Diabetes Information Technology & WebWatch

Using the AIDA—www.2aida.org—Diabetes Simulator. Part 1: Recommended Guidelines for Health-Carers Planning to Teach with the Software

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ABSTRACT

AIDA is a novel diabetes-computing program freely available from www.2aida.org on the Web. The software is intended to serve as an educational support tool and can be used by anyone—patient with diabetes, relative of patient, health-care professional, or student—who has a minimal knowledge of the pathophysiology of diabetes. However, to obtain maximum benefit from the program, a teacher or demonstrator may be helpful. How much (or little) experience should the potential teacher have prior to giving formal lessons with the program? There is no hard or fast "rigid" answer to this. However, one of the aims of this article is to try and encourage people to consider these issues. In this respect it is important to make clear that health-carers cannot just download the program and start teaching with it the next day (or week) if they want their patients to get the most out of lessons with the program. As with many teaching interventions, the rewards of education—"what one gets out of it"—are in part dependent on the effort that one is willing to put in. Therefore teachers have to invest some time and effort into finding out how they can best work with the program to teach their patients in their particular local hospital/clinic setting. A further purpose of this article, and the one that follows in a future issue, is to generate some guidelines and provide some minimum recommendations for small group teaching sessions using AIDA. Previous experience of the authors has revealed a number of ways to improve the outcome of lessons that make use of the software. Among the most important points seem to be the preparation of the teacher, consideration of how to impart preliminary information to help patients understand the pathophysiology of diabetes, the optimum selection of topics to be covered, the arrangement of the lessons, how to involve each of the participants, and how to deal with questions. Other important topics include how to spot and deal with some of the difficulties that may be encountered by participants who apparently seem disinterested, obtaining feedback from the lessons, and practical ideas on how to lead a class.
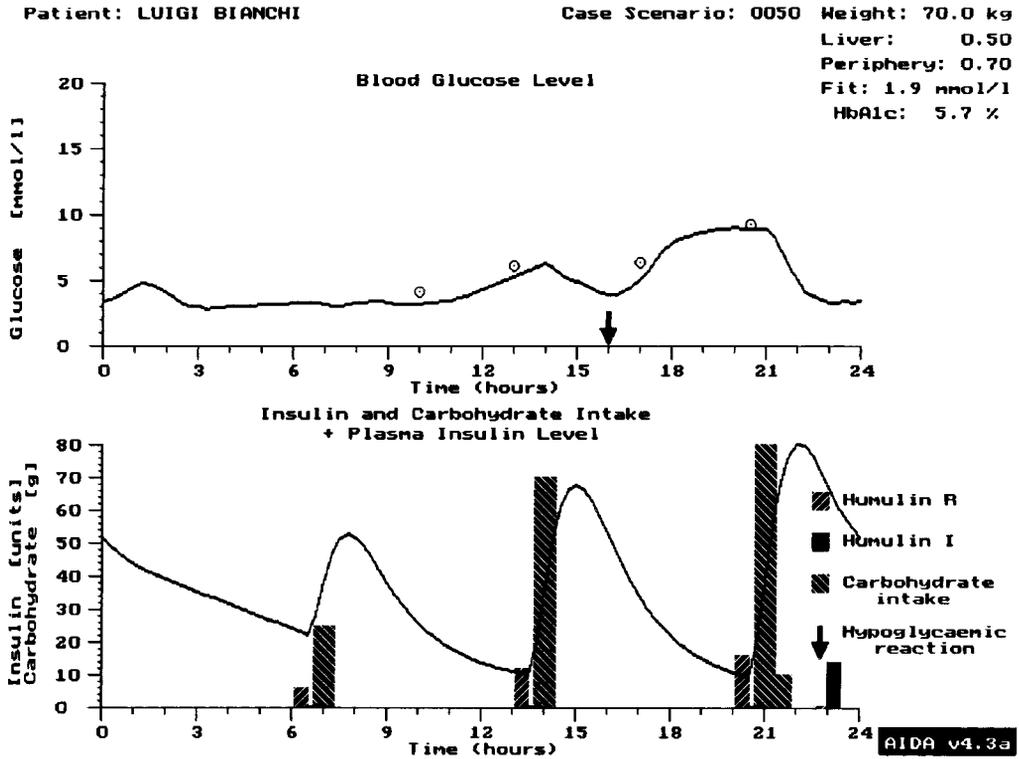
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AIDA is an independent, noncommercial development which is being made available free-of-charge via the Internet—at a dot org (.org) not-for-profit Website—as a noncommercial contribution to continuing diabetes education.
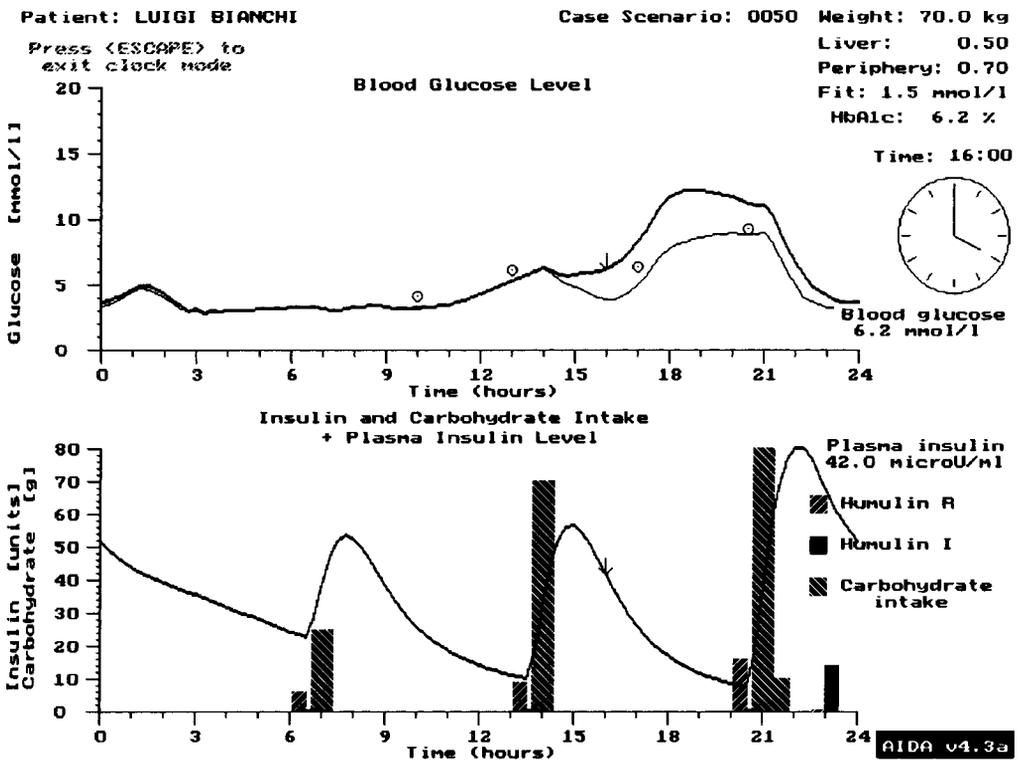
a

