RADIO, IASIS, BigMedilytics: Success stories in H2020 healthcare challenges

Vangelis Karkaletsis
NCSR "Demokritos", Greece

PHC-19-2014 - Advancing active and healthy ageing with ICT: service robotics within assisted living environments

PM-18-2016: Big Data supporting Public Health policies

ICT-15-2017: Big Data PPP: Large Scale Pilot actions in sectors best benefitting from data-driven innovation

RADIO Basic Facts

- **Title:** Robots in assisted living environments: Unobtrusive, efficient, reliable and modular solutions for independent ageing
- **Topic:** PHC-19-2014 - Advancing active and healthy ageing with ICT: service robotics within assisted living environments
- **Contract No.:** 643892
- **Budget:** € 3.8M

The RADIO Action and Concept

Advancing active and healthy ageing with ICT: Service robotics within assisted living environments

TECHNOLOGICAL EDUCATIONAL INSTITUTE *of* WESTERN GREECE

RUHR UNIVERSITÄT BOCHUM

RUB

Robotnik

sensing &control

Simply Seamless

SANTA LUCIA NEUROSCIENZE E RIABILITAZIONE

Hospital General de Granollers

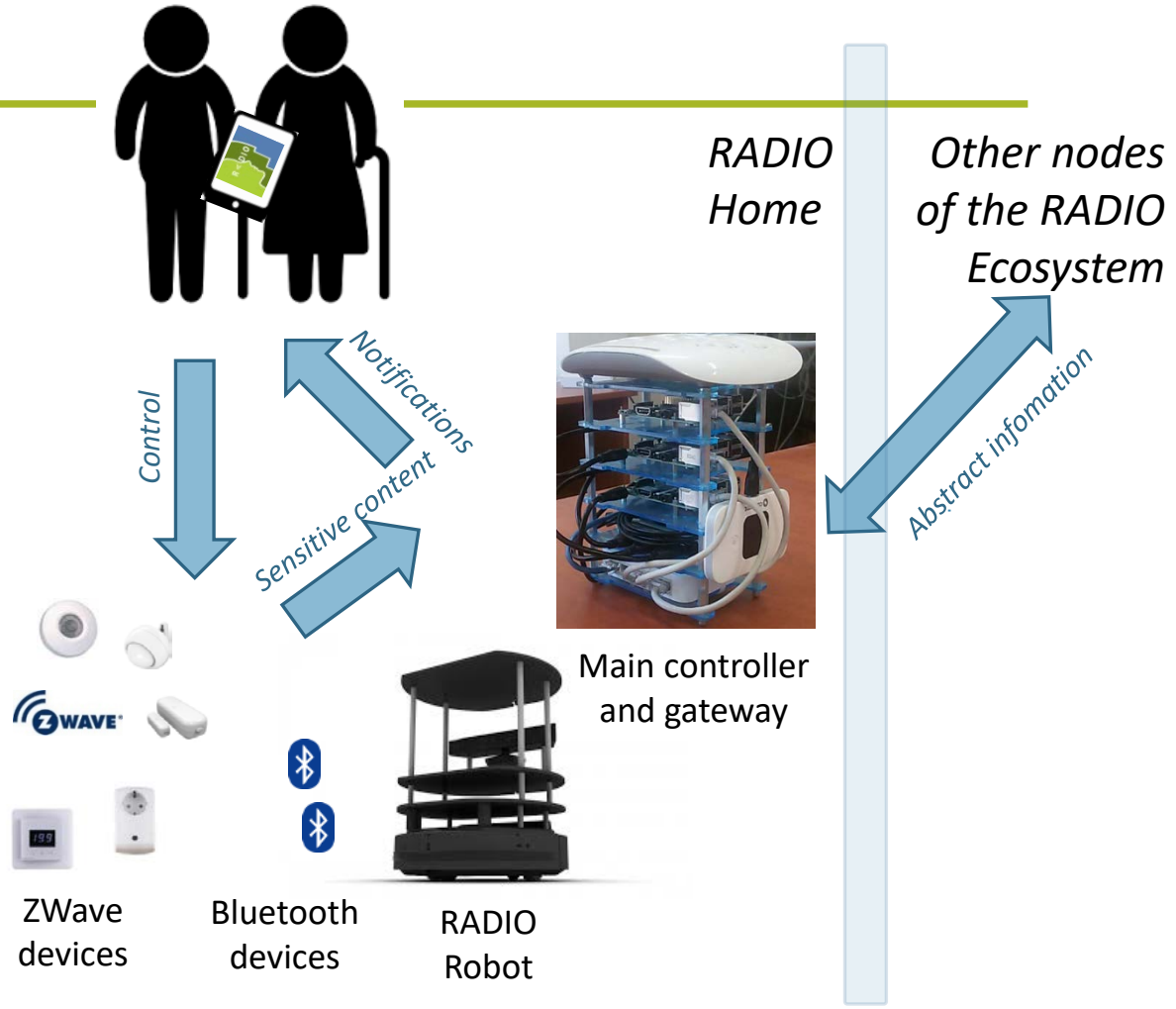
Hospital Universitari

Fundació Privada Hospital Asil de Granollers

- Clinical monitoring for assessing ability to live independently alone
- No stigmatization
  - All monitoring hardware also assists at home
  - Robot finds and guides
  - Using home automation also provides monitoring data
- No functional obtrusiveness
