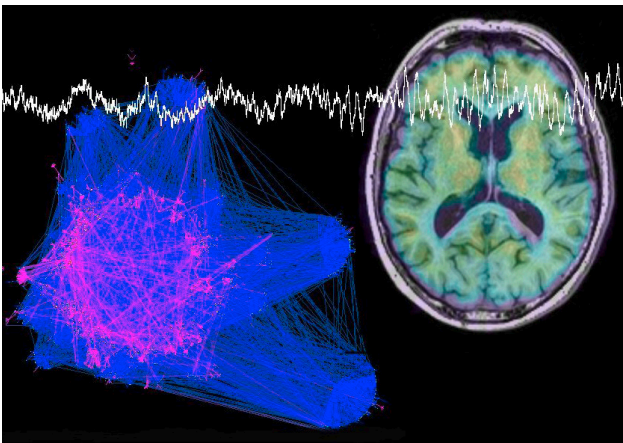


# PredictAD

## From Patient Data to Personalised Healthcare in Alzheimer's Disease

PREDICTAD aims to develop an objective tool for enabling earlier diagnosis of Alzheimer's disease. Biomarkers derived from various data sources of patient monitoring, such as neuropsychological tests, medical imaging, electrical brain activity measurements and blood samples will be studied and combined.



- define efficient biomarkers from heterogeneous patient data and integrate them for making early diagnosis and progress monitoring of AD more efficient, reliable and objective,
- improve the cost-effectiveness of AD diagnostics by optimizing diagnostic protocols, and
- develop and validate an efficient software tool that physicians can use to diagnose and to monitor the progress of AD in real clinical conditions using heterogeneous patient data.

### Project Description

**Project Description:** Heterogeneous data including clinical data such as neuropsychological test scores, MRI imaging, PET (FDG/PIB) imaging, TMS/EEG and biomarkers detected from blood (metabolomic, proteomic) are integrated to identify an efficient combination of markers for early diagnosis of AD and longitudinal follow up.

The project can be divided into three main parts: data quantification, biomarker discovery and visualisation, and validation (Fig. 1).

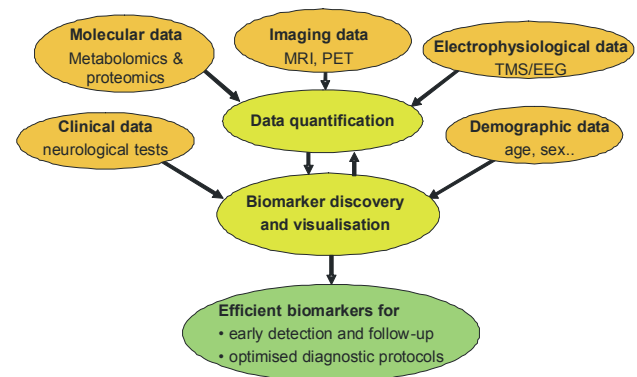


Fig. 1. PredictAD approach.

### Objectives of the Project

**Problem or Context:** Alzheimer's disease (AD) causes long and oppressive suffering and imposes enormous costs to society. Because Alzheimer's disease is expected to quadruple its global prevalence to 106 million by 2050, dementia will be one of the main health issues of the next decades. Currently, there is no curative treatment for AD. When new drugs or prevention strategies become available, early detection, even pre-symptomatic, of the disease will become essential in selecting patients for treatment. Today there is no single test or biomarker that can predict whether a particular person will develop the disease.

**Project:** PredictAD's goal is to provide a standardised and objective tool for enabling early diagnosis of AD, improved monitoring of treatment efficacy, and improved cost-effectiveness of diagnostic protocols. The main objectives are to:

#### SCENARIO

New disease modifying drugs for Alzheimer's disease are being developed and are currently in clinical trials. Therefore, efficient therapies for Alzheimer's disease may become available in the near future. The selection of patients, at the earliest possible phase, will be essential for successful treatment. The backbone of the selection is early diagnosis based on sensitive biomarkers for Alzheimer's disease. These markers must be able to detect the disease already from weak symptoms. Our scenario is that the PredictAD tool will provide a systematic, objective and reliable way for choosing patients for treatment, and for monitoring the efficacy of the treatment.

**Data quantification.** Methods are developed and applied for extracting various biomarkers from data. During the first year, the project has developed tools for extracting biomarkers from TMS/EEG data and segmenting various brain structures from MRI images. In addition, various molecular biomarkers have been extracted from blood samples.

**Biomarker discovery and visualisation.** Hundreds of biomarkers have been extracted and included into statistical models for assessing the status of the patient. Thorough statistical analysis of combined biomarkers is used to define the relevance and efficiency of sets of biomarkers. The statistical models developed are strictly evidence-based allowing personalised healthcare, e.g., taking into account the age and gender of the patient during the analysis. The first version of the software tool, visualising data and analysis results to a clinician, has been developed based on carefully designed application requirements formulated by an international group of clinicians.

**Validation.** Currently data from four cohorts, containing data from about 2000 cases, are used to build the statistical model and validate the performance of the developed methods. The main criterion for the evaluation is the diagnostic accuracy. In addition, the cost-effectiveness of various combinations of biomarkers in AD diagnostics will be studied. This information is used to optimise diagnostic protocols.

## Expected Results & Impacts

PredictAD will produce a software tool for early diagnosis of Alzheimer's disease and for progress monitoring. The backbone of the tool is the statistical model including information about numerous biomarkers measured from a high number of subjects. PredictAD will also generate information about the cost-effectiveness of various patient measurement procedures and new knowledge of biomarkers characteristic to Alzheimer's disease.

Clinicians are currently facing an enormous challenge in AD diagnostics. An early diagnosis may enable doctors to provide medical care at an earlier stage, at a time when clinical diagnosis using only signs and symptoms of disease is challenging.

A major breakthrough in AD prevention and treatment is vital also in the economical sense: the costs of AD to European society are more than 55 billion € per annum and dramatic increase in the number of AD patients is expected in the near future. Early diagnosis combined with future drugs and prevention strategies will delay or stop the onset or the progress of AD. This can be shifted directly to reduced costs.

Finally, PredictAD will affect a single citizen in two aspects. First, having diagnosis earlier and hence also treatment earlier during the disease process will mean reduced suffering for the individual. Second, it reduces the burden of citizen as a taxpayer.

**Heterogeneous data will be integrated to identify an efficient combination of markers for early diagnosis of AD.**



### PredictAD

**From Patient Data to Personalised Healthcare in Alzheimer's Disease**

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- University of Eastern Finland (UEF) (Finland)
- Imperial College London (United Kingdom)
- Karolinska Institutet (Sweden)
- University of Milan (Italy)
- Rigshospitalet (Denmark)

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#### KEYWORDS

Alzheimer's disease, Early diagnosis, Personalised healthcare, Statistical modelling, Multimodal data