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THE AI LAB

How can we leverage innovative solutions in AI and Machine Learning?

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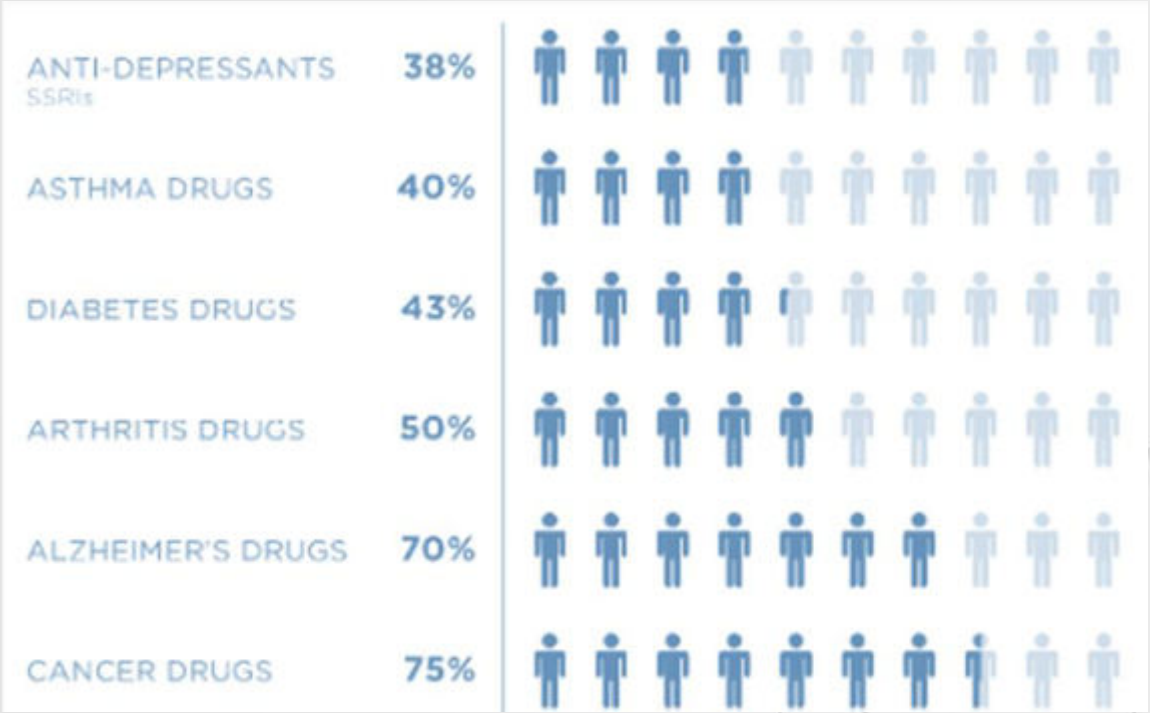
National Center for Scientific Research "Demokritos"

Many drugs don’t work for everyone



Source: Spear et al., Clinical Trends in Molecular Medicine, 2001

Precision Medicine

What is it?

"*Identifying which approaches will be effective for which patients based on genetic, environmental, and lifestyle factors.*"
NRC, NIH, US

Why Now?

Advances in biology and bioinformatics that provide understanding of the molecular basis of disease.