  - Primary users are never asked to charge, use, wear, remember to do anything whatsoever to be monitored

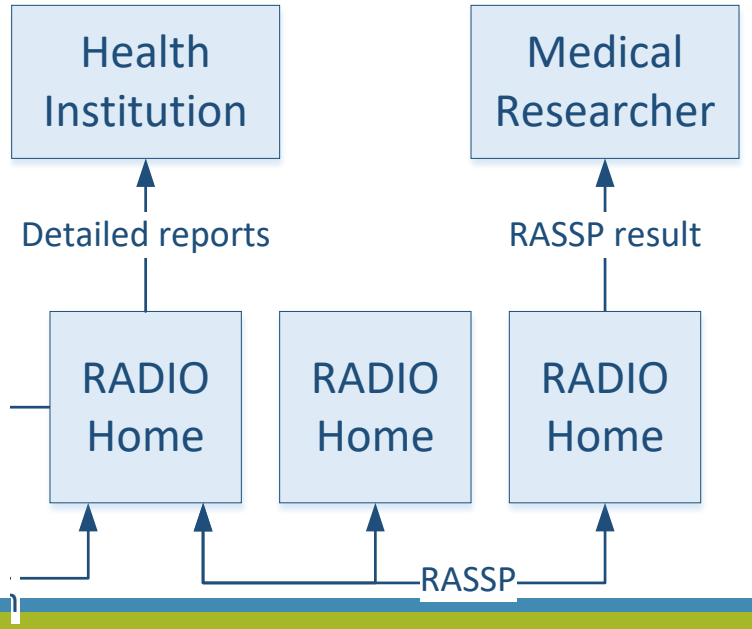
The RADIO System

- Home automation
  - Activities: using appliances to prepare meal, leaving home, watching TV
- Mini-rack with three Raspberry Pi's
  - Off-board computations, prolonging robot's battery autonomy
- The RADIO Robot
  - Motion analysis, audio analysis, object tracking in laser scans
  - Measurements: walking speed, bed transfer speed
  - Activities: medication intake



The RADIO Ecosystem

- Privacy-preserving peer-to-peer distributed computation of statistics
  - Facilitates medical research over sensitive data
- Core conceptual infrastructure and algorithms existed
  - But were never worked into a full, implementable communications protocol
- We designed and implemented protocol and stack
  - Backend software for nodes and for “researcher” node
  - R library that hides RASSP details to provide statistical functions (t-test, average, etc.)
- In addition to usual access control
  - Health professionals see detailed reports about person they are responsible for



iASiS Basic Facts

- Title: Integration and analysis of heterogeneous big data for precision medicine and suggested treatments for different types of patients
- Topic: H2020-SC1-PM-18-2016 - Big Data supporting Public Health policies
- Contract No.: 727658
- Budget: € 4.3M

iASiS
Big Data for Precision Medicine

Vision and Objectives

iASiS Vision:

