

## Automatic Data Processing to Achieve a Safe Telemedical Artificial Pancreas

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### Abstract

#### Background:

The use of telemedicine for diabetes care has evolved over time, proving that it contributes to patient self-monitoring, improves glycemic control, and provides analysis tools for decision support. The timely development of a safe and robust ambulatory artificial pancreas should rely on a telemedicine architecture complemented with automatic data analysis tools able to manage all the possible high-risk situations and to guarantee the patient's safety.

#### Methods:

The Intelligent Control Assistant system (INCA) telemedical artificial pancreas architecture is based on a mobile personal assistant integrated into a telemedicine system. The INCA supports four control strategies and implements an automatic data processing system for risk management (ADP-RM) providing short-term and medium-term risk analyses. The system validation comprises data from 10 type 1 pump-treated diabetic patients who participated in two randomized crossover studies, and it also includes *in silico* simulation and retrospective data analysis.

#### Results:

The ADP-RM short-term risk analysis prevents hypoglycemic events by interrupting insulin infusion. The pump interruption has been implemented *in silico* and tested for a closed-loop simulation over 30 hours. For medium-term risk management, analysis of capillary blood glucose notified the physician with a total of 62 alarms during a clinical experiment (56% for hyperglycemic events). The ADP-RM system is able to filter anomalous continuous glucose records and to detect abnormal administration of insulin doses with the pump.

#### Conclusions:

Automatic data analysis procedures have been tested as an essential tool to achieve a safe ambulatory telemedical artificial pancreas, showing their ability to manage short-term and medium-term risk situations.

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**Abbreviations:** (ADP-RM) automatic data processing for risk management, (BG) blood glucose, (CGM) continuous glucose monitoring, (INCA) Intelligent Control Assistant system, (MPC) model predictive control, (PDA) personal digital assistant, (RI) risk index

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