



POWER2DM

“Predictive model-based decision support for diabetes patient empowerment”

Research and Innovation Project

PHC 28 – 2015: Self-management of health and disease and decision support systems based on predictive computer modelling used by the patient him or herself

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EXECUTIVE SUMMARY

The conceptual design proposed the integration of the KADIS[®] functionalities as API or as RESTful Web-Service. Now the second variant has been transposed as KADIS[®]/TeleDIAB[®] Services. Hereby the integration into the POWER2DM Prediction Service is described as well as the actual existing or developed KADIS[®]/TeleDIAB[®] Services.

POWER2DM Consortium Partners

Abbv	Participant Organization Name	Country
TNO	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek	Netherlands
IDK	Institute of Diabetes “Gerhardt Katsch” Karlsburg	Germany
SRDC	SRDC Yazilim Arastirma ve Gelistirme ve Danismanlik Ticaret Limited Sirketi	Turkey
LUMC	Leiden University Medical Center	Netherlands
SAS	SAS Servicio Andaluz de Salud	Spain
SRFG	Salzburg Research Forschungs Gesellschaft	Austria
PD	PrimeData	Netherlands
iHealth	iHealthLabs Europe	France

OPEN ISSUES

No:	Date	Issue	Resolved
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TABLE OF CONTENTS

Executive summary	2
Open issues	3
Table of contents	3
1 Introduction	4
1.1 Purpose and Scope	4
1.2 References to POWER2DM Documents	4
1.3 Definitions, Abbreviations and Acronyms	4
2 Integration of KADIS®/TeleDIAB® Services	5
2.1 KADIS® RESTful Web-Service	5
3 Description of KADIS®/TeleDIAB® Services	6
3.1 Introduction & Overview	6
3.2 Data Exchange, JSON data set.....	6
3.3 KADIS®/TeleDIAB® Services	8
3.3.1 GetPublicID	9
3.3.2 SendMONdata.....	9
3.3.3 GetPatKurve.....	9
3.3.4 GetMFP	10
3.3.5 GetSIMULA (provided to physicians/diabetologists only)	10
4 Literature references.....	10

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1 INTRODUCTION

1.1 Purpose and Scope

This document describes the initial development stage of the KADIS®/TeleDIAB® Services which are used by the POWER2DM Prediction Services as planned and described in the Conceptual Design for Variant B: POWER2DM Prediction Services (KADIS® RESTful Services for providing the “Metabolic Fingerprint” and performing of simulations).

1.2 References to POWER2DM Documents

- POWER2DM Description of Work (Proposal)
- D1.3 Conceptual Design of the POWER2DM Architecture
- D2.1 Short-term Predictive Component
- D2.5 Mockups for Visualizations of Predictions
- D4.1 Personal Data Model and Service API

1.3 Definitions, Abbreviations and Acronyms

Table 1 List of Abbreviations and Acronyms

Abbreviation/ Acronym	DEFINITION
API	Application Programming Interface
MFP	Metabolic Fingerprint
KADIS®	Karlsburg Diabetes Management System
REST	Representational State Transfer

2 INTEGRATION OF KADIS®/TELEDIAB® SERVICES

2.1 KADIS® RESTful Web-Service

Instead of the previously discussed integration of the KADIS® functionality as an API (preferably as JAVA API) to the POWER2DM Prediction Service another concept using RESTful Web-Services was preferred. Advantage is the possibility to use the existing database and service infrastructure TeleDIAB®/KADIS® provided by the Diabetes Service Center Karlsburg, a spin-off of IDK. Therefore it is possible to provide the various KADIS® functionalities easily to handle by using the KADIS®/TeleDIAB® Services. Moreover, additional services could be involved, supported and scaled up easily.

Basis of the KADIS®/TeleDIAB® Services is the RESTful Web-Service concept, which uses HTTP/HTTPS protocols. REST stands for **R**epresentational **S**tate **T**ransfer (it is sometimes spelled "ReST"). It is based on a stateless, client-server, cacheable communication protocol -- and in virtually all cases, the HTTP/HTTPS protocol is used. REST is *an architecture style* for designing network applications. The idea is that, in contrast to using complex mechanisms such as CORBA, RPC or SOAP to generate connections between machines, simple HTTP/HTTPS are used to allow calls between machines. RESTful applications use HTTP/HTTPS requests to post data (create and/or update), read data (e.g., make queries), and delete data. Thus, REST uses HTTP/HTTPS for all four CRUD (Create/Read/Update/Delete) operations.