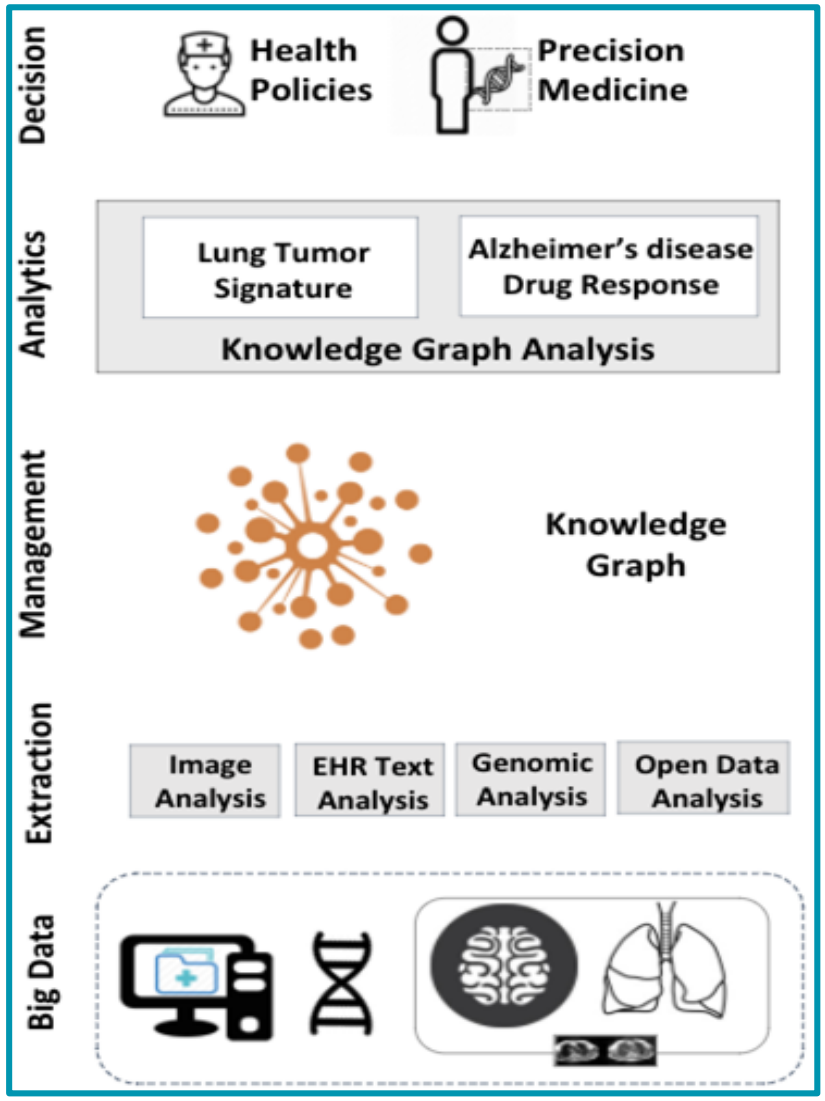
Turn clinical, pharmacogenomics, and other Big Data into actionable knowledge for personalized medicine and health policy-making

iASiS Objectives:

- Integrate automated unstructured and structured data analysis, image analysis, and sequence analysis into a Big Data framework
- Use the iASiS framework to support personalized diagnosis and treatment

