

Automating insulin delivery for critically ill patients

Thousands die or suffer prolonged illness every year, simply because intensive care units are unable to monitor their patients' glucose levels during recovery. One EU project may have solved the problem.

Every year, thousands of intensive care unit (ICU) patients across Europe either die or stay sick for longer than necessary. The cause is the fact that many ICUs cannot easily control the glucose levels in each patient's blood.



"Studies show that when patient's glucose levels are managed carefully, the mortality is reduced and the morbidity is reduced too," says Martin Ellmerer, scientific director of the [CLINICIP](#) project.

Healthcare staff rely on a technique called 'tight glucose control', also known as 'intensive insulin therapy', which uses insulin to control the glycaemic state of recovering surgical patients. The same method is also used to help patients at medical intensive care units to recover faster.

Key recovery technique

The reason? Glucose affects blood toxicology, so careful management is essential to keep patients in the best possible health.

"This is not just about diabetic patients, though it is important for them too. Glucose management is important, we know for sure, for medical and surgical intensive care patients. It's also important in paediatric intensive care cases. Intensive insulin therapy helps many different kinds of patient to survive or achieve a better recovery," comments Ellmerer.

It is five years since medical science realised how vital glucose control is to ICU outcomes, but there is still no complete solution to glucose management, because it is a very, very difficult problem.

"Taking glucose levels manually is time-consuming, and even when you have accurate, regular data, the impact of glucose levels varies from patient to patient, as does the dose of insulin required. It's a very complex problem, one that seems to be even more complex in critical illnesses than in diabetes management" Ellmerer says.

Automated insulin delivery

Enter CLINICIP, aka the Closed Loop INSulin Infusion for Critically Ill Patients. Ultimately, the project hopes to develop an intelligent, automated glucose monitoring and control system for ICUs. It's called 'closed-loop' because monitoring glucose levels and administering insulin would be completed by one self-contained system.

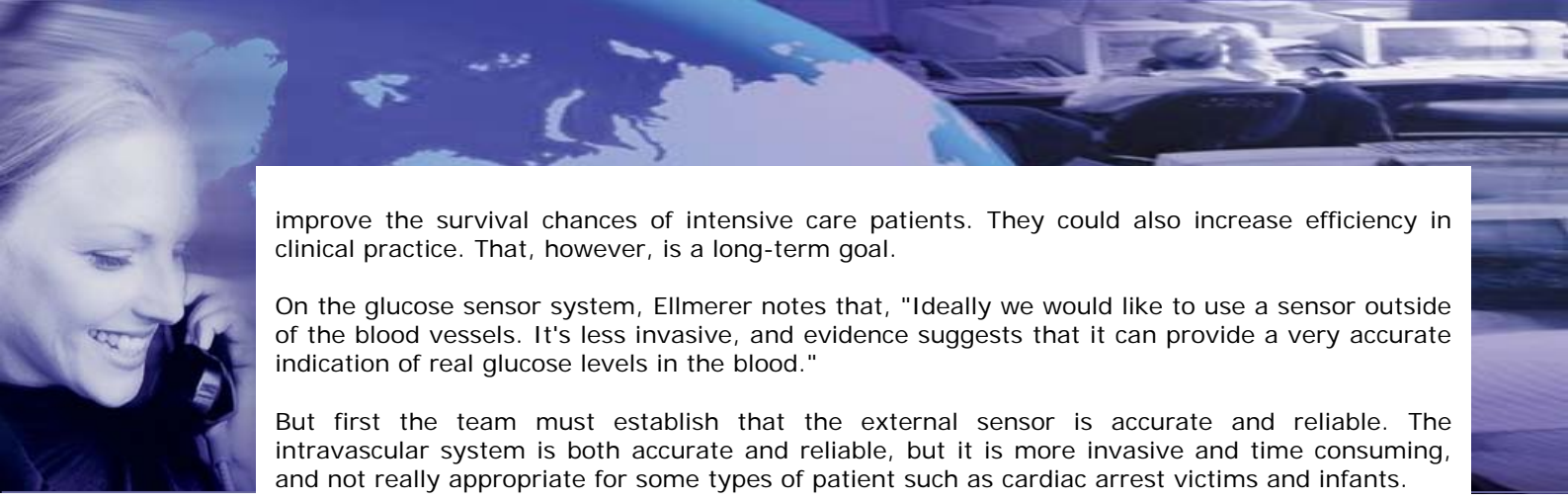
A closed-loop system needs inputs, analysis and outputs. The CLINICIP partners are developing a system that links glucose measurement to a control unit that assesses a patient's needs, and then releases insulin into a saline drip automatically.

They have already developed an algorithm to analyse how much insulin is needed, based on carbohydrate intake and current glucose levels. The team believe they have solved the problem, but it will require long-term validation to get the correct fine-tuning. That algorithm is in trials, and the partners hope to have initial results early next year.

"We are now testing the algorithm, which could be commercialised as a diagnostic support tool," says Ellmerer.

Internal or external glucose sensors?

The project is also currently studying sensor systems, both intra-vascular and extra-vascular – that is, within and outside the veins. If successful, automated sensor systems could greatly



improve the survival chances of intensive care patients. They could also increase efficiency in clinical practice. That, however, is a long-term goal.

On the glucose sensor system, Ellmerer notes that, "Ideally we would like to use a sensor outside of the blood vessels. It's less invasive, and evidence suggests that it can provide a very accurate indication of real glucose levels in the blood."

But first the team must establish that the external sensor is accurate and reliable. The intravascular system is both accurate and reliable, but it is more invasive and time consuming, and not really appropriate for some types of patient such as cardiac arrest victims and infants.

The body interface obstacle

The major obstacle currently facing the project is the body interface, or how the sensor in the body links to the rest of the closed-loop system. Ellmerer says that the team would be interested in hearing from any industrial partners involved in this area.

Even if the body interface problem is solved soon, he believes the full closed-loop system will not be developed within the lifetime of the project, which ends in January 2008. The work will continue however. "There are bilateral agreements between many of the partners to continue the work that we've started here after the life of the project," Ellmerer remarks.

In the meantime, CLINICIP's algorithm has provoked intense interest among medical scientists, and there have been calls to make the algorithm available to all ICUs.

"But it's just not possible yet. We haven't established definitively that it is sufficiently accurate, reliable and safe," warns Ellmerer. "That assessment is under way now."

Contact: Dr Martin Ellmerer
Medical University Graz
Department of Internal Medicine
Stiftingtalstraße 24
A-8010 Graz
Austria
Tel: +43 316 385 72806
Email: martin.ellmerer@healthgate.at

Source: 26 Oct 2006

Legal notice:

This feature article is published by the IST Results service and offers news and views on innovations, emerging from EU-funded Information Society Research.

The views expressed in the article have not been adopted or in any way approved by the European Commission and should not be relied upon as a statement of the Commission or the Information Society and Media DG.

© European Communities, 2005

Reproduction is authorised provided the source is acknowledged.