mosaic PROJECT

Models and simulation techniques for discovering diabetes influence factors

ABSTRACT and GENERAL GOALS

Interest in identifying people at risk of developing Type 2 Diabetes Mellitus (T2DM) has gained extreme importance especially at its asymptomatic phase, when early interventions have a proven beneficial effect on clinically meaningful outcomes. The current diagnostic criteria are focused on identifying groups with significantly increased prevalence of microvascular complications. This suggests that the current diagnostic methods are missing the opportunity to identify IGT and IFG (pre-diabetes) and early symptoms of T2DM, which leads to a late identification and treatment of patients and the consequent development of complications, which could be avoided with an earlier intervention. This paper introduces the MOSAIC project which aims to improve the current standards for diabetes diagnosis and management.

The MOSAIC project aims to develop tools to:

- Advance diagnosis of T2DM, IGT, IFG
- Improve characterization of the aforementioned patients

Evaluate the risk of:

- Developing T2DM
- Developing associated complications

Integrating these tools into a existing diabetes management platform that supports:

- Stratification of the population at risk
- Personalized treatments and definition of the care pathways
- Enhanced professional decision support systems. Drive personalization of therapy and care pathways assignment.

MOSAIC DATA MODELING

β – cell, organ and body modeling

A Model of Beta-Cell Mass, Insulin, and Glucose Kinetics: Paythways to Diabetes.

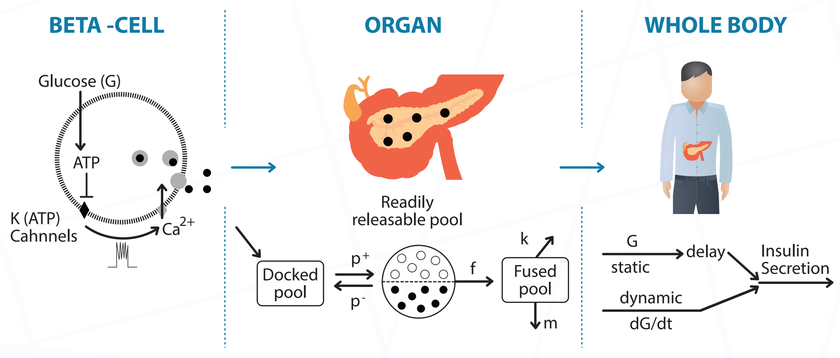
Mathematical modeling of insulin secretion. There are several kinds of models depending on the focus of the model.

From beta-cell modeling aimed to understand how these cells works to minimal modeling techniques which model the disease from a metabolic point of view.

MOSAIC GOALS:

Probabilistic modelling with Bayesian Networks (Universita degli studi di Padova) of glucose regulation, to discover novel physiological biomarkers of the evolution of Type 2 Diabetes.

Multi-scale modelling (Universita degli studi di Padova) of the physiological biomarkers, to increase the understanding of the cellular mechanisms beyond glucose regulation.



Population modeling. Epidemiological studies and analysis

Epidemiology is the study (or the science of the study) of the patterns, causes, and effects of health and disease conditions in defined populations.

It is the cornerstone of public health, and informs policy decisions and evidence-based medicine by identifying risk factors for disease and targets for preventive medicine.

MOSAIC GOALS:

Within MOSAIC we will use information coming from epidemiological studies to improve and enhance the diabetes models. **(Samfundet Folkhalsan i svenka Finland RF, Asociación española para el desarrollo de la epidemiología clínica)**.

Process modeling and mining

Temporal Association Rules (TARs) mining methods to extract frequent complex temporal patterns from clinical data.

Temporal data mining techniques to detect the temporal events that characterize the clinical history of patients after diagnosis.

MOSAIC GOALS:

Data mining to elucidate the mechanisms underlying the onset and evolution of Type 2 DM.

Data mining to guide and support diagnosis process.

Temporal data mining models to assess the stages of the disease and improve risk stratification.

Universita degli studi di Pavia

Elucidating the role of behavioral factors in diabetes evolution and management of care.

Use of individual patient histories to forecast disease complication through multivariate temporal modeling.

Soluciones tecnológicas para la salud y el bienestar S.A

STUDIES and DATABASES ACROSS EUROPE

1 SPAIN

VIVA (study): aimed to describe the most frequent cardiovascular risk factors (CVRF) clustering related to the metabolic syndrome (MS) in a non-diabetic sample. Estimates the probability of developing T2DM and IGT during 10 years in subjects free from these anomalies (NGT).

ePREDICE (study): To compare the effect of 3-year treatment with sitagliptine, metformin or a fixed-dose combination plus lifestyle intervention (diet and exercise), to lifestyle intervention alone on different microvascular parameters (retinal, renal and neurological) in adults with pre-diabetes (IGT, IFG, or both).

