TAVOLA ROTONDA ISO25000

Progetti di qualità, esperienze, best practice

AI & Physical Science Techniques to optimise TC Examination

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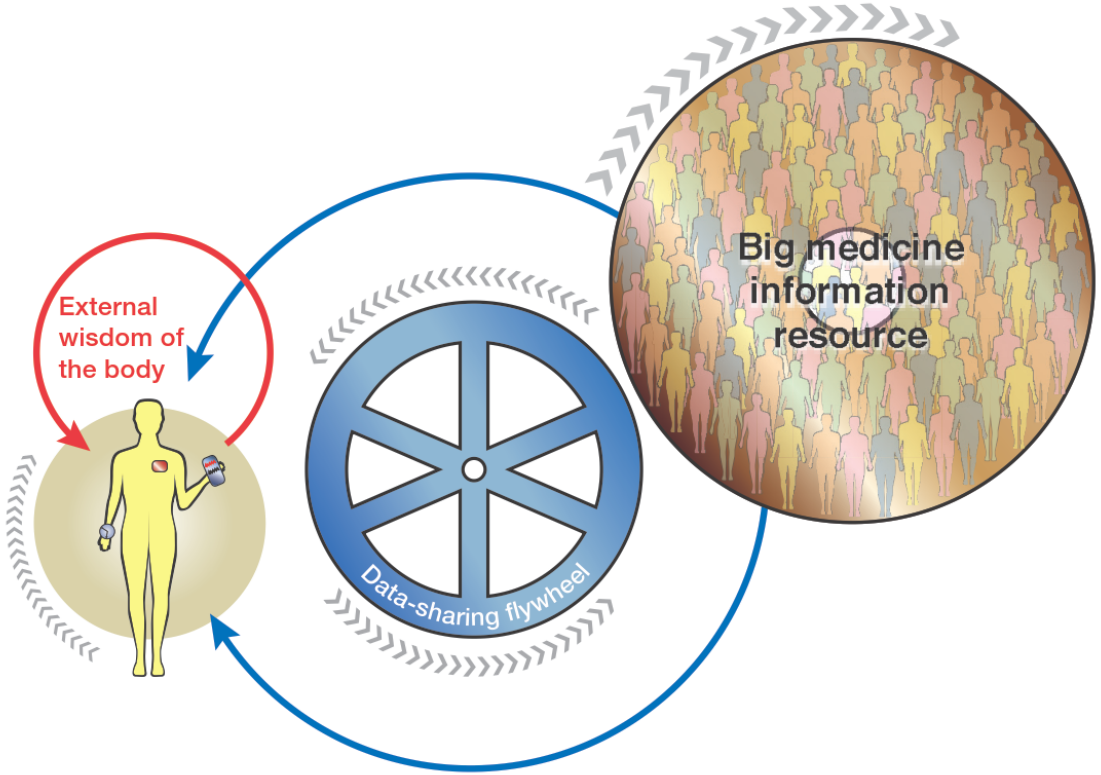
Scenario: Big Data Engine