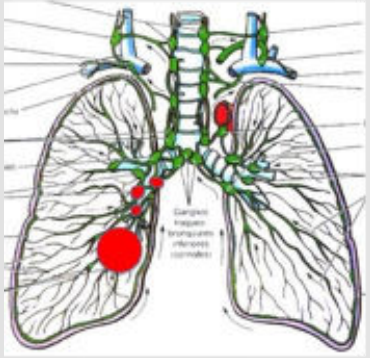
Precision Medicine

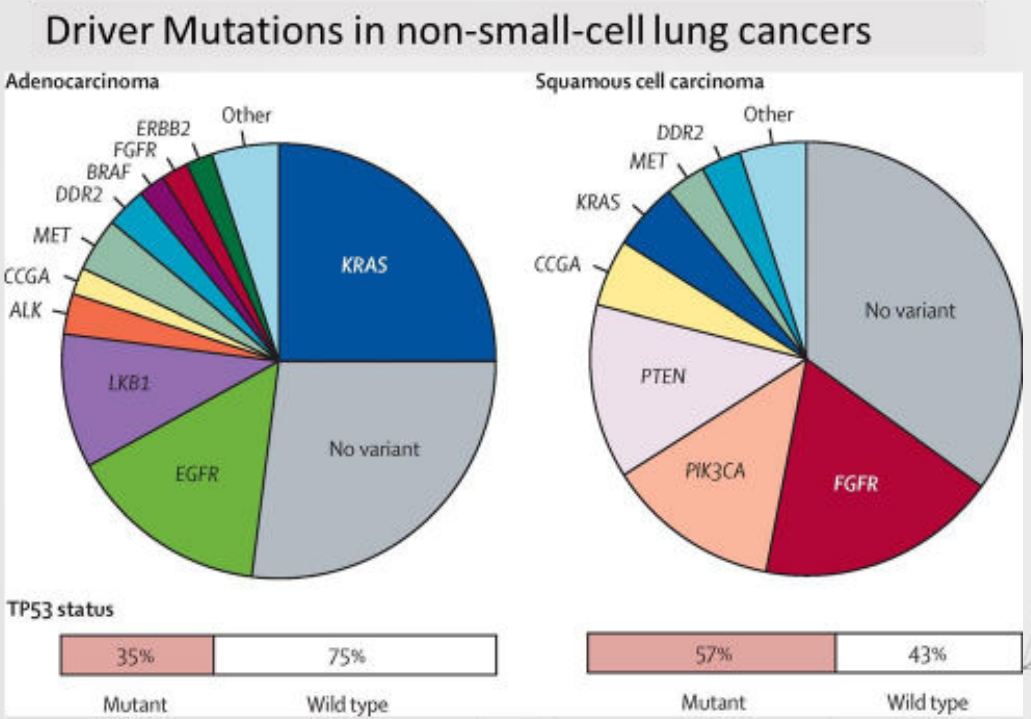
What can it do?

Patient-centered care: treating the person, not the disease

- Optimal therapies for individuals
- Avoid adverse drug reactions
- Reduce treatment costs
- Early detection of disease
- Better prognosis of disease progression
- Facilitate pro-active preventive medicine

