iASiS
Big Data for Precision Medicine

Integration and analysis of heterogeneous big data for precision medicine and suggested treatments for different types of patients.

RADIO

IASIS & RADIO: Two success stories in H2020 healthcare challenges

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NCSR "Demokritos", Greece

SC1-PM-18-2016: Big Data supporting Public Health policies

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

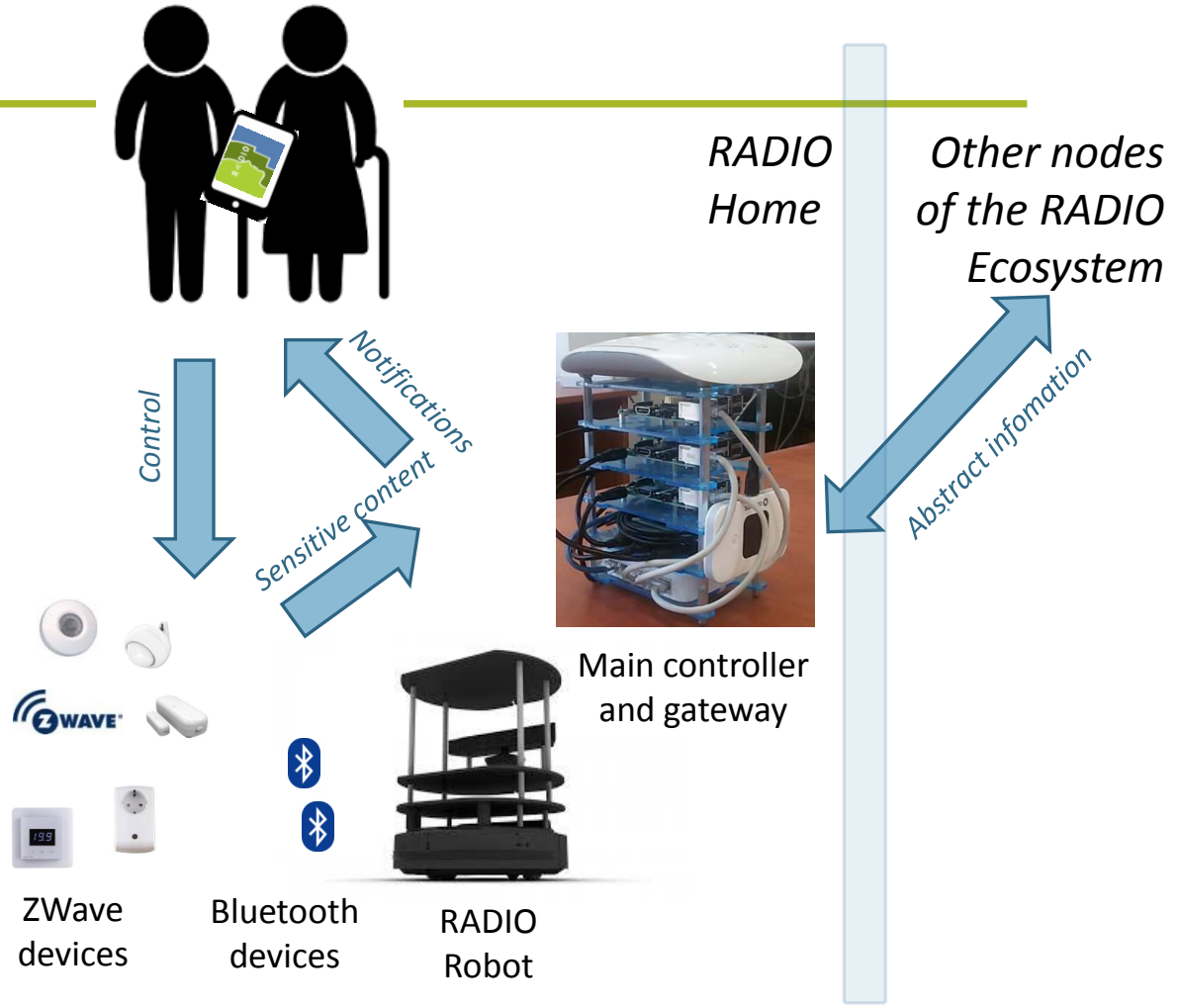
Hospital Universitari

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

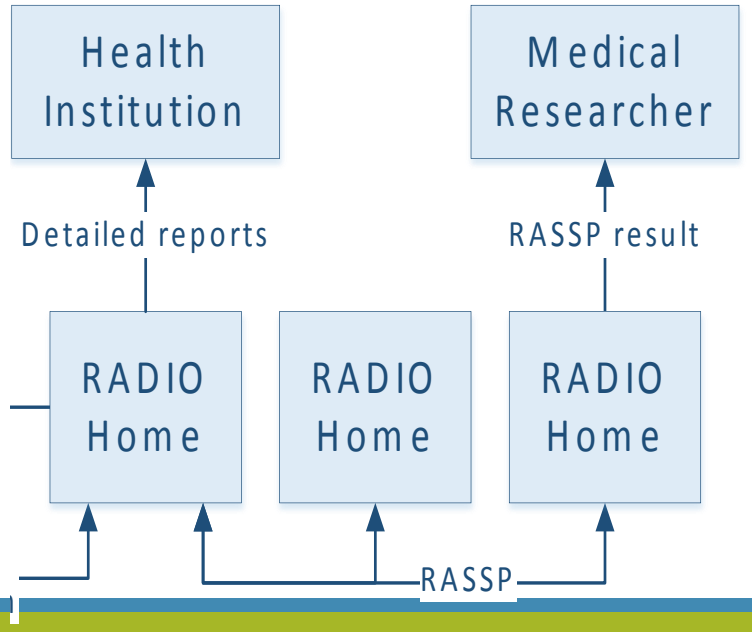
The RADIO System

- 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
- Project Officer: Gisele Roesems

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Big Data for Precision Medicine

Motivation

- Epidemiological data analysis is not sufficient for public health policies in the era of personalized/precision medicine
- We also need explanations, e.g. why a treatment ought to work better for one type of patient than another
- Therefore, we need to combine breadth (across a population) with depth (e.g. personal genome) in the analysis
- Big data analysis can address both breadth and depth, under the appropriate framework. **That's iASiS!**

