Chapter 4

Edutool diabetes simulator

The Edutool diabetes simulator is an educational tool for people with type 1 diabetes, non-diabetic people, care providers and researchers. The goal of the simulation model is to teach patients and non-diabetic people how different external and internal influences may affect their blood glucose level. The simulator will be described to elucidate all characteristic features and present the user-friendliness of the model. The Edutool will then also be compared to the existing simulation models described in the previous chapters. AIDA is presently the most widely used educational simulation model and therefore the Edutool will be compared in particular to this model.
4.1 Introduction

The *Edutool* diabetes simulator is an educational tool for people with type 1 diabetes, non-diabetic people, health professionals and caregivers. The mathematical model, as described in Chapter 3, was derived from first principles; a new generic energy unit (ets) was also introduced. This unit is easy to visualise and simple to implement in everyday life for diabetics, and is therefore ideal for the simulator.

The simulation model uses a very simple user interface where the user can adjust several key factors that influence BG. This can then be seen on the interface by means of adjustable arrows. The amount of insulin required and the energy produced by the liver are shown, as well as food and energy expended or attempted energy expended by exercise. There is a database of food and exercises to choose from that will then influence the simulated BGL of the user.

The simulation can be personalised by the user (diabetic or nondiabetic) by entering glucose and insulin sensitivity parameters. This enables the user to see more accurately what will happen to their BGL under the simulated conditions.

The following sections describe the model in more detail, with emphasis on the educational value of the *Edutool*, its accuracy and how user-friendly it is. The *Edutool* is available free-of-charge from [www.diabetic-edutool.com](http://www.diabetic-edutool.com).

4.2 The *Edutool* diabetes simulator

The *Edutool* diabetes simulator is an easy-to-use simulation model for people with diabetes. The simulation interactively demonstrates the effects of food intake, alcohol consumption, exercise energy expended, insulin administered and stress on BGLs of people with type 1 diabetes. It also takes into account the counterregulation effects of the liver as this also influences the BGL.

The features of the *Edutool* will be highlighted and described as well as the parameters built into the model. This chapter is based on the work of Prof. EH Mathews and Dr R Pelzer.
Introduction

BG control is often a difficult task for people with diabetes. For many it can take years after diagnosis to achieve satisfactory results. There are various problems to be overcome. The Edutool focuses on some of these problems and attempts to address them by incorporating them into an educational simulation program using the latest discoveries (Hildebrand and Mathews, 2004; Mathews, 2004; Mathews et al., 2007; Mathews and Mathews 2004; Mathews and Pelzer, 2007a; Mathews and Pelzer, 2007b; Mathews and Pelzer 2009).

There are several obstacles to be considered and overcome before a simulation model can be designed that will educate people with diabetes on BG control. The obstacles referred to are:

- Problems with the carbohydrate-counting (carb-counting) method (Gillespie et al., 1998).
- Individualising the carb-counting method (Unger, 2007; Walsh et al., 2003; Walsh et al., 1996).
- Ease-of-use of the carb-counting method.
- Uncertain effect of exercise on BG (Hopkins et al., 2004; Wasserman et al., 2003; Wennick et al., 2009).
- Quantifying the effect of alcohol intake on type 1 diabetics (Heller, 2006; Plougmann et al., 2003).
- Trading off the short-term complications with long-term complications to avoid hypoglycaemia (Heller, 2006).
- Stress and its effect on BG (Dickerson and Kemeny, 2004).

During the development of the Edutool these obstacles were overcome and the solutions incorporated into the model. However, it must still be experimentally validated to establish the educational value of the simulation model.

First, the simulation and its features will be described in the following paragraphs.

BG control platform (main user interface)

Figure 21 shows the basic BG control platform. The most important feature of this interface is the coloured oval in its centre. The oval shows the BGL in mmol/L or mg/dL. The unit can
be specified by the user, but for the purpose of this study mmol/L will be used. The colour will change to indicate whether the BGL is in the desired normo-, hypo- or hyperglycaemia range.

**Figure 21:** *Edutool:* basic layout of the BG-simulation user interface (www.diabetic-edutool.com).

The normoglycaemic range values can be set by the user in the settings window as shown in Figure 22:
As the BGL fluctuates, the oval changes colour. Green indicates that the BGL is within the normoglycaemic range. As the BG moves further away from this desired range, the colour of the oval changes to orange which indicates a cautionary warning. The oval will finally turn red which indicates critically low or high BGLs. Situations leading to red ovals should be avoided to prevent long- and short-term diabetic complications (Franco-Bourland, 2011; Ng, 2011).

