



CENTRO
INTERDISCIPLINARE
DI RICERCA IN
SCIENZE DELLA VITA
E TECNOLOGIE DELLA SALUTE



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

INTERDISCIPLINARE
CENTRO FARMACISTRI
ICT RESEARCH



LTTA
Laboratorio per la Tecnologia
della Terapia Avanzata



BIOPHARMANET-TEC



Partners

Lead partner

IRET Foundation

Partners

- CIRI-SdV – University of Bologna
- LTTA – University of Ferrara
- CIRI ICT – University of Bologna
- Biopharmanet-TEC – University of Parma

Companies

- *Alfasigma S.p.A.*
- *Wellmicro S.r.l.*

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AI4ChemoBrain

AI4ChemoBrain: a machine learning/artificial intelligence model for personalized medicine: development of a predictive demonstrator for cognitive complications during chemotherapy based on subject-derived phenotype and omics data

Introduction to the project

Seventy per cent of cancer patients report cognitive problems in concentration, learning and memory, slowing down of thinking, reasoning planning, etc. during and after treatment, such that their quality of life is impaired, making it difficult to carry out daily activities. Overall, this symptomatological picture is called “**chemobrain**”. It may disappear within months, but 30% of breast cancer survivors report that it persists even 10 years after the end of treatment.

To date, the possible mechanisms are unknown, and there is therefore no prevention and/or treatment strategy.

AI4ChemoBrain intends to develop an individual risk predictive model of the onset of *chemobrain*, based on biological determinants (cognitive function, markers of systemic inflammation, markers of intestinal dysbiosis collected in mouse models of *chemobrain*).

The ML/AI model will be able to **guide adjuvant therapies**, including ones, helping to improve the empowerment of cancer patients and reduce the economic burden of treatment side effects. This will also have a **significant impact on several production chains**, including pharmaceuticals, biotechnology, nutraceuticals, ICT (Information and Communication Technology) and the national health service.

Objectives

The initial dataset consists of more than 15,000 data already held by the lead partner, validated through scientific publications and correlation statistics, on cognitive and biomolecular phenotype derived from multiple repeated tests on animal models of cognitive disorder.

An initial model will be built on this data, which will subsequently be implemented with data derived from cognitive profiling, plasma biochemistry, and metagenomic analyses derived from the gut microbiota in animal models of *chemobrain*.

The final product will be a prototype demonstrator (software) using the ML/AI predictive model developed and validated above.

The **ultimate goal** is thus to identify patients at risk of *chemobrain* from data collected by non-invasive or minimally invasive approaches at the beginning of treatments, in order to develop personalized preventive interventions.

Activities

The AI4ChemoBrain project consists of three main activities:

1. **ML/AI model training:** historical preclinical cognitive and omics data will be used according to supervised learning techniques;
2. **ML/AI model testing:** the model obtained in activity 1., will be tested with a data set derived from a preclinical *chemobrain* model, in order to assess the predictive ability of the *chemobrain* (unsupervised learning techniques) in comparison to conventional and correlation statistics;
3. **ML/AI model validation** by:
 - a. Data set derived from a second preclinical model of *chemobrain* in subjects with cognitive decline;
 - b. Data set derived from an external cohort.

The combination of the data sets will enable to study the contribution of each descriptor with respect to the model's predictive ability. Data augmentation, transfer learning and fine-tuning techniques may be used to overcome any problems related to the availability of large data sets in the context of the *chemobrain* in order to improve the predictive capabilities of the ML/AI model.