Patient: LUIGI BIANCHI   Case Scenario: 0050 Weight: 70.0 kg
                                                             Liver: 0.50
                                                             Periphery: 0.70
                                                             Fit: 1.9 mmol/l
                                                             HbA1c: 5.7 %

Blood Glucose Level

Insulin and Carbohydrate Intake
+ Plasma Insulin Level

Humulin R
Humulin I
Carbohydrate
  intake
Hypoglycaemic
  reaction

AIDA v4.3a

b

Patient: LUIGI BIANCHI   Case Scenario: 0050 Weight: 70.0 kg
Press <ESCAPE> to   Liver: 0.50
exit clock mode   Periphery: 0.70
                     Blood Glucose Level   Fit: 1.5 mmol/l
                                                             HbA1c: 6.2 %

                                                             Time: 16:00

                                                             Blood glucose
                                                             6.2 mmol/l

Insulin and Carbohydrate Intake
+ Plasma Insulin Level

Plasma insulin
42.0 microU/ml
Humulin R
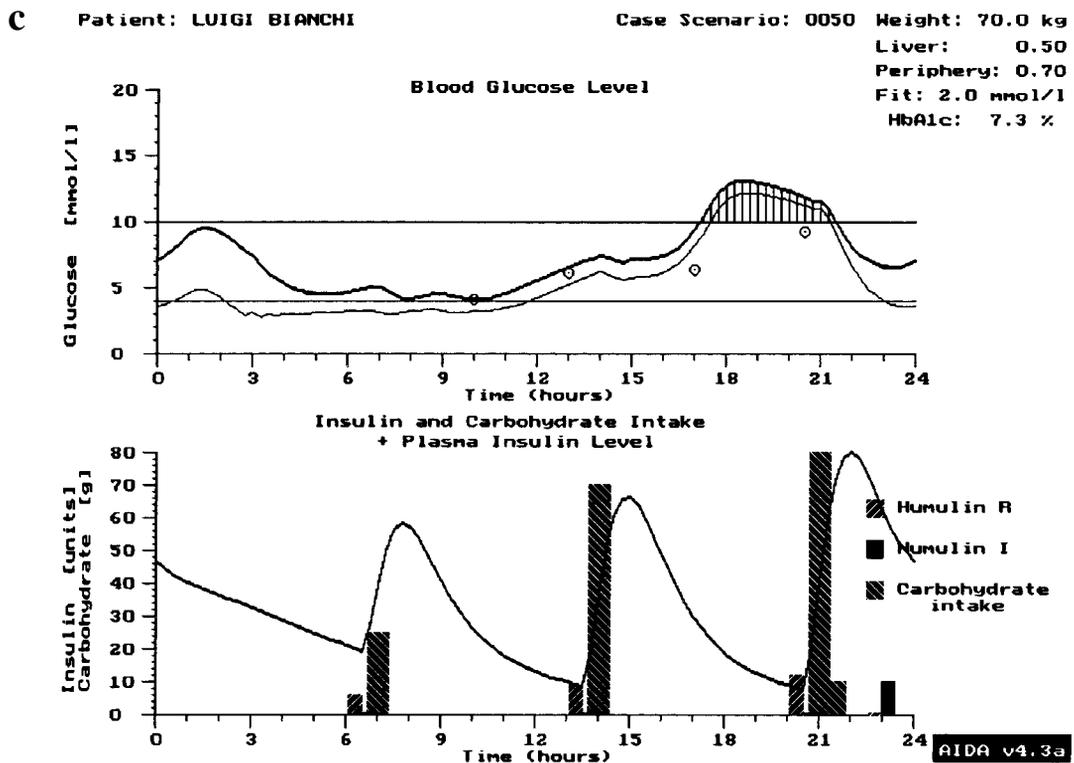Humulin I
Carbohydrate
  intake

AIDA v4.3a

Figure 1.

FIG. 1. (a) Baseline 24-h simulation from the AIDA simulator following parameter estimation for an example patient with insulin-dependent (type 1) diabetes mellitus on a four times daily short-acting, regular (Humulin R) and intermediate-acting (Humulin I) insulin regimen. **Lower panel:** Insulin and carbohydrate intake with predicted 24-h plasma insulin curve. **Upper panel:** Predicted 24-h steady-state blood glucose profile computed on the basis of the insulin and carbohydrate intake. As can be seen the simulated patient reported a symptomatic hypoglycemic episode at around 16:00 h (4 p.m.). Luigi Bianchi is a pseudonym. (b) Change to insulin dosage regimen shown in (a). The lunchtime (13:30 h, 1:30 p.m.) short-acting (Humulin R) insulin dose has been reduced from 12 units to 9 units, and the resulting expected glycemic profile has been simulated. The most recent blood glucose simulation is shown by the bold, black line—while the previous blood glucose simulation from (a) is shown as the lighter, gray line. As can be seen there is no longer predicted to be such a low blood glucose level at (16:00 h, 4 p.m.)—the time of the previous symptomatic hypoglycemic episode. (c) Further changes to the insulin dosage regimen shown in (b). The before-supper (20:30 h, 8:30 p.m.) short-acting (Humulin R) insulin dose has been reduced from 16 units to 12 units, and the bedtime (23:00 h, 11 p.m.) intermediate-acting (Humulin I) insulin dose has been reduced from 14 units to 10 units. The resulting blood glucose profile has been simulated. A user-definable normoglycemic range (4–10 mmol/L [72–180 mg/dL]) is shown superimposed. The simulated patient is no longer at such great risk of hypoglycemic episodes, particularly overnight.

INTRODUCTION

THE EDUCATION OF THE DIABETIC PATIENT is of considerable interest because the possible impact of this simple and low-cost intervention on the course of the disease may be formidable in terms of health maintenance and cost containment. However, the true effectiveness of educational interventions is still largely unproven. We have been using a novel educational diabetes software program that has shown considerable promise in a preliminary (pilot) randomized controlled trial setting with a small number of patients.[1,2] We are currently planning to commence a larger-scale study in a number of separate centers.