When the user starts the simulation, an initial BG value can be specified by adjusting the value in the coloured oval. This is done by clicking on the (+) or (−) signs on either side of the oval. The value will then be increased or decreased in increments of 1 mmol/L or 10 mg/dl (as defined in the settings window, shown in Figure 22).

The factors that influence the BGL directly are depicted by vertical adjustable arrows. Arrows pointing upward increase the BGL; downward arrows decrease the BGL. The factors that cause the BGL to rise are: ‘energy eaten’, which is food intake in –ets; and ‘energy from liver’ which is stored glycogen converted to glucose and released into the bloodstream.

**Figure 22**: _Edutool_ settings window.
(measured in \( \text{ets} \)). Factors that cause the BGL to decrease are: ‘energy stored’ due to ‘insulin’ administered (\( U \)); and ‘exercise energy expended’, both measured in \( \text{ets} \).

The direct influence of food intake on the BGL is shown by the adjustable arrow for ‘energy eaten’. The user may either adjust the arrow by moving it and thus increasing the magnitude of \( \text{ets} \) ingested, or may choose food from the categorised database as shown in Figure 23:

**Figure 23:** *Edutool* food database, with the baking category as an example on the right.

Once the preferred foodstuffs and quantity have been chosen, the BGL in the coloured oval on the main user interface will increase with the \( \text{ets} \) value of the chosen food or beverage. The BG value shown in the oval is the predicted steady-state value. This value was calculated by adding the increase in BGL, as a result of the selected meal, to the initial BG value. This will be discussed in more detail later in this chapter.

To quantify the energy value of the foodstuffs in the *Edutool*, \( \text{ets} \) was chosen because it accounts for the metabolic efficiency of the specific foodstuff – by taking into account the indirect influences of protein, fat and fibre of the food (Mathews and Pelzer, 2009; Pelzer *et al.*, 2011). The carb-counting method lacks this level of detail and is therefore less accurate. As shown in Chapter 3 of this study, \( \text{ets} \) can accurately predict the postprandial glycaemic effect on diabetic patients, as well as the effect it has on healthy people (Mathews and Pelzer, 2009).

Indirect influences are shown as horizontal arrows on the user interface. The left-hand arrow is ‘exercise attempted’. An exercise, and the duration performed, is chosen from the database by clicking on the desired exercise and increasing or decreasing the time. This is illustrated in Figure 24:
Another indirect influence on the BGL is the arrow to the right of the oval – ‘insulin’. The amount of ‘energy stored’ can be changed by adjusting the insulin dosage.

As not all diabetic patients’ BGLs are equally sensitive to ingestion, it is essential to measure this sensitivity per individual. In the next two sections it is shown how this patient characterisation is dealt with by the Edutool. Two options are available, namely, a simple and more detailed characterisation.

**Simple (quick) characterisation**

To accurately simulate the BG response of the user, an estimation of the sensitivity to must be characterised. This can be done in a quick estimation by asking the user a few relevant, but easy questions. This procedure is shown in Figure 25.

A diabetic patient should be able to answer these questions easily and without too much effort since the questions pertain to daily BG control. The questions to estimate glycaemic sensitivity would include a question regarding how much the diabetic’s BGL would typically increase after eating a simple meal such as two slices of bread, or two apples.
Figure 25: Simple characterisation of patient performed by analysing the answers to a few questions.

This quick estimation of glycaemic sensitivity characterisation is less accurate than the detailed characterisation which will be discussed next.

**Detailed (accurate) characterisation**

Patient characterisation allows the tool to make accurate predictions of the glucose being absorbed into the blood as a result of a meal. This will be explained, inter alia, using Figure 26.

Figure 26 (a) shows that \( \text{ets} \) takes into account the metabolic efficiency (\( \eta_{\text{cho}} \)) of the specific type of CHO. It can also be seen from Figure 26 (b) that a specific person’s CHO-to-BG conversion efficiency (\( f_{\text{CHO}} \)) must be accounted for to establish the true amount of glucose released into the blood due to CHO metabolism.
Figure 26: Simplified illustration of carbohydrate energy breakdown. (a) Relationship between energy available from a bomb calorimeter and average blood glucose energy available through digestion of a CHO. (b) Relationship between blood glucose energy available and energy metabolised by a specific person.