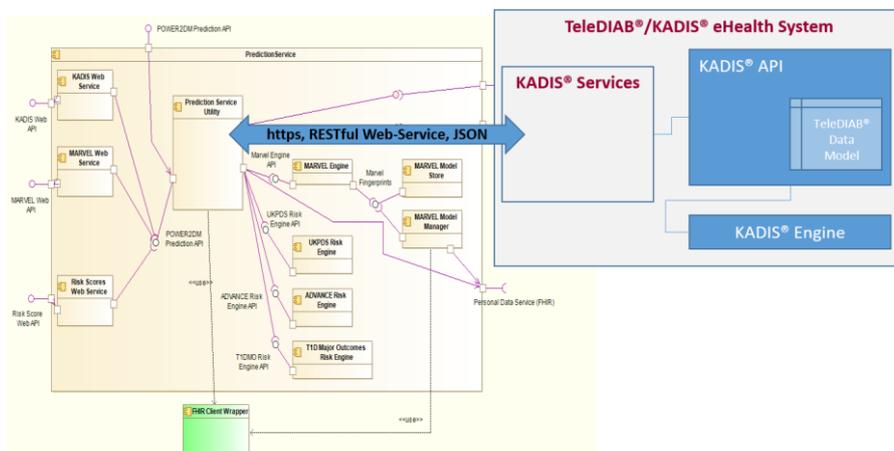


Figure 1 – Integration of the KADIS®/TeleDIAB® Services into the POWER2DM Prediction Services by HTTPS, RESTful Web-Service with JSON data exchange

However, data to be send to and received from the KADIS®/TeleDIAB® Services, which are using JSON data sets, needs an interface within the POWER2DM Prediction Services to be translated to the POWER2DM data model.

3 DESCRIPTION OF KADIS[®]/TELEDIAB[®] SERVICES

3.1 Introduction & Overview

KADIS[®]/TeleDIAB[®] Services are embedded into the TeleDIAB[®]/KADIS[®] eHealth system with general access to the data model, program logic modules and the KADIS[®] engine, which is a high speed calculator for simulation as well as identification (KADIS[®] setup) procedures. Based on this complexity and a performant data base, KADIS[®]/TeleDIAB[®] Services will be provided as RESTful Web-Service via an URLMap. For the POWER2DM Prediction Services the URLMap provides an easy to use call for the various KADIS[®]/TeleDIAB[®] Services by HTTPS protocol. In the direction to TeleDIAB[®]/KADIS[®] the URLMap defines routes to the different KADIS[®]/TeleDIAB[®] Services. Using this mechanism KADIS[®]/TeleDIAB[®] Services could be designed as simple as possible which results in a high performance for the user of the KADIS[®]/TeleDIAB[®] Services. Moreover, the URLMap is suitable to handle a theoretically unlimited number of services.

3.2 Data Exchange, JSON data set

JSON (JavaScript Object Notation) is a data-interchange format. It can easily be generated and parsed by machines. It is based on a subset of the JavaScript Programming Language, Standard ECMA-262 3rd Edition - December 1999. JSON is a text format that is completely language independent. JSON uses conventions of the C-family of languages, including C, C++, C#, Java, JavaScript, Perl, Python, and more. In JSON data could be presented as objects containing a collection of name/value pairs. A second structure in JSON are ordered list of values. Since all modern programming languages supporting these structures, it makes sense that such a data format is used for data exchange in POWER2DM.

