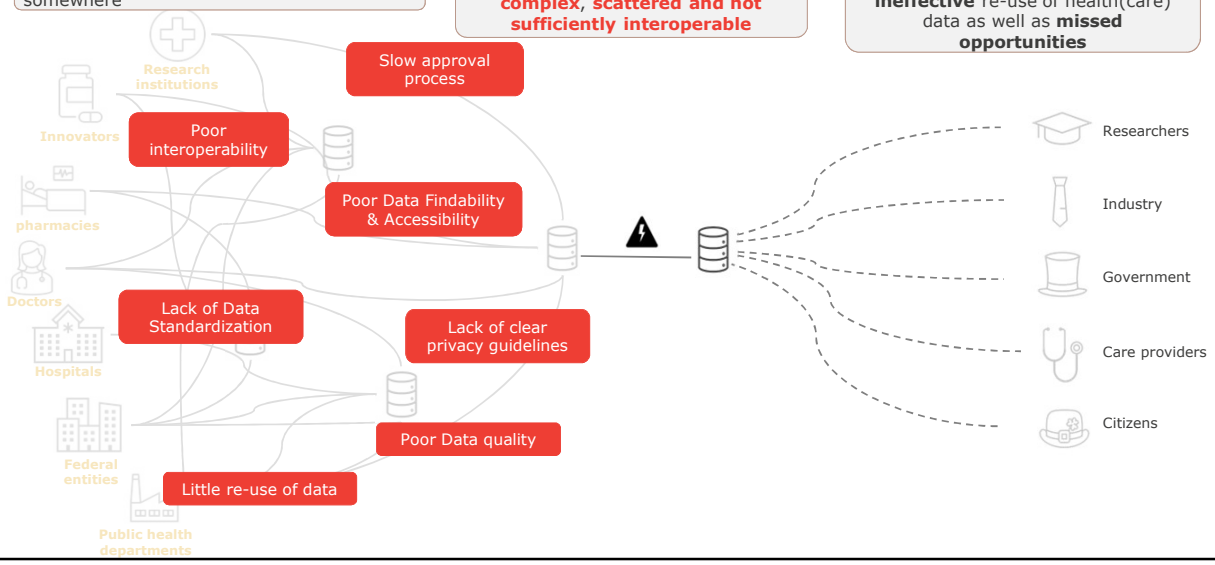
56

But there is a lot to improve to facilitate secondary use of health(care) data

Numerous relevant **data(sets) is available** somewhere

...but the (data) landscape is **complex, scattered and not sufficiently interoperable**

Ultimately leading **to inefficient and ineffective** re-use of health(care) data as well as **missed opportunities**



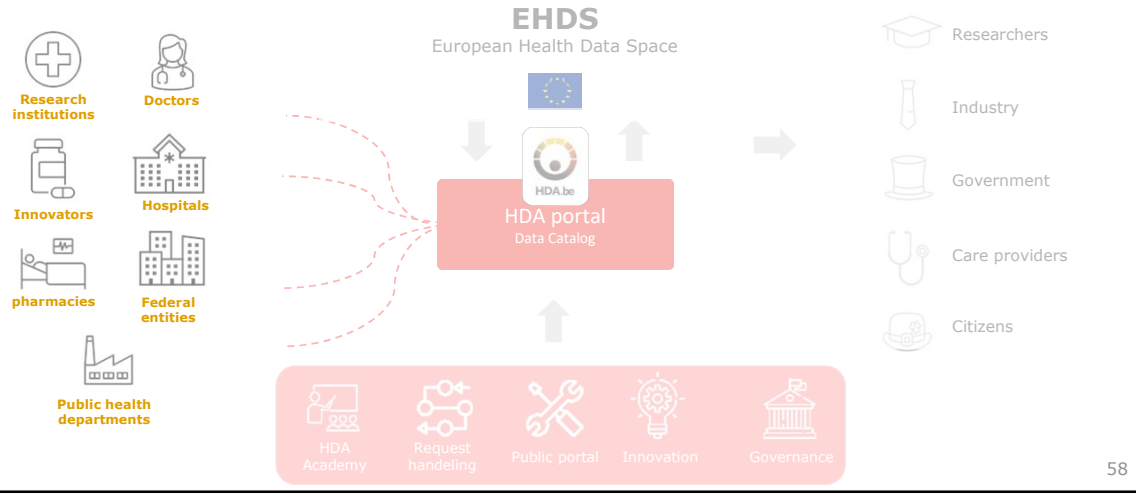
HDA.be

The field of play of the HDA

Numerous data providers & data streams from diverse sources..