Note that this factor can in some cases be larger than one. This characterisation factor ($f_{CHO}$) should be measured for each individual to customise the simulation model for him/her. The procedure to achieve this will now be discussed.

Equation 10 – see also Figure 26 (b) – is used to calculate the amount of $\text{ets}_{absorbed}$ absorbed into the blood as a result of digestion of a meal containing $\text{ets}_{meal}$ for a specific person with a specific CHO absorption efficiency of $f_{CHO}$. (Note that the $\text{ets}_{meal}$ value already includes the effect of the metabolic efficiency of the specific CHO while $f_{CHO}$ is person-specific.)

$$\text{ets}_{absorbed} = f_{CHO} \cdot \text{ets}_{meal}$$

A linear relationship between BG increase ($\Delta BG_{meal}$) and $\text{ets}_{absorbed}$ is assumed for normal values of food intake. This is modelled by Equation 11 using the person-specific equivalence factor ($k_{BG/ets\ food}$), namely:

$$\Delta BG_{meal} = k_{BG/ets\ food} \cdot \text{ets}_{absorbed}$$
By substituting Equation 10 into Equation 11 and defining the patient-specific factor $f_{BG/ets food}$ as:

$$f_{BG/ets food} = k_{BG/ets food} \cdot f_{CHO}$$  \hspace{1cm} (12)

Through simple substitution calculations, $f_{BG/ets food}$ is now defined by Equation 13:

$$f_{BG/ets food} = \frac{\Delta BG_{meal}}{ets_{meal}}$$  \hspace{1cm} (13)

After a fasting period the patient is fed a known amount of $ets_{meal}$, the blood glucose increase ($\Delta BG_{meal}$) is measured and these values are substituted into Equation 13 to find the patient-specific constant $f_{BG/ets food}$. With this person-specific characterisation estimated, the BG increase for any meal with a known $ets_{meal}$ can now be calculated using Equation 13.

When using the accurate characterisation procedure, the educational tool opens a window as shown in Figure 27. The $f_{BG/ets food}$ factor, or $ets$ sensitivity, is then entered to set up the simulation with the correct values to allow for accurate BG simulation.

![Figure 27](image_url)

**Figure 27:** Detailed characterisation of patient: the measured patient parameters can be entered on this form.
**Bolus insulin administration**

Bolus insulin is required for good glycaemic control throughout the day. The amount administered and the calculations associated with this process are very important. Overdosage can lead to hypoglycaemia whereas underdosage can lead to hyperglycaemia. These conditions can lead to short- and long-term health complications for the diabetic (Albisser et al., 2001; García-Jaramillo et al., 2010). Therefore, accurate calculation of the amount of bolus insulin required by the diabetic is extremely important.

As with glycaemic response to food ingested, every individual differs in their insulin sensitivity. Therefore, for accurate glycaemic control, as well as accurate simulation results, it is essential to estimate the sensitivity of each individual. Once again there are two characterisation procedures: the simple characterisation and the detailed characterisation procedure.

*Simple (quick) characterisation*

To estimate the insulin sensitivity of a person with diabetes, a simple question must be answered to determine the sensitivity factor. The user is asked how many units of short-acting insulin would be used to lower BG by 5 mmol/L. This process is shown in Figure 25. The more detailed procedure is described in the next section.

*Detailed (accurate) characterisation*

Insulin is necessary for BG uptake from the blood into cells and organs (György et al., 2010). A linear relationship exists between the amount of insulin secreted by the pancreas and the amount of food (ets) ingested in nondiabetic subjects (ets_meal), (Mathews and Pelzer, 2009). Similarly, for the reverse process a linear relationship is assumed between insulin administered, and glucose energy cleared from the blood.

The equivalence factor for this relationship is known as insulin sensitivity and is measured by adopting a similar procedure to that used for the ets intake vs BG response in Equations 10 to 13. Similarly, the final equation for person-specific insulin sensitivity (fBG insulin) is given by Equation 14:
\[ f_{BG/\text{insulin}} = |\Delta BG_{\text{insulin}}| / I_{\text{bolus}} \]  

Note that $\Delta BG_{\text{insulin}}$ is the measured blood glucose decrease for a given amount of insulin ($I_{\text{bolus}}$) and is therefore the absolute value.