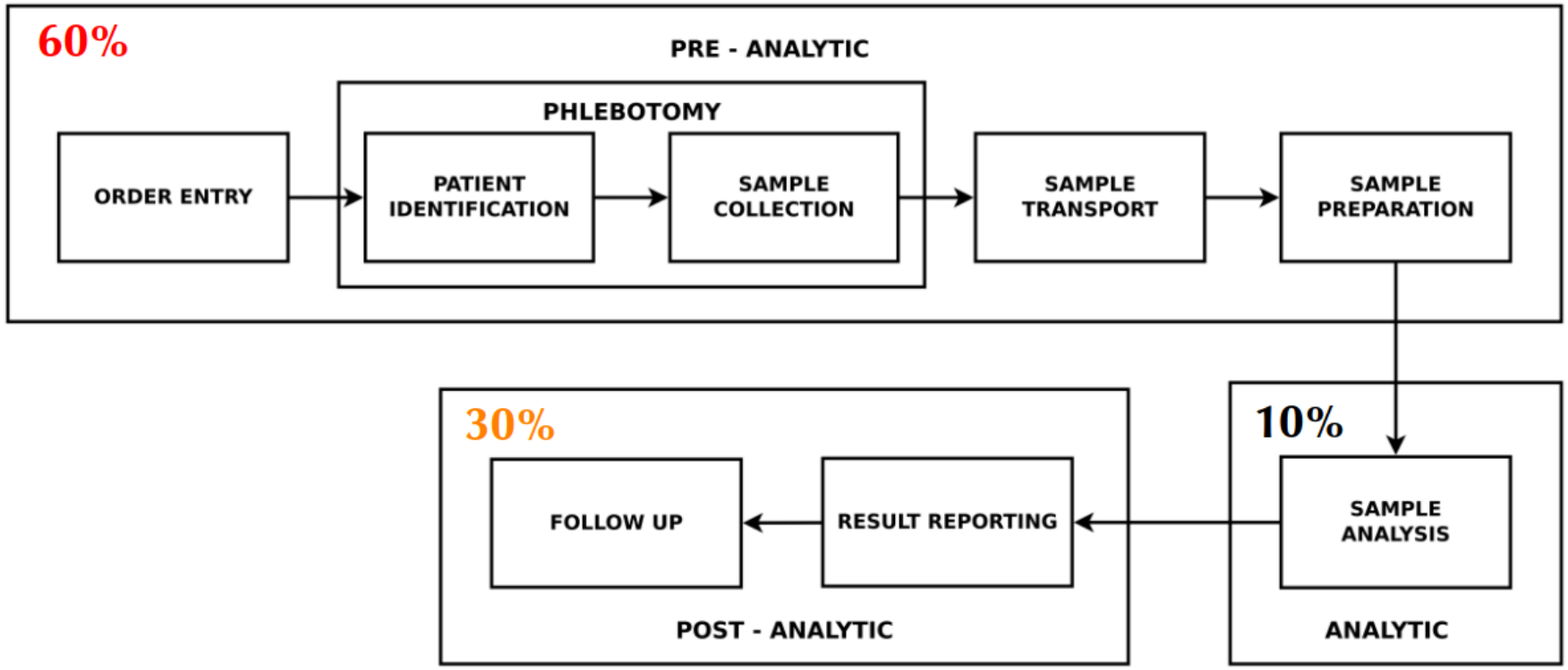
Big Data imply at least:

1. **massive storage (eterogeneics or distributed recipes in italy as well in EU)**

2. **Appropriate algorithms** combined with **relevant computational resources.** IA (e.g. supervised deep learning) seems e promising approach

The medical data ownership engine. Each individual gets direct feedback of her/his own generated data through **biosensors**, **imaging**, **physical examination** tools and **laboratory tests**, comprising a new 'external' wisdom of the body. Such data are fed into the **flywheel** of the engine and eventually, when there are enough individuals amassed into a **big medicine resource**, there is a breakthrough to form a **valuable medical knowledge resource**. That, too, provides external **feedback** to the individual for optimal prevention and medical treatment.

Error Distribution within a Clinical Process



Plebani et al. Clin Chem Lab Med. 2006;44(6):750-9

Variability within the clinical procedures & parameter definitions (Semantic for IT interoperability)