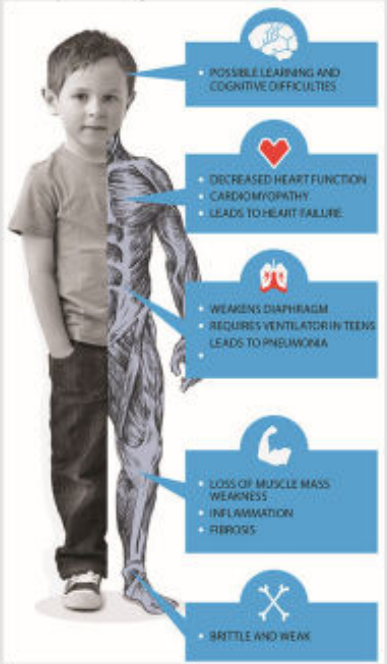
Example 1: Cancer



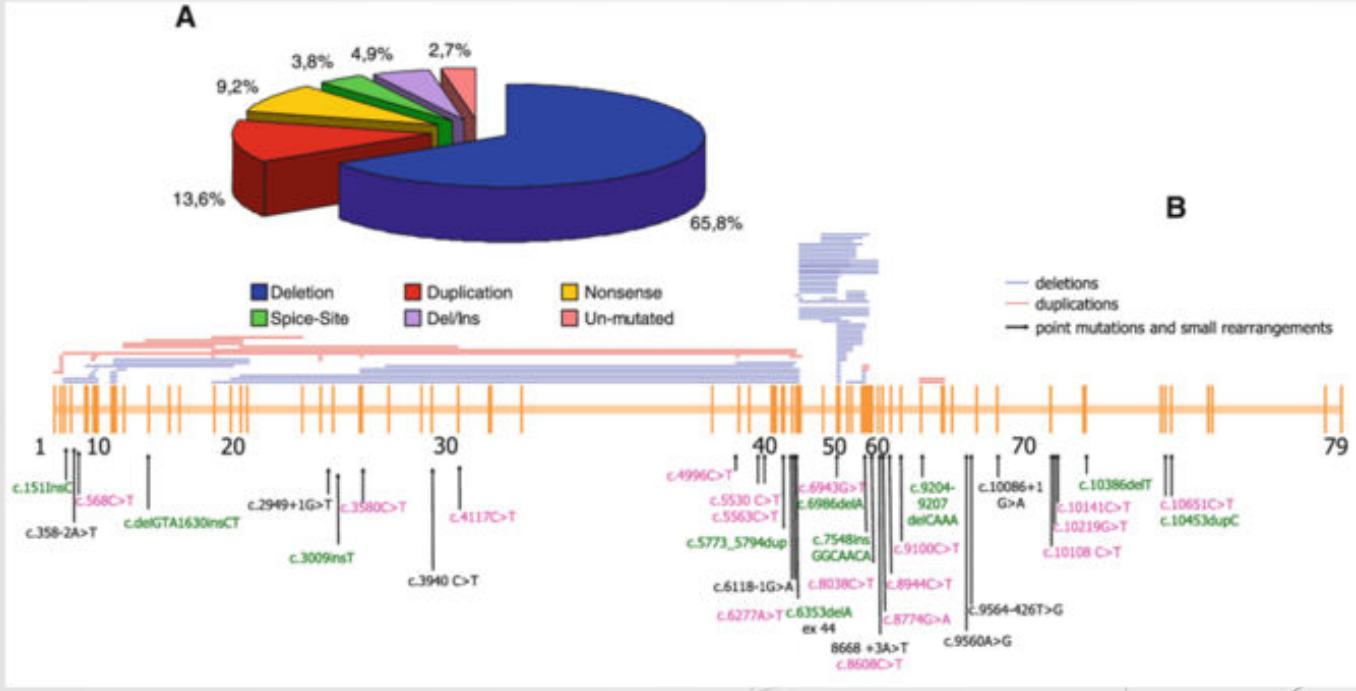


Source: Hiley et al., The Lancet, 2016.