However, before embarking on this larger-scale study we feel the need to share with all the teachers involved a common philosophy and a common teaching method. Since the information in this article, and the one that follows,[3] is born out of the experience of the authors with the software, gained in a range of different settings, including workshops with primary care physicians (general practitioners) and student nurses,[4,5] we feel that it may also

be useful more generally to provide this information to any health-care professionals who wish to teach using AIDA.

The AIDA software has been described in detail elsewhere in the literature.[6,7] Briefly, it can be considered in two parts: (1) as a model of glucose–insulin interaction in type 1 diabetes mellitus[8] and (2) as an interactive simulation program for PCs to provide access to the model output in a graphical form. The aim of the program is to provide a self-learning and self-explaining tool for use by people with diabetes, their relatives and carers, students, and health-care professionals. The software is not restricted to any particular "preconceived" user. In this respect, while the majority of users seem to download the software for personal use, there are also a significant number of student and health-care professional users.

Figure 1 demonstrates a little of what AIDA can do. Figure 1a shows a baseline simulation for an example case scenario with a patient who has very (too) tight glycemic control. Blood glucose information is given in the top graph, while insulin and carbohydrate details are given in the lower graph. As can be seen a hypoglycemic episode has been recorded in the middle of the afternoon, at around 16:00 h (4 p.m.). The main utility of the AIDA diabetes simulation approach comes from being able to make changes to regimens such as this and then resimulate the effect(s) of those change(s) on the blood glucose profile. Therefore, for instance, in Figure 1b we can see the glycemic effect being simulated of reducing the dose of the patient's lunchtime (13:30 h, 1:30 p.m.) short-acting (Humulin R) insulin dose from 12 units to 9 units. This is expected to lead to a higher simulated blood glucose profile in the afternoon/early evening with a predicted blood glucose level of around 6.2 mmol/L (112 mg/dL) at the time of the previous "hypo."

However, the patient's overall glycemic control remains far from ideal, with a sharp drop in the blood glucose level being seen overnight. Figure 1c demonstrates the glycemic effect of reducing the 20:30 h (8:30 p.m.) before-supper short-acting (Humulin R) insulin dose from 16 units to 12 units and reducing the bedtime (23:00 h, 11 p.m.) intermediate-acting (Humulin I) insulin dose from 14 units to 10 units.

A user-definable normoglycemic range (4–10 mmol/L [72–180 mg/dL]) is shown superimposed. As can be seen the simulated changes lead to a much more satisfactory blood glucose profile with the patient no longer having low blood glucose levels overnight. If this sort of glycemic control was maintained longer-term, the AIDA v4.3a model[7] predicts that a glycosylated hemoglobin (HbA_{1c}) level of around 7.3% would result, as compared with an HbA_{1c} level of 5.7% for the example with hypoglycemia shown in Figure 1a. Interactive graphical simulations such as these can be useful for educational purposes in small group teaching sessions to elicit a discussion, for example, about some of the benefits and drawbacks of trying to maintain very tight blood glucose control.

AIDA comes with 40 such sample case scenarios for simulation (Tables 1 and 2), and additional cases can be created by users. Further examples of the sort of simulations that AIDA can offer can be found elsewhere in this journal,[6] and at www.2aida.org on the Internet.

It should perhaps be highlighted that AIDA is not restricted to use solely by insulin-dependent (type 1) diabetic individuals receiving insulin injections. While the current version of the software does not provide a facility for simulating endogenous insulin secretion, this will be offered in the next release of the program. Nevertheless a number of reports of usage of AIDA for simulating diabetes regimens have been received from people with non–insulin-dependent (type 2) diabetes mellitus,[9] as well as from people using insulin pumps.[10]

As a learning tool, we believe that AIDA can accelerate the acquisition of *experience*—particularly of situations that may be new to an individual—or outside their existing experience. The approach can offer users ideas about alternative ways of tackling a particular diabetes problem—and a range of AIDA users have reported finding the software particularly helpful in generating ideas for later discussion with their diabetes educator, diabetologist, or endocrinologist.[10] However, while all this is of interest, and encouraging, we recognize the need for more formal evaluations of the software to define its precise role in diabetes education.[11]

In this article, and the one that follows,[3] we

TABLE 1. AIDA CASE SCENARIO DATABASE INDEX, SUMMARIZING BY CASE NUMBER THE FIRST 20 CASES THAT ARE INCLUDED AS STANDARD WITHIN THE PROGRAM

0001	Prepregnancy\hyper\split-evening dose\short+intermediate preps
0002	Nocturnal hyper\am hypo\4×/day injections\short+intermediate preps
0003	Midday hyper\4×/day injections\short+intermediate preps
0004	Mid-morning hypo\4×/day injections\short+intermediate acting preps
0005	Overweight\hyper\4×/day injections\needs to decrease food intake
0006	Nocturnal hypo\3×/day injections\short+intermediate acting preps
0007	Low am BG\split-evening dose\short+intermediate acting preps
0008	pm hyper\large lunch+supper\2×/day inj\short+intermediate preps
0009	Nocturnal hyper\nephropathy\4×/day inj\short+intermediate preps
0010	Nocturnal hyper\4×/day pen regimen\short+long acting preps
0011	am hypo\3×/day inj\split-evening dose\short+intermediate preps
0012	pm hyper\wide BG swings\split-evening dose\short+intermediate preps
0013	Mid-morning low BG\split-evening dose\short+intermediate preps
0014	hyper\insulin resistant\2×/day inj\short+intermediate acting preps
0015	Overweight\needs to decrease food intake\3×/day injections
0016	pm hyper\3×/day injections\short+intermediate acting preps
0017	pm hyper\3×/day inj\split-evening dose\short+intermediate preps
0018	Nocturnal hypo\'pen' regimen\4×/day inj\short+long acting preps
0019	Pre-pregnancy\pm hyper\4×/day inj\short+intermediate acting preps
0020	am low BG\pm hyper\2×/day inj\short+intermediate acting preps

Abbreviations: hyper = hyperglycemia; hypo = hypoglycemia; prep(s) = insulin preparation(s); inj = injection; BG = blood glucose; am = morning; pm = afternoon; RTG = renal threshold of glucose; ins = insulin; 2× = 2 times; 3× = 3 times; and 4× = 4 times.

shall consider what is the process that potential teachers and computer operators should go through before being regarded as competent to use, and teach with, the AIDA software. It is difficult to be certain what are necessarily the best criteria to apply to assess whether a diabetes educator, nurse, diabetologist, endocrinologist, or pharmacist is suitably trained with AIDA to actually teach using it. However, formalizing the process recommended for prospective teachers—prior to embarking on teaching lessons using the software—is proba-

