

55.25% 67.55%

10 GIUGNO 2025

L'epidemiologia dei tumori
tra nuovi bisogni di salute, ricerca
clinica e innovazioni tecnologiche



**Candiolo
Institute
EPO-IRCCS
Comprehensive
Cancer
Center**

Integrating AI into Translational and Clinical Research

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Candiolo Cancer Institute IRCCS



Background: Advantages of AI in clinical and translational research

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Accelerated Target Discovery



Smarter Preclinical Models



Biomarker Discovery & Validation



Patient Stratification



Drug Discovery-Repurposing &
Combinations



Multi-modal Data Integration

Background: Application of AI in clinical and translational research

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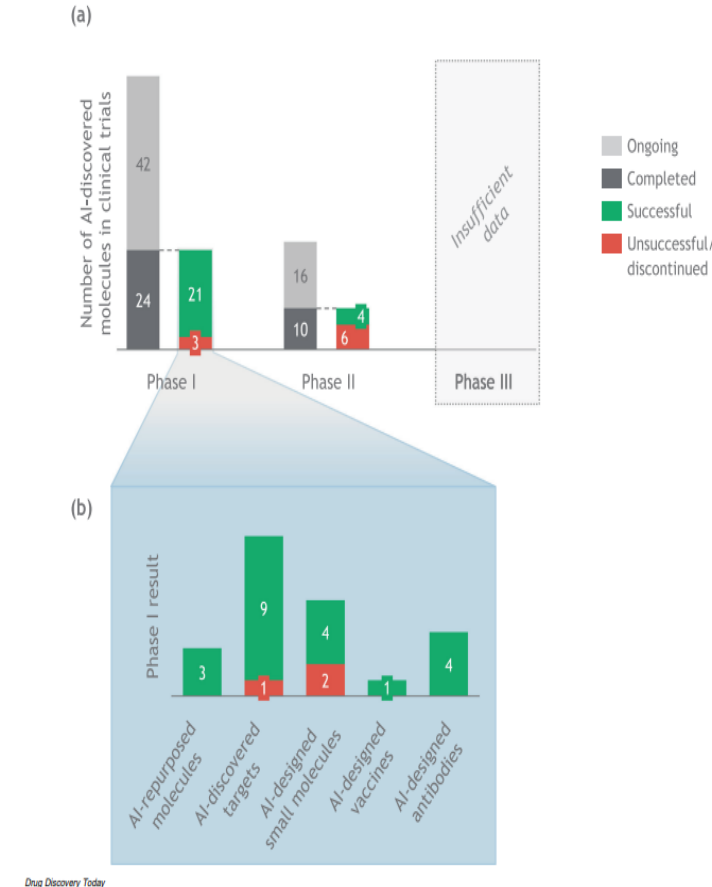
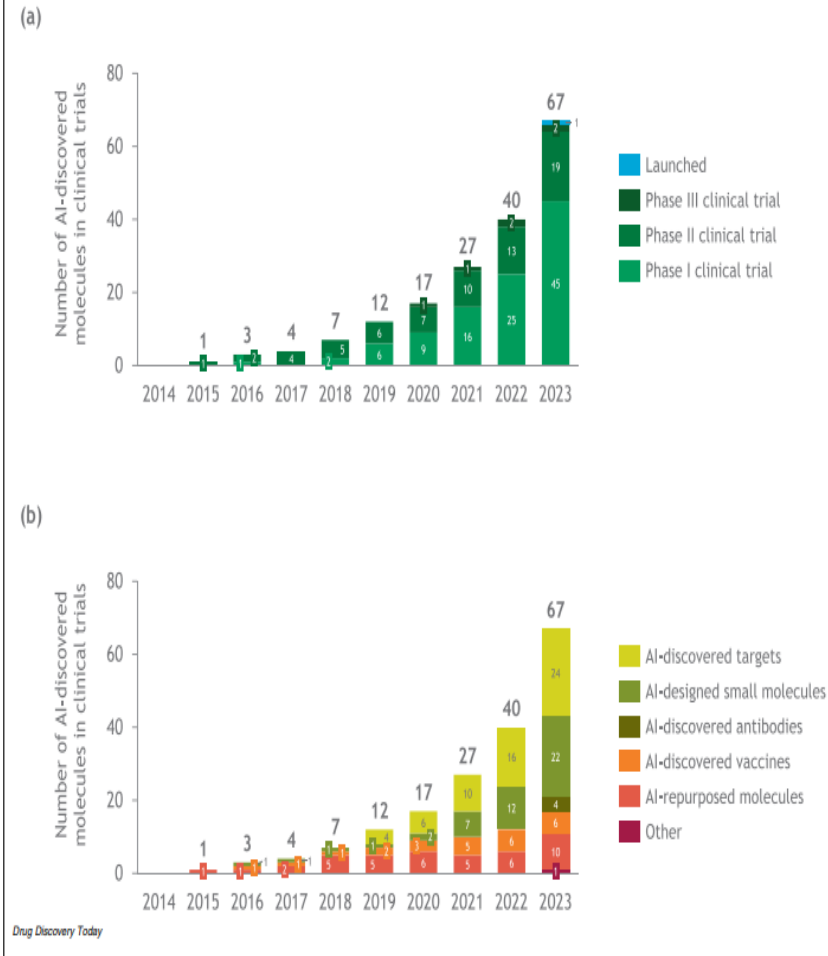


