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 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 (eg: 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) which will be updated on a minute by minute basis 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 Ltd 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 (2nd Year)

At the end of the second year of the Avert-IT project (December 2009), we have made considerable progress towards achieving our project objectives and are confident of meeting our overall project aims in the remaining year of the project. Specifically, the following objectives have been successfully achieved by the end of Period 2:

- 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 functional 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 nearing completion and hardware and software systems rolled out to each of the project clinical centres. The hyponet system is now completed, tested and being used to actively recruit patients to the observational phase of the clinical trial in the

lead centre in Glasgow and we anticipate that the remaining clinical centres will also be on-line within the next 2-3 months. The central database repository and supporting trial support systems are also in place the trial coordinator can login to this service remotely via a VPN connection and can quickly and efficiently co-ordinate the monitoring and validation of live patient data being acquired for the study.

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.

In the Avert-IT research to date, early assessment of the accuracy of the BANN to predict hypotension events in the first 5 patients recruited is showing a very promising sensitivity for early identification of instability in arterial hypotension.

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 final year of our project we will in the first half of the year complete recruitment of sufficient patients to allow a formal assessment of the sensitivity and specificity of the BANN for prediction of arterial hypotension adverse events in live clinical data. We are close to having the 2nd phase randomised controlled trial design complete to enable the start of a full RCT of the Hypopredict system in 6 clinical centres by the middle of 2010.

Consortium Members

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Universitätsklinikum Heidelberg
Azienda Ospedaliera San Gerardo Di Monza
Kauno Technologijos Universitetas
The University Of Glasgow
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