TABLE 2. SUMMARIZES BY CASE NUMBER THE SECOND 20 CASE SCENARIOS INCLUDED AS STANDARD WITHIN THE AIDA DATABASE

0021	Overweight\insulin resistant\BG swings\4×/day 'pen'\short+long preps
0022	Mild hyper\pre-pregnancy\2×/day inj\pre-mixed/biphasic preparation
0023	am+pm low BG\3×/day inj\short+intermediate preps\try split-evening dose
0024	3×/day inj\short+intermediate acting preps\split-evening dose
0025	Significant glycosuria\3×/day inj\short+intermediate acting preps
0026	Hyper\2×/day inj\pre-mixed/biphasic prep\try different biphasics
0027	Hyper\4×/day injections\short+intermediate acting preps\vary RTG
0028	Nocturnal hypo\3×/day injections\high ins levels/low dietary intake
0029	2×/day inj\short+intermediate preps\switch to pre-mixed/biphasic prep
0030	Nocturnal hyper\4×/day injections\short+intermediate 'pen' regimen
0031	am hypo\overweight\3×/day injections\short+intermediate acting prep
0032	Insulin resistant\overweight\2×/day\intermediate acting prep
0033	Overweight\2×/day inj\intermediate acting prep\needs to reduce diet
0034	Nocturnal hyper\4×/day inj\short+intermediate acting prep
0035	Mid-morning hypo\pm hyper\4×/day inj pen regimen\short+intermediate preps
0036	3×/day inj\split-evening dose\try omitting am insulin injection
0037	Shiftwork\4×/day injections\short+intermediate acting preps
0038	Hyper\2×/day injections\pre-mixed/biphasic preparation
0039	Pre-pregnancy\hyper\3×/day inj\split-evening dose\short+intermediate preps
0040	am low BG\3×/day inj\split-evening dose\short+intermediate preps

Abbreviations as for Table 1.

bly going to be of increasing importance as the program becomes more widely applied.

In particular, we wish to avoid a situation in which people inexperienced with AIDA—having heard good things about the program—try to rush in to use it, and teach with it, without spending an appropriate amount of time becoming familiar with the software and what it can offer. In this respect, we also recognize the need to achieve some balance between ensuring that teachers are adequately skilled with the program—while at the same time not making the recommended training process to become an "accredited" AIDA teacher too long or arduous.

Connected with this, while our ideas about the training process may evolve and develop with greater experience of teaching and running further workshops using AIDA, we felt that it would be useful to document our present thoughts on this topic. Related to this the teaching methods documented in this article are not written in "tablets of stone"—but this is the recommended process as of early 2002. Furthermore it is apparent that eventually this approach could also become a "blueprint" or guide for what people with diabetes and/or their relatives could maybe do with the program—on their own—if they wish to become fully conversant with what the software can offer.

In this "Diabetes Information Technology and WebWatch" column, and the next,[3] we will aim to provide some recommendations and guidelines for optimum use of the program in small group teaching sessions. We will also highlight the importance of selecting patients who may benefit the most from the software, and discuss choosing targets for the lessons, how to set up a lesson, preliminary information that needs to be covered, the role of the teacher, possible questions from participants, possible difficulties that may be encountered, different characters that may be found in classes, obtaining feedback at the end of lessons, and practical issues about running such computer-assisted diabetes education sessions.

SELECTION OF PATIENTS WHO MAY BENEFIT MOST FROM AIDA

Selecting patients who may benefit the most from AIDA is one of the more important as-

pects of planning to use the software. There is obvious agreement that "not all patients are the same" and that education is not a universal panacea. As will be highlighted below, communication is not a one-way process. In this respect both the speaker and the recipients should be tuned to the same "wavelength." That is to say the recipients, if possible, should understand at least the basics of diabetes and be able to read a graph, and be interested in what is going on.

In our experience the most pragmatic subjects are not too old (less than 50 years of age), curious, collaborative, and team-oriented individuals. Educational status (level previously reached at school, high school, or university) is not important as a determinant for obtaining benefit from AIDA.

SELECTING THE TARGETS OF LESSONS

Selecting the targets for lessons is another important topic. Some aspects of diabetes are more apt to be treated (and taught) than others. As a general rule we suggest to discuss more practical aspects of the disease (e.g., carbohydrate counting, hypoglycemia, and managing diabetes with concurrent illnesses) in conjunction with the simulator rather than more theoretical aspects of the disease. In some settings giving the patients a questionnaire in advance to identify their weaknesses may theoretically increase their interest in, and therefore the yield of, the lessons—although we have yet to try this approach ourselves in a workshop or teaching setting.

As we have highlighted previously,[11,12] the aims of the six study lessons that we recommend for small group teaching sessions with AIDA are to learn: (1) how to match insulin and dietary intake; (2) about regulation of blood glucose levels overnight; (3) about the role of the renal threshold of glucose and the role of exercise; (4) about the avoidance and treatment of hypoglycemia; (5) about behavior in case of shift work or travel abroad; and (6) how to manage blood glucose control in unforeseen circumstances.

Furthermore, in our experience, AIDA may be particularly useful as an educational tool to help with reducing the number of hypo-

glycemic episodes.[1,2] Patients can learn using the simulator how to respond correctly in relation to the seriousness of the "hypo" and in relation to the timing of the preceding insulin injection. Another important aspect for such lessons is the possibility to recreate case scenarios on the basis of the patient's own experience. Obviously these cases should concern the general topic of the lesson being discussed.