Field	AI function
Omics & Multi-omics	Pattern recognition, clustering, feature selection
Biomarker discovery	Predictive/prognostic modeling
Drug discovery & repositioning	Virtual screening, target prediction
Medical imaging	Diagnostic support, lesion detection, image segmentation
Clinical trials	Patient matching, remote monitoring, simulation
Personalized medicine	Patient stratification, treatment optimization
Risk prediction & prevention	Early warning systems, continuous monitoring
Research workflow support	Literature mining, hypothesis generation

Background: Example of Application of AI in translational research

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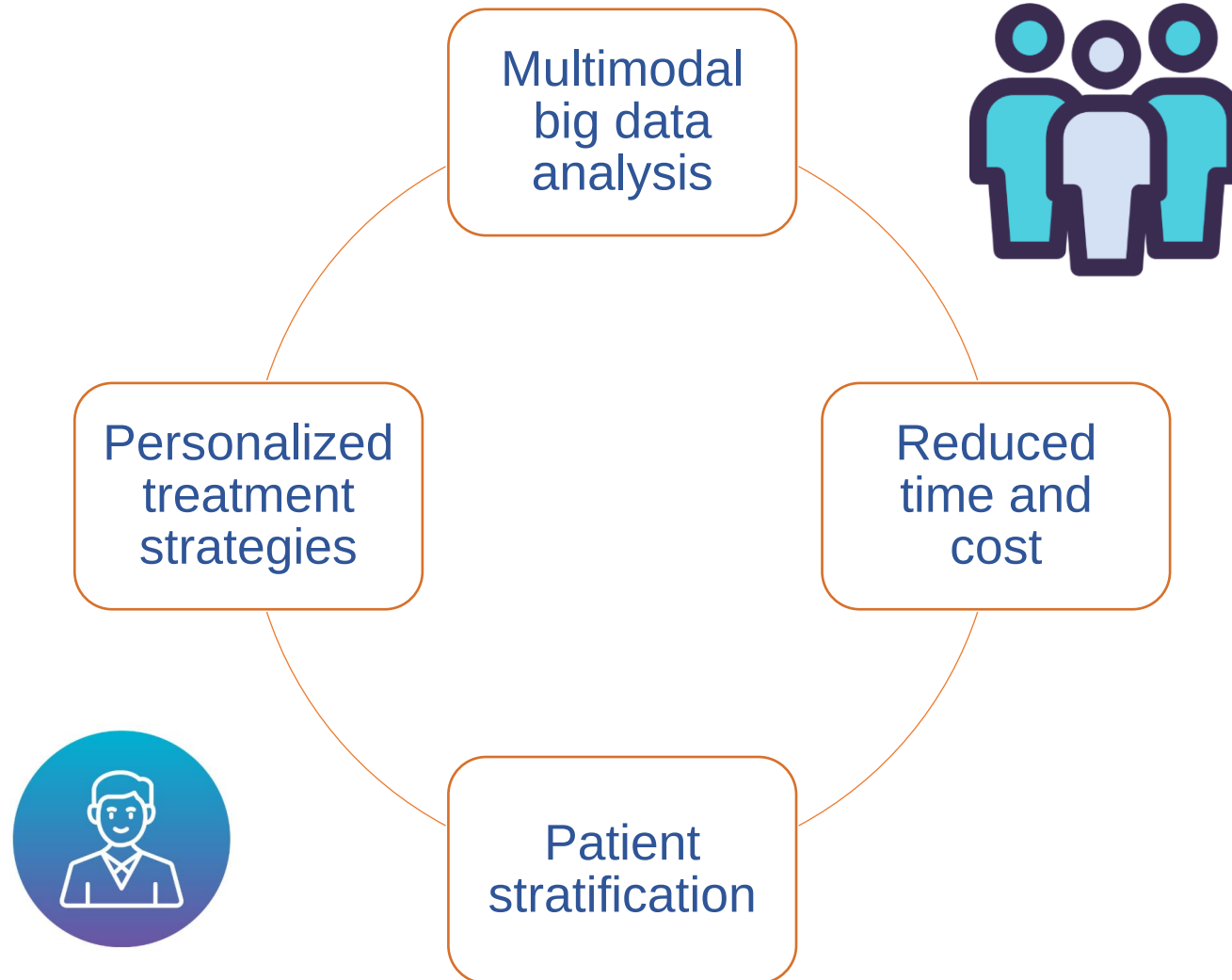