Insufficient contestual information

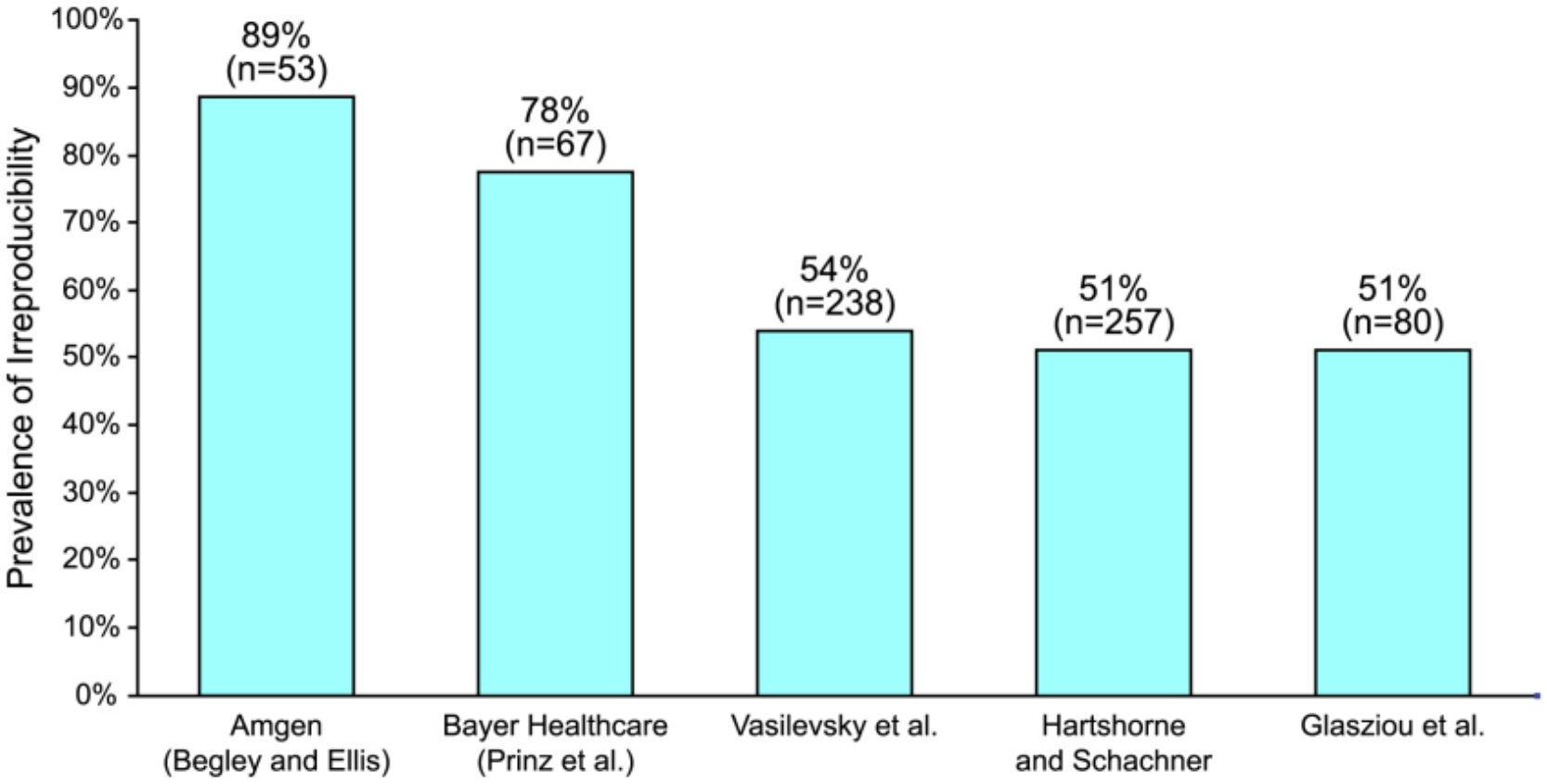


Fig 1. Studies reporting the prevalence of irreproducibility. Source: Begley and Ellis [6], Prinz et al. [7], Vasilevsky [8], Hartshorne and Schachner [5], and Glasziou et al. [9].