Along similar lines we recommend that a good use of AIDA is to teach "what if" type thinking (i.e., "what would you do if a particular situation occurred?"). Many patients seem to react to a particular blood glucose value, both high and low, by modulating the *following* dose of insulin, rather than by incorporating this experience into their knowledge and using it to correct in due course the *preceding* dose of insulin. Acting in this way they can enter a dangerous loop of frustration and anxiety

that can lead to no good, and can actually result in denial of the disease. AIDA seems of particular use in teaching this "what if" mentality (we have also described this as "forward thinking," as compared with "backward-type thinking").[11]

SETTING THE "STAGE"

Before starting the first class the teacher should make clear that the lessons are not a challenge and that there is rarely a single "solution" to a particular clinical diabetes problem. Rather there are usually a range of solutions that may apparently be the best in a particular setting. Furthermore it should be highlighted that there is no participant who is cleverer than another. Even if this is not stated explicitly, the teacher should pay particular at-
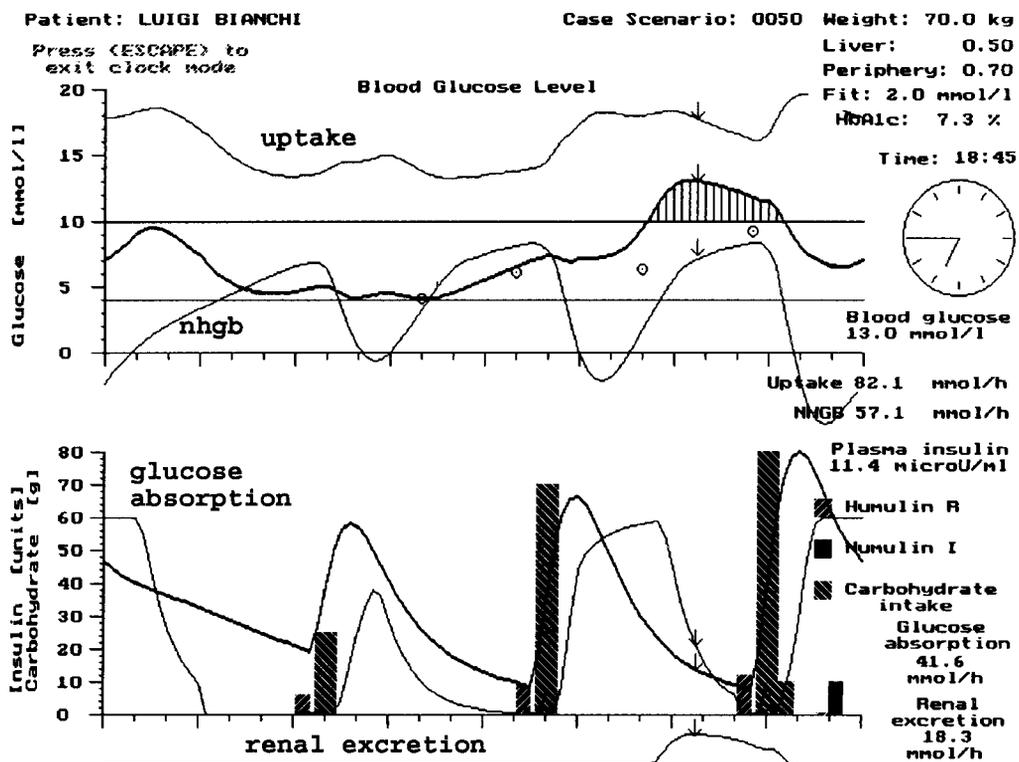

FIG. 2. Simulation shown in Figure 1c in "Fluxes" mode allowing the different glucose fluxes within the model to be viewed interactively. "uptake" is the grouped peripheral, central nervous and red blood cell utilization of glucose; "nhgb" is the net hepatic glucose balance; "glucose absorption" refers to the systemic appearance of glucose from the gut; and "renal excretion" describes the loss of glucose via the kidneys into the urine. As can be seen, at 18:45 h (6:45 p.m.) renal excretion of glucose into the urine peaks, as the blood glucose level is at nearly its highest, above the renal threshold of glucose (RTG = 9.0 mmol/L, 162 mg/dL).

tention to avoid a competitive situation developing, which may not be the most constructive for the class as a whole.

Although setting the "stage" may seem like a mundane issue—establishing the optimum number of participants, arranging them around the computer, and sorting out the length of the lessons are all important factors to be considered *prior* to running lessons with the simulator.

In our experience the best small group option seems to be to have a session with six attendees. The number of subjects participating ideally should match the number of parameters that the teacher intends to follow during the lesson. AIDA offers the viewer the possibility to follow the time profiles of at least six parameters—blood glucose level, peripheral glucose uptake, net hepatic glucose balance (NHGB), insulin level, glucose absorption from the gut, and renal glucose excretion (Fig. 2). Each of these requires special attention and, as will be explained later, should be monitored by one attendee as part of the learning process.

Further parameters are the amount of carbohydrate ingested, the dose of insulin injected, the HbA_{1c} level, and the hepatic and peripheral insulin sensitivity parameters (S_h and S_p).

Ideally the best arrangement would be to give every participant an individual computer display to follow, and via which maybe to interact with the program.[13] However, this is usually not possible under general working conditions in a standard diabetes clinic. Furthermore we currently have no experience with such an arrangement. Nevertheless in our experience an effective compromise is to have two monitors/displays connected to a single computer (Fig. 3), which is possible with no further hardware interventions using a portable (notebook) computer.[13]

PRELIMINARY INFORMATION

All patients should receive some preliminary information to enable them to understand the basic pathophysiology of insulin secretion, in-
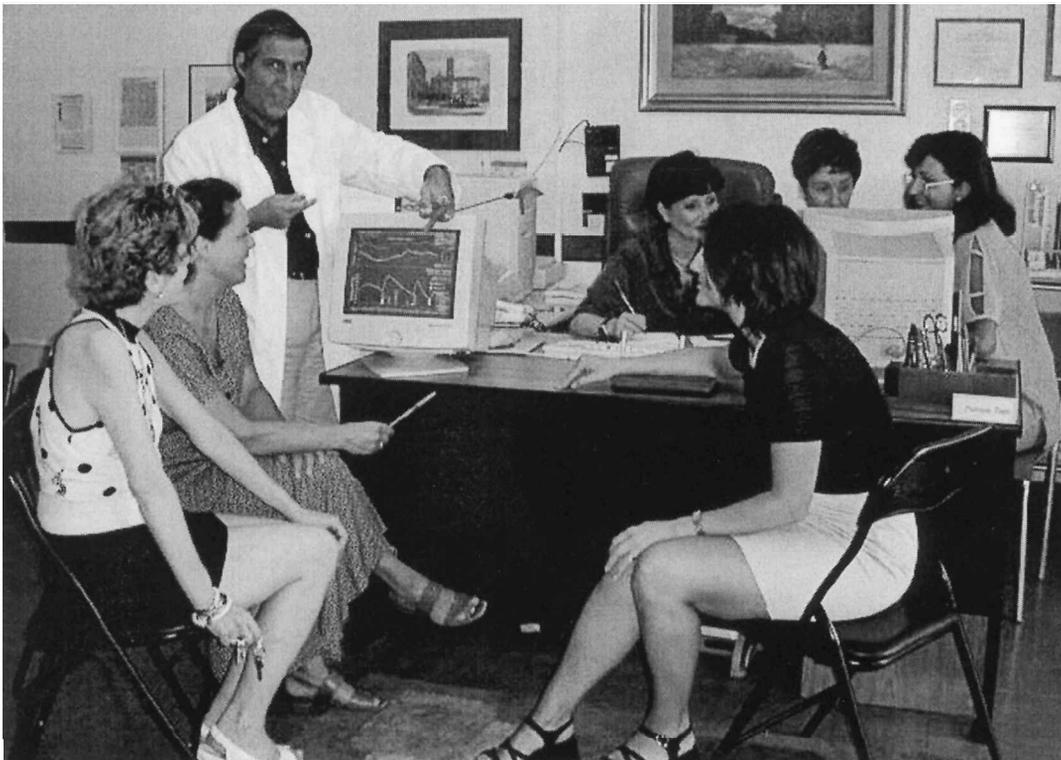