In Phase I AI-derived molecules can have a success rate of 80–90%, and II the success rate is 40%, albeit on a limited sample size, comparable to historic industry averages, but 4/6 were discontinued due to business priorities

Background: Advantages of AI in clinical setting

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Background: AI in IRCC and CCC

HOW AND WHEN SCIENTIFIC EVIDENCE SHOULD BE APPLIED IN PRACTICE?

National Health Research Programme (NHRP) 2023-2025

MANDATE

for

Istituti di Ricovero e Cura a Carattere Scientifico



IRCCS must act as a driving force for the application of research knowledge to clinical practice by:

- Prevention
- Diagnostic pathways
- Therapeutic pathways
- Costs and organisational processes

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Background: Organisation of European Cancer Institute - AI indicators manual 3.2 (→4*)

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300
indicators

18.55	AI applications used in cancer care comply to the Artificial Intelligence Act (Regulation (EU) 2024/1689) and Medical Device Regulation (Regulation (EU) 2017/745)	Centres policy Strategy Doc
18.56	There is a quality management programme for AI applications including regular checks if the AI application performs according to specifications.	Documentation of the QMP framework, including policies, processes, and standard operating procedures (SOPs) for cancer care. Protocols for clinical guidelines, patient safety, and treatment pathways.
18.57	It is documented in which cancer patients and/or cancer care settings a given AI application can be used.	SOPs or documentation with criteria
18.58	There are processes to ensure that only trained and competent personnel use a given AI application.	Process document

*Confidential

Candiolo Experience with AI: Radiomics



An AI Platform integrating imaging data and models, supporting precision care through prostate cancer's continuum

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Overall objective:

- To create a repository (Prostate-NET) of mp-MRI examinations with related clinical and pathology data dedicated to PCa;