iASiS
Big Data for Precision Medicine

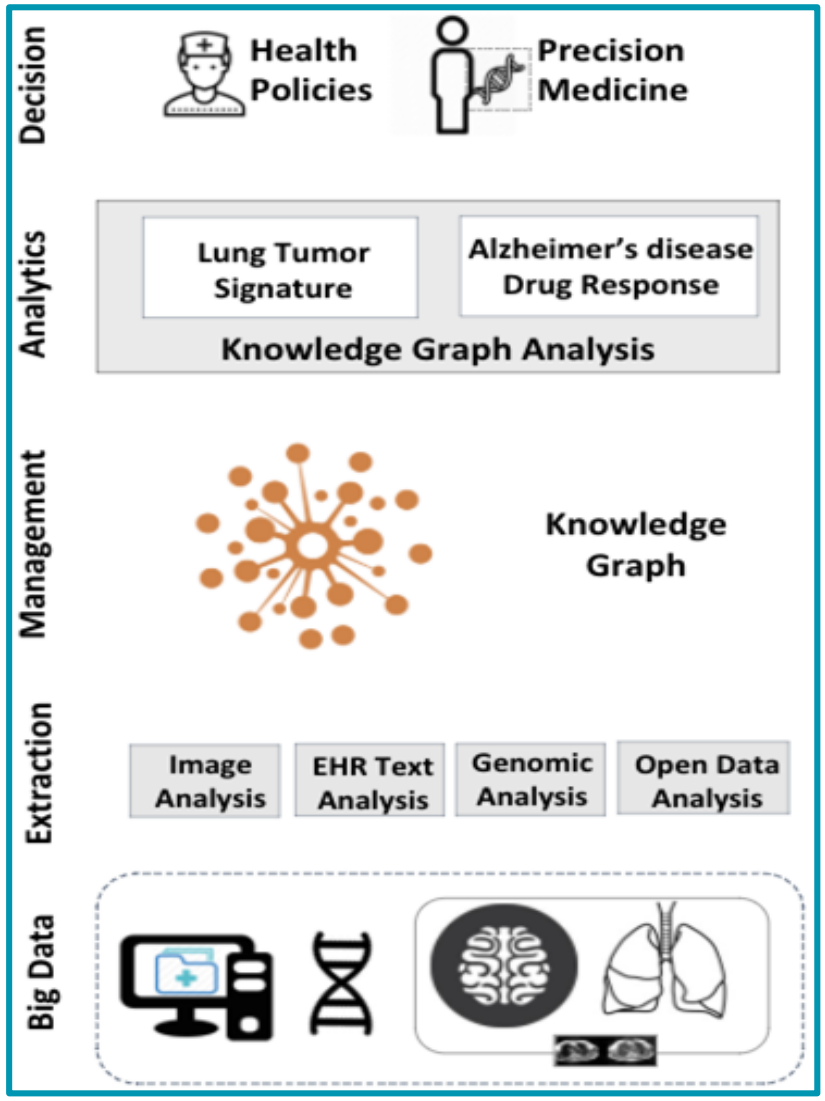
The iASiS Framework



- iASiS analyzes:
  - EHRs (English & Spanish)
  - MRI & PET/CT images
  - Genomic data (e.g. liquid biopsy samples)
  - Related bibliography (e.g. PubMed)
  - Biomedical databases (e.g. DrugBank)
  - Biomedical ontologies (e.g. GO, UMLS)

iASiS
Big Data for Precision Medicine

The iASiS Framework



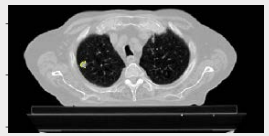
- Extracted knowledge is fused in the iASiS knowledge graph
  - Unified semantic schema
  - Linked data
  - Machine-processable knowledge
- iASiS end-users can:
  - Perform natural language questions
  - Receive answers along with justifications
  - Identify patterns in patient populations
  - Make informed decisions
- All steps of data management and analytics enforce privacy and access control

iASiS
Big Data for Precision Medicine

Lung Cancer Use case

Select treatment for long survival

Input: patient data



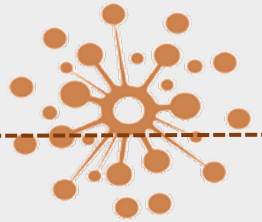
Output

Patient categorization into survival groups

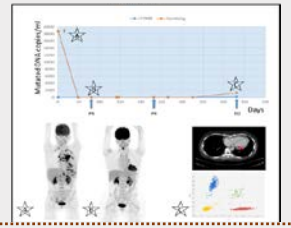
Treatment Recommendation

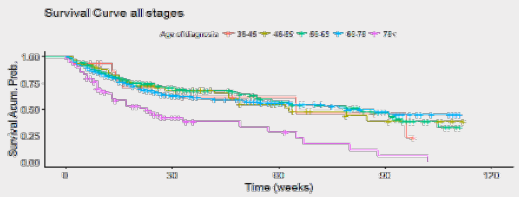
online

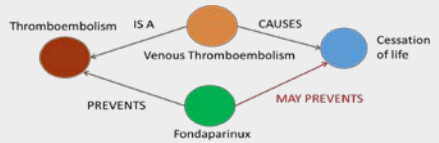
offline



Analysis





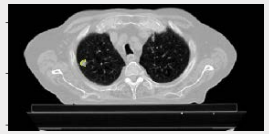


iASiS Big Data for Precision Medicine

Alzheimer's Use case

Which drug is most suitable for a particular patient?

