Documentation for Medicsen's API

Request

Request Parameters	Parameter Type	Format	Description
`Payload`	body	JSON	Required. The data input for the request in JSON format.
api-version	query	string	Required. It must be "`api-version=2.0`".
details	query	string	Optional. If it is set to TRUE, you will receive an output with additional information (see below).

Payload

Sample request (JSON object):

```
{
   "Inputs":  {
      "predictor_input":  {
         "ColumnNames":  [
            "time",
            "glucose",
            "cho_simple",
            "cho_complex",
            "ins_fast",
            "ins_slow",
            "mass"
         ],
         "Values":  [
            ["2019/08/05 16:00", 120, 10, 40, 3.5, 0, 75],
            ["2019/08/05 16:15", 121, 0, 0, 0, 0, 75],
            ["2019/08/05 17:35", 132, 0, 0, 0, 0, 75],
            ["2019/08/05 18:45", 0, 0, 0, 0, 20, 75],
            ["2019/08/05 19:00", 140, 0, 0, 0, 0, 0]
         ]
      }
   },
      "GlobalParameters":  {}
}
```

Input parameters:

Input name: `predictor_input`

Input type: `DataTable`

Input columns:

Name	Type	Description	Allowed values
`time`	Object (string)	The time (with date included) of the glucose/carbohydrate/insulin measurement. The format must be "`yyyy/mm/dd HH:MM`".	Only if it is with the format "`yyyy/mm/dd HH:MM`". Otherwise it'll throw an error or maybe it'll output strange values.
`glucose`	Numeric (float)	The glucose measurement. It must be in **milligrams per deciliter** (mg/dL).	Only positive numeric values up to 600 mg/dL. Use the value 0 for missing data.
`cho_simple`	Numeric (float)	The amount of ingested simple carbohydrates (simple sugars). It must be in **grams (g).**	Only positive numeric values. Use 0 for missing data.
`cho_complex`	Numeric (float)	The amount of ingested complex carbohydrates. It must be in **grams (g).**	Only positive numeric values. Use 0 for missing data.
`ins_fast`	Numeric (float)	The injected dose of bolus insulin. It is any kind of fast acting and rapid acting insulin. It must be in **insulin units (IU).**	Only positive numeric values. Use 0 for missing data.
`ins_slow`	Numeric (float)	The injected dose of basal insulin. It is any kind of slow acting or long acting insulin. It must be in **insulin units (IU).**	Only positive numeric values. Use 0 for missing data.
`mass`	Numeric (float)	The person's weight. It must be in **kilograms (kg).**	Only positive numeric values. Use 0 for missing data.

Note:

- Each array contained inside the "Values" field is a time step, i.e. a measurement.
- It is required to send a minimum of 4 glucose measurements to ensure proper functioning of the algorithm. Otherwise it will throw an error due to the lack of data.
- It will only use the first value of the mass (weight). You only need to specify that value, the rest can be set to zero.
- If you use a value of mass equal to zero, it'll throw an error.
- It will only use data up to 24 hours in the past, counting from the last glucose measurement.
- It will discretize the data in regular 15 minutes intervals. If there are several points within 15 minutes, they will be averaged.

Response

A successful operation returns status code 200 (OK).

For information about error codes, see Common REST API Errors Codes.

Response headers

The response may include standard HTTP headers. All standard headers conform to the HTTP/1.1 protocol specification.

Response Header	Description
Content-Type: `application/json`	Indicates that the content body is in JSON format.

Output parameters:

Output name: `predictor_output`

Output type: `DataTable`

Output columns:

Name	Type	Description
`pred0`	Numeric (float)	The current glucose measurement (last glucose measurement from input data). Is in **milligrams per deciliter** (mg/dL)**.**
`predn (all rest of 12 ‘‘pred’’ columns)`	Numeric (float)	The future glucose predictions. Here “n” refers to the minutes, so a prediction made 45 minutes from the value pred0 will be called pred45. It is expressed in **milligrams per deciliter** (mg/dL)**.**
`time`	Object (string)	The time (with date included) of the `pred0` glucose measurement. The format is ‘‘`yyyy/mm/dd HH:MM:SS AM/PM`’’.