Are inventorised and made accessible via the **HDA portal, its Data Catalog** and other supporting functions. FAIR data and EHDS standards compliance as design-principles;

Facilitating secondary use of health data towards various personas

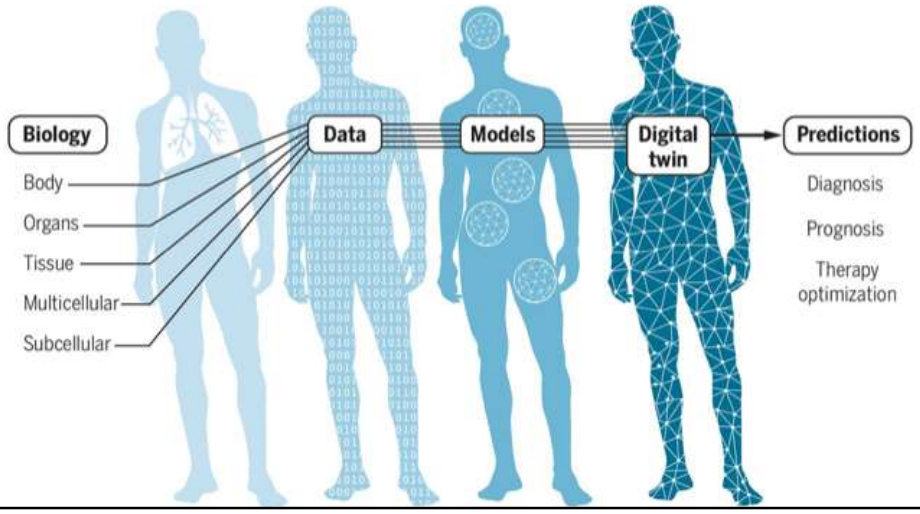


58 HDA.be

OP WEG NAAR ONZE "DIGITAL TWIN"

Building a personalized digital twin

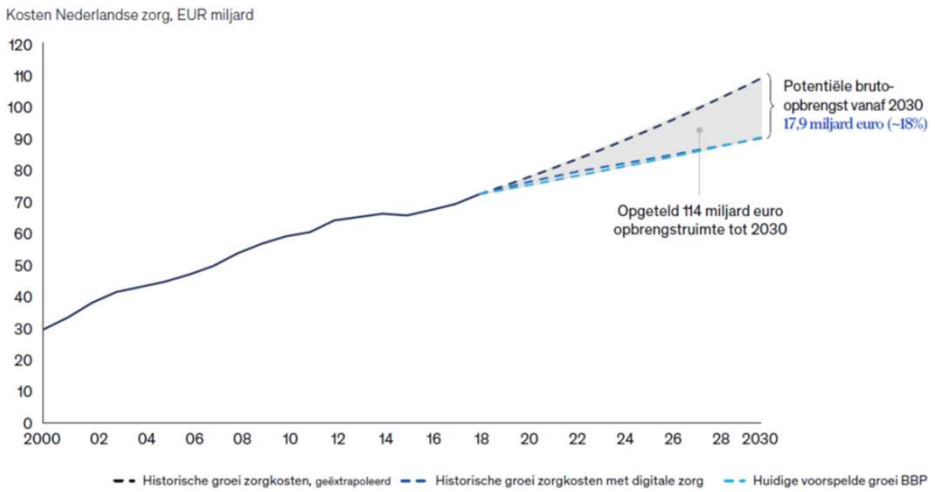
Data from multiple scales are needed to build computational representations of biological processes and body systems that are affected by viral infection. These submodels are integrated and personalized with clinical data from individual patients. The digital twin can then be used to derive predictions about diagnosis, prognosis, and efficacy and optimization of therapeutic interventions.