Example 2: Rare Disease



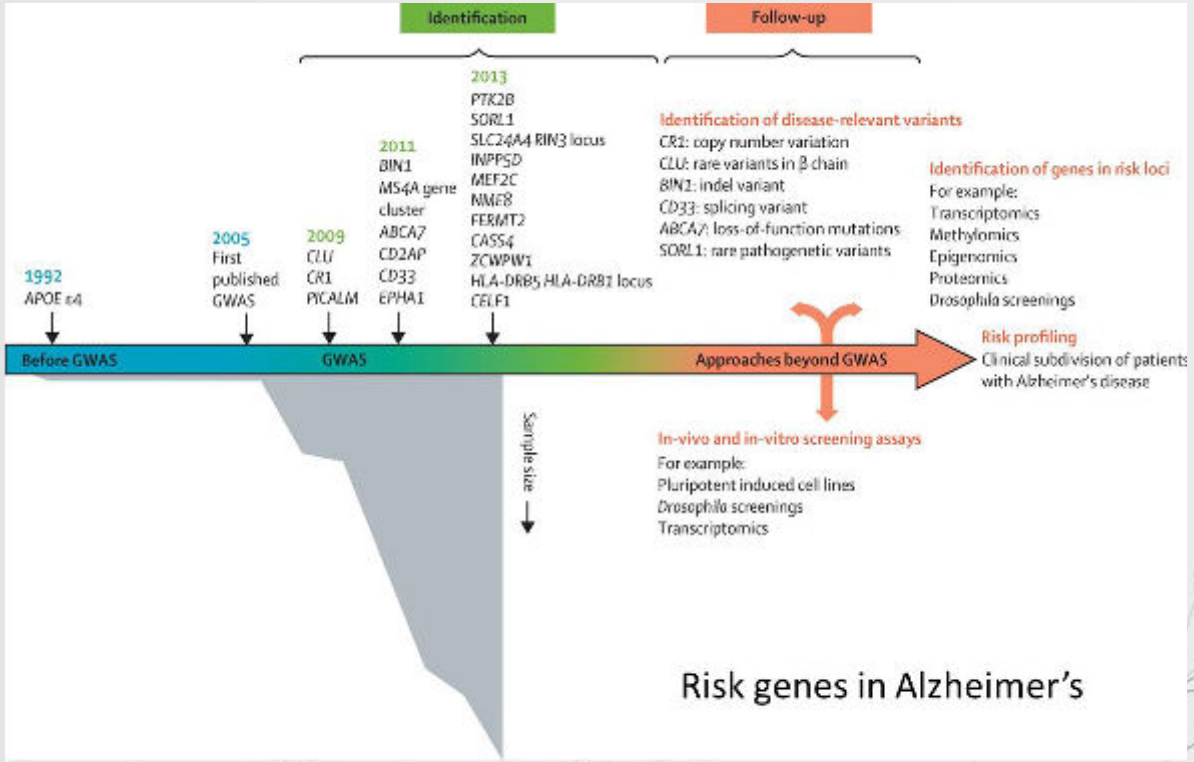
Source: cureduchenne.org



Example 3: Neurodegenerative Disease

Types of Alzheimer's:

- Early onset (<65)
- Late onset (>65)
- Familial (inherited)



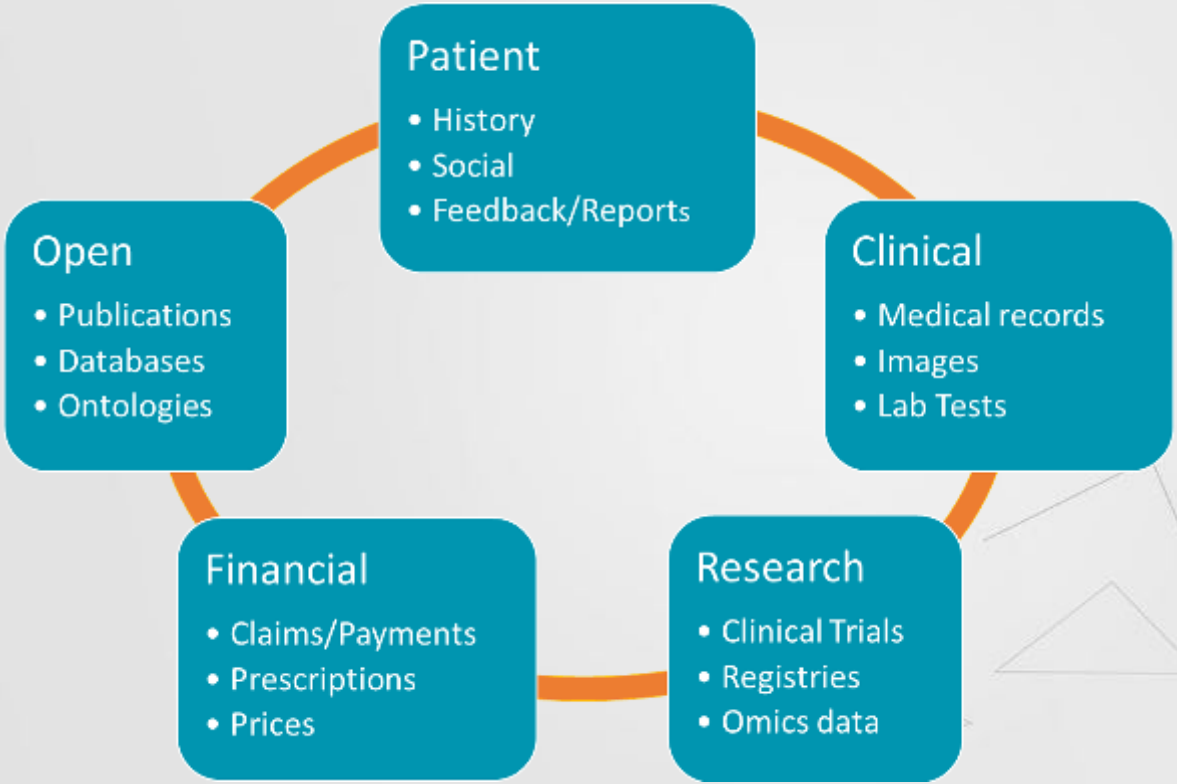
Source: Cuyvers and Sleegers, Lancet Neurology, 2016.