Input: patient data



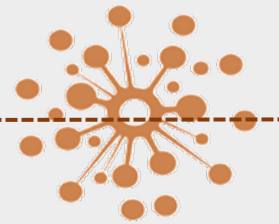
Output

Positive response estimates for each available drug

Drug Recommendation

online

offline



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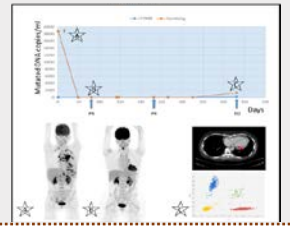
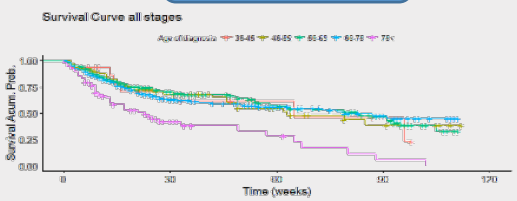
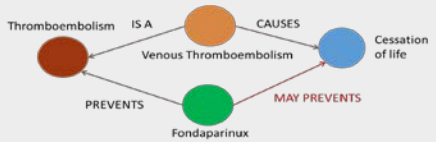


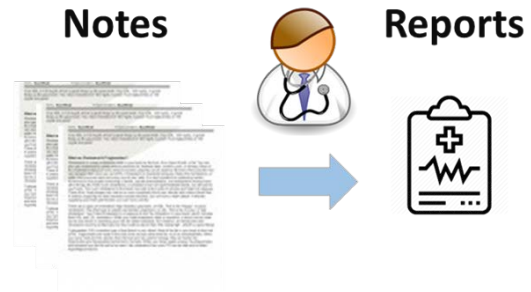




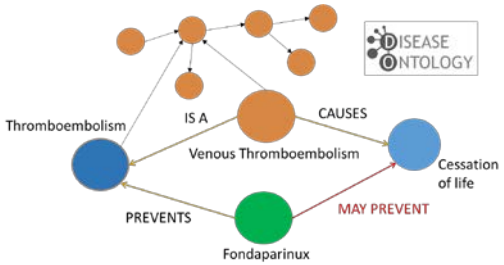
iASiS Big Data for Precision Medicine

Current status: iASiS in numbers

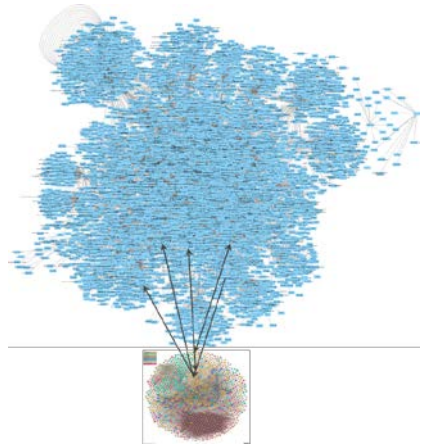
- Electronic health records: 7,146 reports, 171.878 clinical notes, 706 patients (LC)

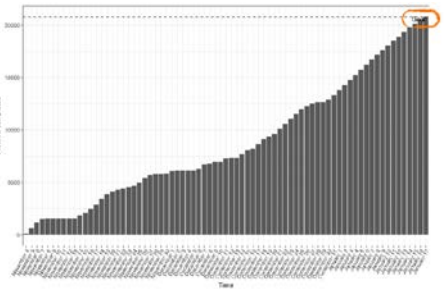


- Open data: 266,170 articles (LC & AD), 168,831 concepts, 1,001,180 extracted relations