UNIVERSITEIT GENT

59

BESPARINGEN DIGITALE TRANSFORMATIE



UNIVERSITEIT GENT

BESPARINGEN PER TECHNOLOGIE

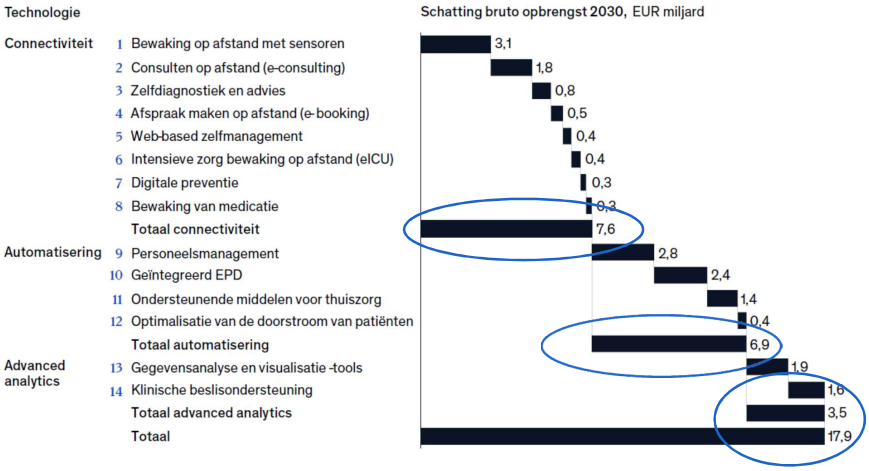
Mobiele gezondheidszorg

Lean & automatiseren

Datawetenschappen

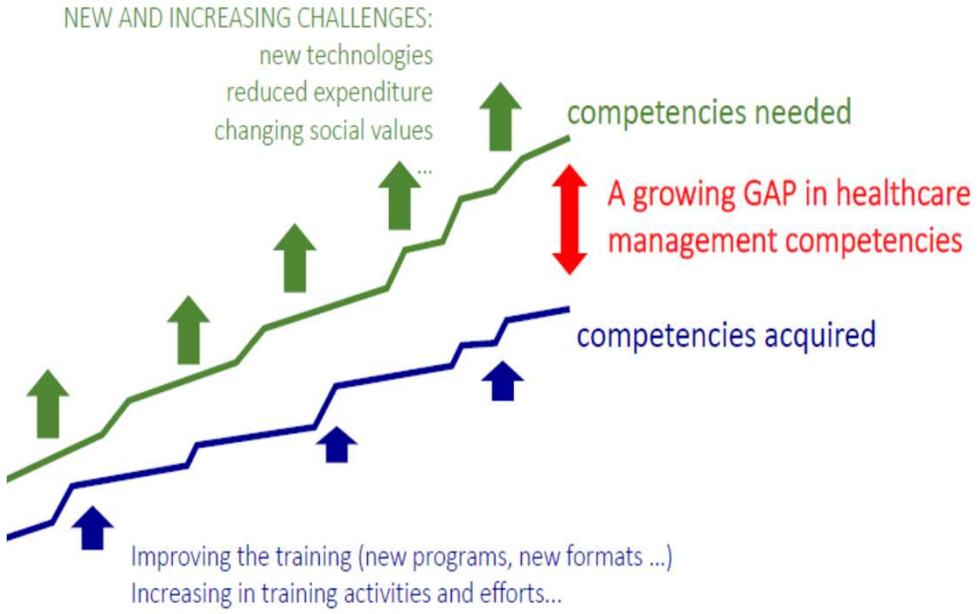
Figuur 1

Opbrengsten in 2030 lopen op tot 18 miljard euro, meeste potentieel zit in technologie met een focus op connectiviteit



UNIVERSITEIT GENT

NOOD AAN OPLEIDEN



UNIVERSITEIT GENT

62

NIEUWE JOBS

DATA SCIENTIST
This person knows how AI works and can design AI models to perform tasks required at a hospital or health system.

