Big Data for Medical Analytics

BIGMedilytics

Population Health and Chronic Disease Management

Diabetes

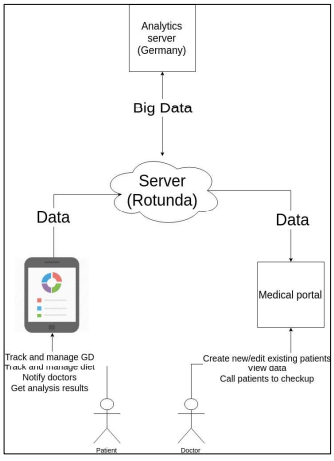
This pilot aims to develop a complete monitoring system, including a mobile app (connected with glucometers to ease data collection, and presenting analytics results to the patients), and a web portal to present the data to the medical team.

Gestational Diabetes

Gestational diabetes (GDM) is a condition of glucose intolerance with first recognition or diagnosis in pregnancy. Prevalence of GDM has seen a dramatic increase in recent years due to internationally applied changes in diagnostic criteria along with the global obesity epidemic, more sedentary lifestyles and advancing maternal age. Due to inconsistencies in screening and diagnosis as well as sociodemographic variability, the prevalence of GDM ranges from 1.7% - 20% across studies.
Self-monitoring of blood glucose levels is the cornerstone of management of GDM. The association between GDM, poor glycaemic control and adverse perinatal outcomes has been established for many years.

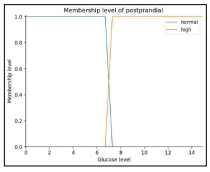
Neonates born to diabetic mothers have a higher incidence of macrosomia, increased operative delivery rates, increased rates of birth complications and higher admission rates to neonatal ICU to correct metabolic imbalances. The rising prevalence of GDM also represents a major public health concern as affected mothers are at increased risk of Type two diabetes later in life.
Rising healthcare costs associated with the increased prevalence of GDM necessitates the introduction of innovative strategies for monitoring and management of the condition. To this end we propose the introduction of an app-assisted remote monitoring program for women with GDM to reduce the burden of ever-increasing demand on the health care service and to foster patient-oriented care with the self-monitoring of their condition.

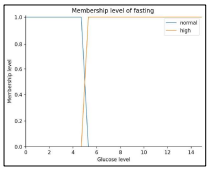
Infrastructure and APP

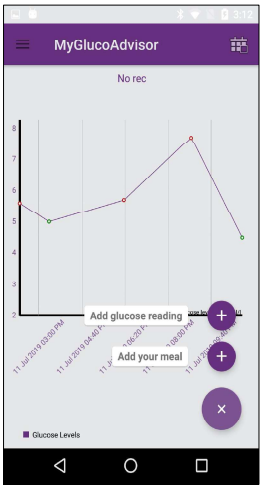


The system belongs to a new generation of Remote Patient Monitoring applications which are based on modern edge computing architecture for collecting health data from wearable devices, processing the data in real time on smartphones and alarming the patient and the doctor in the case of any out of range readings.
Additionally, patient data is sent, through secure channels, to the hospital server, where medical staff can analyze the data in short term (e.g. some daily trends) and issue corresponding notifications. Simultaneously, the data is processed using data analytical methods for detecting trends in patient behavior. The system is also capable of predicting potential out of range trends and alerting both doctor and patient.

The application itself collects not only glucose readings, but is capable of collecting dietary data to provide context for those readings. It displays this information to patients in a clear and concise format, including weekly summaries, as well as educational information in the form of notifications. The app is capable of setting reminders to measure glucose levels, and it also provides motivational pop-ups as a form of support to patients.

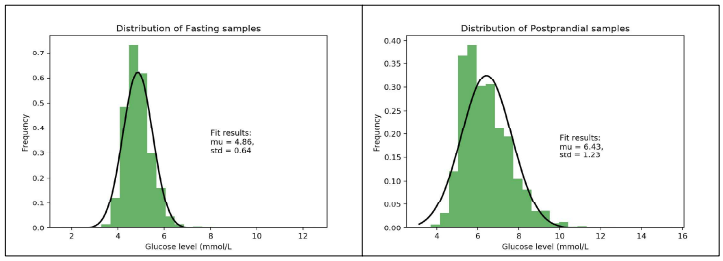






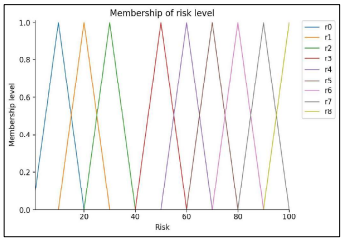
Data

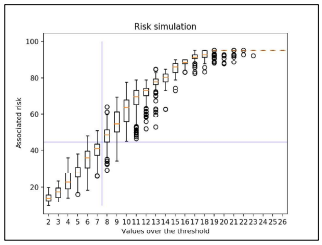
The data used for validating the model was collected from a pre pilot study in the Rotunda Hospital, Dublin. GDM patients are diagnosed approximately in the 28th week of pregnancy. Participating patients were asked to collect four daily glucose level measurements until delivery, one in the morning (fasting) and the remaining three readings taken one hour after the three main daily meals (postprandial). For this analysis, fully anonymized data from 50 patients was used, with different levels of adherence to the schedule of measurements, ranging from one every week (i.e. around 10 measurements in the whole period), to several daily measurements (i.e. 700 measurements).



Analytics

We used a fuzzy inference system for defining a risk value, due to its explainability and interpretability. The input values are the glucose measurements. We derived the thresholds from protocols collected from the ranges used in hospitals in Ireland. The output value is the risk associated to a patient, generated by expert knowledge. The rules are human-readable sentences used as an input for the model. We had a dimension problem (the model needed 2^28 rules) that was solved by not using the time component of the rules from the previous week. The results show that most of the values lay on the lower left and upper right quadrants, representing that both criteria agree, and all the measurements with low or high risk are reflected in the risk score. The border cases assign a higher risk score with patients with higher average glucose readings.





HUAWEI · Nissatech innovation centre · The Rotunda Hospital Dublin · RCSI Royal College of Surgeons in Ireland

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