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

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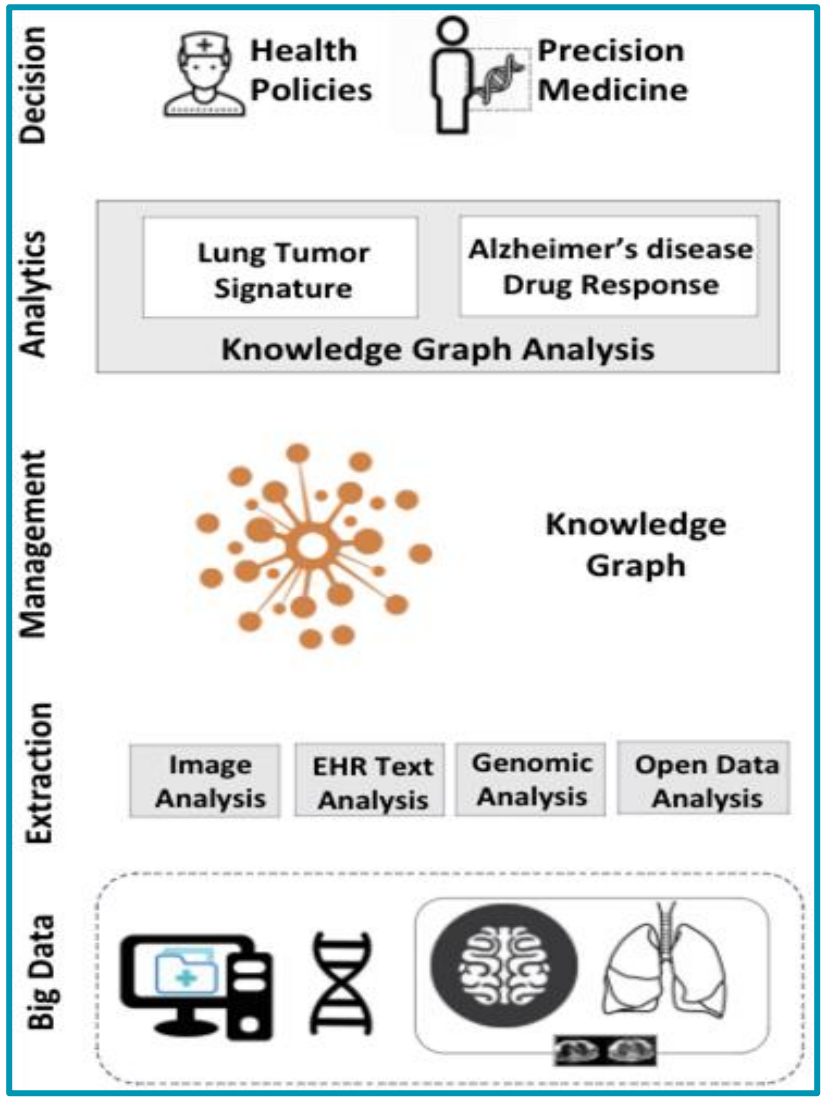
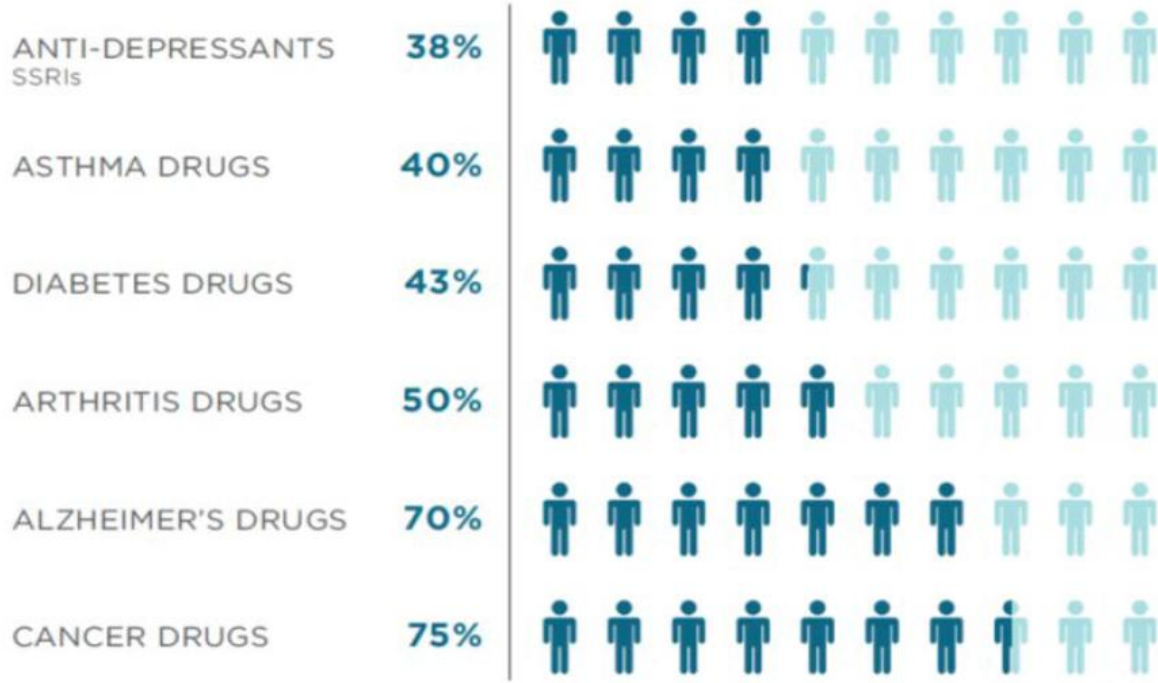
The iASiS Framework