AI ENGINEER
This person builds the AI models to perform the tasks required at a hospital or health system.

DATA GOVERNANCE EXPERT
This person makes sure the data are clean and accurate by setting the policies around how data are collect-ed. They are also respon-sible for making sure that when staff do their jobs, they're doing them ethically, protecting the privacy and

DATA ENTRY EXPERT
This person curates, cleans, scrubs and structures data from a variety of internal and external sources into the system that feeds AI models with the data they need to perform the tasks required at a hospital

DATA ENGINEER
This person builds the system that fuels the AI models with the data they need to perform the tasks required at a hospital or health system.

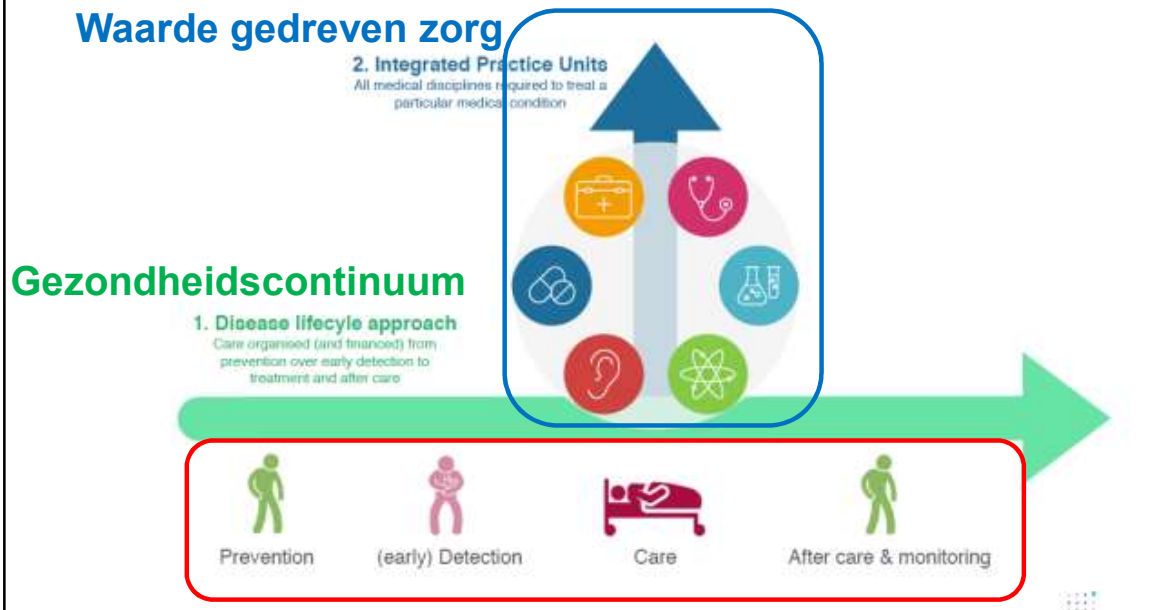
CHIEF AI OFFICER
This person leads the effort to explore potent opportunities, develop cogent AI strategy, an harness the necessar funding, professionals technology and organiz tional resources to imp ment them. They mus understand the clinica workflow — the front-li

BESLUIT

UNIVERSITEIT GENT

DATA GEDREVEN GEZONDHEIDSZORG

Waarde gedreven zorg



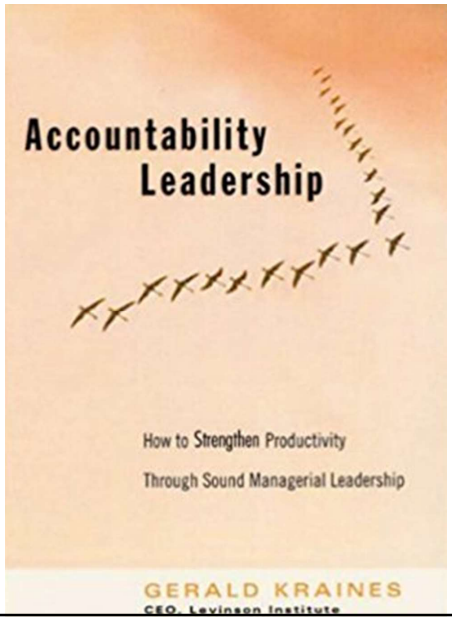
Benthurst & Co

Privacy?

