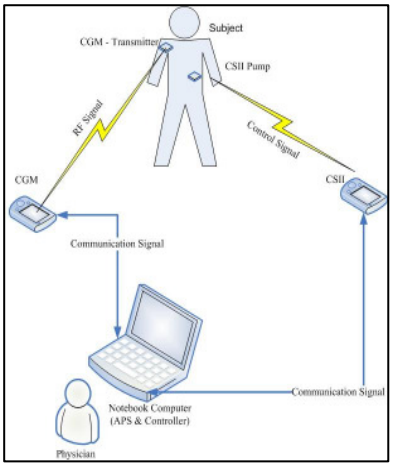
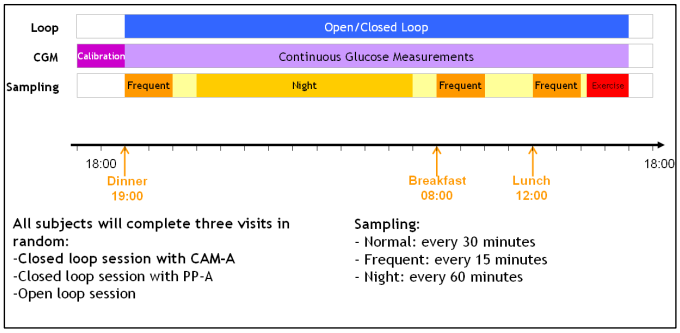
1. Publishable summary

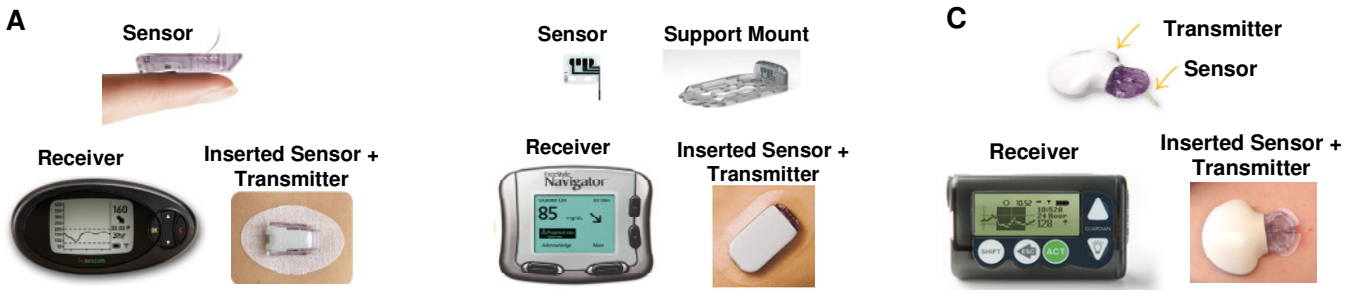
1.1 Description of the work performed

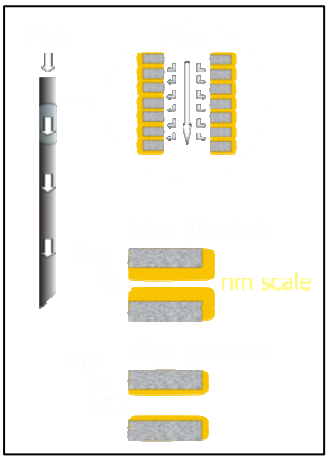


The major aim of the AP@home project is developing an Artificial Pancreas (AP) for "at home" use. This should allow patients with diabetes to live a close to normal live. One track of our project is focussed on testing an AP system which uses an off-the-shelf continuous glucose monitoring (CGM) system and insulin pump (two-port system). In parallel we are developing in the second track a single-port AP system. This novel approach shall allow to monitor glucose and infuse insulin via the same port.
Our project has made good progress in its first year with respect to its aims: We were able to start the first clinical trials with a two-port AP system. The algorithm (this is an calculation rule that translates the measured glucose levels in appropriate insulin infusion rates to keep blood glucose in the target range) was implemented into a platform that communicates with the CGM system (a Dexcom Seven plus sensor from Dexcom, San Diego, CA, USA) and the insulin pump (Omnipod, Insulet, Bedford, MA, USA). In a large clinical trial with six consortium centers two different versions of such an algorithm are studied versus conventional treatment (standard open loop) in 48 patients with type 1 diabetes. The patients remain in the clinical research centres for 24 h during the three study days. Aim of the study is to keep blood glucose within the target range (70-144 mg/dl (180 mg/dl after meals)) during the night and the experimental interventions. The performance of the two different algorithms (one was developed in Cambridge, UK and the other by Padua and Pavia, Italy) is challenged by disturbing factors like meals (dinner, breakfast and lunch) and exercise (30 min on a bicycle ergometer). On a control day the patients will use their insulin pump according to their own insights.



