# *"AID-GM system (Advanced Intelligent Distant – Glucose Monitoring) to monitor health status and metabolic control of young people with type 1 diabetes"*

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## Aim of the study

In type 1 diabetes, it is well recognized that collecting additional information about diet, physical activity, health status, stress and any patients' everyday behavior, is crucial to evaluate accurately metabolic control and therapeutic prescription adherence.
The aim of this study is to test AID-GM (Advanced Intelligent Distant – Glucose Monitoring) a web-based platform, able of collecting automatically patient generated health data (PHGD) coming from different sources (blood glucose sensors, activity trackers, vocal messages, etc).

## Patients and methods

Thirty young TDM1 patients (over 11 years), under multiple daily injection therapy and using a FGM sensor (FreeStyle Libre®, Abbott Diabetes Care, Alameda, CA) will be overall enrolled. To determine time spent walking and sedentary time, a Fitbit device will be delivered.
AID-GM is developed as a Java-based web application, and its architecture is shown in Figure 1.

it supports advanced temporal data analysis functionalities for the extraction of qualitative patterns from time series data (thnks to (Java Time Series Abstractor), a framework to process temporal data and extract knowledge-based patterns from them .
AID-GM will be used to automatically collect and share data coming from these sensors and provide several advanced analysis and visualization tools. Moreover, a mobile app will be used by patients to record vocal messages reporting any relevant health information. An automatic tool will extract the information from messages and store them into the system database. Finally, the system is able to automatically detect specific temporal patterns in single or group of patients' data, like for example *rebound effect* and *dawn effect*. The temporal analysis can be focused on specific time frames (e.g. days of the week, moments of the day, etc).