- Genomic data: 20,778 proteins x 98,608 RNAs interaction network





→ Knowledge graph: 231,693,984 triples

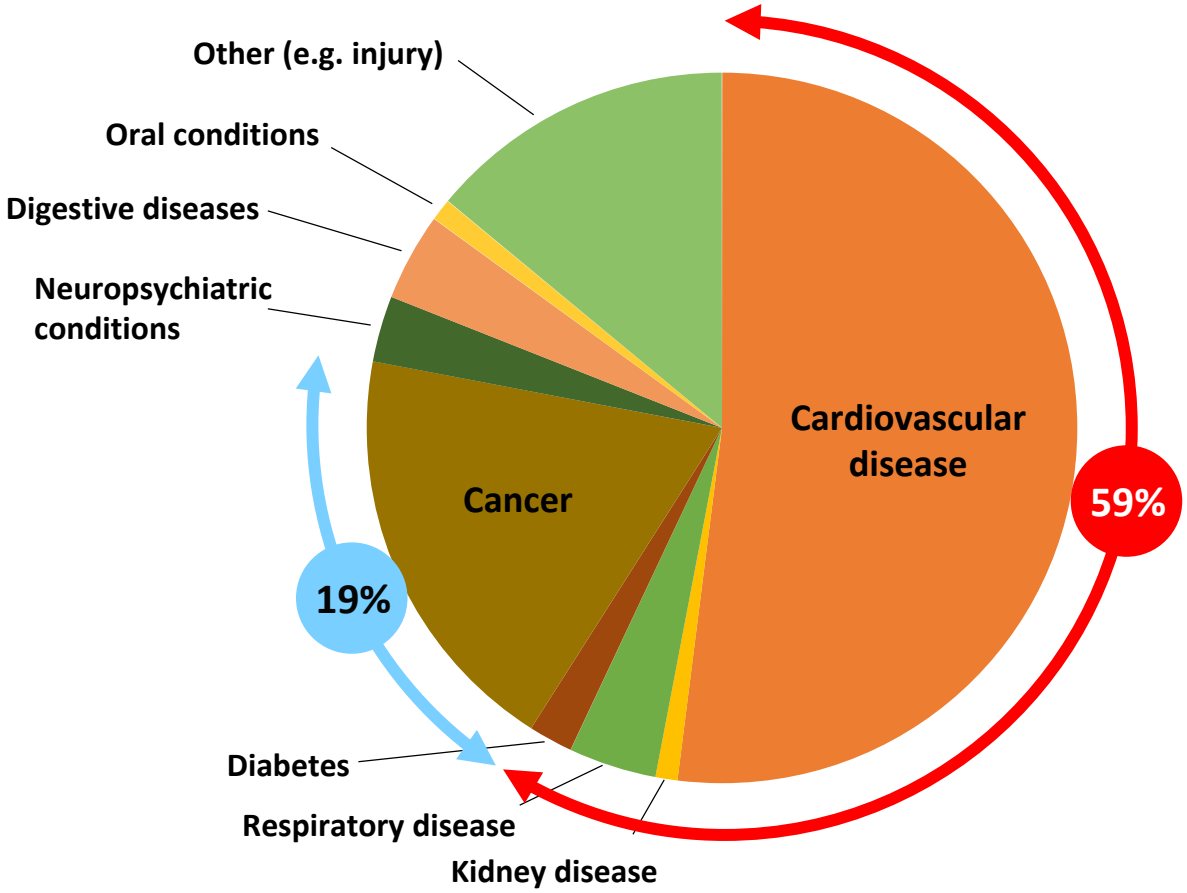
iASiS
Big Data for Precision Medicine

Beyond Data Analysis

- iASiS handles sensitive patient data from hospitals: EHRs, MRI and PET/CT images, blood and liquid biopsy samples
- Ethics Committee led by external advisor to oversee the adherence to rules, regulations and patient consent per data source.
- Data management plan using FAIR principles and corresponding tools.
- Data access control, including anonymization, hardware and software protection, regulated access.

BigMedilytics aims to use state-of-the-art Big Data technologies in order to improve the productivity of the Healthcare sector by reducing cost to the patient, improving quality through better patient outcomes and delivering better access

Percentage of deaths from non-communicable diseases in Europe



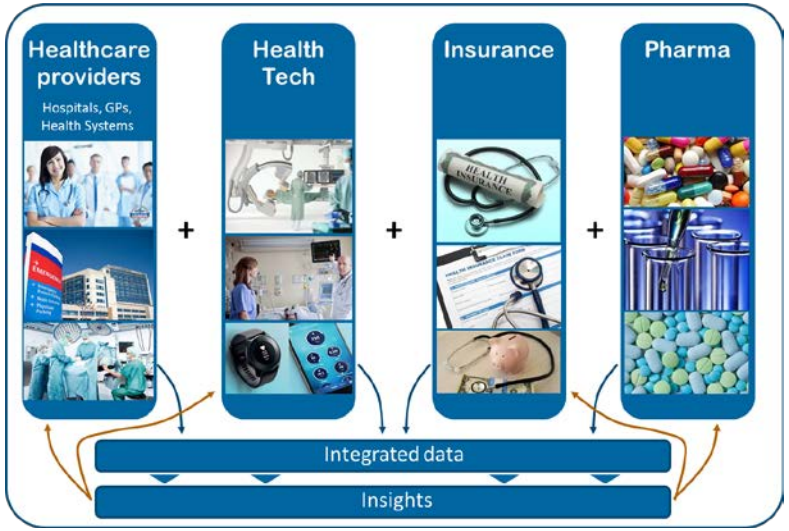
BigMedilytics covers *all* the major disease groups in Europe which cause 78% of the deaths:

