TBICare

European Commission
Information Society and Media

Evidence based Diagnostic and Treatment Planning Solution for Traumatic Brain Injuries

TBIcare will provide an objective and evidence-based solution for management of traumatic brain injury by improving diagnostics and treatment decisions for an individual patient. It does this by analysing and combining a wide range of biomarkers. It will provide clinical decision-making assistance and improved outcome.

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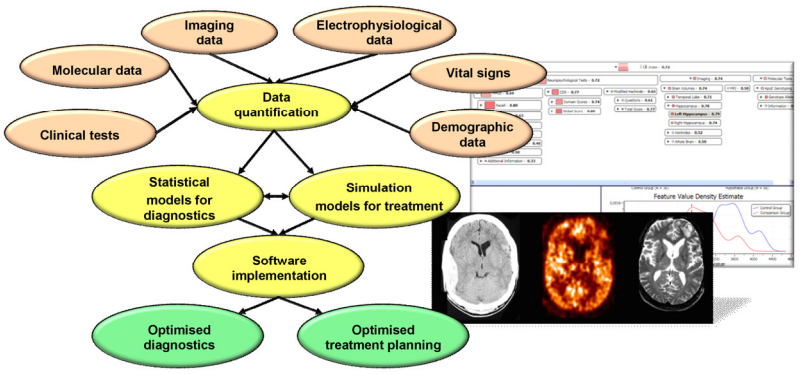
Objectives of the project

Problem of Context

Traumatic brain injury (TBI) occurs when a sudden trauma causes damage to the brain – it is a major health problem and the most common cause of permanent disability in people under the age of 40 years. Its yearly cost in Europe exceeds 100 billion Euros. Statistics show a steep increase in TBI incidence; 21% over the last five years – threefold the rate of population increase. Despite this, TBI has been seriously underrepresented in medical R&D efforts compared to many other, less significant health problems.



Project

TBIcare provides an objective and evidence-based solution for management of TBI by improving diagnostics and treatment decisions for an individual patient.

The objectives are to:

- Develop a methodology for finding efficient combinations of multi-modal biomarkers used in statistical models to objectively diagnose an individual TBI patient,
- Realise a simulation model for objectively predicting outcome of the planned treatment of an individual patient,
- Create a software solution to be used in daily practice to diagnose and plan treatments,
- Explore new approaches for extracting information from multi-source and multi-scale physiological databases for management of an extremely heterogeneous disease; and
- Develop innovative data quantification methods for the clinical TBI environment.

Project Description

The project develops a tool to make the day-to-day clinical work of doctors easier and revolutionise the treatment of traumatic brain injury. It will enable professionals to match patient-related variables with injury-related variables through the combined use of various databases. Using extensive databases and system simulation, the software will then form a detailed analysis of the nature of the patient's brain injury, its optimal treatment and predicted outcome.

The simulation model helps a scientist to better understand a human as a system – a viewpoint central to the Virtual Physiological Human

SCENARIO

Harry had a serious car accident. At the hospital he is drowsy, confused and has a headache. He has a pelvic fracture, internal bleeding and external wounds. Clinical parameters, brain injury biomarkers and physiologic state are obtained. A CT scan reveals diffuse brain injury and contusions. Should the fracture be stabilized operatively due to bleeding or is external stabilization sufficient – what is best for the injured brain? The TBIcare software uses all available data to calculate the risks for treatment alternatives, thus helping the clinician to choose. Similar decisions, using updated data, are made throughout acute care, providing optimal guidance.

A high number of vital signs or biomarkers, relevant to TBIs, are explored from sets of heterogeneous data. These include structural and functional changes visible in imaging data, changes in electrophysiology; changes in bedside multimodality monitoring parameters and changes in metabolomics visible in the blood. We define sets of biomarkers from several thousands brain injury cases retrospectively, and from several hundreds TBI cases and healthy controls prospectively. The goal is to build statistical models allowing standardised and objective interpretation of data from a single patient. The diagnostic rules are derived by comparing the patient data to the most similar cases in a database using statistical inference.

Additionally, the project uses these statistical models as basis for construction of an individualised simulation model. It is personalized for each patient using data only from similar cases.

The simulation model helps a scientist to better understand a human as a system – a viewpoint central to the Virtual Physiological Human. A clinician is able to test the influence of various treatments by first simulating them. As the variability of the individuals and traumas is huge, we do not expect that a simulation model built from hundreds of cases is enough for reliable prediction of the outcome. However, our aim is to develop a strictly evidence-based simulation model for objectively predicting the outcome of treatment and rehabilitation of an individual TBI patient. The model provides objective evidence-based information about the most probable outcome and will be a step towards a scientifically valid approach for treatment planning. This model will be a basis for future development, where an increasing amount of validated clinical data will continuously improve the reliability and usability of the model.
These scientific objectives are supplemented by realization of technical objectives: a software solution to be used in daily practice to diagnose and plan treatments; new approaches for extracting information from multi-source and multi-scale physiological databases; and innovative data quantification methods for the clinical TBI environment.

Expected Results & Impacts

TBIcare develops a software solution to make the day-to-day clinical work in the context of traumatic brain injury easier as well as revolutionise treatment planning. Additionally, it provides a simulation model that helps a scientist to better understand a human as a system. Finally, it delivers a software solution to be used in daily practice to diagnose and plan treatments; new approaches for extracting information from multi-source and multi-scale physiological databases; and innovative data quantification methods for the clinical TBI environment.

TBIcare has impacts for healthcare professionals by improving the healthcare process and increasing medical knowledge; for the patients and their nearest by increased quality adjusted life years; for society it brings reduction in healthcare costs and losses due to working disability, and for the European industry it brings an impetus to increased global competitiveness by providing immediately exploitable innovative methods.

TBIcare

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- Imperial College London (United Kingdom)
- Complexio S.a.r.L. (France)
- Kaunas University of Technology (Lithuania)
- GE Healthcare Finland Oy (Finland)

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KEYWORDS
Traumatic Brain injury, Early diagnosis, Statistical modelling, Personalised health, Simulation