Total Patients	Total Data Points	Total Images
12,816	24,022	8,425,386

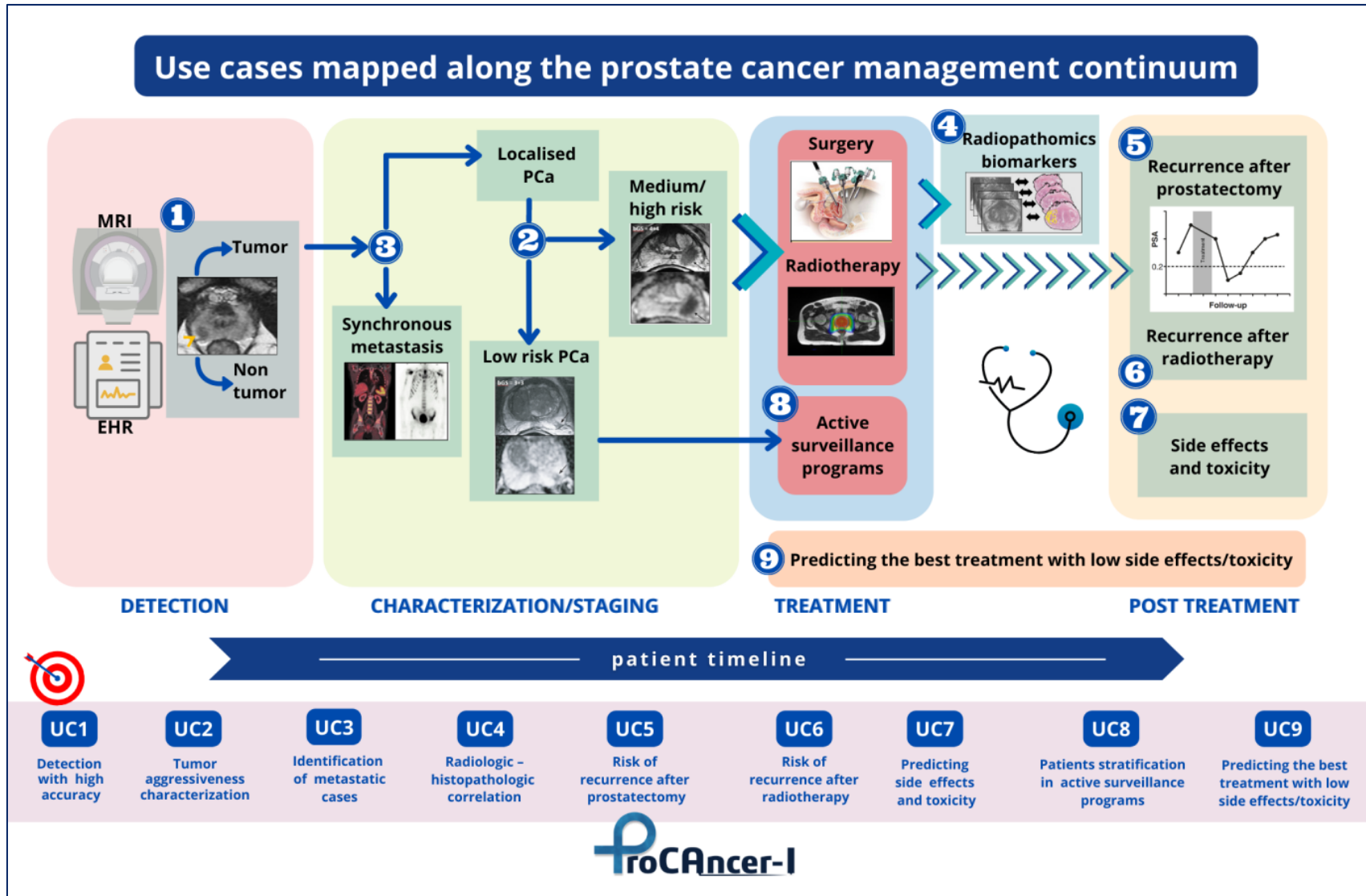
- To exploit the Prostate-NET for 9 different clinical scenarios to improve diagnosis, characterization, treatment and follow-up of men with PCa.

DT-TDS-05-2020:
AI for Health Imaging

European Union's
Horizon 2020 research
and innovation
programme under
grant agreement
No. 952159

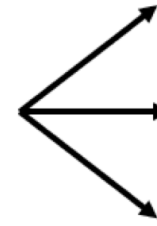
20 partners (13 clinical
+ 6 technical + 1 legal)
across EU and US

The 9 Use Cases: from detection to post-treatment outcome prediction



The scientific problem

Today



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-  Improved Outcome
-  No benefit
-  Adverse side effects



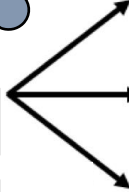
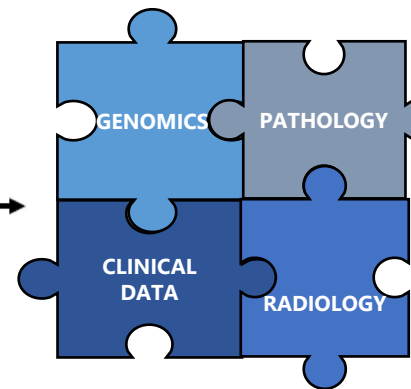
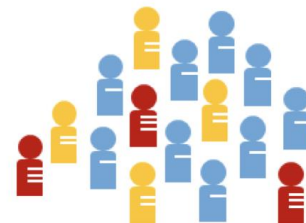
The convergence between Artificial Intelligence (AI) and Precision medicine will revolutionize the patient care pathway

AI Biomarkers



2030

Precision medicine



-   Improved Outcome
 -   Improved Outcome
 -   Reduced side effects
- Personalised treatment