- iASiS focuses on two use cases:
  - Lung cancer
  - Alzheimer's disease

- General-purpose drugs are often ineffective



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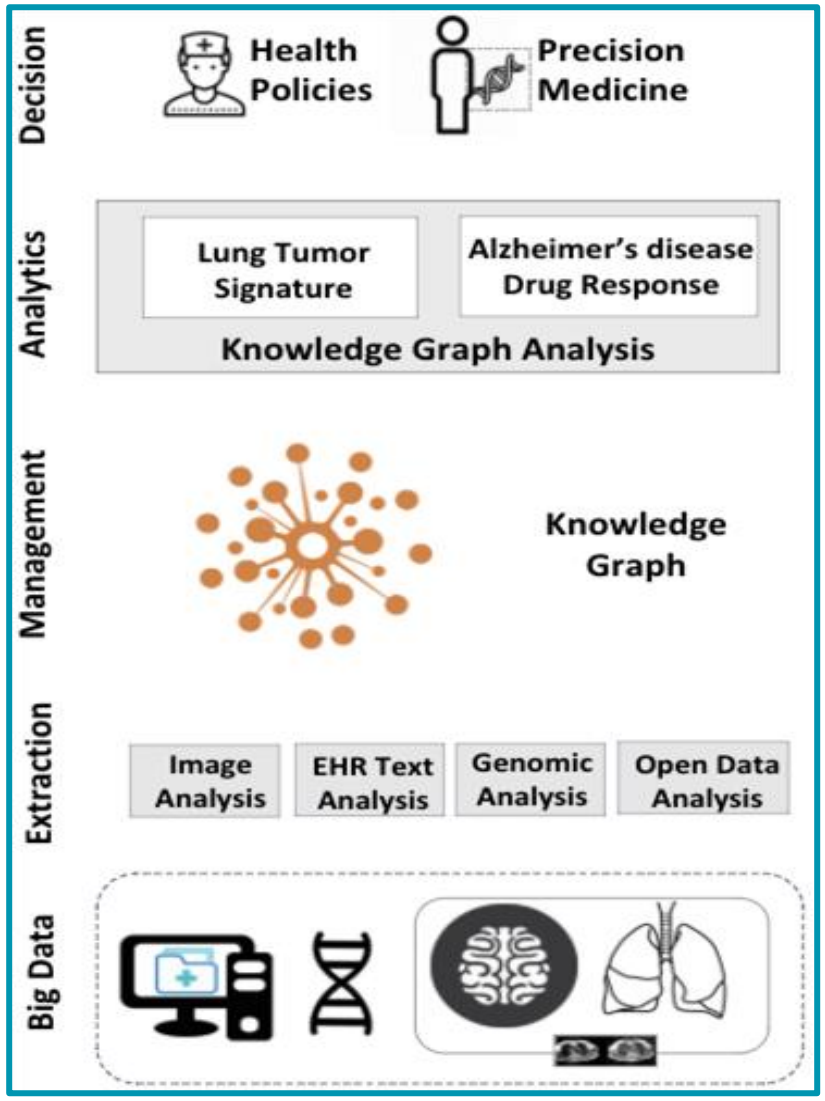
The iASiS Framework



- 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)

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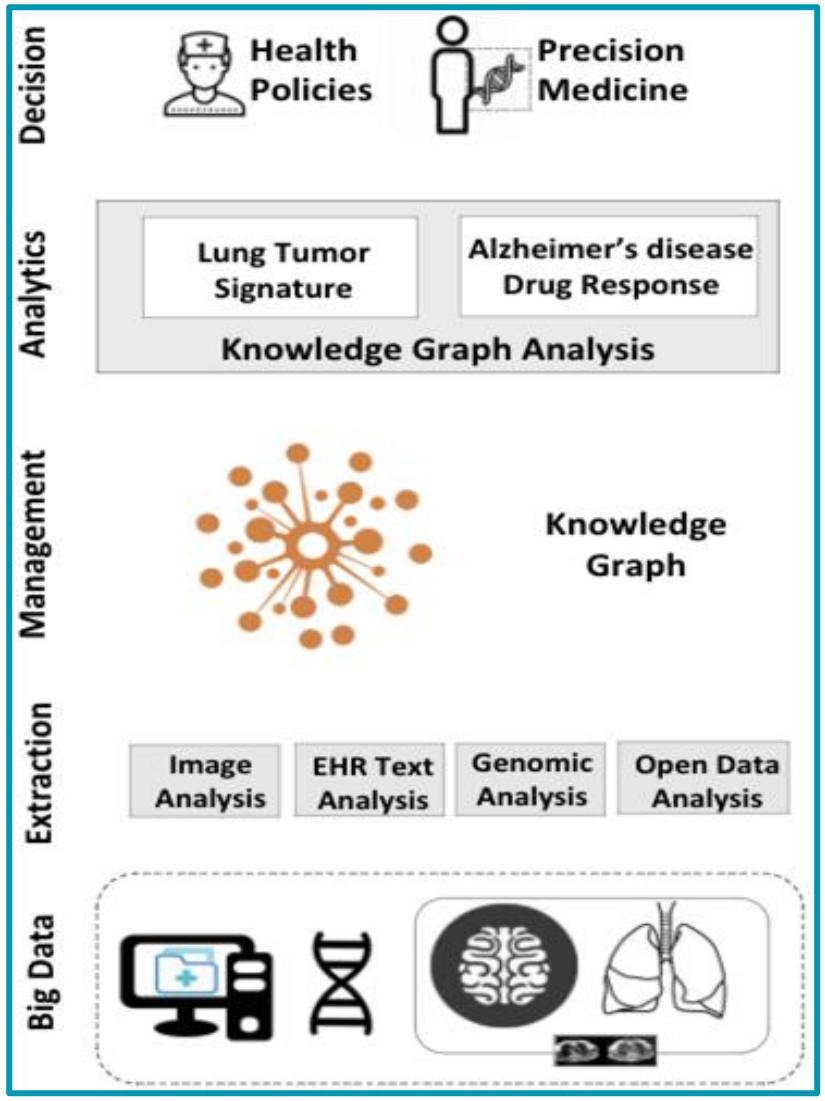
The iASiS Framework