UNIVERSITEIT GENT

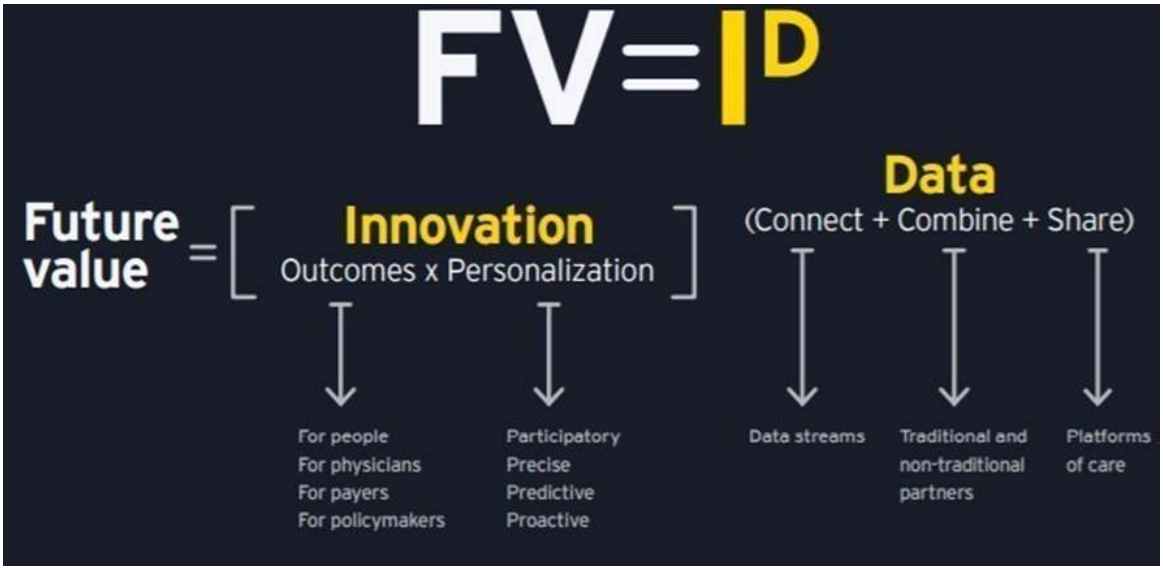
TOEKOMST VAN ONS GEZONDHEIDSSYSTEEM

- **Investeren in infrastructuur (5G et al)**
- **Opleiden van talent & levenslang leren voor "de makers van de wereld van morgen"**
- **Leiderschap & governance**



UNIVERSITEIT GENT

TOEKOMSTIGE WAARDE

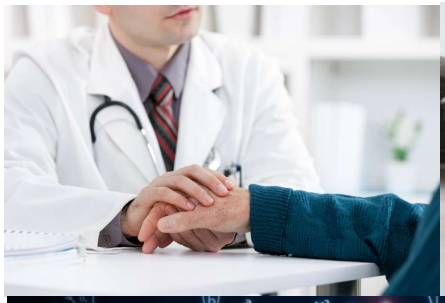


UNIVERSITEIT GENT

°EY, 2019

68

ETHIEK & EMPATHIE



UNIVERSITEIT GENT

FACULTEIT INGENIEURSWETENSCHAPPEN EN ARCHITECTUUR

Prof. Pascal Verdonck

gewoon hoogleraar medische technologie

Pascal.verdonck@ugent.be

www.ugent.be

Ghent University

@ugent

Ghent University

UNIVERSITEIT GENT