Before the insulin sensitivity ($f_{BG/\text{insulin}}$) can be estimated, the effects of previously administered short-acting insulin must first be eliminated by the person’s system. This means that the last bolus, or short-acting, insulin administration should have taken place more than three hours prior to the insulin sensitivity test.

To be conservative a slightly smaller insulin dosage ($I_{\text{bolus}}$) than would normally be used to lower such an elevated glucose value to the normal range, is then administered. The insulin sensitivity value measured in mmol/(L.U) or mg/(dL.U) is then approximated using Equation 14. The insulin sensitivity value can be entered into the Edutool diabetes simulator in the window as shown in Figure 27.

Various factors influence insulin sensitivity (Muis et al., 2006). Therefore, it is important to measure this value for the individual rather than relying on an estimated value. For most individuals, insulin sensitivity changes during the course of the day (Klonoff et al., 2009). More than one sensitivity value could be measured by conducting the sensitivity test at different times of the day (e.g. morning, afternoon and evening).

Internal and external effects on BGL

The Edutool interactively incorporates several external- and internal influences on the user’s BGL. These influences include food ingestion, exercise, stress, alcohol, and the regulatory- and counterregulatory hormones (i.e. insulin and glucagon). The following section will demonstrate how the Edutool diabetes simulator integrates these influences.

Effect of food ingestion on a specific person’s BG

The effect of food intake on a specific person’s BGL is depicted in Figure 28. The specific foodstuffs are chosen from the database as illustrated in Figure 23.
The arrow that represents ‘energy eaten’ increases with the value of the chosen foodstuff – in this case 11. As the size of the arrow increases, the BGL value in the oval shape also increases. The oval changes colour if the BGL rises above the desired level – outside the normoglycaemic range – and thus insulin is required to lower the BGL to a desirable level.

**Effect of bolus insulin on a specific person’s BG**

To increase the amount (U) of insulin administered, the user can drag the ‘insulin’ arrow on the main user interface to the required size. As the number of units increase, more glucose energy is being stored (‘energy stored’ arrow). The value of the BGL in the oval shape decreases and the shape changes colour from red to orange, and finally to green.
As depicted in Figure 29, 7 U of insulin is required to lower the specific person’s BGL to within the normoglycaemic range after 11 –ets were ingested (shown in Figure 28).

Effect of insulin overdosage and blood glucose counterregulation on BGLs

In reality, diabetics often administer too much insulin, especially postprandial doses (García-Jaramillo et al., 2010). When too much insulin is administered, and thus too much BG stored, it leads to hypoglycaemia. Glucose energy from the liver will be released to counteract the hypoglycaemia. This is depicted in Figure 30.

![Figure 30: Edutool main BG control interface when too much insulin is administered and the liver counterregulation is activated.](image)

As the body senses hypoglycaemia, the liver starts converting glycogen to glucose and releasing it into the blood. Therefore, the counterregulation mechanism tries to prevent hypoglycaemia (Pelzer et al., 2011). There is, however, a limit to the amount of glucose that the liver can produce on demand. Livers of diabetes patients are often overstressed due to previous overuse of insulin (Cryer and Gerich, 2003) and therefore become less effective.

Initially, within a year of being diagnosed, the liver of the diabetic has the ability to produce up to 20 –ets of energy on demand. As the diabetes progresses, this ability decreases and the overstressed liver’s ability to produce energy in the event of hypoglycaemia diminishes to approximately 7 –ets. This is depicted in Figure 31.
Figure 31: Maximum counterregulation level of the liver. (a) A type 1 diabetic one year after a diagnosis with type 1 diabetes. (b) A type 1 diabetic four years after diagnosis, with a further reduced counterregulation level.

The simulator is therefore able to demonstrate how BG responses of a newly diagnosed diabetic will differ from that of one that has already been diagnosed for a few years.

**Effect of exercise on BGLs**

The effect of exercise energy expended on a person’s BGL is measured in $\text{Expended}$. The $\text{Expended}$ comes mainly from the glucose available in the blood and can be calculated by Equation 15:

$$\text{Expended} = \frac{E_{\text{Expended}}}{f_{\text{Expended}}} = \frac{E_{\text{Expended}}}{55}$$  \hspace{1cm} (15)

The energy being expended ($E_{\text{Expended}}$) is calculated by taking the type, duration and intensity of the exercise, as well as the body weight of the diabetic into account. Therefore, good approximations of BG response due to exercise can be made for an individual. The user selects the exercise regime by selecting the type and duration of an exercise on the simulator (depicted in Figure 24).