FIG. 3. Seating arrangement of the participants during a typical small-group AIDA diabetes simulation lesson. (Due to privacy rules, the people seated around the table are nondiabetic subjects who volunteered for the photograph.)

sulin action, and diabetes mellitus. In our experience one of the most ignored features of the dynamics of insulin is the role of the liver (both gluconeogenesis and glycogenolysis). Also, this is a topic of interest to patients who are often completely unaware of, and puzzled by, the possible increase in blood glucose levels after prolonged fasting. Equally important is to point out the difference between the fasting and the fed state, and the different role of the glucose absorbed through the gastrointestinal tract in these two conditions. We suggest using the two slides, illustrated previously in this journal,[5] which summarize the principal metabolic derangements that can be found in diabetes. These teaching slides can be found at www.2aida.org/teaching on the Web.

Furthermore, since introducing AIDA means moving from a purely static view of diabetes to a more dynamic one, it takes dedication and skill to explain the time profile along which the phenomena (parameters like blood glucose, NHGB, insulin, etc.) evolve (Fig. 2). However, we believe that only in this way—taking time to explain the dynamic nature of the disease—can the optimum benefit be obtained from the simulator.

THE TEACHER

It may be useful to consider here who might be best to teach with AIDA. However there is no definitive answer to this.

The teacher can be a doctor, a nurse, or a diabetes educator. Pharmacists have also taught using AIDA.[14] In fact any health-carer who understands human pathophysiology and the derangements induced by diabetes, and has sufficient knowledge about the program, could be a teacher. In those countries in which the figure of a nurse/educator has a prominent role in diabetes education, this can be a very good option. Alternatively, if the doctor usually delivers diabetes education, then a doctor can also be an ideal teacher. In fact, the formal qualifications of the teacher matter less than the amount of preparation made before the lessons, and the teacher's familiarity with the AIDA program.

Ideally the dominant figure (i.e., the teacher) should be the one who operates the program. However, we have also found that cooperation between the teacher who introduces the discussion and suggests the necessary adjustment(s), or asks *open* questions, and one of the participants who operates the program can be an equally satisfactory solution. Furthermore, this second option offers the opportunity to have the teacher *outside* the area of "action" and possibly standing, thus improving his/her authority and the attention of the participants. Think, for example, of the old trick in a Greek tragedy with a "telling voice" (commentator) outside the main theater stage area.

The computer operator does not, in fact, need to be either the teacher or a participant. However, requiring an extra person to be present solely to operate the program introduces an additional "burden" in terms of staffing levels to run such lessons. In rare cases both the teacher and the computer operator may belong to the medical staff (i.e., when a doctor is in charge and a nurse or an orderly operates the computer). However, whatever the specific arrangement, we advise that only one individual should be in charge.

Incidentally, if all this attention to the class setting may seem a little excessive, one should remember that the aim is to provide relevant information and have the patient retain that information. Everything that can improve participants' attention and reduce unnecessary distractions is of considerable importance.

We also recommend that the teacher should have a strong knowledge of the pathophysiology of diabetes, and the computer operator should have a good knowledge of the program and more generally the computer being used. Furthermore, there needs to be close agreement between the teacher and computer operator. Nothing is worse than hesitation or uncertainty about the program's functions. Any difficulty switches the attention of the participants from learning about diabetes to merely technical matters, like "try this key." Similarly, if there are two trainers (a teacher and a computer operator) we recommend avoiding any interference—like the teacher suggesting how to use the computer—or the operator answering any disease-related question from the attendees.

In order to assist prospective AIDA teachers

and computer operators in getting the maximum out of the program, a 72-page printed AIDA hard copy manual has been compiled (Fig. 4a). This is similar to that which was made available previously to health-care professionals in the United Kingdom by the British Diabetic Association (Fig. 4b),[15] and provides the most detailed information about how to make use of the software. Photocopies of this manual are freely available to health-care professionals who are interested in maybe teaching using AIDA in their local diabetes clinics/hospitals/centers. To receive a copy of the manual from the AIDA authors, by post/air mail, health-carers simply need to fill in their contact details/postal address on the Web-based form at www.2aida.org/interest

THE PARTICIPANTS' ROLE(S) AND COMMUNICATION SKILLS

As intimated above, when conducting lessons with AIDA, a very useful trick is to give each participant a role monitoring the fluxes displayed by the program (Fig. 2). For example, subject A may follow the blood glucose line, subject B the HbA_{1c} value, subject C the glucose absorption from the gut, and so on. In this way all the participants can become equally involved. Furthermore, they are joined in a common effort to solve the problem for that particular case scenario, and this can foster friendship.

Teaching medicine, certainly in years gone past, did not generally involve too much learn-
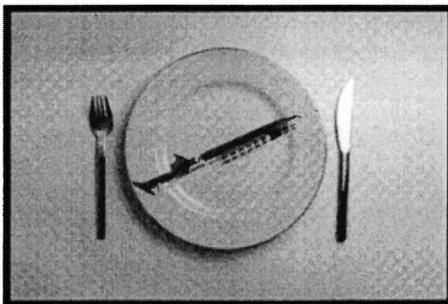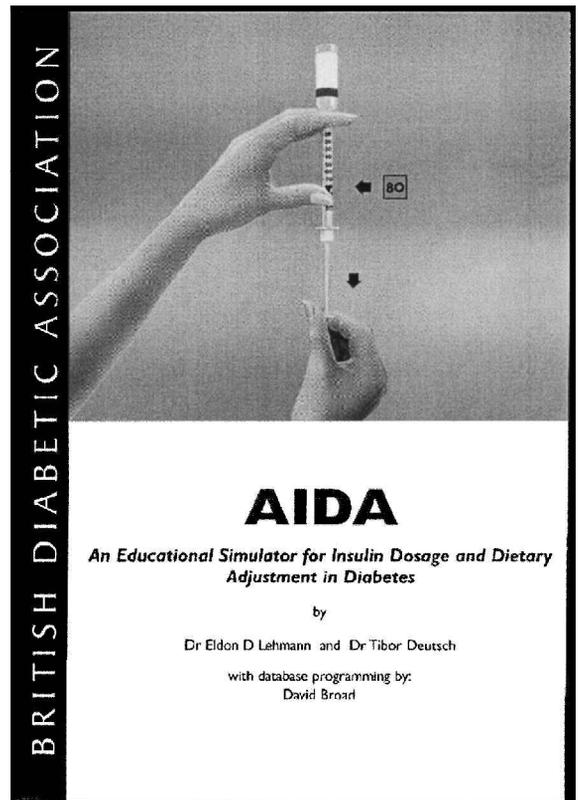
a

