A Mobile Platform for Personalization of Insulin Delivery based on a Patch Pump and Reinforcement Learning

Starting date: *January 2016*   **Duration:** *2 years*

MyTreat
Intelligence in the Artificial Pancreas

Project coordinator: *S. Mougiakakou, Diabetes Technology Research, ARTORG Center, University of Bern*
Clinical partner: *Dep. of Diabetes, Endocrinology, Clinical Nutrition and Metabolism, "Inselspital"*
Industrial partner: *Debiotech SA*

Project Goals and Scientific Innovation

Scope of MyTreat is to develop a mobile platform for the personalized delivery of insulin for diabetic patients based on the combined use of

Online adaptive algorithms

Reinforcement learning for insulin dose optimization:
- Model free
- Self-learning strategy
- Low computational cost

Data-driven models for alarm generation

Devices

- **Insulin infusion:** A highly accurate patch pump
- **Glucose monitor:** Commercially available
  - Continuous glucose monitoring (CGM) device
  - Self-monitoring blood glucose (SMBG) device

Mobile phone

- **Android platform:** Very convenient user interface to control the pump
- **Second SIM card:** Dedicated to secure the medical data and to facilitate the accesses
- **SMBG:** Integrated into the cell phone
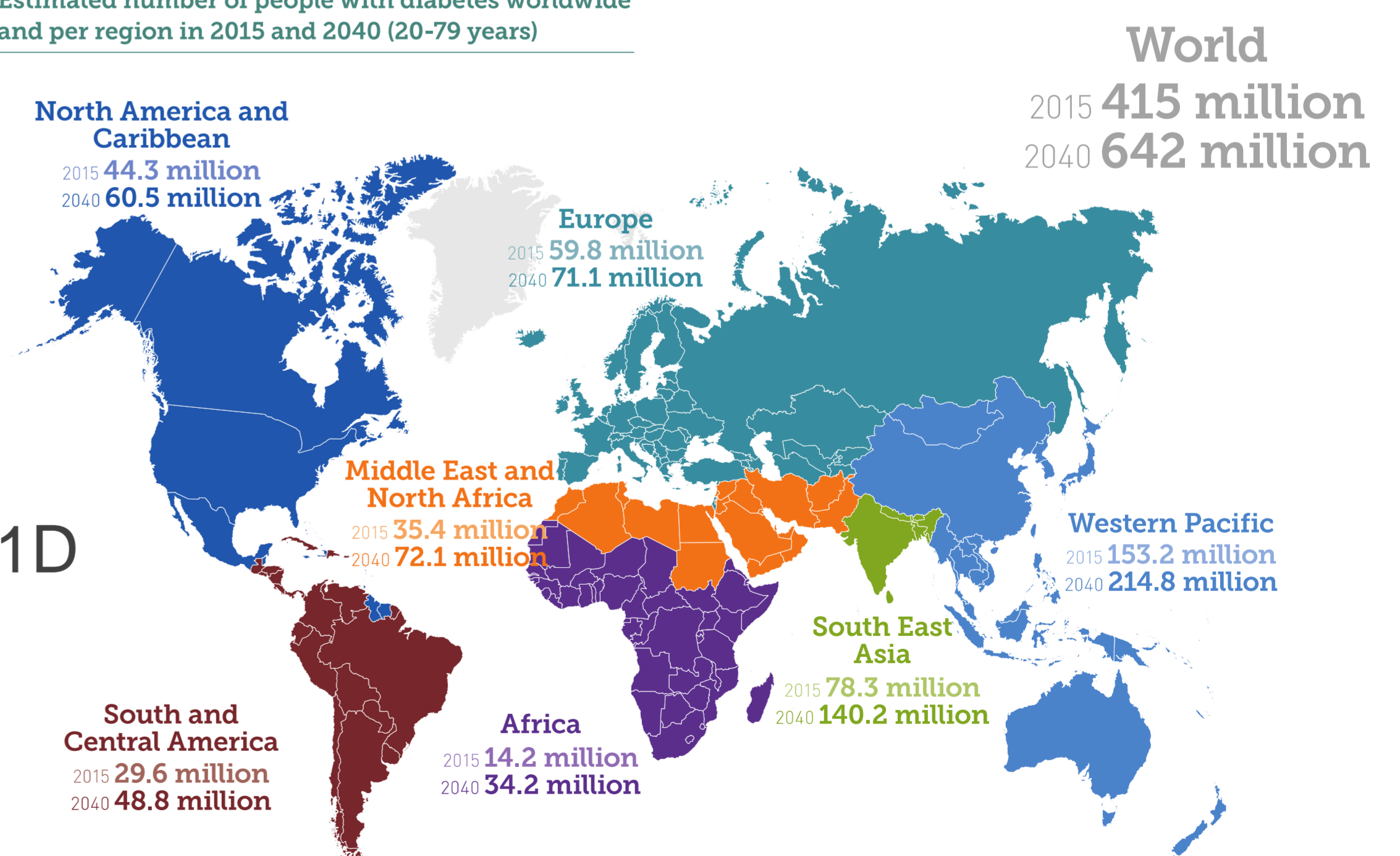
Key Findings and Results
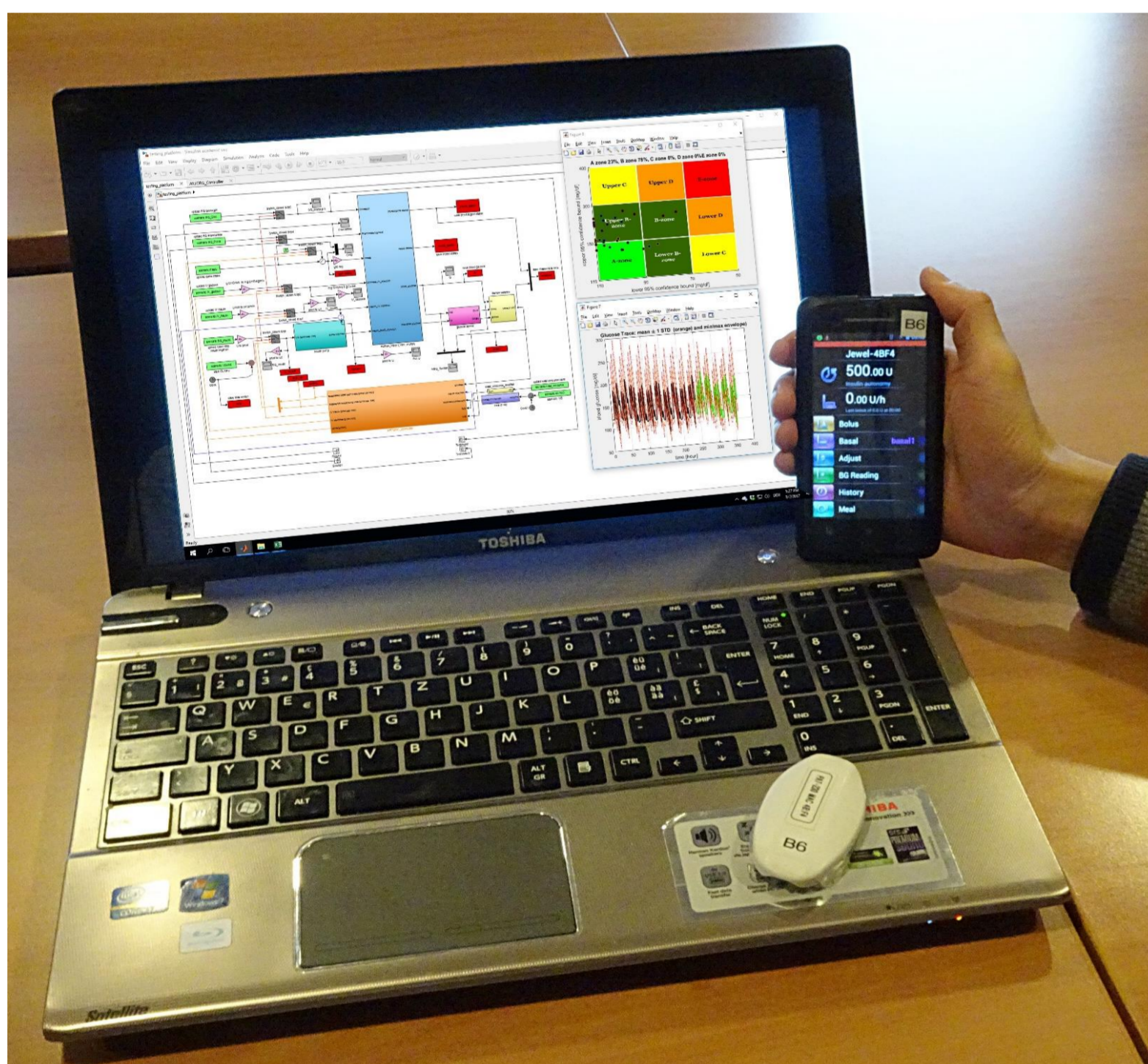
- Adaptive Basal Bolus Algorithm (ABBA)
  - Personalization on a daily basis of the basal infusion rate and the three main pre-prandial boluses
  - Compensation of meal's effect even with meal size uncertainties in the order of 25%
  - Alarm generator based on the fusion of a number of statistical and machine learning data-driven models for early detection of hypo- and hyperglycemic events (20 min ahead in time)
  - Evaluation using the FDA accepted simulator for individuals with type 1 diabetes (T1D)
- ABBA's integration into the JewelCOM™ Android smartphone