For example, if the user wants to attempt 16 units of exercise with an initial BGL value of 5 mmol/L, the BGL will lower to 3 mmol/L (shown in Figure 32).
Figure 32: Effect of attempting 12 ets of exercise on the BGL of the specific person being modelled.

This exercise decreases the BGL but also causes the liver to counteract by releasing ets into the bloodstream. The diabetic’s liver only has the capacity to release 7 ets of energy. Therefore, the diabetic being modelled will still fall into a hypoglycaemic state.

If, however, the diabetic ate a snack of 10 ets prior to the exercise, his BGL will increase and not counteract the effect of the exercise as would be expected (Figure 33). The liver still releases energy into the bloodstream, without signs of hypoglycaemia. Instead, the body only manages to expend 10 ets of exercise, even though 16 ets were attempted.

This is because the cells in the body require insulin to take in the BG to be used in muscles and the organs. The diabetic’s insulin deficiency is the cause of the problem and therefore insulin must be administered as shown in Figure 34. Also note that the ‘exercise energy expended’ increased to 16 ets after the bolus insulin was administered.
Figure 33: The effect on the diabetic’s BGL when eating a snack prior to exercising.

Figure 34: The effect of insulin on the BGL if exercise is attempted.

Effect of alcohol on BGLs

Heavy alcohol consumption has been associated with an increase in BGLs (Klatsky, 2007). This is due to the suppressive effect alcohol has on the liver’s counterregulation ability. In the Edutool simulator this effect is shown as depicted in Figure 35.
In this example, two cans of beer were consumed with a combined energy value of 4 kcal. From Figure 35 it is evident that the available ‘energy from liver’ has been reduced. Previously, the liver’s counterregulation limit was shown with a blue line, whereas the lower limit is now indicated with a red line.

**Effect of stress on BGLs and how it should be accounted for**

Short- and long-term stress induce a fight-or-flight reaction. The release of epinephrine due to this reaction raises the BGL of the affected person (Lucidi et al., 2002). For diabetics this poses a significant problem due to their insulin deficiency. *Edutool* can simulate the amount of insulin required to counter short- and long-term stress for a person with diabetes.

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**Figure 35:** Effect of alcohol on the liver’s counterregulation ability.
As illustrated in Figure 36, the user can adjust his stress level. The level of stress ranges from ‘no’ stress to ‘very high’ levels of stress. This illustration shows the interactive simulation of what happens when the diabetic is under stress. All daily activities – such as eating and injecting short- and long-acting insulin – and metabolic energy requirements are taken into account.

Using this tool, the patient will be able to see what happens to his BGL when under different levels of stress. The amount of insulin required in these conditions can be calculated and thus educates the user in BG control when stress is accounted for.

**Integrated simulation**

The human BG subsystem is under the influence of constant external and internal disturbances (Lucidi et al., 2002). The Edutool diabetes simulator takes several of these disturbances into account in an integrated manner as described previously in this chapter. The effect of food intake, bolus insulin administered, exercise, alcohol consumption, psychological stress and the counterregulation of the liver have been described.
The model will now be compared to existing models based on the data input required, the built-in considerations taken into account by the model, and lastly, the output produced by the model.

### 4.3 Comparison between *Edutool* and previous simulation models

The integrated *Edutool* diabetes simulator will now be compared to other existing models. The comparison is not as extensive as the description of models done in Chapter 2. This is due to the limited literature available describing the features and functions of these models, and not all models are available free-of-charge.

Due to the vast amount of existing simulation models and the difference in their form, features and functions, it is almost impossible to compare these models (Sørensen, 1985). In the following table a comparison has been done to elucidate the distinguishing features of several of the existing models and compare them with the model presented in this study.
Table 2: Comparison of existing diabetes simulation models and the *Edutool* diabetes simulator.

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<th>DIABLOG</th>
<th>Archimedes Gylcaemia Simulator</th>
<th><em>Edutool</em> Diabetes Simulator</th>
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</tr>
</tbody>
</table>
Table 2 (continued): Comparison of existing diabetes simulation models and the *Edutool* diabetes simulator.