b

FIG. 4.   (a) Front cover of the 72-page printed AIDA hard copy manual, which is freely available to health-care professionals for teaching/evaluation purposes via www.2aida.org/interest at the AIDA Website. (b) Front cover of the British Diabetic Association (BDA) version of the AIDA hard copy manual,[15] which was previously made available, in 1997, to health-care professional members of the BDA in the United Kingdom, together with the AIDA software on $3^{1}/_{2}$" diskette. The BDA has since been renamed "Diabetes UK."

ing of communication skills. However, communications skills are critical to involve any person with a chronic disorder like diabetes, especially if the subject does not have any great computer experience and is not "visually orientated," or does not have experience with the graphical format being portrayed.

As an example try to envisage the most intriguing theatrical presentation performed by a somnolent or monotonous actor, and you will see how it can be destroyed. In the same way AIDA can be made less or more exciting if the teacher, for example, turns his/her back to the audience and keeps looking at the screen rather than interacting with the participants. Although we suggest prospective teachers should address themselves to the best local books about teaching and educational methods, we can suggest the following texts on this topic.[16–18]

CHARACTERS

Everyone who tries to teach with AIDA can possibly encounter an unexpected character or two in the audience. The ability to deal with such characters can influence to a greater or lesser extent the success of the lessons. When confronted with a computer some people tend to show the worst of their nature, and try to thwart the attempts of the teacher to get the best out of the software. The following are some of the more frequently encountered characters:

The "I know everything." Now and then one can find an occasional patient who thinks he or she knows everything and tends to "oust" all the others from the discussion. This is most characteristic of subjects with a longstanding history of diabetes. Caution must be exercised. We suggest not confronting them, but rather letting them speak, then pointing out gently the inconsistencies in their reasoning. Sometimes it may be useful to resort to the software to show them the outcomes of their opinions. Most important is not to fall into some traps: (1) do not get drawn into an argument; (2) do not let them take the lead; and (3) if the situation seems irreparable it may be necessary to drop the participant from future lessons, rather than damage the experience for the others.

The shy. These are people who seem very intelligent and quick, but who really are fearful of showing their lack of comprehension. One can spot them because they tend to be quiet and nod assertively. A good option is to ask them frequently about the parameter they are following. It is not infrequent to hear them answer "ah, uh, well, where is the glycosylated hemoglobin" (or whatever variable they are meant to be following). A good option is to help them gently, without making them feel guilty. Simply look at them, and point out what the correct answer is, following the parameter with your finger (or a laser pointer). Insist on the point till you are sure the shy understands.

The untrusting (skeptical). This is the worst case. If they become disruptive for the class, and if there is no sign of improvement in a short time, it may become necessary to drop such people from future lessons, rather than damage the experience for the others.

POSSIBLE QUESTIONS FROM PATIENTS

There are a certain number of questions about the program that can be expected from the participants of a lesson or class using AIDA. These include:

Question: The 80 g carbohydrate limit for meals is too restrictive (this is especially true in the Mediterranean area where the carbohydrate content of the diet is quite high). *Response:* The carbohydrate content can be doubled simply by including another meal at a slightly different time (say 15 min later).

Question: Why is the maximum possible number of insulin injections set at just four? *Response:* The number of people who inject insulin more than four times per day is very limited. Furthermore, one can create up to eight different insulin injections using AIDA, although only at four different times per day.

Question: How can I evaluate the S_h and S_p parameters? *Response:* The model finds values for these hepatic (S_h) and peripheral (S_p) insulin sensitivity parameters as the best fit between the observed blood glucose levels entered into the soft-

ware and those calculated (predicted) by the program. Although not standardized, the S_h and S_p parameters can be manipulated to show the effects, for example, of generalized increased physical activity or inactivity and of, say, generalized hepatic impairment.

Question: Why does the model not include the very rapidly acting insulin preparations (e.g., Humalog/Lispro)? *Response:* The very rapidly acting insulin preparations will be included in the next release of the program.

Question: Why if one includes blood glucose values far apart during the day, does the model seem to discard them, and leave them as outliers, thus not reflecting the "true" behavior? *Response:* Any consistent simulator must be based on hard data that are also frequently sampled. Furthermore, the observed blood glucose data that are entered ("Glucostix measurements") are only used really during parameter estimation (using the fitting or "estimate" function) and for displaying blood glucose data points on the graphs. Therefore, after the parameter estimation has been finished, the observed blood glucose data become irrelevant. You can change them to any values you like; they do not have to correspond to the simulation curves. However, during parameter estimation, if the observed blood glucose data points are very different from the predicted (simulated) values, parameter estimation will not be possible for that particular case scenario.

POSSIBLE DIFFICULTIES ENCOUNTERED BY THE PARTICIPANTS

Possible "difficulties" that may be encountered by the participants should also be anticipated. These include:

Question: "I cannot see the line" (meaning the profile of one curve). *Response:* Make sure that the person does not suffer from color blindness. If not, the person may need to adjust his/her position to get a better view of one of the computer screens (see Fig. 3 for one possible seating arrangement).

Question: "What does that line mean?" *Response:* Spend some time explaining the details of the graphs.

Question: "What does the term "fit" mean?" *Response:* We suggest dropping the explanation; otherwise, simply explain that the fit concerns S_h and S_p. Trying to summarize the calculations, or providing a detailed explanation, takes too much time during a lesson and does not appear beneficial for the majority of participants. For teachers who are interested, more details about the parameter estimation/fitting routine can be found elsewhere in the literature.[8]

Question: "What are S_h and S_p?" *Response:* It does not seem to be too fruitful to spend too much time trying to explain these concepts to a nontechnically orientated audience. It does not appear to help very much with their actual learning using AIDA.