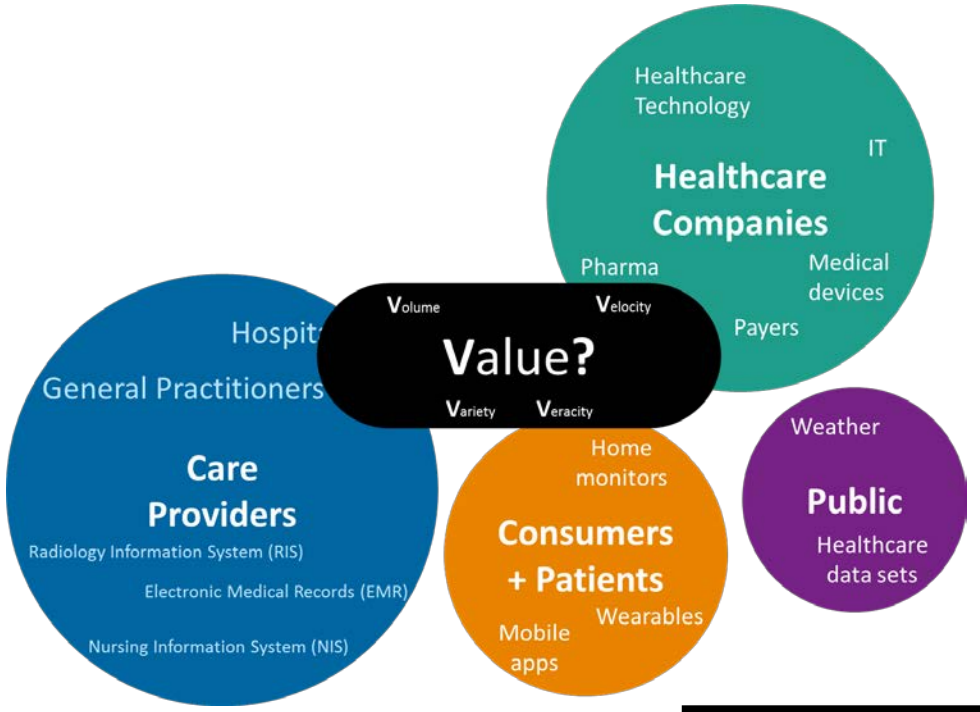
- Cardiovascular disease
- Cancer
  - Breast cancer
  - Lung cancer
  - Prostate cancer
- Chronic respiratory disease
- Diabetes
- Kidney disease
- Comorbidities

Challenges: Technical/Non-technical

Enabling collaborative innovation across all key players in the Healthcare and Data Value Chains

- Patients
- Healthcare Providers
- Payers
- Vendors (Medical diagnostics and Services, Pharmaceuticals, HealthcareIT)
- Knowledge Institutions