In another small clinical-experimental study we asked patients with type 1 diabetes to carry two Dexcom CGM systems in parallel. One of the systems was calibrated according to the manufacturers instruction (every 12 h), the other was calibrated only once after 48 h. Aim of this study was to evaluate a calibration algorithm that provides improved CGM glucose recordings.
For the development of the single-port systems, which requires a single skin puncture as opposed to two punctures with the two-port system, the development made by Graz, Austria has resulted in five different prototypes (two different types were developed: one with a glucose sensor outside the skin and the other inside the skin) that will be tested in animal studies. Approval for the first animal experiments was obtained.





The single-port system developed by Sensile in Switzerland has a membrane that is supposed to alter its properties according to the prevailing glucose levels. Such changes alter the characteristics of the insulin pulses applied via the same catheter. Analysis of these changes provides information about the glucose levels in the subcutaneous tissue and can be used to adjust the insulin infusion accordingly. It has to be demonstrated that the membrane of these catheters truly respond to glucose (currently this has been shown for pH changes only) and that the induced changes in permeability are large enough to allow a meaningful control of blood glucose levels.
Two other clinical studies are currently in preparation: in one the performance of different CGM systems will be evaluated in a head-to-head comparison and in the other the performance of a conventional insulin pump will be evaluated in comparison to that of the patch-pump used in the large AP study mentioned above.
In order to enable usage of an AP system under home conditions high safety requirements have to be fulfilled, e.g. in case the system signals an alarm (too low glycaemia for example) this information shall be transmitted to a physician via a Telemedicine approach.

1.2 Description of the main results achieved

Within the first year of the project the following main results were achieved:

The first large clinical trial comparing the performance of the two different AP algorithms used to keep the blood glucose value in target range by using a conventional CGM and an insulin patch pump has started in the first of the six participating centres throughout Europe. The experimental part of this study is expected to be finalized in summer 2011.

The smaller trial which analyses the impact of calibration on the performance of a CGM system for the large trial was performed successfully by comparing two identical CGM systems with different calibration procedures.

The two other protocols about a head-to-head comparison of CGM systems and the performance of two different insulin pump types were submitted to the ethical committees and the regulatory authorities .

The first prototypes for the single-port AP systems were successfully developed for the Graz approach. The five different prototypes are about to be tested in animal studies. For the other single-port AP system using a glucose responsive membrane a test stand was developed that will allow to start proof-of-concept experiments soon.

In parallel a telemedicine platform was successfully developed. This allows data transfer from the AP system to a supervising clinical centre.

Also, all project management, dissemination and exploitation of the project activities are well on track, including publication activities.

1.3 Expected final results

The results of the first clinical trials performed or started recently indicates that highly relevant information for optimization of the currently used algorithms will be gained, especially during challenging situations, that means after meals and during/after exercise. Probably none of the two algorithms used in the large AP study is optimal to control blood glucose excursions under such circumstances, it might very well be, that employing a combination of both will allow us to reach this goal. The smaller scale clinical studies that has been performed/will be started soon supports optimization of the algorithm development by providing relevant information about the performance of widely used CGM systems and insulin

pumps. In summary, our achievements towards the final goal of our project, i.e. running a clinical trial with a two-port AP system at home, are very good. Also the development of single-port AP approaches has made very good progress.

1.4 Potential impact and use

The results of this project will lead to innovations benefiting European patients with diabetes, European health care and European industry for one of the major diseases presenting a massive challenge to European health care and society in general.

The outcomes of the project will have an impact on health care and scientific competitiveness. The knowledge on AP systems will increase significantly and improve significantly healthcare and patient comfort. The closed loop systems will allow secure, swift and seamless communication of health data from the device to the patient – continuous glucose trails, hypoglycaemia alarm – and to the health care provider. The links and interaction between patients and doctors will be improved and facilitating a more active participation of patients in the care process. The knowledge will increase the scientific competitiveness of scientists and clinicians in the diabetes field. This will lead to expansion of high-skilled jobs in pharmaceutical, therapeutics and related telemedicine services in European research and clinical organizations.

Due to the early stage after the first period there is no commercial outcome of the AP@home project and no scientific publications.

1.5 Project website

The first version of our homepage with all relevant information about the AP@home project was recently replaced by a much improved version (www.apathome.eu). The internal part of this homepage for data exchange within the consortium will be up and running soon.

1.6 Project Logo

1.7 Contact details

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