Original article

A MODEL TO SIMULATE SELF ONITORING OF BLOOD GLUCOSE

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Abstract : An application software using database is being developed for assisting young diabetics with access to personal computers, in self monitoring of blood glucose. This 'user-friendly' package is also suitable for nursing staff in a networked patient care system through Foxbase + (multi-user Xenix OS). Brief outline of the system features are input variables as blood glucose and presence of urine ketones, any illness, increased activity or reduced diet; output reports of computer suggested clinical assessment; easy and ready accessibility to data management and analysis.

The advantages of Self Monitoring of Blood Glucose (SMBG) ([1],[2]) over other modalities of analysing blood glucose (like Hospital based tests) have already established this as better suited in diabetic health care for Insulin Dependent Diabetics (IDDs) and pregnant women-

An important component of SMBG is- health education of the diabetic, self assessment of health status and recognition of possible critical conditions. A computer software though not a substitute of this component, can well supplement SMBG in IDDs by prompting for necessary decisions to be derived at and on further treatment ([3], [4]).

The data generated through SMBG can also be interpreted into guidelines to the patients by feeding it into a computer programmed with instructions for analysis of SMBG data. Further based on this analysis, timed reports can be generated and graphs plotted, to help the Physician in better assessment of the patient's status.

Objectives

1. The prime objective is to develop a system which is menu-driven and 'user-friendly' computer software to help young diabetics (IDDs) by simulating SMBG.
2. This is also to support a multi-user environ ment for nurses and physicians to assess and interpret the large amount of data generated during SMBG.

Principle :

"The effect of urine ketones, diet, illness and activity at different levels of blood glucose, in a diabetic is considered and the appropriate guidelines are offered".

The display on the monitor showing as either CAUTION or CRITICAL' is based on ranges of glucose value linked to the clinical parameters as above. The definition of blood glucose values to be associated with risk parameters are based on the observations pertaining to Indian environment.

Methodology :

Hardware and Software Requirement

The single user version requires PC or PC-XT of standard configuration with preferably

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a DATABASE Package or BASIC for development and execution. The multi-user version requires a PC-AT with multi-user FOXBASE+ software and terminals placed at monitoring points.

Data Management

Data generated by day-to-day monitoring of patients is 'entered' into computer through a menu-driven and pre-formatted electronic entry sheet. Pre-conditioned filters are set for data entry lots to avoid entry errors. The earlier data entered on a particular day into the electronic sheet, is 'edited' bor the subsequent time-to-time entries of the day.

In a multi-user system, as the same hard disk is used by several diabetics along with nurses and physicians, file structure for data storage, nomenclature for files, options for floppy or hard-disk storage and update interval choice are considered by the software itself based on the replies to the queries prompted by it.

Options and utilities are also given to 'translate' the data into commonly used software packages such as dBASE IV, Lotus 1-2-3,. HG or ASCII format acceptable to that particular system. These translate procedures are helpful in analysing the back log data.

Data Analysis

The blood glucose values are identified into five groups as less than 50; 50 to 79; 80 to 119; 120 to 299 : and 300 mg/dL or above.

The clinical risk parameters associated with blood glucose are scored for entering into computer as follows:

1.	Activity	:	(1) more	(2)	less	...	(than "routine")
2.	Illness	:	(1) present	(2)	absent		
3.	Diet	:	(1) less	(2)	more	...	(than "routine")
4.	Urine Ketones	:	(1) present	(2)	absent		

Based on these scores, all input values are analysed and the parameters are related to blood glucose value. The guidelines offered are the direct out come of a prototype system adopted for this purpose as shown in the figure.

Further Development :

Statistical Analysis

Data stored is analysed for average, maximum and minimum values of blood glucose between a particular date to another; the corresponding standard deviation, mode, median, percentile values; as well as time and date of hypo or hyperglycemic status.

Graphic Representation

Graphs on glucose profile are plotted to depict the glucose values on a particular day, average glucose values from time to time and percentile values with target levels.

Direct output reports

The regular reports that can be generated from the SMBG data storage and analysis are as follows :

1. Daily, weekly, monthly check lists or data dump for the purpose of hardcopy.
2. Printing of flowchart which shows the influence of clinical risk variables on blood glucose leading to critical or cautious status. This helps to educate patients on—how they should respond for each of these situations.
3. Limited suggestion on immediate control of blood glucose.
4. Generating a "BEEP" sound alarm in case of CRITICAL status of blood glucose and directions to seek expert advice.
5. Hardcopies of the various graphic displays and profiles and the statistical reports which will help the physician in knowing the trend of the values
6. Options are given for all outputs to be linked to presentation software like HG for easy understanding and research purposes.

Previous Insulin Dose

At a later stage, a component of timed analysis is to be added to this software for recognising the dependence of blood glucose value on the previous dose of insulin. For example, in case of hypo—or hyperglycemic states, the software has to seek for and be able to analyse the latest insulin dose.

Execution of the softwire for therapeutic guidelines will be the final stage in a series of developing the system after designing, development testing and implementation.

Future Scope :

The SMBG data stored in database can be linked with a hypothesis developed by the physicians based on gaining knowledge and emerging experience. Thus linked, this software performs as an expert system and is categorised as Artificial Intelligence (AI). AI output can be modulated to adjust insulin dosage mechanically, as in a Robotics system. With such systems operating in very near future, it is most likely that a needy diabetic can readily have "expert" advice even at home at any given time-

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