# 1. PUBLISHABLE SUMMARY

## AVERT-IT Project

Avert-IT is an EU-funded project to develop a mechanism, for use within intensive and high-dependency care units, which will have the ability to monitor and predict the likelihood, and primary causes of arterial adverse hypotension events. The full project title is *"Advanced Arterial Hypotension Adverse Event prediction through a Novel Bayesian Neural Network"* and will run for three years, beginning in January 2008.

### Background

Intensive Care patients can experience Adverse Events associated with sudden episodes of low blood pressure. These Adverse Events may impact all of the main organs resulting in longer lengths of stay, increased care costs and reducing quality of outcomes. Existing technologies enable clinicians to know when these events have occurred and treat the effects.

Medical techniques for avoiding Adverse Events currently exist, but clinicians don't have a reliable way to predict the occurrence, so there's no opportunity for intervention.

Research indicates average lengths of stay can be reduced by up to 30%, and outcomes improved for a similar proportion of patients, if these Adverse Events can be avoided through prediction and intervention. Potential savings across the EU exceed 5 billion euros, annually.

A model for predicting Adverse Events offers potential for improving outcomes across a wide range of conditions and or illnesses.

### Objectives

The main scientific objective of the project is the determination of the weighted association between multiple patient parameters and subsequent arterial hypotension. The association will then be used to define the novel Bayesian neural network, which will be trained against the BrainIT dataset, before undertaking a clinical trial to demonstrate the Avert-IT project concept.

The main technological objective will be the development of an IT-based decision support system (*"HypoPredict"*) appropriate for deployment within intensive and high dependency care units. The system will be capable of:

- Automatically and continually monitoring at least four in-vivo patient parameters (ECG, arterial blood pressure, Oxygen saturation and core temperature), together with open interfaces providing input of key demographic data (age, gender etc.) and periodic data (clinical pathology results etc.) related to the patient.
- Outputting a continuous Hypotension Prediction Index (HPi).
- Providing primary and secondary weighted causal data (current values of input parameters) in parallel with the HPi to facilitate appropriate intervention selection by clinician (for example, elevated core temperature could be indicative of sepsis, a common precursor to hypotension).
- Providing updated HPi, and primary and secondary causal data values, immediately upon any change detected in the patient parameter input set.

## Resources

The resources in terms of data, technology and expertise for the project will be combined from a variety of areas:

- Historic patient care data from 22 specialist brain injury units across Europe.
- Grid technologies for secure data access across multiple specialist units and hospitals.
- Baysian Artificial Neural Network (BANN) techniques for analysing data.
- Specialists in treating Traumatic Brain Injury (TBI) from 6 leading hospitals, in Sweden, Germany, Italy, Spain, Lithuania and Scotland.
- C3 Global's expertise in device monitoring, data analysis and reporting, and software development, distribution and support.

## Outputs

The project will also look to develop an exploitation model for the commercialisation of the software in product/service sales across international markets. For such commercial exploitation, C3 Global will have exclusive access to the results of the research. Potential opportunities include:

- Monitoring of intensive care patient treatment
- Clinical trials of both drugs and medical devices
- BANN (Bayesian Artificial Neural Network) techniques for asset performance management and environmental monitoring and control

## Current Status (1st Year)

At the end of the first year of the Avert-IT project (January 2009), we have made strong progress towards achieving our project objectives and are confident of meeting our overall project aims in the remaining 2 years of the project. The first year of the project has focused on achieving the project scientific objectives in relation to creating the weighted association between multiple patient parameters and subsequent arterial hypotension and defining the novel Bayesian neural network. Specifically, the following objectives have been successfully achieved in Period 1:

- Starting with an initial 6 individual definitions of hypertension provided by the project clinical centres, we have identified a useable, working set of key patient parameters for deployments of the weighted inputs to the Bayesian Neural Network Engine.
- Using the defined patient parameter set, we have developed a framework for and tested the BANN algorithms at the heart of our system, developing this into a provisional design for our "HypoPredict Engine".
- We have created and tested clinical user interfaces which will be utilised by the Avert-IT clinical centres while testing our system in the project clinical trials.

- The development of the Avert-IT “Hypo-Net” application is well under way and roll out to each of the project clinical centres is already underway. When complete, the Hypo-Net application will allow our clinical partners to quickly and efficiently upload the required data from the clinical site data capture systems into a database and to co-ordinate and regulate the uploading of the study data from the six participating centres into a secure, central repository.
- We have made extensive plans and preparations for the exploitation and dissemination of the project results which has resulted in Avert-IT being recognised as a model of “Best Practice” for the EC funded USEandDIFFUSE project.

**What does this mean for Avert-IT?**

In simple terms, Avert-IT has taken major steps forward in patient diagnosis through the BANN development. Essentially, the Avert-IT BANN works as follows:

Take a full set of measures for an individual patient and present them to 100 clinicians. How many of the 100 predict an adverse hypotension event will occur in the next hour?

That’s what the BANN is doing - being 100 clinicians with different opinions.

In the Avert-IT research to date, the clinicians are already getting it right 35% of the time, but this is only the beginning…

While this is already a significant achievement, with the addition of further functionality to the prediction engine these clinicians will be getting it right much more often.

## Future Work

Given our success to date, we are confident of meeting all of the scientific and technical objectives we have set ourselves within the Avert-IT project. In the next phase of our project we will train and validate our Hypo-Predict Engine against the BrainIT database. Following this development work and full roll out of our Hypo-Net technology we will then begin a 6 centre clinical trial in the next reporting period, moving the Avert-IT project towards our aim of developing an IT-based decision support system (*"HypoPredict"*) appropriate for deployment within intensive and high dependency care units.

# Consortium Members

Pera Innovation Ltd

C3 Global Ltd

Uppsala Universitet

Universitätsklinikum Heidelberg

Azienda Ospedaliera San Gerardo Di Monza

Kauno Technologijos Universitetas

The University Of Glasgow

Greater Glasgow Health Board

Institut Català de la Salut

Philips Medizin Systeme Böblingen GmbH.

## *Further Information*

For further information on the Avert-IT project, please visit the projects main web site at: http://www.avert-it.org or our exploitation site at: http://avertit.wordpress.com

## *Contacts*

For more information on the AVERT-IT project please contact the commercial manager Steve Reeves (steve.reeves@avertit.info), the technical co-ordinator Ian Piper (ian.piper@blueyonder.co.uk) or the overall co-ordinator Nick Rawling (nick.rawling@pera.com).

For all queries relating to the grid technology used please contact Professor Richard Sinnott (r.sinnott@nesc.gla.ac.uk).