Candiolo Experience with AI

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ProCAncer-I



Radiomics



Genomics

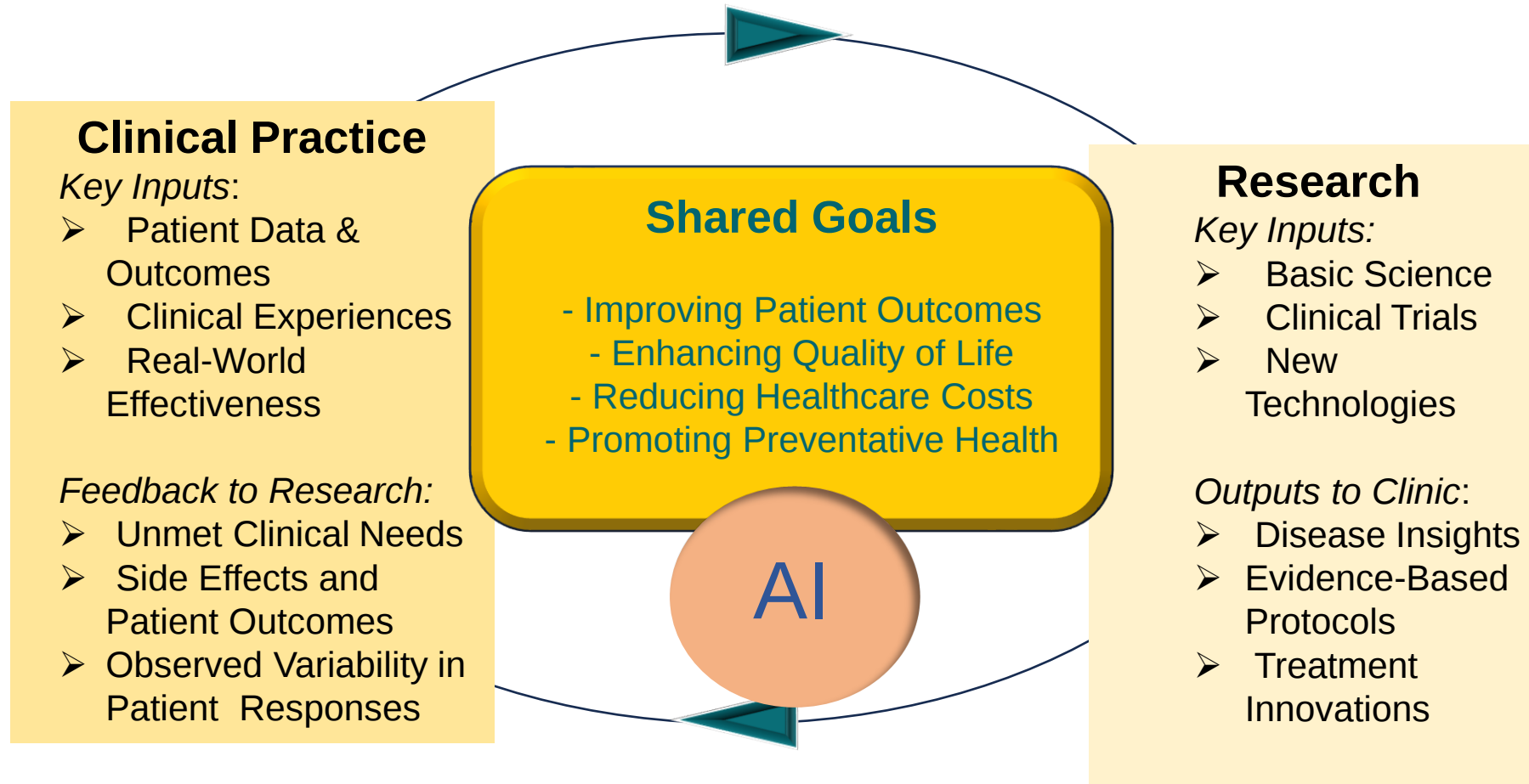


Institutional AI Integration program



FPO-IRCCS-Comprehensive Cancer Center (CCC)

2025
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The key word of Accreditation & Designation Programme is:
COMPREHENSIVENESS

FPO-IRCCS-Comprehensive Cancer Center (CCC)

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COMPREHENSIVENESS

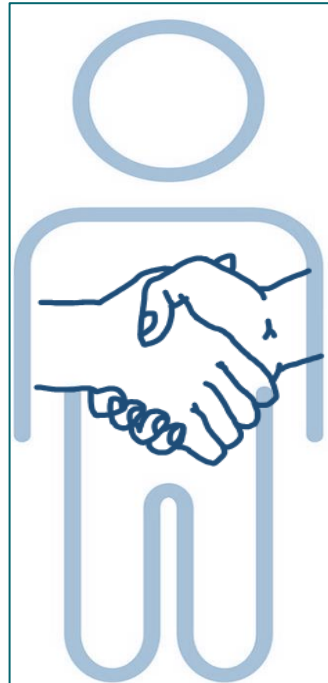
of both professional infrastructure and performance.