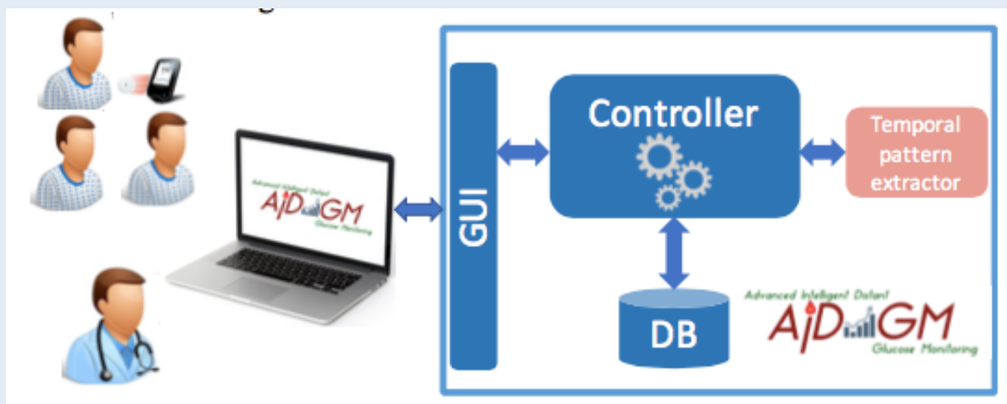



**Figure 1.** System Architecture: the temporal pattern extractor is based on JTSA framework.

## Results

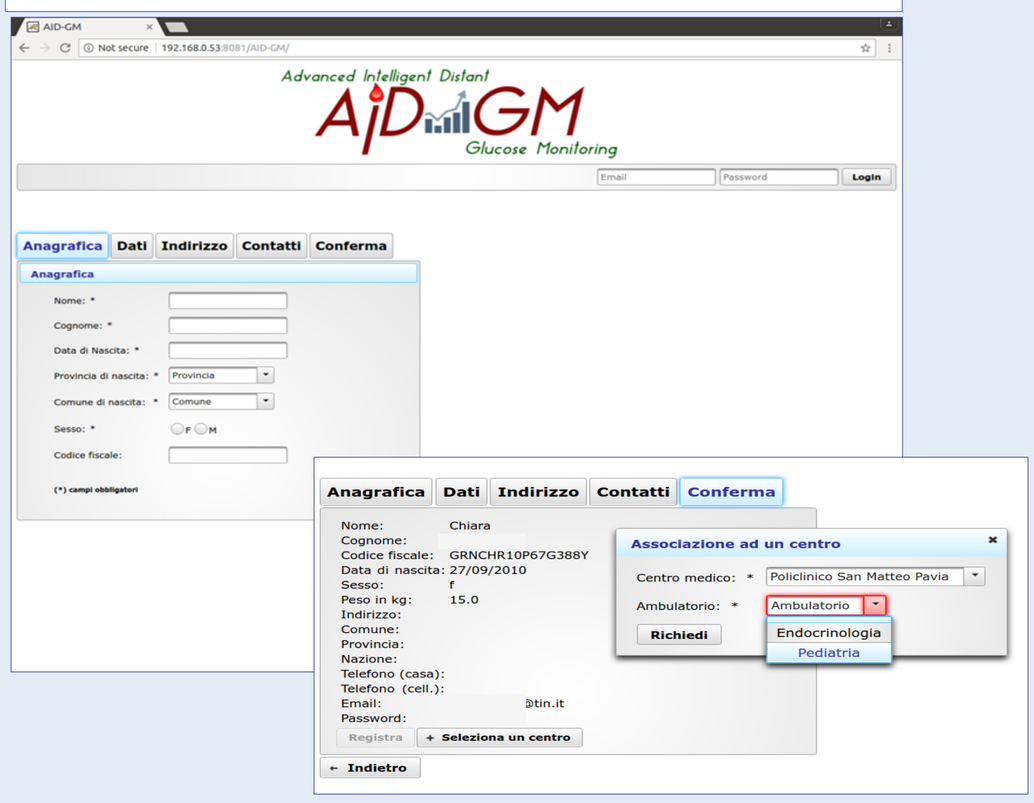
The application is easy to use by both patients and care providers.
Table 1 shows a list of the main AID-GM functionalities and specifies the type of user (patient and/or physician) each of them is available for.

Being designed as a web application (Figure 2), AID- GM allows users to access their data at any time and from any location, provided that an internet connection is available. Consequently, patients can rapidly share their data with the physician, without having to use paper-based diaries or pdf files

**Table 1.** AID-GM functionalities and users

| Functionality | Patient | Physician |
|---|---|---|
| User access through secure authentication | x | x |
| Enrollment request in a clinical center | x | |
| Set-up of daily habits (time of meals, wakeup and bedtime for each day of the week) | x | |
| View and approve new patient enrollment requests | | x |
| Set-up of patient-specific hypoglycemia and hyperglycemia thresholds | | x |
| Enter/modify the insulin therapy | | x |
| View the insulin therapy | x | x |
| Association of a BG monitor device to a patient | x | |
| Upload of BG monitoring data | x | |
| Request for a consultation | x | |
| View the BG overall time series, daily trends and average profile of a patient | x | x |
| Patterns analysis on one patient | x | x |
| Patterns analysis on a group of patients | | x |
| View group statistics | | x |
| View patients list, and uploaded monitoring data | | x |

**Figure 2.** Interface of the application




The most important and novel functionalities of the systems are those related to group analysis and temporal patterns extraction. Statistics on a group of patients can help the physician to quickly identify patients who need closer control and possible therapy adjustments.
As regards patterns extraction, AID-GM currently supports 10 types of patterns, among which there are 5 complex patterns. These represent well-known clinical phenomena, which could identify potentially risky situations. Among these complex patterns, we have included the night-time, the dawn effect, and the rebound effect.

The system offers the active on-line inspection and analysis of real-time generated data for health status monitoring and prevention/prediction and the health-related data (heart rate, physical activity) access.

Finally, a potential usage of the platform will be in the context of clinical research trials running in realistic day-by-day settings.

## Conclusions

The platform supports effectively home care supplying every information and analysis tools useful to increase knowledge about the factors influencing the patient's glucose metabolic control. Using the platform, it will also be feasible to design observational clinical trials collecting PHGD at low cost with long follow-up with the aim of deriving model-based indexes of glucose metabolism and increasing the insight on basic mechanisms underlying diabetes disease.

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