

# Avert-IT

## Advanced Arterial Hypotension Adverse Event Prediction

Avert-IT aims to improve patient outcomes and reduce lengths of hospital stay through avoiding arterial hypotension (dangerously low blood pressure) by interpreting early signals of its onset. This will allow us to predict the hypotensive events and therefore enable intervention to avoid their occurrence.

### Objectives of the Project

Intensive care patients can experience adverse events associated with sudden episodes of low blood pressure. These episodes may impact all of the body's main organs resulting in longer lengths of hospital stay, increased care costs, poorer patient outcomes and death. Today, monitoring devices alert physicians and nursing staff when hypotensive episodes occur, enabling them to take rapid corrective actions. Yet, clinicians do not have a reliable way to predict/anticipate the occurrence of these episodes, so there is no opportunity for prior intervention. Research indicates average lengths of stay could be reduced and outcomes improved for a similar proportion of patients if these hypotensive episodes could be avoided through prediction and intervention. Potential annual savings across the EU could exceed € 5 billion.

The Avert-IT project envisages the development of a novel bed-side monitoring and alerting system dedicated to the prediction and notification to physicians and nursing staff of variations in the condition of the patient that are likely to lead to hypotension without appropriate clinical intervention.

The main objectives of the project are to:

- Identify the association between multiple patient parameters and the occurrence of sudden hypotensive episodes
- Develop software to predict hypotension based on recognition of the associations described above
- Validate the solutions in clinical trials
- Build an exploitation model for commercialisation of the software in product/service sales across international markets

### Project Description

Weighted associations between demographic and periodic data and Hypotensive episodes will be identified.

These associations will then form the basis for the initial definition of a novel Bayesian Neural Network trained against a large multi-national "Brain-IT" project dataset.

A prospective clinical trial is planned to demonstrate the effectiveness of the AVERT-IT project concept.

Innovative, secure access, software will be developed to interface existing hospital data sources with electronic patient record systems.

A secure distributed data access platform (HypoNet) will be built which will allow remote access to data from each centre in a secure role based approach.

The main research will focus on combining resources:

- Historic patient care data from 22 specialist brain injury units across Europe
- Secure data access across multiple specialist units and hospitals via Grid technologies
- Data analysis using Bayesian Artificial Neural Network (BANN) techniques
- Specialists in treating traumatic brain injury from 6 leading hospitals, in Sweden, Germany, Italy, Spain, Lithuania and Scotland
- Expertise in device monitoring, data analysis and reporting, software development, distribution and support by Commercial partner C3 Global

### Achieved to Date

Since the project start in January 2008 Avert-IT has progressed closely to the original plan. Our achievements so far include:

- Agreed a common definition for hypotension for use by our six multi-national neurosurgery centres

#### SCENARIO

A young woman, involved in a road traffic accident is in a coma and admitted to the neuro-intensive care unit. She is placed on a ventilator to maintain her breathing and closely monitored to ensure her blood pressure remains within normal limits. All her minute by minute blood pressure data is logged onto an AVERT-IT computer and the HypoPredict software looks for patterns that may predict low blood pressure. If a drop in blood pressure is predicted, the AVERT-IT system warns the medical staff giving them more time to treat the patient and prevent a dangerous drop in pressure.

- Built and implemented our bed-side systems for use by nurses to capture observed data, including interventions
- Built and implemented the system architecture (*Hyponet* Grid architecture) enabling transmission of observed and monitored data to our research centre
- Trained our *Hypopredict* Bayesian Neural Network (i.e. adapted the data analysis tool) to identify upcoming hypotensive episodes)
- Identified areas for further research including relationships between apparent false positive predictions
- Outlined an exploitation plan which implements the foreground Intellectual Property Rights in phases.

## Expected Results & Impacts

- Accurate prediction of hypotension, allowing earlier and less aggressive intervention, would dramatically improve patient outcome, leading in turn to a quantifiable reduction in the duration of average patient stay with associated reduction in cost
- Capability to alert clinicians of upcoming hypotensive episodes
- Core technology for applying Bayesian Artificial Neural Network concepts in health care applications
- Platform for multi centre collaborative research
- Facilities supporting clinical governance and evidence based medicine



### MEDNet

**Advanced Arterial Hypotension Adverse Event Prediction Through a Novel Bayesian Neural Network**

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#### Partners:

- Pera Innovation Ltd (United Kingdom)
- C3 Global Limited (United Kingdom)
- Uppsala Universitet (Sweden)
- Universitätsklinikum Heidelberg (Germany)
- Azienda Ospedaliera San Gerardo Di Monza (Italy)
- Kauno Technologijos Universitetas (Lithuania)
- The University Of Glasgow (United Kingdom)
- Greater Glasgow Health Board (United Kingdom)
- Hospital Universitari Vall d'Hebron (Spain)
- Philips Medizin Systeme Böblingen GmbH (Germany)

**Timetable:** from January 2008 to December 2010

**Total cost:** € 2,305,000

**EC funding:** € 1,780,000

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### KEYWORDS

Grid technologies, International research cooperation, Health professionals knowledge, Patient safety, Decision support systems, Prevention