

The Artificial Pancreas for People with Diabetes

Algorithms for Pen and Pump Insulin Administration – NABIIT Application 2007

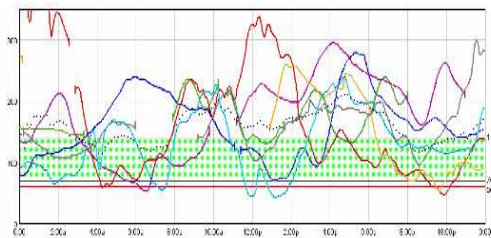
Diabetes

WHO estimates that 170 million people suffered from diabetes in 2000 and this number increases to 370 million in 2030. The costs of diabetes in USA was \$132 billions in 2002.

In healthy people, the blood glucose is controlled by release of insulin from the pancreas. Insulin is released such that it lowers blood glucose to the right value of 90 mg/dL and keeps it between 70 and 110 mg/dL. It never becomes lower than 60 mg/dL at which people fall into coma and may die.

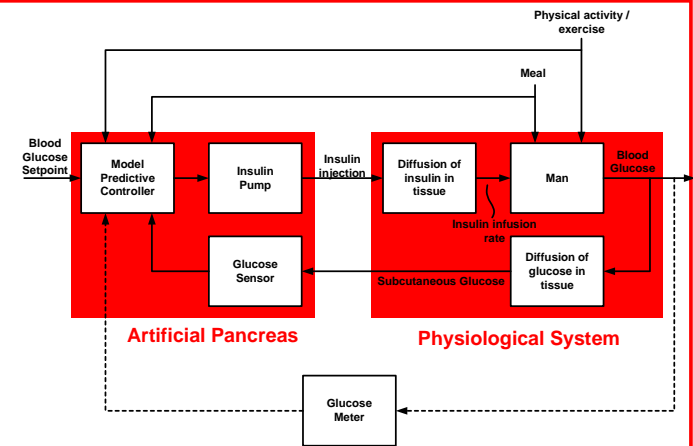
People with diabetes do not produce insulin. Insulin must therefore be injected to keep blood glucose in the normal range. To most people it is difficult to inject the right amount of insulin at the right time – see the Figure below.

We improve insulin therapy and develop systems and software for automatic injection of the right insulin dose at the right time based on glucose sensors and mathematical models.



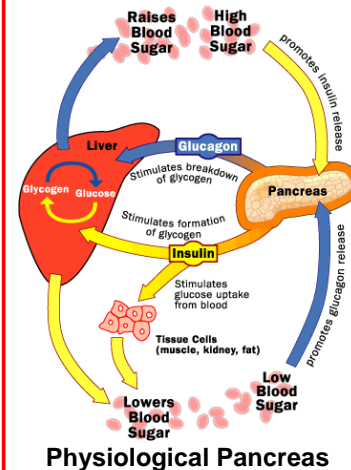
Blood glucose for conventional insulin therapy

Closed-Loop Diabetes Care System



Physiological and Artificial Pancreas

The artificial pancreas is an intelligent system that computes (A) how much insulin to inject (B) based on glucose measurements (C&D).



Artificial Pancreas

B.Sc.-, M.Sc-, PhD-, and Post Doc-Projects

- Mathematical models of glucose-insulin metabolism
- Numerical simulation of glucose-insulin metabolism
- Numerical methods for simulation of ODEs
- Parameter estimation in dynamic models
- Model predictive control (MPC)
- Second-Order Cone Programming based MPC
- Numerical methods for nonlinear MPC.
- Numerical optimization algorithms
- Numerical methods for experimental design
- Software design for the artificial pancreas

Project Partners (NABIIT)

- DTU – IMM and BioCentrum
- Hvidovre Hospital
- University of California – Santa Barbara
- Uppsala University
- Novo Nordisk A/S