Clinical Activities



- Multidisciplinary care paths
- Multiskilled teams
- Advanced technologies
- Precision medicine in routine diagnosis (e.g 500 genes)

To exchange knowledge, foster collaboration, and continue our shared mission to improve outcomes for cancer patients worldwide



Research Activities



3 Research Lines

- Line 1 - TRANSLATIONAL -Development of molecular markers/targets and translational platforms for precision medicine in tumours
- Line 2 - CLINICAL - New strategies for diagnosis, treatment and follow-up in oncology
- Line 3 – ORGANIZATIONAL/QUALITY OF LIFE -Development of integrated models for the clinical care management of patient with cancer

MULTIDISCIPLINARY and MULTISKILLED TEAMS

Health Direction

Patient Board

Patient
Association

Nurses and
Technicians

Surgical Department

GI Surgery

Head&Neck
Surgery

Gyneoncology
Surgery

Senology

Soft tissue surgery

Urological Surgery

Thoracic Surgery

Dermatology

Robotic Surgery Programs

Prostate

GI

Gynecology

Breast

Core Activities

Intensive Care

Radiotherapy

Health Physic

Nuclear
Medicine

Endoscopy

Radiology

Clinical
Pathology

Pathology and Molecular
Diagnostic

Pharmacy

AI
PROGRAMS

Advanced Technology
and Automation
Platforms

Quality Management
Team
ISO 9001

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Medical Department

Oncological
Ward

Day Hospital

Internal
Medicine

Hospice

Psycho-oncology

Cardiology

Dietetic & Clinical Nutrition

Pneumology

Odontostomatology

Out patient service



12 Platforms

- Breast cancers
- Gastric cancers
- Colon cancers
- Pancreatic Cancers
- Prostate cancers
- CUP
- Sarcomas
- Melanoma
- Head & Neck cancers
- Ovarian cancers
- Lung cancers
- Lymphoma, Myeloma; Leukemia

Research Operative Units

GRANT OFFICE
RESEARCH LEGAL OFFICE
TECHNOLOGY TRANSFER OFFICE
CLINICAL RESEARCH UNIT

10 Core Facilities

Scientific Direction <> International Scientific Board

ONCOGENOMIC	BIOINFORMATIC	IN SITU RNA ANALYSIS (RNAscope)	ADVANCED MICROSCOPY
CELL / ORGANOID CULTURE	FLOW CITOMETRY & CELL	SINGLE CELLS UNIT	ANIMAL ENCLOSURE
EXPERIMENTAL PATHOLOGY	BIOBANK		

17 Basic & Translational Research Labs

CANCER STEM CELL RESEARCH	ONCOGENOMICS	CANCER EPIGENETICS	MEMBRANE TRAFFICKING
VASCULAR ONCOLOGY	CELL MIGRATION	TRANSLATIONAL CANCER MEDICINE	LABORATORY OF GENE TRANSFER
TUMOR MICROENVIRONMENT	CELL ADHESION DYNAMICS	PANCREATIC CANCER HETEROGENEITY	CANCER HETEROGENEITY
NEUROVASCULAR BIOLOGY	GENOMIC ARCHITECTURE OF CANCER	IMMUNONCOLOGY	MOLECULAR BIOLOGY
TRANSLATIONAL TRANSCRIPTOMICS	IIGM LAB		