- 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

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Lung Cancer Pilot

Motivation:

- Lung cancer among the most
  - common and deadly diseases
  - costly cancers
- Lung cancer is a heterogeneous disease. Characteristics differ among
  - patients
  - tumor regions

iASiS will enable:

- Discovery of correlations among tumor spread, prognosis, response to treatment
- Unraveling molecular mechanisms that predict response to different tumor types (signatures)

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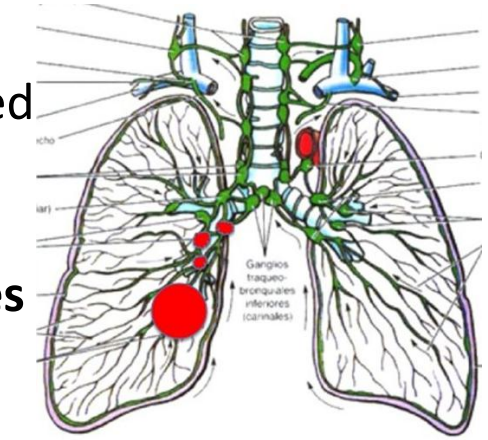
Lung Cancer Pilot Data

- **EHRs in Spanish**
- **PET/CT Images**
- **Genomic Data/Liquid Biopsy Samples**

+

- Pharmacological knowledge extracted from **publicly available datasets**
- **Biomedical ontologies** and **taxonomies**
  - terminology standardization
  - semantically describing the EHRs



Hospital Universitario Puerta de Hierro Majadahonda

SaludMadrid

Comunidad de Madrid

EUROPEAN GENOME-PHENOME ARCHIVE

NIH NATIONAL CANCER INSTITUTE Genomic Data Commons

PubMed PMC UniProt DRUGBANK

GENEONTOLOGY Unifying Biology

DISEASE ONTOLOGY

MeSH

Unified Medical Language System®

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Alzheimer's Disease Pilot

Motivation:

- Approximately, 10% of people over 65 suffer from Alzheimer's
- Heterogeneity of the symptoms impedes accurate diagnosis and treatments

iASiS will enable:

- Discovery of patterns associated with prognosis, outcomes and response to treatments
- Association of medical and lifestyle advice to Alzheimer's risk and stages of severity

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Alzheimer's Disease Pilot Data

- **EHRs in English**
- **MRI Brain Images**
- **Genomic Data**

+

- Pharmacological knowledge extracted from **publicly available datasets**
- **Biomedical ontologies** and **taxonomies**
  - terminology standardization
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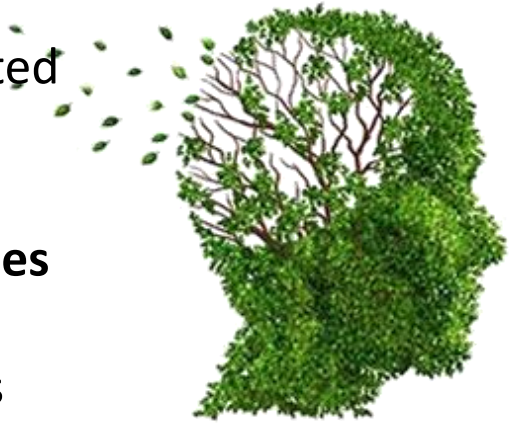

biobank uk

CRIS NETWORK

St George's University of London

CRITICAL PATH INSTITUTE

PubMed PMC UniProt DRUGBANK

GENEONTOLOGY Unifying Biology

DISEASE ONTOLOGY

MeSH

Unified Medical Language System ®

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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.

iASiS Partners

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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

http://project-iasis.eu

http://radio-project.eu

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