Business Potential

- In 2015, 12% of global health expenditure is spent on diabetes (USD 673 billion)
  1 in 11 adults had diabetes (415 million)
  every six seconds a person dies from diabetes (5 million deaths)
- In 2040, Diabetes-related health expenditure will exceed USD 802 billion
  1 in 10 adults will have diabetes (642 million)
- In 2020, Artificial Pancreas (AP) market share could reach up to 50% of T1D
- In 2020, AP will generate an annual revenue of up to USD 68 million

Year	2015	2016	2017	2018	2019	2020
New pump sold on that year (T1D)	155'000	164'300	174'158	184'607	195'683	207'424
Expected AP market share (T1D)	10%	20%	30%	40%	50%	50%

Estimated number of people with diabetes worldwide and per region in 2015 and 2040 (20-79 years)

World 2015 415 million 2040 642 million

North America and Caribbean 2015 44.3 million 2040 60.5 million

Europe 2015 59.8 million 2040 71.1 million

Middle East and North Africa 2015 35.4 million 2040 72.1 million

Western Pacific 2015 153.2 million 2040 214.8 million

South and Central America 2015 29.6 million 2040 48.8 million

Africa 2015 14.2 million 2040 34.2 million

South East Asia 2015 78.3 million 2040 140.2 million

International Diabetes Federation. *IDF Diabetes Atlas update poster, 7th edn.* Brussels, Belgium: International Diabetes Federation, 2015.

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