AI for precision medicine

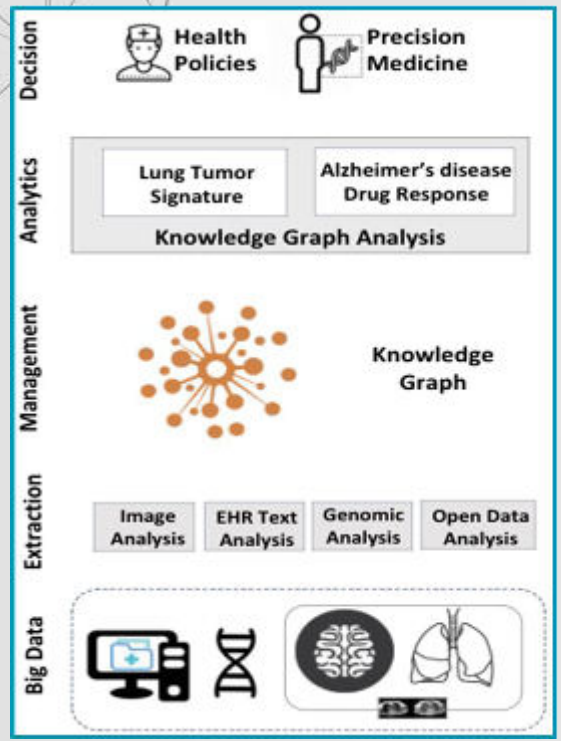
- Technology helps understanding disease mechanisms
- Understanding leads to cure
- Discovery depends on the analysis of big data