Note:

- The predictor is designed to work only with data coming from persons with Type I Diabetes Mellitus.
- The prediction will be done from the last glucose value, meaning that if after the last glucose there is any kind of information (e.g. carbohydrates or insulin) it will be used as future data.

Sample response (JSON object):


```
{
    "Results":  {
        "predictor_output":  {
            "type":  "DataTable",
            "value":  {
                "ColumnNames":  [
                    "pred0",
                    "pred15",
                    "pred30",
                    "pred45",
                    "pred60",
                    "pred75",
                    "pred90",
                    "pred105",
                    "pred120",
                    "pred135",
                    "pred150",
                    "pred165",
                    "pred180",
                    "time"
                ],
                "ColumnTypes":  [
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Numeric",
                    "Object"
                ],
                "Values":  [
                    [
                    ”104.009263669471”,
                    ”96.2364046604062",
                    "99.2647391878364",
                    "102.744641274917",
                    "106.089699255478",
                    "108.584562644434",
                    "110.679614334562",
                    "112.167824226935",
                    "113.470337538897",
                    "114.435026850847",
                    "115.118934184411",
                    "115.570538408333",
                    "115.831295991142",
                    "8/5/2019 7:00:00 PM"
                    ]
                ]
            }
        }
    }
}
```

Note:

- If you set the request parameter ‘‘`details`’’ as ‘‘`FALSE`’’ you won’t receive the fields ‘‘`ColumnNames`” neither ‘‘`ColumnTypes`’’, just the ‘‘`Values`’’ field containing the predictions. Otherwise, i.e. `details=TRUE`, you will receive an output with those fields, as in the example above.
- Although Medicsen provides predictions up to 3 hours, the error might be elevated for those predictions beyond 1 hour. It is advised to work only with the predictions for the first hour and use the rest of the values to study the future glucose trend.

Accuracy of the algorithm

During the 3 years of development and optimization of our algorithm, we have done several tests on different databases of diabetic patients to validate the performance of the algorithm and estimate its accuracy. The data we have used come from various sources:

- From different diabetic patients who have voluntarily offered us their daily data. All of them had a continuous glucose monitor, to guarantee its validity both in value of the glucose level and in time of the day. In addition, many of them also shared their data on administered medications, meals during the day and physical exercise, as well as other parameters such as stress, illness, etc.
- From a simulator validated by the FDA to perform simulations of diabetic patients under different medication and meal conditions, as well as different patient profiles such as women, men, children, various age profiles, etc.
- From the anonymized data of the users of our algorithm, also classifying according to the data of their profile, such as those mentioned above as relevant for a proper prediction of glucose values.

Based on the tests with all these data, we have managed to determine the accuracy ranges of the algorithm. The average error of the algorithm, for one-hour predictions, ranges between 10 mg/dL and 20mg/dL depending on the patient, the number of glucose measurements and the accuracy of the continuous glucose monitor, if used, but in all cases it is less than 20 mg/dL. The error was calculated using RMSE (root mean squared error).

The algorithm predicts the best in the moments of the day where there are less external factors, reaching in the most cases an average error of less than 10 mg/dL. These periods are during sleep or a few hours before or after a meal. It is also important to mention that the error decreases when the data comes from a well-controlled diabetic patient, the data is measured regularly and it is a quality data, that is, there is no lack of food or insulin injection, and these measures are within usual periods. On the other hand, the error is greater when very few data are used, in some cases having an error greater than 20 mg/dL. That is why from the API a minimum of measures are required for the algorithm to return a prediction and, in case of not having them, it returns an error. Major errors also occur right after a meal intake.

It is also important to mention that the error may come from the continuous glucose monitor used, if used. Sometimes, some of these continuous glucose monitors have what are called "outliers" or other failures and sometimes they measure the glucose levels with a significant error. This is something that has happened to us with some of the patients who have given us their data. In case of detecting significant divergences between the levels measured by the continuous glucose monitor and the levels measured in blood, it is recommended to use the levels measured in blood, which are always the most accurate.

Finally, it is important to keep in mind that predictions beyond one hour may have an error greater than 20 mg/dL and should not be used as a reliable prediction, but they may be useful for estimating the trend of the curve of glucose from 1 hour.