1 Clinical Research Unit

ADVANCED CLINICAL AND PHASE I RESEARCH UNIT

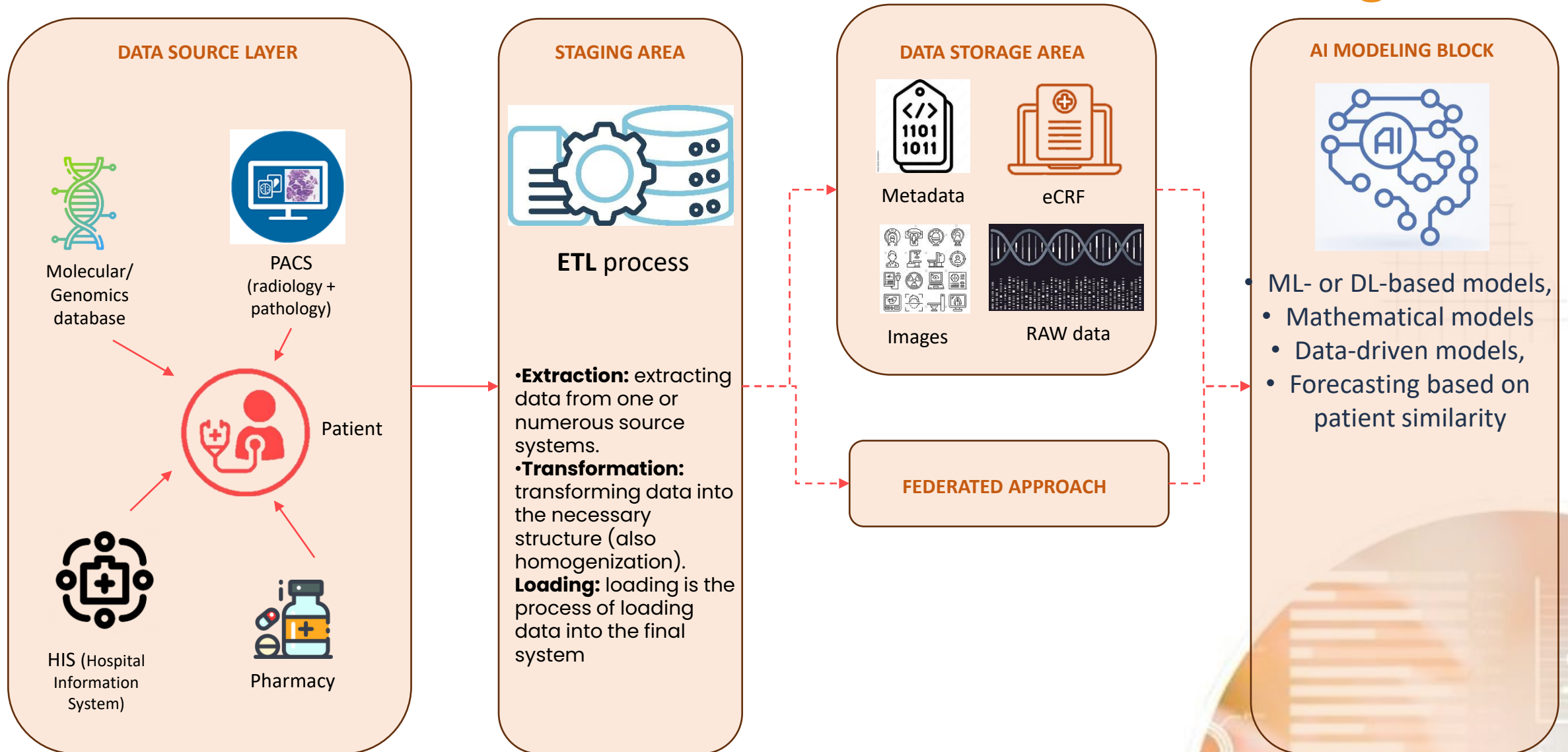
AI
PROGRAMS

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Data collection infrastructure for AI modeling



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Data collection infrastructure for AI modeling