doi:10.1371/journal.pbio.1002165.g001

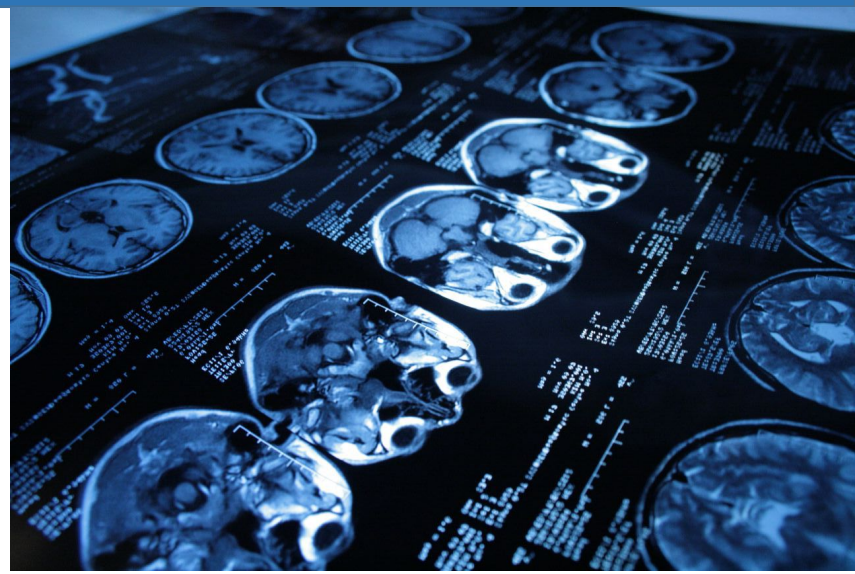
From Freedman et al. PLOS Biology 2015

AIM: to OPTIMIZE TC Examination

- Computerized Tomografy is e radiodiagnostic technique used since'70, (X rays beam attenuated by physical structures), to carry out 3-dimensional dataset for the diagnostic process.

- TC exam is estimated to be circa 60.000.000 per year in EU. *(source OECD e EUROSTAT)*

- Today a thoracic TC give a dose two order of magnitude higher of a traditional X Ray *(source ICRP)*



To optimize TC examination in order to lower value of exposition to radiation (ALARA principle), keeping high level of diagnostic capability.

Project: “Intelligenza artificiale e tecniche mutuate dalle scienze fisiche per una efficace ottimizzazione degli esami TC” funded by UO Careggi (FI, Italy)

- Big Data and AI are technological challenges capable to disrupt the actual health organization and promote better clinical results. To promote the future of digital medicine, however, we need to overcome several critical issues: dataset quality, semantic interoperability, error reduction in clinical data, **robustness** and **explainability** of AI algorithms, **reliability** of the information associated to clinical process (irreproducibility)
- The **Careggi hospital project** is within this field of interest for ISS. The project proposes a *new approach to image processing*, in order to improve the diagnostic capability of actual TC apparatuses, and also to lower the radiation dose.

Mauro Grigioni, Director of National Center for Innovative Technologies in Public Health

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- **Aim**: 3D segmentation and reconstruction, low contrast source detection on images whit noise
- **Radiomics**: complex 3D reconstruction and feature extraction (shape, flatness, skewness, dishomogeneity etc) are intended to **identify** accurately the **lesion** and to lower the radiation dose.
- To build a **virtual observer** (VO) capable to investigate on different protocols the same radiated **phantom**; the VO is trained on radiologist’s diagnostic advice, subsequently the VO is used on higher data volume relative to the phantom for different protocols, varying the radiation dose.
- Finally **Quality Assurance** of the radiological process making use of AI will be provided, in view of the continuous quality improvement.

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Big Data e AI critical Issues – Quality Assurance

Dataset and Processes Quality

- Informative contents (e.g. coherence, accuracy…)
- Quality & Standardization of production mode
- Clinical appropriate data (contestual info in Bio Bank)
- Qualification/Validation needs

Rule of thumb: a supervised deep learning algorithm will generally achieve **acceptable performance** with around 5,000 labeled examples per category, and will match or **exceed human performance** when trained with a dataset containing at least **10 million labeled** examples.
(Deep Learning, Goodfellow et al. 2016)