➡ AI is essential for precision medicine decisions

Biomedical Data Landscape

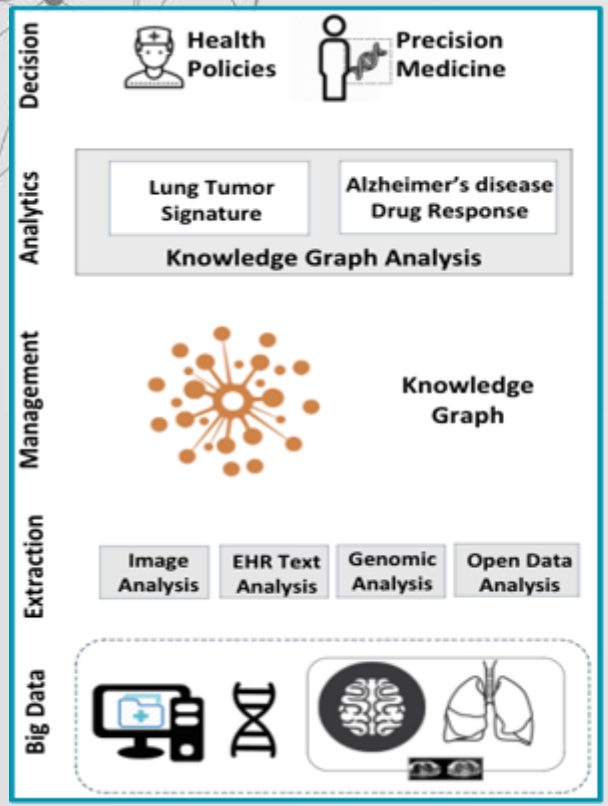


The iASiS framework



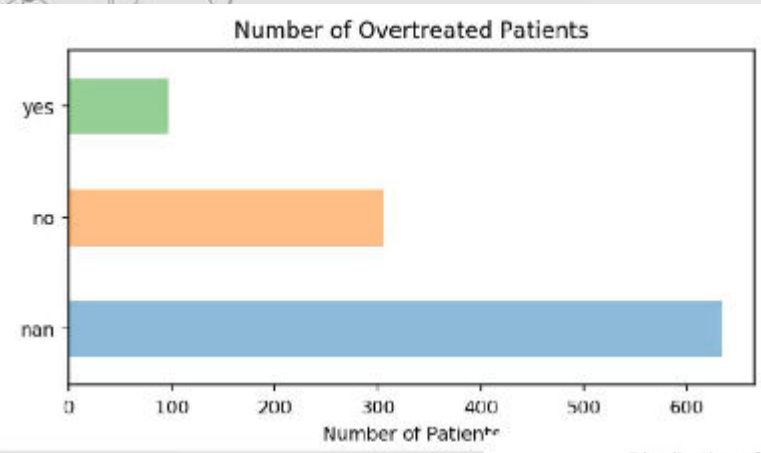
- iASiS analyses:
  - EHRs (English & Spanish)
  - MRI & PET/CT images
  - Genomic data (e.g. liquid biopsy samples)
  - Related bibliography (e.g. PubMed)
  - Biomedical databases (e.g. DrugBank)
  - Biomedical ontologies (e.g. GO, UMLS)

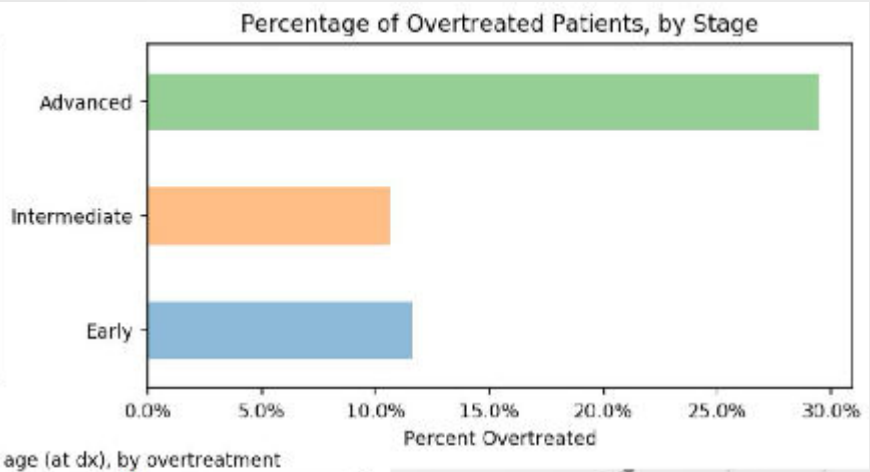
The iASiS framework

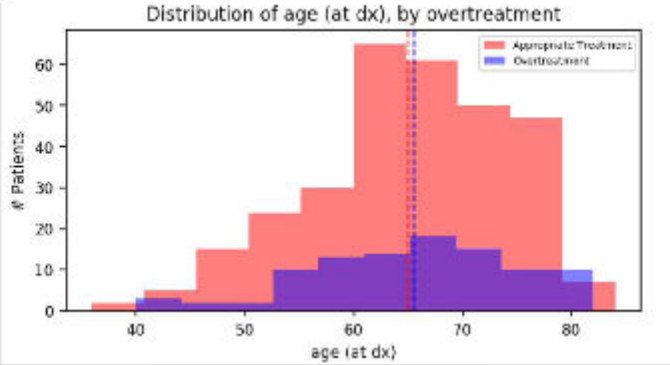


- Extracted knowledge is fused in the iASiS knowledge graph
  - Unified semantic schema
  - Linked data
  - Machine-processable knowledge
- iASiS end-users will be able to:
  - Receive answers along with justifications
  - Identify patterns in patient populations
  - Make more informed decisions
- All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