Healthy Breakfast (study): To design an standard breakfast as a substitute for the OGTT, to be performed at home. To elaborate an algorithm for the automatic diagnosis of dysglycaemia in patients with high risk using a CGM system.

OpT2mize (study): Study to assess continuous subcutaneous insulin infusion (CSII) in diabetes type 2. 400 patients are being managed using Carelink iPro2 to collect blinded CGM data in order to obtain more than HbA1c as endpoint.

Carelink (study): Database storing information from almost 7500 T1DM (80%) and T2DM (20%) subjects in Europe.

GECHRONIC (study): Study on remote management of complex chronic patients, including remote monitoring. Data from 90 complex chronic patients of Valencia Health Agency in one year of monitoring.

La Fe (Hospital Database): Database of clinical data retrieved during the daily activity in the Health Department, including hospital and primary care. Population covered by the Department is around 200.000 inhabitants.

Managed Outcomes (study): Healthcare processes for diabetes patients in primary care. 2000 T2DM patients form Valencia Health Agency.

3 SWEEDEN and FINDLAND

BOTNIA (PPP and BPS) (Studies). The Botnia study includes today approx. 10,000 individuals from 1400 families. Of them, about 3400 have diabetes and 1000 have IGT or IFG. Around 2800 non-diabetic individuals have been prospectively followed during a median time of 8 years (the Botnia Prospective Study). The PPP–Botnia study is a population-based study designed to obtain accurate estimates of prevalence and risk factors for diabetes, impaired glucose tolerance and the metabolic syndrome.

2 ITALY

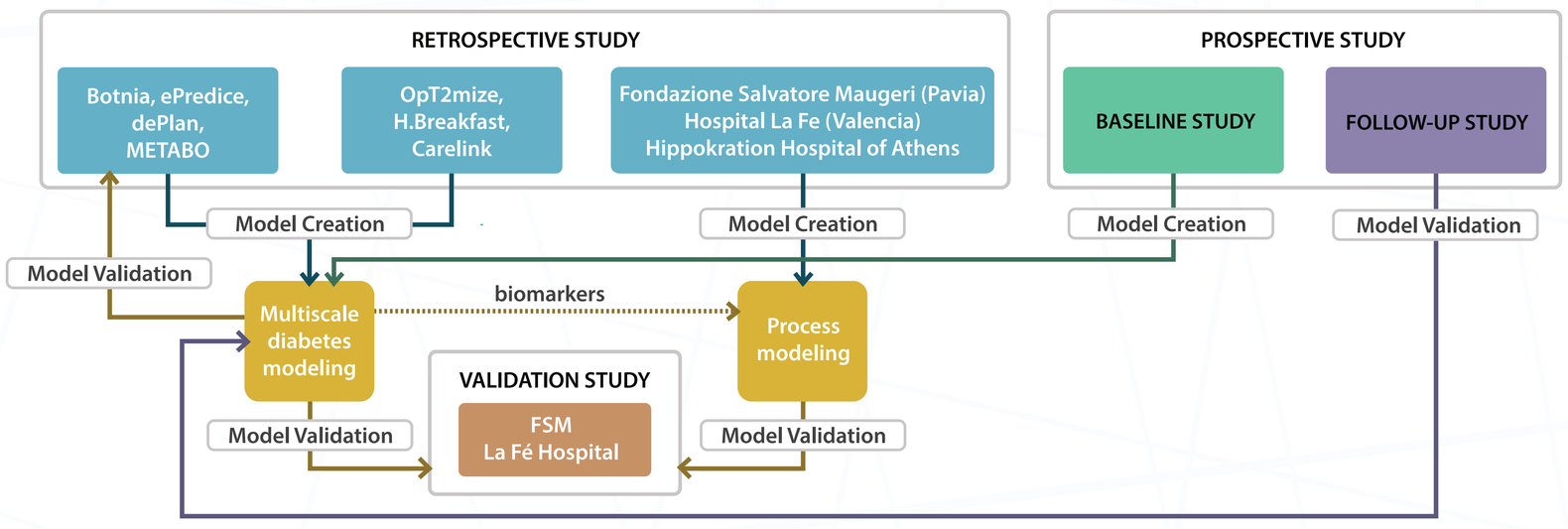
FSM (Hospital database): Database of clinical data retrieved during the daily activity in the Diabetology Ambulatory.

ASL Pavia (Hospital database): Continuous databases of both clinical and administrative data of 2500 T2DM patients in Pavia, Italy.

4 GREECE

Hyppokration Hospital of Athens (Hospital Database). It tracks the continuous follow-up of 560 type 2 diabetic patients.

RETROSPECTIVE and PROSPECTIVE STUDIES



* **VALIDATION STUDY:** The enhanced models will be integrated within to ICT tool already validated for the Chronic Disease management focus on Diabetes: METABO and NOMAD. Using these tools the new validation process will be carried out at FSM and Hospital La Fé.

Co-funded by the Seventh Framework Programme of the European Union