The KADIS[®]/TeleDIAB[®] Services uses the list of values structure for the request of a public ID to compile all relevant data to this ID. The JSON data exchange format is exemplified here for the request to the KADIS[®]/TeleDIAB[®] Service and the response from it:

REQUEST: { "identifier": "ACP2DM#Code", "publicID": "", "language": "en" }

RESPONSE: { "identifier": "ACP2DM#Code", "publicID": "P-54609812", "language": "en" }

The KADIS[®]/TeleDIAB[®] Service for sending data of the KADIS[®] Diagnostic Test over at least 3 days uses JSON data sets containing objects which correspond to the TeleDIAB[®] data model. An example is:

REQUEST:

```
{
  "publicID": "P-*****",
  "identifier": "ACP2DM#Code",
  "diabtyp": "Typ2",
  "diabseit": 1993,
  "insulin": 1,
```

```

"oad":1
"glp1":1
"groesse": 162,
"gewicht": 114,
"alter": 72,
"geschlecht": "w",
"messDaten": [{
  "datumzeit": "24/05/2016 07:30",
  "smbg": 212,
  "meal": "C",
  "insulin": [{
    "name": "Apidra",
    "form": "kurz",
    "mix": "",
    "insdosis": 40
  }],
  "oad": [{
    "wirkstoff": "Sitagliptin",
    "oaddosis": "100",
    "anzahl": 1.0
  }, {
    "wirkstoff": "Glimepirid",
    "oaddosis": "4",
    "anzahl": 0.5
  }
]
}
]
}

```

RESPONSE: {„code“:“0“,„msg“:“Transaction OK“}

3.3 KADIS®/TeleDIAB® Services

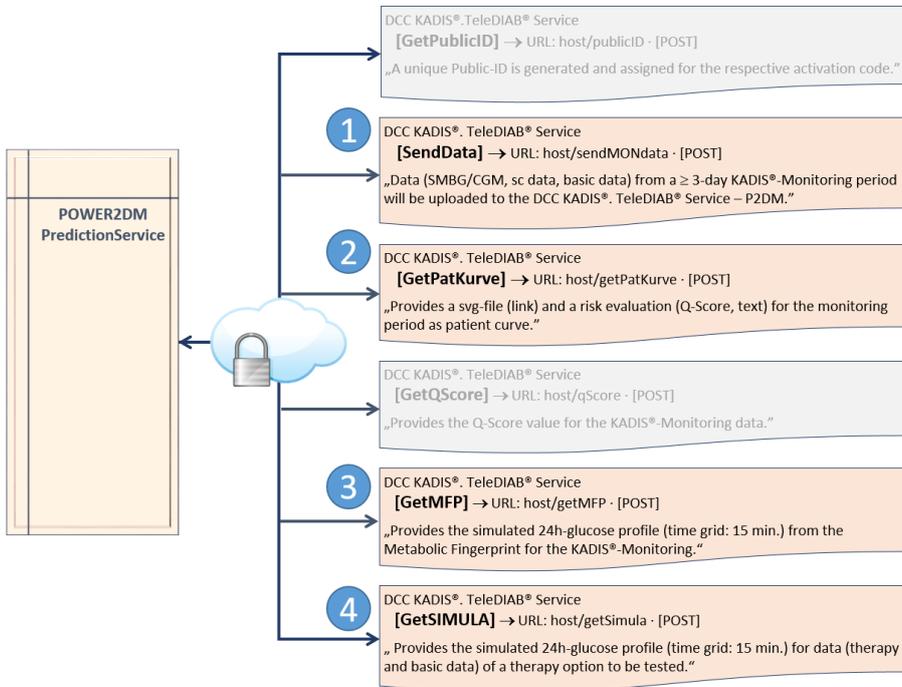


Figure 2 – Overview of all currently provided KADIS®/TeleDIAB® Services

The KADIS®/TeleDIAB® Services are described in more detail and in the sequence how they should be used in figure 3.