Question: "I generally do not know that I am going to eat 30 minutes before eating." *Response:* This gives the teacher an opportunity to exploit the potential of AIDA for simulating various clinical situations. For instance, it is very easy to show the effect of variously changing the timing of an insulin injection in relation to a meal (see Fig. 5), in order to address this point.

CLOSING SUMMARY

As a short checklist, the most important issues about how to lead a practical lesson using the software seem to be:

1. to select the participants on the basis of their age, interest, open-mindedness, and intention to cooperate.
2. to accurately set the stage (use a portable computer with two screens, or if possible an overhead projector).[13]
3. the teacher should accumulate a good prior experience with the program, running it many times before giving lessons with AIDA. The teacher should also have some experience with general usage of the computer. In some settings having one subject, different from the teacher, who operates the program may turn out to be useful.
4. the lessons with the simulator should be preceded by some general information about the physiology of carbohydrate metabolism and the pathophysiology of diabetes.
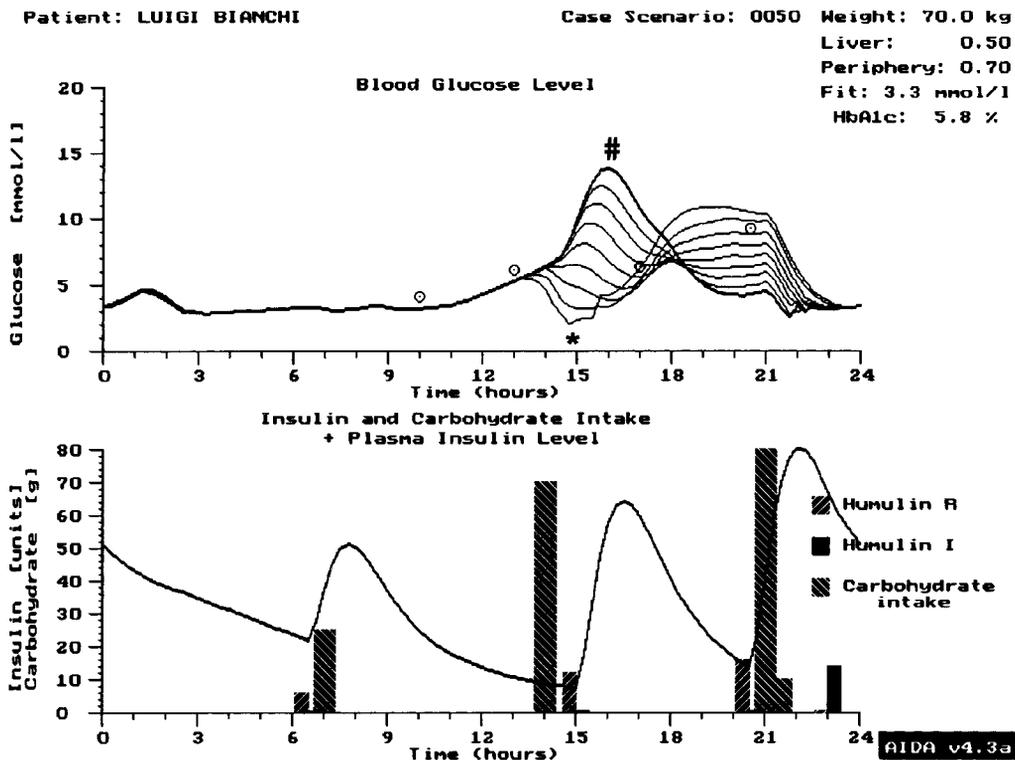5. the teacher should be prepared to cope with

FIG. 5. Based on the case scenario shown in Figure 1a, highlighting how the effects of changing the time of the before-lunch short-acting (Humulin R) insulin injection in relation to the meal can be simulated. This example shows how injecting the insulin too early leads to a hypoglycemic episode (*) just shortly after the meal, whereas injecting the insulin too late—after the meal—can lead to a postprandial hyperglycemic episode (#) with a substantially raised blood glucose level. Simulations have been run with the insulin injection administered at 15-min intervals between 13:00 h (1 p.m.) and 15:00 h (3 p.m.).

some difficult characters to be handled in such a way as to avoid "damage" to the group as a whole.

In part 2 of this article[3] we will address other points, in particular that:

6. any progress should be monitored accurately with (a) a set of questionnaires;[4,12] (b) measurements of the HbA_{1c} levels before and after the lessons; and (c) patients keeping a record of any symptomatic hypoglycemic episodes.
7. ideally lessons with the software should form part of a randomized-controlled trial[1,2] to help more formally establish the role of the program in diabetes education sessions.

SYSTEM AVAILABILITY

The latest release of AIDA (v4.3a) can be downloaded, without charge, from: www.2aida.org on the Internet. The program runs on IBM PC or compatible 80386/80486/Pentium-based machines and requires approximately 3 Mb of hard disk storage space. The software can also be used on Apple Macintosh computers running PC emulators such as Virtual PC or SoftWindows. A fully Internet-based version of AIDA, called AIDA online, is also available for use free-of-charge at www.2aida.org/online on the Web. This allows AIDA's diabetes simulations to be run from any computer, anywhere, provided it has an Internet connection and a graphical display.

An interactive educational Diabetes/Insulin Tutorial that has been integrated with AIDA online can also be accessed without charge at www.2aida.org/tutorial on the Web. This allows visitors to dynamically simulate some of what they have learnt in the tutorial about balancing insulin and diet in diabetes, using AIDA online.

People who wish to be automatically in-

formed about future updates and enhancements to the AIDA/AIDA online diabetes software range can subscribe (for free) to the AIDA diabetes simulator announcement list by sending a blank email note to subscribe@2aida.org

Any readers who might be interested in collaborating by teaching in their clinics using AIDA or by applying a standardized randomized controlled trial protocol[1,2,11] for an evaluation of AIDA in clinician, specialist nurse, or educator-led patient teaching sessions are invited to contact one of the authors. Further information about the evaluation of AIDA for patient education can be found at www.2aida.org/evaluate on the Internet.

Health-carers who would like to receive by post/air mail an AIDA hard copy manual, for teaching purposes, can register their interest at www.2aida.org/interest on the Web.

FURTHER TOPICS

If you would like to suggest further topics or Websites for future "Diabetes Information Technology & WebWatch" columns, please email information—with a brief description of the site/suggestion—to Dr. E.D. Lehmann at info-www@2aida.org (please write Diabetes WebWatch in the subject line). You can also fax information to (503) 218-0828, quoting Diabetes Information Technology & WebWatch.

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