Molecular/
Genomics
database



HIS (H
Inform
Syst

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AI MODELING BLOCK



or DL-based
mathematical
data-driven mo
forecasting bas
patient simila

Work involved to implement the Infrastructure for AI modeling

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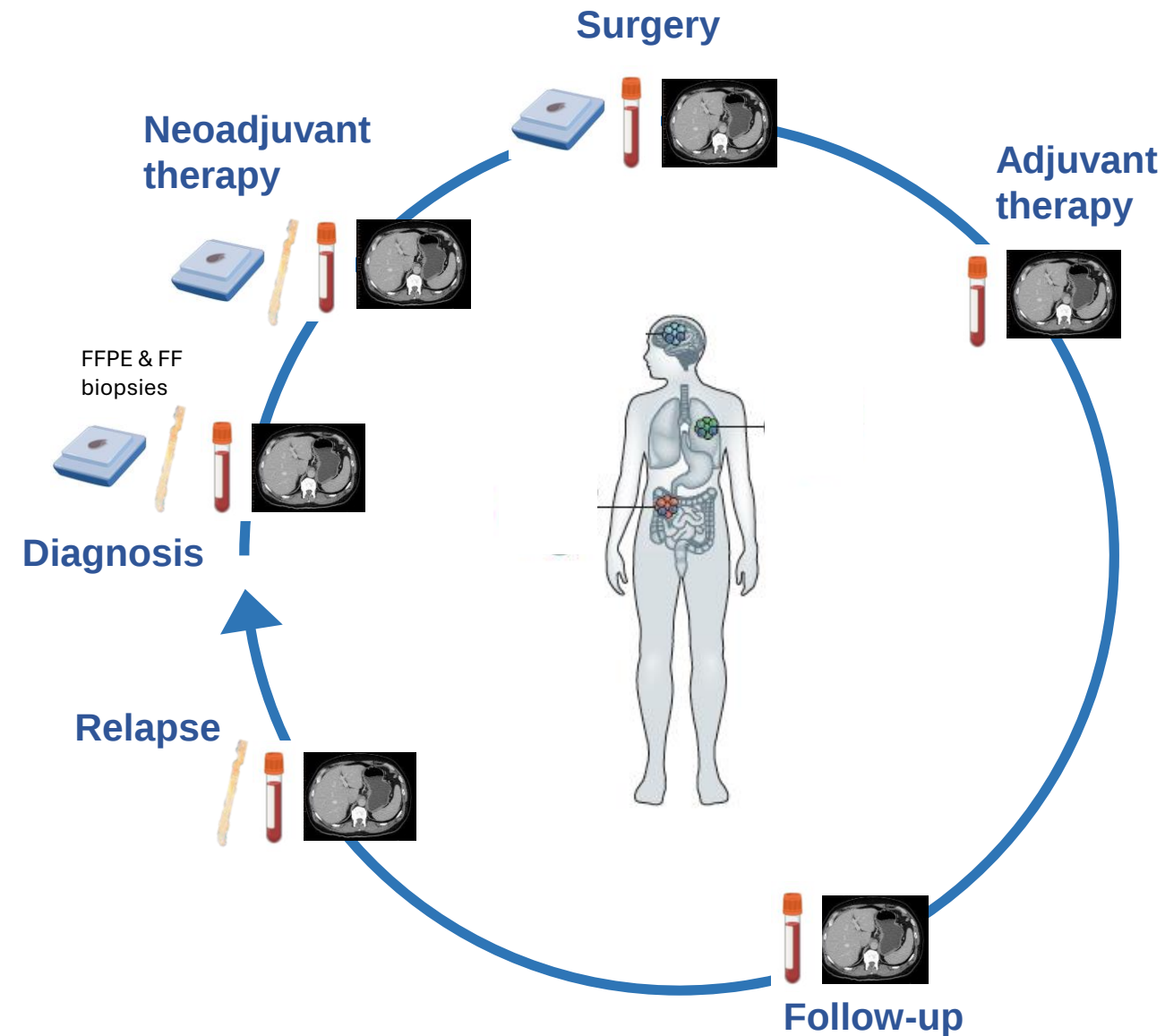
- Requirements analysis and project planning
- Design, research and economic analysis of the requirements for implementing the data collection architecture
- Definition of data extraction rule
- Data extraction and harmonization
- Data anonymization and analysis of search requirement
- Integration of multimodal data
- Development of the digital twin
- Clinical decision support system integration



The Candiolo Cancer Atlas (TCCA)

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Targeting unmet clinical needs

➤ Multi-omic characterization of paired tumor-normal tissues, blood, and microbiome

- Targeted/whole-genome DNA sequencing
- RNA sequencing
- ctDNA
- Epigenomics (ATAC-seq, CUT&Run, Hi-C)
- Single-cell DNA/RNA sequencing
- Spatial transcriptomics
- Gut microbiome sequencing
- Serum proteomics

➤ Pathomics and radiomics

➤ AI-driven data integration

CONCLUSION

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- IA è oramai un area di ricerca in espansione e di altro interesse nell'ambito clinico
- Sviluppo della IA è d'interesse della comunità oncologica tanto da diventare un criterio per l'accREDITamento dell'OECI come CCC
- L'attività di ricerca non può essere «lasciata» alla responsabilità di singoli ricercatori o gruppi, ci vuole un intervento sistematico istituzionale
- Dopo gli studi pilota PRO-Cancer e validazione della estrazione dei dati genomici è stato lanciato un progetto istituzionale xx
- Candiolo IRCCS hub