Lung-Cancer: Overtreatments



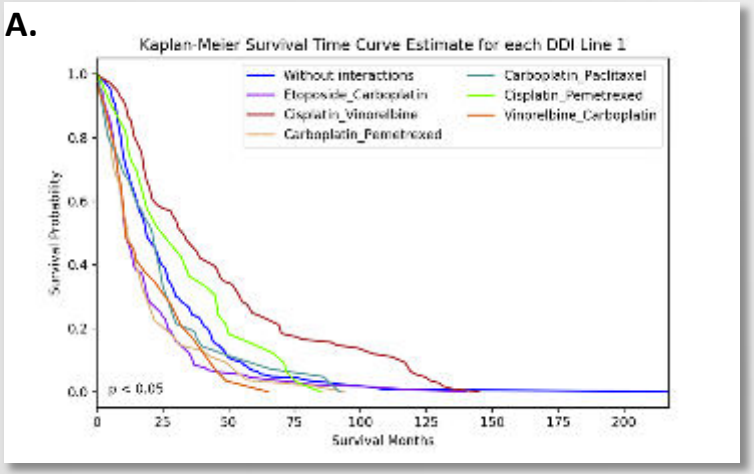




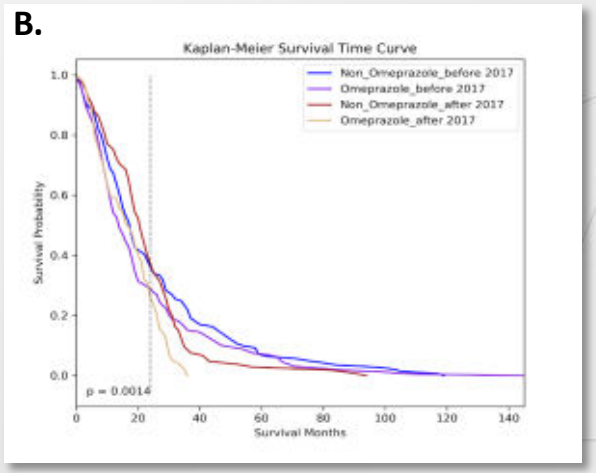
Lung-Cancer: Toxicities

- Exploring IASIS knowledge graph, we observed, with statistical significance, a difference among the different chemotherapy schemes (figure A)
  - the combination with vinorelbine and cisplatin the most effective one
  - the combination of vinorelbine and carboplatin is the most toxic one
- Drug-Drug Interactions (DDIs) with non-oncological drugs (figure B): Omeprazol, is known to decrease the efficiency of several oncological treatments