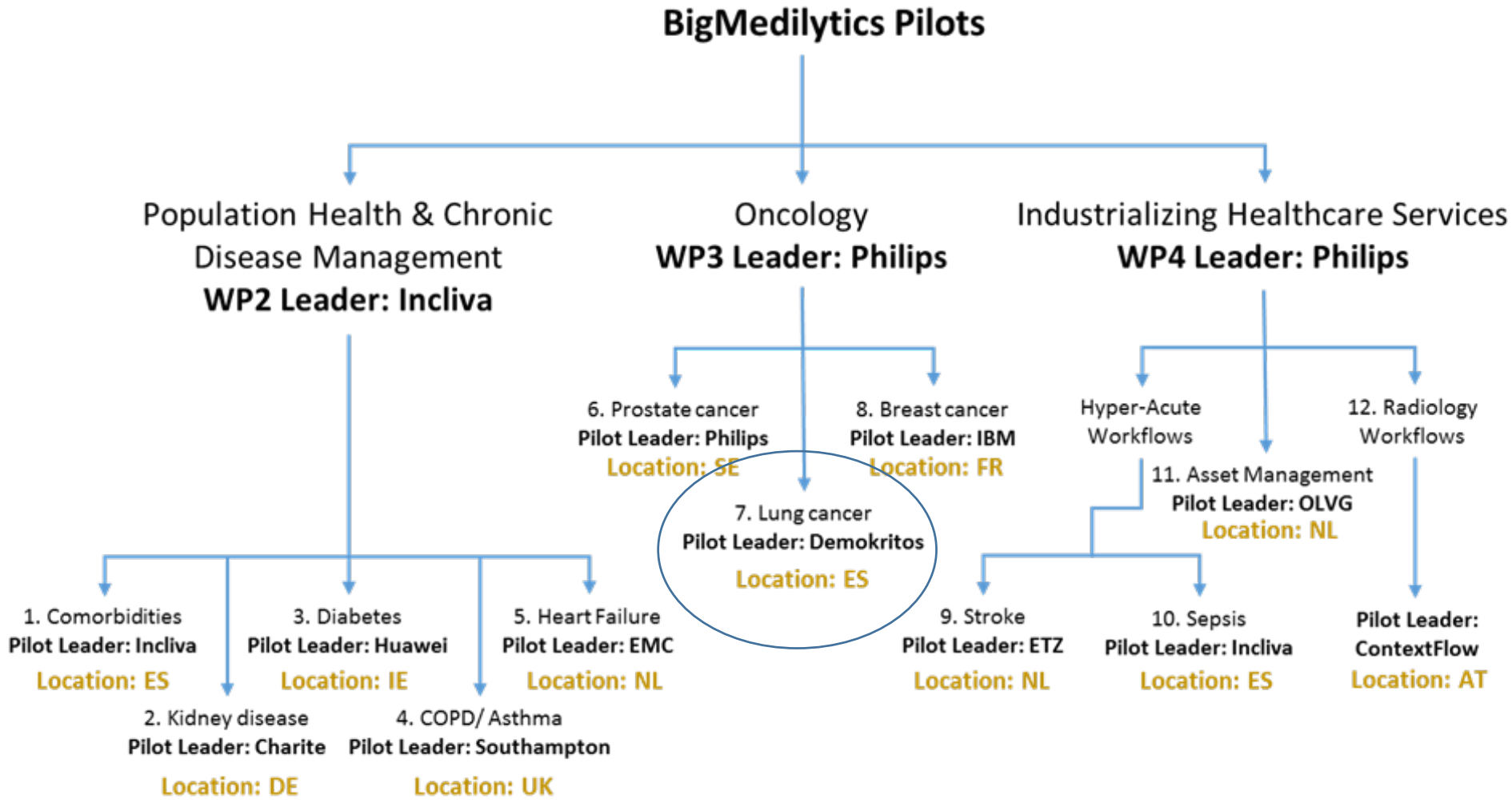
Business Model Innovation

Legal

Ethics

Scale concepts across Europe

12 pilots across 3 themes



Lung cancer pilot: big data approach

Big Data

Patient data
- Electronic Health Records
- Call center logs
- Mobile app logs

Open Data
- Publications
- Databases
- Ontologies

Artificial Intelligence

Data Analysis
- Text mining
- Statistical learning

Data Integration
- Knowledge graph
- Meta-analysis

Precision Medicine

- Improved risk stratification
- Discovery of potential toxicities
- Explanation of adverse effects

How to create success stories

- Start early – a good proposal needs time and evolution
- Clear unique project objective
- Form the Consortium:
  - Clear unique (set of) target group(s)
  - Clear set of partners – are they THE voice of the market?
- Make sure you know the current (market) situation and your starting point
  - Check the list of H2020 current projects

How to create success stories

All three sections are equally important:

- Excellence:
  - Focus and show how you innovate
  - Explain the overall concept underpinning the project
- Impact:
  - Quantify! Describe in a concise, yet robust, manner your baseline, benchmarks and assumptions
  - Plan activities to monitor your performance
- Implementation:
  - Take your time to decide the best methodology to be applied – can it deliver?

How to create success stories

- Design your budget "bottom-up":
  1. define tasks
  2. Estimate efforts needed (person man-months of work)
  3. Translate person-months into EUR

- Ethics, privacy-legal issues
  - Advisory board
  - External Ethics/legal advisors

Thank you for your attention

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