<table>
<thead>
<tr>
<th>Built-in Considerations</th>
<th>Name of simulation model</th>
<th>AIDA</th>
<th>DiasNet</th>
<th>KADIS®</th>
<th>DIABLOG</th>
<th>Archimedes Glycaemia Simulator</th>
<th><em>Edutool</em> Diabetes Simulator</th>
<th>SiDairy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Characterisation of CR</td>
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<td>CRH</td>
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<td></td>
<td>Insulin Action Profiles</td>
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<td></td>
<td>Gut Glucose Absorption</td>
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<td></td>
<td>Basal Energy Expenditure</td>
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<td></td>
<td>Primary/Secondary Glucose Storage</td>
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<tr>
<td></td>
<td>Personalised Factors*</td>
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<td>•</td>
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<tr>
<td>Output</td>
<td>Circadian Profiles of BG</td>
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<td>•</td>
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<tr>
<td></td>
<td>Insulin Doses Prediction</td>
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<td></td>
<td>Hyper Episode Prediction</td>
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<td>Hypo Episode Prediction</td>
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<td></td>
<td>Optimise Metabolic Control</td>
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</tr>
</tbody>
</table>

*Personalised factors: these factors include a patient's specific CHO, fat, protein and fat absorption rate, liver function, different factors regarding the BG utilisation, retrieval and storage efficiencies.

1,2,3,4,5,6,7: See Table 4 for explanations.
### Table 3: Comments associated with simulation models in Table 2.

<table>
<thead>
<tr>
<th>Name of simulation model</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIDA</td>
<td>AIDA is merely a tool to play with and simulate different scenarios for diabetics. It must not be used to adjust insulin doses or dietary requirements.</td>
</tr>
<tr>
<td>DiasNet</td>
<td>1. There are only two types of insulin to choose from: Lispro and NPH (and mixtures of the two). This simulation can be used for education and communication between patient and doctor.</td>
</tr>
<tr>
<td>KADIS®</td>
<td>2. The insulin action profiles are given in terms of different formulations of the insulin, dosage and route of application. The effect of exercise is determined by means of equivalent insulin doses to the amount of exercise. The personalised factors can only be obtained by means of diagnostic tests.</td>
</tr>
<tr>
<td>DIABLOG</td>
<td>3. There are four predefined patients that can be selected to base simulations on. 4. The type of insulin can only be chosen as short-acting or long-acting insulin. 5. Has a glucose counterregulatory feature following hypoglycaemia.</td>
</tr>
<tr>
<td>Archimedes Glycaemia Simulator</td>
<td>This glycaemia simulator is very extensive and includes the pertinent organ systems.</td>
</tr>
<tr>
<td><em>Edutool Diabetes Simulator</em></td>
<td>6. The new ets concept is used to estimate amount of CHOs consumed and the specific absorption rate for the patient.</td>
</tr>
<tr>
<td>SiDairy</td>
<td>7. The program requires an ‘insulin action time’ to estimate how long the insulin will work.</td>
</tr>
</tbody>
</table>
Discussion of comparison

As can be seen from the previous tables, the Edutool diabetes simulator is one of two integrated simulation models – the other being the Archimedes glycaemia simulator. The Archimedes glycaemia simulator is an extremely complex model where the main purpose is not to educate people with type 1 diabetes, but rather to assist health care professionals during clinical trials (Eddy and Schlessinger, 2003).

The user interface of the Edutool is easy to understand as well as aesthetically presented. The databases for food and exercise are easy to access and navigate once opened. The adjustable arrows make it easy for the user to experiment with the BGL in the coloured oval in the centre of the BG control interface.

Figures 37 and 38 show the input and simulation screens of the AIDA simulation model (available free-of-charge from www.2aida.org). AIDA is one of the most salient diabetes software tools available on the Internet for educating diabetics and care providers. During the experimental validation of the Edutool users will be randomly assigned to assess both Edutool and AIDA using similar questionnaires, thus providing a comparison-based analysis of the Edutool.

From the following figures it is evident that in comparison with the Edutool’s input screens as described above, as well as the method of presenting the simulated results, AIDA is not an integrated model and is more complicated in presenting its results than the Edutool.
Figure 37: AIDA data input screen.

Figure 38: AIDA simulated BG and insulin profiles.


4.4 Conclusions

The Edutool diabetes simulator apparently fills the gap in educational software for an integrated simulation model that is easy to use and with results that are simple to understand. To prove this deduction, experimental validation is required and is discussed in the next chapters.
4.5 References