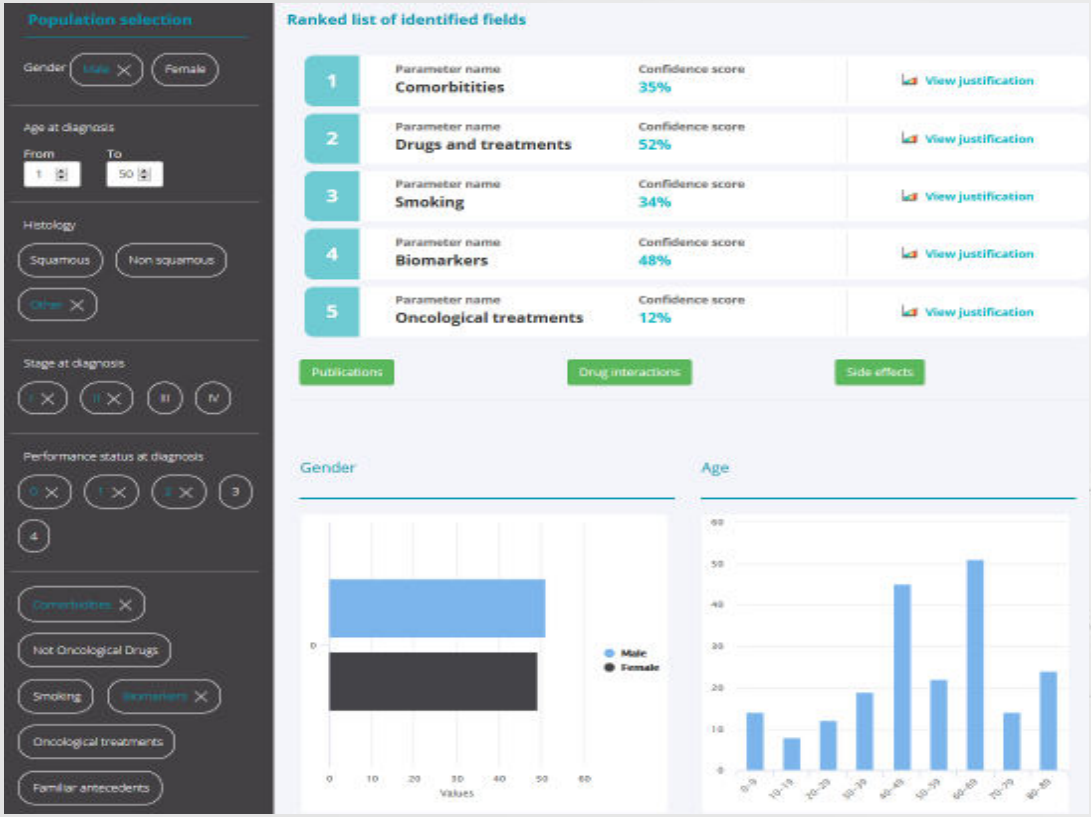
A.



B.



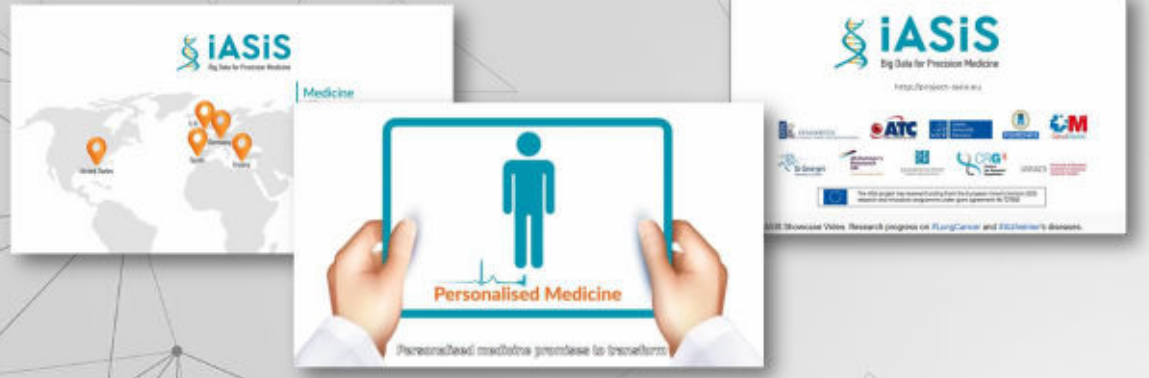
Visualization of results: iASiS Dashboard



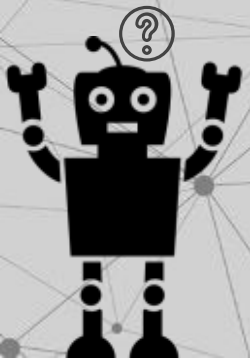
Food for thought

- Technology helps understanding disease mechanisms
- Understanding leads to cure
- Discovery depends on the analysis of big data

- **Not sharing or not using data costs lives**
- 80% of rare diseases are genetic
- Data sharing is imperative for rare diseases
- Beyond genetics: environmental & social factors for precision medicine
- Beyond drug discovery: **data analytics for prevention**



Showcase video: https://project-iasis.eu/node/187



Thank you!