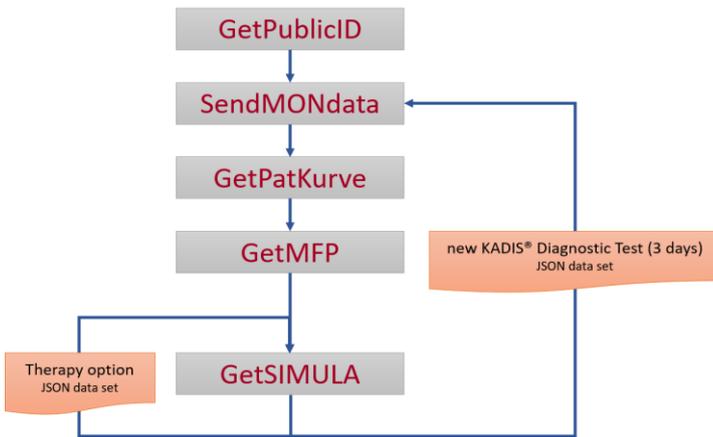


Figure 3: Example of a sequence of using KADIS®/TeleDIAB® Services

3.3.1 GetPublicID

As described before, the KADIS®/TeleDIAB® Services are embedded on the one hand to the TeleDIAB®/KADIS® eHealth system and correspond on the other hand to the TeleDIAB® data model which is object-oriented with a patient-object in the root. Therefore, at the first step a public ID has to be requested from the KADIS®/TeleDIAB® Services. This public ID will be created by the KADIS®/TeleDIAB® Service “GetPublicID” and is unique for TeleDIAB®.

3.3.2 SendMONdata

After performing the KADIS® Diagnostic Test which comprises at least a 3 day monitoring period on the basis of a KADIS®-related structured measurement plan including some basic data, which are necessary for the KADIS® setup procedure (e.g. type of diabetes). All these data, which are compiled according to the JSON data format will be transferred to TeleDIAB®/KADIS®. If the transaction is successful, the TeleDIAB® program will respond with “OK”. The data, which are allocated to the given public ID provide the basis to start the setup procedure of the KADIS® model, which is performed automatically. This means that the KADIS® model will be adapted (KADIS® Setup) to the individual data of the patient (glucose data, basic and self control data). The result of this procedure is a set of individual model parameters, which will be stored in TeleDIAB®. The automatic setup procedure is done by the KADIS® Engine (Fig 1). For each of the 3 days of the KADIS® Diagnostic Test at first a 24h-glucose profile will be calculated. Based on these profiles in the next step of the KADIS® setup procedure a so called “Typical Day” is estimated, which is summarized finally by the KADIS® setup program to the so called “Metabolic Fingerprint” (MFP) of a given diabetic patient. The MFP includes the calculated typical personalized 24h-glucose profile, the basic data and the self control data which are associated with the typical day.

If the same data will be transferred again, the KADIS®/TeleDIAB® Service overwrites the stored data. But if data of a new KADIS® Diagnostic Test are sent to the public ID, the KADIS®/TeleDIAB® Service will create a new object for the KADIS® Diagnostic Test. After sending the response “transaction OK”, all following services “GetPatKurve”, “GetMFP”, “GetSIMULA” have to be repeated to get the results for the actual (last) KADIS® Diagnostic Test. In order to get results of earlier KADIS® Diagnostic Test, the property ‘date of test end’ (“testEndeDatum”) should be set properly in the JSON data set of the request.

3.3.3 GetPatKurve

Once the KADIS® Setup was successfully performed, the KADIS®/TeleDIAB® Service “GetPatKurve” provides to the user the Q-Score analytic and the patient curve as a scalable vector graphic. This service is added by a short comment to the result of the Q-Score analytic.

3.3.4 GetMFP

In order to be able to use the calculated 24h-glucose profile within the POWER2DM Prediction Service, the KADIS®/TeleDIAB® Service “GetMFP” provides the value list for it in JSON format.

3.3.5 GetSIMULA (provided to physicians/diabetologists only)

The MFP will be presented to the responsible physician/diabetologist for a given patient after login to the POWER2DM UI. The physician/diabetologist, which should be familiar (i.e. trained) to the KADIS® program, will be supported by using the KADIS®/TeleDIAB® Services efficiently to realize weak points in the metabolic control of the patient and to test ideas and strategies to improve the therapeutic outcome by running interactively the KADIS® simulation program online. The therapeutic options to be tested could be entered into the POWER2DM UI and subsequently tested by the KADIS®/TeleDIAB® Prediction Service “GetSIMULA”. Within seconds the physician/diabetologist will get as a result what he could expect concerning the 24h-glucose profile for the therapeutic option he has entered into the KADIS®/TeleDIAB® Prediction Services program before. These KADIS®/TeleDIAB® Service can be repeatedly used by the physician many times in order to find the best personalized therapeutic options for the given individual patient quick and save.

4 LITERATURE REFERENCES

1. Rodriguez Alex, RESTful Web services: The basics, Updated: Feb 09, 2015, <https://www.ibm.com/developerworks/webservices/library/ws-restful/>
2. Introducing JSON, <http://json.org>